**CFA 6 Fixed Income**

**6.1 Fixed Income Instrument Features**

Loans: Private, non-tradable

Bonds: Standardised, tradable

Investors lend capital (aka principal, par, face value)

* Issuer promises to pay principal + coupon

Issues: Govs, corporations, supranational entities, local govs

Asset backed securities: Bonds backed by cash flow of assets

Maturity: Date of final cash flow paid

* Tenor: Time remaining until maturity
* If original maturity <1 year: Money market
* If original maturity >1 year: Capital market
* No stated maturity: Perpetual bonds

Principal: Repayment usually at maturity

Coupon rate: Annual % of par value paid

* If frequency is less than 1 year, divide the annual amount by that frequency (e.g., a fixed 5% semi-annual coupon pays 2.5% every year)

Floating rate notes (aka Floaters): Pays coupons on variable market interest + fixed margin

* Variable market interest is called Market Reference Rate
* Usually quarterly (but fixed margin given as annual figure)

Zero coupon (aka pure discount): No interest

Senior debt ranks higher than Junior debt (aka subordinated debt)

Embedded options: Some bonds have options attached or can be converted to equity

**Yield measures**

Yield: Expected return from investing in the bond

* Lower price = Higher yield, for fixed coupon bonds

Yield curve: Maturity on X axis, Yield on Y axis

Upward sloping yield curve: Normal

* Longer maturities have higher returns for more uncertainty

**Repayment sources**

Sovereign bonds: Repaid from taxes and ability to print money

* Lowest credit risk
* Used as a benchmark to assess extra returns (called spreads)

Local gov bonds: Repaid from local taxes and revenue (e.g., toll roads)

Secured bond: Repaid from operating cash flow with a legal claim (aka lien, or pledge) on specific assets if a default occurs

Unsecured bond: Repaid from operating cash flow, with no legal claims on assets

**Bond covenants**

Bond indenture: Legal contract between issuer and lender

* Defines the obligations on the issuer
* Contains the covenants

Affirmative covenants: Specify requirements the issuer must fulfil

* E.g., timely financial reports, specify use of proceeds, right to redeem at premium in M&A
* Two examples: Cross default, Pari passu

Cross default: If the issuer defaults on any other debt, the issuer is considered to have defaulted on this bond

Pari passu: Bond will have same priority of claims as issuer’s other senior debt issues

Negative covenants: Place restrictions on the issuer

* Restrictions on leaseback agreements
* Pledges of collateral (can’t use same assets to back other debt)
* Issuance of debt that is more senior (aka negative pledge clause)
* Additional borrowing, buybacks, dividends (requires incurrence test which looks are financial ratios)

**6.2 Fixed Income cash flows**

**Common structures**

Bullet structure: Principal is paid as a single payment at maturity, coupons are interest

Amortising loan: Periodic payments include both interest and some repayment of principal

* E.g., car loans and mortgages

Fully amortising: Principal fully paid off when past period payment made

* Constant payment in each period
* The interest portion of payment in each period gets smaller
* FV = 0

Partially amortising: Some repayment of principal at maturity (called Balloon payment)

* Difference in calculation is FV is not 0

Sinking fund provisions: Requires issuer to pay back some of the principal at specified times during the bond’s life

* Advantage: Less credit risk
* Disadvantage: Reinvestment risk

Waterfall structures: Establishes principal repayments to holders of ABS and MBS

* Split in tranches of varying seniority
* E.g., Junior tranches don’t receive principal repayments until senior is paid

**Other structures**

Step up coupon bonds: Coupon rate increases over time in a predetermined way

* Protects against rising interest rates

Leveraged loans: Loans to borrowers of lower credit

* Coupon can increase if credit quality of issuer decreases
* Can be linked the NB/EBITDA or credit rating (credit-linked notes)

Payment in kind: Allows issuer to make coupon payments by increasing the principal amount

* May do this if the firm thinks cash flows can’t service debt

Green bonds: Coupon paid increases if certain environmental goals aren’t met

Index-linked bond: Coupon or principal linked to an index

* Inflation-linked bond (aka linkers): Increase cash flows in line with inflation

Two types of inflation-linked bonds:

* Interest-indexed bonds: Coupon rate is adjusted for inflation while principal is unchanged
* Capital-indexed bonds: Coupon rate constant, but principal is adjusted for inflation

Capital-indexed bonds

* More common, example is TIPS
* Inflation won’t decrease the real value of coupon payments as principal changes

Zero coupon bond: Only a single payment at maturity

* Must trade below par

Deferred coupon bond: Coupon payments don’t begin until a specific time after issuance

**Fixed income contingency plans**

Embedded options: Contingency provision in bond indentures

Straight bonds don’t have contingency provisions

Callable bond: Gives issuer right to buy back bonds before maturity at a fixed price

* Call protection: When the bond isn’t callable
* Useful for issuer if they can redeem the bond early, then issue a new one if the market yield is lower (e.g., if interest decreases or credit-worthiness increases)
* Bondholder has call risk: Uncertain redemption date
* Callable bonds cheaper than straight bonds due to call risk – difference in value is value of call option

Putable bonds: Gives bondholder right to sell the bond back to the issuer at a fixed price

* Useful for bondholder if interest has risen or credit-worthiness has declined
* Putable bonds more expensive than straight bonds – difference in value is value of put option

Convertible bonds: Gives bondholder right to exchange bond for a specified number of shares

* Conversion price: Par amount per share for conversion
* Conversion ratio: Par value of bond divided by conversion price
* Conversion value: Market value of shares received upon conversion

**Warrants**

Can attach warrants to straight bonds when issued

* Right to buy shares at a specific price
* Can be detached from bond issue and traded

**Contingent convertible bonds**

Cocos: Bonds that convert to equity automatically if a specific event occurs

Issued by some European banks

* Banks must maintain a specific amount of equity financing
* If it falls below the level, some debt is converted

**Foreign bonds**

Domestic bonds: Bonds traded in issuer’s home country and currency

Foreign bonds: Bonds of foreign issuers, but denominated in currency of where they trade

Eurobonds: Issued outside the jurisdiction of any one country, and can be in any currency

* Less regulation
* NOT the same as bonds in Euros
* Global bonds: Eurobonds trading in at least one domestic market and the Eurobond market
* Referred to in the currency they are denominated in (e.g., Euroyen, Eurodollar)
* Issued as registered bonds with a record of ownership

Currency of bond is key determinant of yield

* Driven by interest rates of the country which affect the currency

Suluk bonds: Sharia compliant with restrictions on interest payment and use of proceeds

* Payments considered to be cash flows from rent on underlying assets

**Taxation of bond income**

Most often interest income on bonds is taxed as regular income

Municipal bond in the US are exempt from income tax in the state of issue and at national level

Gains in selling the bond are capital gains tax

Pure discount bonds (e.g., zero coupon) essentially include interest income in par value

* Can create a tax liability even with no cash payments

**6.3 Fixed Income Issuance and Trading**

**Fixed income market segments**

Bond markets segmented by:

* Type of issuer
* Credit quality: Greater than BBB or Baa3 is investment grade, less than BB+ or Ba1 is high-yield bonds
* Original maturities: Short term (<1 year), intermediate (1-10 years), long term (>10 years)

|  |  |  |  |
| --- | --- | --- | --- |
|  | <1y | 1-10y | >10y |
| Risk free | T-Bills | Treasury notes | Treasury bonds |
| Investment grade | Repo  Commercial paper  ABCP | Unsecured corp bonds  ABS | Unsecured corp bonds  MBS |
| High yield |  | Secured corp bonds  Leveraged loans |  |

Secured corp bonds are in high yield as riskier companies have to offer security to investors

Fallen angels: Companies which get downgraded due to deteriorating credit quality

Well established companies can use commercial paper

* Done by a syndicate of banks with credit facilities

**Investor positioning**

Pension funds and insurance companies:

* Like long term investment grade securities to match their long term liabilities
* Owning high yield assets often prohibited by regulators

Corporations:

* Seek returns on excess liquidity by investing in CP, repos, ABCP, not T-Bills

Central banks:

* Use Treasury notes as monetary policy tool to alter monetary reserves of commercial banks

Bond funds and ETFs: Usually investment grade intermediate

Asset managers, HFs, Distressed debt:

* May seek higher returns from higher yield intermediate securities

Banks: Use risk free assets from across whole maturity spectrum

**Fixed income indexes**

1) Fixed income indexes have way more bonds than equity indexes

* Each firm can have multiple types of bonds outstanding
* Bond trackers use sampling techniques rather than purchasing all the constituents

2) Bonds maturing and being issued more frequently

* More turnover in index than equity ones

3) Index weights affected by debt issuance trends in maturity and credit quality

* Higher weighted to gov

Aggregate indexes: Contain broad selection of bonds

Can have a focus on geography, credit quality, sector, maturity

* Benchmark index selected should match this

**Primary market fixed income**

Bonds can be sold through Public offering or Private placement

* Debut issuer: Issuing for the first time

Underwritten offering: Bond issue guaranteed by bank

Best efforts: Not guaranteed, bonds sold on commission

Shelf registration: Bond issue registered with regulators in aggregate value, then issued over time when issuer needs funds

Require roadshows to find investors

* Repeat issues take much less time

Gov bonds sold through private auction

**Secondary market fixed income**

Majority of market is OTC

Dealers post quotes with bid and asking prices

* Gov bonds, higher credit, recently issued (aka on the run), have tighter spread
* Less liquid, smaller, older (aka seasoned), have wider spreads

Distressed debt: Bonds of issuers expected to file for bankruptcy

* DD investors aim to profit from reversal of fortunes, liquidation rates, or restructuring

**6.4 Fixed income markets: Corporate issuers**

**Short term funding for non-financial corps: External loan financing**

External loan financing (aka bank lines of credit)

* Agreement between borrower and bank to draw down funds

1) Uncommitted line of credit – most unreliable

* Bank offers a line of credit at the MMR + fixed credit spread
* No fees outside of interest
* Uncommitted: Can refuse to lend

2) Committed line of credit - reliable

* Banks offers credit for a specific time period
* Charge a commitment fee (usually 50bps) over the period
* Regulators require banks to hold higher reserves on committed lines
* Can withdraw the agreement at maturity – gives renewal risk for borrowers

3) Revolving line of credit – most reliable

* Long term, can be for years
* Banks place restrictive covenants on borrowers
* Fees similar to committed line of credit

Secured loans: Backed by collateral

* For weaker credit companies

Factoring: Transfer of collection of receivables to a lender at a discount to face value

**Short term funding for non-financial corps: External security based financing**

High credit rating corps can issue commercial paper

* Costs less interest than loan
* Used to fund working capital or as bridge debt

Bridge debt: Temporary debt until permanent debt can be secured

CP is rolled over when it matured

* Rollover risk: Risk it can’t replace old CP

Borrowers maintain backup lines of credit to mitigate rollover risk

**Short term funding for financial institutions**

Commercial and retail deposits are a major short term funding source for banks

* Checking accounts: Transaction services, immediate funds, pay no interest
* Operational deposits: Made by larger customers who need custody and clearing
* Savings deposits: Stated term and interest rate

Savings deposit can be a certificate of deposit

* Non-negotiable CDs cannot be sold before maturity (no early withdrawal without penalty
* Negotiable CDs can
* Negotiable CDs are important funding source for banks

Interbank funds: Funds loaned between banks (rate is MMR + margin)

Central banks fund market: Banks can borrow excess reserves here

* Rate is Central banks fund rate: Influenced by open market operations and availability of short term funds
* Can be lender of last resort – higher rate

Banks can sponsor ABCP (asset backed CP)

1. Transfers collateral to a SPE for cash (an off balance sheet vehicle)
2. SPE sells ABCP to investors, collateral backs the SPE

**Repos**

Repo: Sells a security to another with a commitment to buy it back at a higher price

* Essentially a loan with security as collateral
* Repo rate: Annualised interest implied by the prices

To protect lender against potential decrease in security value, the borrower must give extra collateral

* Called initial margin (e.g., 103%)

Repurchase price:

Haircut: Discount applied to the market value of collateral

Variation margin: Extra collateral required if the market value of the collateral falls below the repo rate multiplied by the initial margin

Overnight repo: For one day

Term repo: For longer period

Interest rates on repos are less than loans and other short term borrowing

The borrower retains the rights to the benefits of the securities over the repo term

Master repurchase agreement: Has the contractual terms of the repo

**Repo applications**

Main uses of repos

* Financial institutions financing positions held in their trading activities
* Banks and investors lend to earn the repo rate on excess funds
* CBs can use repos to affect money supply
* Short sellers can use repos of borrow securities they want to short (called reverse repo)

**Factors affecting repo rate**

Higher if:

* Interest rates for other short term financing are higher
* Repo term is longer
* Repo is under-collaterised or is not delivered to lender

Lower if:

* Higher credit quality of collateral
* Collateral security is low in supply/high in demand

**Repo risks**

Risks of repo:

* Default risk: Failure to make repo payment at end of term
* Collateral risk: Collateral may not be able to generate value
* Margin risk: May not receive margin, may be inaccurate
* Legal risk: Contracts cannot be legally enforced
* Netting and settlement risk: Netting of transactions and selling cash and collateral

Tri-part repos: 3rd party arranges and administers repos

* Mitigates the risk

Bilateral repo: Only 2 parties

**Investment grade vs high yield funding**

Longer debt has higher yields, but shorter debt has rollover risk

* Especially for high yield debt

Credit concerns:

* Default risk are usually only concerns for high yield
* Credit downgrade is risk for investment grade

Credit spreads smaller for investment grade than high yield

Fewer restrictive covenants on investment grade

* High yield has many restrictive covenants, including ratios

Investment grade more standardised and across multiple maturities

* High yield is less standardised, and don’t really have maturity >10 years, don’t have ability to take advantage of refinancing opportunities

High yield issuers more likely to structure debt to be repaid earlier if credit quality improves

* E.g., using callable debt, prepayment options

High yield returns are more equity returns like than investment grade

**6.5 Fixed Income Markets for Government Issuers**

**Sovereign debt**

Have highest credit rating as backed by power to collect taxes

Public sector has to produce financial reports – based on cash, not accruals

* Should also consider implied assets (expected future tax revenues) and implied liabilities (promised future expenditures)

Developed market issuer

* Stable, diversified economies, with clear fiscal policy and reserve currency

Emerging market issuer

* Faster growing, less stable, more concentrated economies
* Can raise domestic debt or external debt

Domestic debt: Issued in nation’s home currency and held by domestic investors

External debt: Owed to foreign creditors, can be in home currency or foreign currency

* Home currency gives risk of currency weakening (direct risk), foreign currency gives risk of missing payments (indirect risk)

Debt management policy: Sets out the amount and type of debt the gov is going to issue

* Depends on fiscal policy

Since Ricardian equivalence doesn’t hold in practise, govs need to balance long and short term debt

Short term sovereign debts as like alternatives to bank deposits

* This may push yields lower than they should be

Gov debt yields are used as benchmarks for non-gov debt

Asset managers use gov debt to manage interest rate risk

**Non-sovereign Gov Debt**

Non-sovereign gov bonds: Issued by states, provinces, counties, entities to fund services

Agency bonds (aka quasi-gov bonds): Issued by entities that the national gov creates for specific purposes

* E.g., Ginnie Mae – for mortgage loans
* Have yields and credit similar to gov bonds

General obligation bonds: Raised by regional govs to fund public spending

* Backed by taxes

Revenue bonds: Raised by regional govs to fund a specific project

* Backed by project revenue

Supranational bonds: Issued by international institutions (WB, IMF, ADB)

* High credit quality and liquid

**Trading of gov bonds vs corp bonds**

Sovereign issues use regular public auctions to issue debt

* Can use competitive bids or noncompetitive bids

Competitive bids: Set the price of the debt issue

* Competitive bids are ranked highest to lowest, and allocated to highest price first
* Cut-off yield: Lowest price successful competitive bid

Noncompetitive bids: Guaranteed to have their allocation met at the price determined by competitive bids

* Bonds are allocated to noncompetitive bids – guaranteed allocation

Single price auction: All investors pay the cut-off yield, regardless of that yield they bid

* Minimises yield volatility 🡪 More likely a successful auction

Multiple price auction: Successful competitive bidders pay the price they bid

* Likely bids are close together and large in size

Primary dealers are designed by the sovereign issuer

* Make competitive bids, submit bids in behalf of 3rd parties, act as a counterparty for CB for monetary policy

Gov bonds traded in quote driven OTC markets

On-the-run bonds: Recently issued gov securities

* Represent risk free benchmark yields

Other objectives for purchasing gov bonds:

* Used by CB for monetary policy
* Foreign govs buy to hold as reserves
* Some financial institutions need to hold for regulatory reasons
* This decreases yields relative to non-gov bonds

**6.6 Bond Prices and Yields**

**Yield to maturity**

Yield to maturity: Market discount rate for discounting a bond’s cash flows

Example: 5 year, 10% coupon, annual pay bond with $100 par value

2nd🡪Clear work

N=5 (number of periods – not necessarily years)

PMT=10 (coupon payment per period – remember to de-annualise)

P/Y=1 (frequency per year – best keep this unchanged)

FV=100 (par value)

I/Y=10 (YTM – entered as whole number, remember to de-annualise)

CPT🡪PV=-100

If YTM < Coupon rate 🡪 Bond trades at a premium to par

If YTM > Coupon rate 🡪 Bond trades at a discount to par

A 1% decrease in YTM increases the bond’s value more than a 1% increase in YTM decreases the bond’s value

* Convex price yield relationship

Can solve for YTM by defining N, P/Y, PMT, FV 🡪 CMP I/Y

To actually earn the YTM, need to hold the bond to maturity and reinvest all cash flows for the same YTM

**Accrued interest**

Bond trades that fall between coupon payment have accrued interest

* Accrued interest: Portion of the coupon payment that is owed to the seller

Different day count methods:

* Actual/Actual (usually gov bonds)
* 30/360 (usually corp bonds, assume each month has 30 days)

Flat price: Bond prices are quoted without accrued interest

* Quoted price is the flat price

Full price (aka dirty price): Includes accrued interest

We can’t calculate Flat price and get Full price from it

* Need to calculate Full price and get Flat price from it

**Bond features relationships**

A decrease in YTM increases price

Price of a bond with a lower coupon rate is more sensitive to a change in YTM

Price of bond with a longer maturity is more sensitive to a change in YTM

Convex price yield relationship:

* A % decrease in price when YTM increases, is smaller than % increase in price when YTM decreases

Constant yield price trajectory: Bond price converges to par value as maturity approaches (aka pull to par)

**Matrix pricing**

Method of estimating YTM of bonds that are not traded or newly issued

* Use YTMs of traded bonds that have similar credit quality, maturity, and coupon, to the nontraded one

Interpolation: Suppose you have a 2 year bond and a 5 year bond and you are trying to find YTM for 3 year bond

Can calculate corporate bonds and treasury bonds

* Work out the spread for one year
* Assume the same spread for the year you are looking for

E.g., if you have a 4 year treasury, 5 year corporate, and 6 year treasury, and you want to find 6 year corporate

* Calculate the 5 year treasury using interpolation and find the spread between 5 year corporate
* Add that spread to 6 year treasury

**6.7 Yield and Spread Measures for Fixed Rate Bonds**

YTM is discount rate that makes PV of cash flows equal to price

* For a semiannual YTM, remember to annualise the number you get from the calculator

Periodicity of bond: Number of annual coupon payments per year

**Effective annual yield**

YTM is not the same as the effective annual yield (the real payoff)

**Yield measures**

Street convention yield: Yields calculated using the stated coupon payment dates

* If it falls on weekend, it will be next business day

True yield: The yield calculated using the actual coupon payment dates

Current yield (aka income yield, running yield): Looks only at the annual interest income

* Doesn’t care about capital gains, losses, or reinvestment income

Simple yield: Includes the discount/premium to par

* Add the amortisation of the premium/discount (assume straight line)

Yield to call: For callable bonds, can be calculated for each possible call date and price

* Yield to worst: Lowest YTM and various yields to call (can be just holding to maturity)
* Calculate the yield from the start date to the call date

A callable bond is a straight bond + a short call option position:

* Since the right to call lies with the issuer, not the bondholder

Option adj price (aka straight bond) can be used to calculate option adj yield

* Should have a lower yield than a callable bond

Remember Option adj is taking the option away

**Yield spread measures**

Yield spread: Different between bond yield and yield of benchmark security

For fixed coupon bonds, on the run gov bond yields for the same maturity are the benchmarks

* G-Spread: Spread over a gov bond
* Use interpolation if a bond of the same maturity doesn’t exist

Can use rates for interest rate swaps in the same currency and tenor as benchmarks

* Called Interpolated spreads (I-Spread)

If the spread increases, can suggest credit risk

**Zero volatility spread**

Different individual cash flows at different maturities can have different yields

* Spot rates: Yields earned by individual cash flows at different maturities

YTM is the weighted average of these spot rates

Using spot rates instead of YTM is more precise for spreads

Z-Spread (Zero volatility spread): The same number you can add to each individual benchmark spot rate for each period, to make the PV of cash flows equal to the price

**Option adjusted spread**

Used for bonds with embedded options

Takes the option yield component out of the Z-spread

* Spread to the gov spot rate if the bonds were option free

Z Spread yield will be higher than OAS

**6.8 Yield for Floating Rate Instruments**

**Floating rate notes**

FRN values are more stable than fixed rate debt

* Coupon rate is reset periodically based on MRR

Coupon rate is based on MRR + fixed margin based on credit risk at time of issuance

Quoted margin: The fixed margin above MRR

* Essentially coupon rate minus MRR

Discount margin (aka required margin): The margin required to price the FRN at par

* Essentially YTM minus MRR

Coupon rate for next period is set using the MRR for this period

* Interest is paid in arrears

At issuance QM = DM

* Stays this way unless credit quality changes
* If credit quality declines, DM increases
* If credit quality improves, DM decreases

**Money market instruments**

Can be quoted as add-on yield or discount yield

Add-on yield: Interest earned

* CDs, repos, MMR usually quoted as add-on
* First work out the absolute interest, then the % interest gain (that is your HPY)

Bond equivalent yield is the add-on yield based on 365 days

Discount yield: Annualised current discounts of the securities at face value

* T-Bills, CP usually quoted as discount

**6.9 Term structure of interest rates**

**Spot rates**

Spot rates: Discount rate for a single payment in the future

Pricing a bond with spot rates:

YTM is the weighted average of the spot rates

Spot curve: Shows spot rates vs maturity for a particular type of bond/issuer

**Par yields**

Par yield: The coupon rate at each maturity for the bond to be priced at par

* Essentially YTM at each maturity

**Forward rates**

Forward rate: Borrowing/lending rate for loan to be made at a future date

* Can be used as discount rates

Written as: 2y1y

* In 2 years from now a 1 year loan is made

No arbitrage condition:

This can be arranged to give the geometric mean return which is the spot rate:

Spot rates can be used to calculate forward rates:

Can calculate forward rates of loans of more than 1 period:

**Different curves**

Spot rate yield curve (for US treasury bonds):

* Plot of spot rates vs maturity
* Usually upward sloping

Yield curve for coupon bonds:

* Shows YTMs of similar tyles of bonds at different maturities
* Weakness: distortions can arise from illiquidity (on the run used to minimise this), taxation differences

Par curve:

* Can be constructed from spot curves – based on theoretical yields
* Shows the yields of par bonds vs maturity

Forward yield curve:

* Shows forward rates for periods in the future

If the forward curve is upward sloping:

* Spot will be upward sloping too, but less so
* Par will be upward sloping too, and close but slightly less than spot rate

**6.10 Interest rate return and risk**

**Sources of return on a fixed rate bond**

3 sources of return

* Coupon and principal payments
* Interest earned on coupon payments that are reinvested
* Capital gain/loss if sold before maturity

We assume there is no credit risk (bond makes all payments) and no reinvestment risk (interest reinvested at same YTM as bond)

5 conclusions

* If investor hold to maturity, they will earn YTM of when purchased if the market YTM doesn’t change over the life of the bond
* Same if they sell it before maturity
* If market YTM changes (i.e., reinvestment rate changes) after purchase, the return will be higher/lower than YTM at purchase
* If market YTM increases after purchase but before first coupon date, the return will be lower than original YTM if held for short period
* If market YTM decreases after purchase but before first coupon date, the return will be lower than original YTM if held for long period

Investment horizon: Time the bond is held for

* Horizon yield: Compound annual return over investment horizon

**Unchanged YTM, held to maturity**

Calculate the PV of the bond as usual using the BA II

Calculate the interest gained on the coupon payments

* Coupon and gains, minus the absolute coupon payments
* E.g., Interest for a 6% coupon with 7% YTM for 3 years is:

**Unchanged YTM, sold before maturity**

Carrying value: Assuming the YTM hasn’t changed, this is the bonds value including the amortisation of the discount/premium

Capital gains/losses are measured relative to the carrying value

Holding to maturity has no capital gain/loss

Sold before maturity at the same YTM has no capital gain/loss

**Changed YTM, held to maturity**

If the yield increases before the 1st coupon payment, holding to maturity will give a greater YTM than at purchase

* Return on coupon reinvestments increase

If the yield decreases before the 1st coupon payment, holding to maturity will give a smaller YTM than at purchase

* Return on coupon reinvestments decrease

**Changed YTM, sold before maturity**

If YTM decreases after purchase and it is sold quickly 🡪 Return goes up

If YTM decreases after purchase and it is sold after a long time 🡪 Return goes down

Shows the trade-off between price risk (YTM changing from point of purchase) and reinvestment risk (future reinvestment rate)

Short term horizon: Price risk > Reinvestment risk

Long term horizon: Reinvestment risk > Price risk

If the investment holds to maturity, then there is no price risk, as will always get par value

To work out the coupon interest portion:

* N, I/Y, PMT all normal
* PV = 0
* CPT 🡪 FV

**Macaulay duration**

For each bond, there is an investment horizon that is neither too short for price risk, nor too long for reinvestment risk

* Gains in reinvestment income are balanced by a price loss, and vice versa

Macaulay duration: Average time until the receipt of cash flows from a bond

* Weighted avg of no. of years until each of the promised cash flows is paid
* The weights are the PV of each cash flow as a % of bonds full value

Use of Macaulay duration: If you hold the bond to the Macaulay duration, you will still have the original YTM yield, even if it immediately changes after purchase

Can also do it with semi-annual periods (remember to divide by 2 to get annualised)

Duration gap: Difference between Macaulay duration and investment horizon

Positive gap: Macaulay duration > Investment horizon

* Exposes to price risk from increasing rates

Negative gap: Macaulay duration < Investment horizon

* Exposes to reinvestment risk from decreasing rates

**6.11 Yield based bond duration measures and properties**

**Modified duration**

Modified duration for annual pay:

Modified duration for semi-annual pay:

Modified duration gives an estimate for the % change in bond price given a 1% change in YTM:

For semi-annual remember to divide by 2 before doing this

**Approximate modified duration**

Can approximate modified duration using bond values for in increase and decrease in YTM of the same size

is price of bond if YTM decreased by

is price of bond if YTM increased by

is the current bond price

needs to be entered as a decimal

Can calculate the YTM first. Then calculate the PV of the bond if the YTM was higher and lower

**Limits of modified duration**

Modified duration is a linear estimate of the relationship between price and YTM

* The actual relationship is convex

Modified duration is good for small changes in yield, not large

**Money duration**

Money duration: Expressed in currency units

Shows the change in bond value for a 1% change in YTM

* If you multiply Money duration and YTM, you get the change in bond value for that change in YTM

Price value of a basis point (PVBP):

* Money change in the full price of a bond when its YTM changes by 1bp (0.01%)

**Effects on interest rate risk**

Higher maturity usually means higher interest rate risk

* However, it is possible an increase in a discount coupon’s maturity decreases the Macaulay duration

If YTM remains constant, the Macaulay duration decreases smoothly over time, and goes up slightly at each coupon payment date

Higher coupon rate means lower interest rate risk

* More of the bond’s value is received sooner

FRNs have very limited price risk as coupon adjusts to interest rate

* Macaulay duration for FRN is the time to the next coupon reset date at the end of the current period

Increase in YTM will decrease interest rate risk

* Convex relationship means price is less sensitive at higher YTMs

**6.12 Yield based bond convexity and portfolio properties**

**Convexity**

Convexity means our duration estimates are not accurate for large changes in yield

* Can introduce a convexity term

Convexity at period t:

is the period yield:

Convexity is the weighted average convexity of individual cash flows using the PV of cash flows as weights

* Similar to Macaulay duration

For non-annual coupons

* Each period requires a convexity calculation (this is the same)
* Divide weighted convexity figure by the periodicity squared to annualise

Approximate convexity is given by:

needs to be given as decimal

A bond is more convex if: Longer maturity, lower coupon rate, lower YTM

**% change in price given duration and convexity**

% change in price is made up of the duration effect and convexity effect:

needs to be decimals

Convexity adjustment the same for an increase or decrease in yield

**Money convexity**

Money convexity is given by:

Change in full bond price is made up of duration effect and convexity effect:

needs to be decimals

**Portfolio duration**

2 ways:

1. Do a single duration and convexity for all the portfolio’s cash flows
2. Find the duration and convexity for each bond in portfolio and take a weighted average based on the weight of the bond in portfolio

1st approach theoretically correct

2nd approach is easier to apply

is the full price of bond divided by the total portfolio value

Limitation:

* Assumes YTM of every bond in portfolio must change by the same amount (called parallel shift)

**6.13 Curve based and empirical fixed income risk measures**

Embedded options can mean for early termination of the bond

* All the previous duration measures were calculated with straight bonds, these are different as they have a single well defined YTM
* Bonds with embedded options do not have a single well defined YTM

Effective Duration: Interest rate risk for bonds with embedded options is based on changes in the benchmark curve, rather than changes in the bond’s own YTM

is a change in the benchmark yield curve

Effective duration assumes spread remains the same

* Only captures sensitivity to benchmark curve

Effective convexity:

Option free bonds always have positive convexity

Callable bonds can have negative convexity

* Call option is more valuable at low yields as the call option puts a limit on increases in bond value
* I.e., Price increase from drop in YTM can be smaller than price decrease from rise in YTM
* At low yields, callable bonds have lower duration than equivalent straight bonds

Putable bonds always have positive convexity

* At high yields, the put is more valuable
* At high yields puttable bonds have lower duration than equivalent straight bonds

For option free bonds, there can be small differences between modified duration and effective duration

* Shift in benchmark yield curve will generate non parallel shifts in the gov spot curve when yield curve isn’t flat
* Only the same if the yield curve is flat

Estimating expected price change for bond:

Effective duration and convexity are not necessarily better estimates of bond prices for small yield changes

* Modified duration and convexity are
* Due to other considerations other than gov rates determining exercise decision

**Key rate duration**

Key rate duration (aka partial duration): Sensitivity of the bond/portfolio value to changes in the benchmark yield for a specific security, holding other yields constant

* Shows impact of non-parallel shifts

Sum of key rate durations is the effective duration

Shaping risk: Effect of non-parallel shift in the yield curve of bond portfolio

* Key rate shows effect on portfolio of a yield change at that maturity

Key rate duration calculation:

**Analytical vs empirical durations**

Analytical duration: Based on mathematical analysis (what we have done)

Empirical durations: Observed historical relationship between benchmark yield changes and bond price

* Useful if the spread for corporate bond changes (we have assumed the spread doesn’t change for analytical ones)
* E.g., Flight to quality (gov bond yields decrease, corporate credit spreads increase)

Analytical useful for gov bonds (safer)

Empirical useful for corp bonds (riskier)

**6.12 Credit Risk**

Credit risk: Risk from failure of borrower not making a payment (i.e., default)

Bottom up drivers:

* Capacity: Ability to make payments
* Capital: Other resources available to borrowers to reduce debt reliance
* Collateral: Value pledged
* Covenant: Legal terms and conditions
* Character: Borrower’s integrity and commitment

Top down drivers:

* Conditions: General economic environment
* Country: Geopolitics, law
* Currency: FX fluctuations

3 types:

* Secured corporate debt: Backed by operating cash flows, business investments, and collateral
* Unsecured corporate debt: Backed by operating cash flows and business investments
* Sovereign debt: Backed by tax revenue, tariffs, additional debt issuance, sale of public assets

Illiquid: Unable to raise cash to service debt

Insolvent: Assets < value of debt

* Both can default

Cross default clause: Default on one bond is a default on all

Pari passu clause: Bonds of a certain type rank equally in default process

**Measuring credit risk**

Credit risk is measured using expected loss:

Probability of default: Given in annualised terms

Loss given default: Can be a percentage or an absolute value

Recovery rate: Proportion of claim recoverable if default

* Loss severity = (1 - Recovery rate)

Expected exposure is given by:

Loss given default is given by:

Credit spread can be estimated as:

If actual credit spread < estimated credit spread, then don’t invest

Estimating probability of default: Quantitative metrics, ratios

Estimating LGD: Type of bond, seniority

* Investment grade have lower probability of default
* High yield can have lower LGD as much is secured

**Credit ratings**

Investment grade:

* Moody’s: Aaa to Baa3
* S&P and Fitch: AAA to BBB-

Non-investment grade:

* Moody’s: Ba1 or lower
* S&P and Fitch: BB+ or lower

Default:

* Moody’s: C
* S&P and Fitch: D

Risks of relying on credit rating agencies:

* Lags market pricing
* Some risks are hard to assess (e.g., litigation, M&A), can lead to split ratings
* Can make mistakes (e.g., subprime mortgages)

Rate the issuer and the bonds themselves

* Issuer: Corporate family ratings (based on senior unsecured debt)
* Specific: Corporate credit ratings (called notching if different from issuer rating, more common for lower rated companies)

**Credit spread risk**

Credit spread risk: Risk yield spreads widen, causing prices to decrease

* Main concern for investors

Macroeconomic factors

* Credit risk spreads widen during recessions
* During recessions, credit curves rise and flatten (could even be inverted) as the probability of a near term default increases
* During expansions, credit curves lower and steepen
* High yield spreads are more volatile (flight to quality, wide bid-ask spreads)

Issuer specific factors

* E.g., Credit rating

Market liquidity risk: Bid-offer spreads

* Higher risk for less traded, lower credit quality, and less debt outstanding bonds
* Calculation: Calculate the yield at bid, and the yield and ask, and subtract difference

Effect of a change in spread on price:

**6.13 Credit analysis for gov issuers**

**Sovereign debt**

Credit risk of govs depends on ability to tax

* This depends on stable economic growth and low inflation

5 qualitative factors

1. Institutions and policy – e.g., property rights, culture, reporting transparency, stable politics, willingness of gov to pay its own debts
2. Fiscal flexibility – ability to increase taxes, or decrease public spending
3. Monetary effectiveness – credibility, independence of CB
4. Economic flexibility – economic growth
5. External status – standing of a country’s currency (e.g., does it have reserves)

3 quantitative factors

1. Fiscal strength – low debt burden ratios (debt to GDP or revenue), low debt affordability rations (interest to GDP or revenue)
2. Economic growth and stability
3. External stability – high FX reserves to GDP, FX reserves to external debt, low debt to GDP (near and long term), unconcentrated exports

**Non-sovereign debt**

Agencies: Quasi gov entities for a gov sponsored role

* Similar to gov debt

Gov sector financing institutions: Set up for a specific gov mission

* Similar to gov debt

Supranational issuers: E.g., World Bank, Development Bank

* Set up by groups of govs
* Credit rating depends on support of the govs

Regional govs (e.g., Municipal bonds)

* General obligation bonds: Unsecured and backed by entity with tax power
* Revenue bonds: Issued for specific projects, and the project is sole source of funds
* Ultimately depends on tax base, as they have no monetary policy

**6.14 Credit analysis for corporate issuers**

Qualitative factors

* Business model – stable and predictable cash flows
* Industry competition
* Business risk
* Corporate governance – debt covenants (potential to issue new debt that is dilutive to claims, preferential treatment of equity investors)
* Accounting policies

Quantitative factors – estimating future financial statements

* Consistency and strength of revenues and profits
* Level of leverage, liquidity, coverage of debt service payments

Measures to use:

* CFO, FCF
* FFO (funds from operations, similar to CFO but excluding change in WC)
* RCF (retained cash flow, operating cash flow minus dividends)

**Seniority of debt**

Seniority rankings: Shows priority of claims in a default

Secured:

1) First lien

2) Senior secured (second lien)

3) Junior secured

Unsecured:

4) Senior unsecured

5) Senior subordinated

6) Subordinated

7) Junior subordinated

All debt in the same category is pari passu (have the same priority)

A strict priority of claims may not be applied in practice

* Can be negotiated
* Debtholders further down the line may get paid earlier to accelerate the process

Structural subordination: If a parent owns a subsidiary, the subsidiary may be required to service their own debt before the parent’s debt

* The parent is effectively subordinated for the subsidiary’s cash flows

**6.15 Fixed income securitisation**

3 steps to securitisation process:

1. Bank/corp that holds originates the debt (issuer) creates a pool of debt based assets
2. The pool of assets (aka the collateral) is sold to a separate legal entity called a Special Purpose Entity (SPE)
3. SPE issues Asset Backed Securities (ABS) supported by cash flows of the collateral

Benefits to issuers (originating bank/corp)

* Can make more loans with the proceeds
* Improved profitability – can charge feeds for making the loan, and for selling collateral
* Lower capital reserve required – credit risk is removed from balance sheet
* Improved liquidity

Benefits to investors

* Tailored risk and return – aligns with investor needs
* Access – can access the pool without making loans themselves
* Liquidity – easier to be sold

Benefits to economies and markets

* Decreased liquidity risk – ABS more liquid than collateral
* Improved market efficiency
* Lower financing costs, lower leverage

Risks to investors

* Collateral cash flows are uncertain and can vary
* Credit risk is passed to investors (e.g., 2008)

Issuer of collateral is the originator, issuer of ABS is the SPE

* Don’t get this confused!

Seller (originator): Sells the collateral to SPE

Servicer: Collects payments on loans, sends delinquency notes (can still be the originator)

Disinterested trustee: Trustee appointed to oversee collateral and cash flows with no other interest in the structure

Bankruptcy remote: The financial position of the originator doesn’t affect the value of claims of ABS holders as SPE is a separate legal entity

* Only have a claim on collateral sold to SPE

Purchase agreement: Describes terms of purchase of collateral by the SPE

Prospectus agreement: Describes fees to servicers, how cash flows are distributed, etc

**6.16 ABS instrument and market features**

**Covered bonds**

Covered bonds: Similar to ABS, but the cover pool (underlying assets) remains on the balance sheet of the issuer

* Usually are mortgage loans and not in US

Usually have lower yields than ABS

* Dual recourse: If default, investors have claims over cover pool and other assets of the issuer
* Mortgages in cover pool usually have upper limits to loan to value ratio
* Usually overcollateralized

Issuer won’t benefit from a reduction in required capital reserves

Issuer needs to replace non performing or prepaid assets in the cover pool so it always provides the promised payments

* Unlike ABS which the pool of assets is fixed at issuance

Can have different provisions under default

* Hard bullet covered bond: Default if issuer fails to make a payment, leading to acceleration of payments to covered bondholders
* Soft bullet covered bond: Can postpone maturity for a year if payment is missed, postponing default and payment acceleration
* Conditional pass through covered bond: Converts to pass-through bond on maturity if any payments are still due, so payments recovered from cover pool are passed through to investors

**Credit enhancement structures**

Features of ABS to mitigate credit risk from defaults in the collateral pool

Overcollateralization: When value of collateral exceeds the face value of ABS

* Excess value that can be defaulted before investors face credit losses

Excess spread: Reserves build up in ABS by earning higher income on collateral than the coupon promised to ABS investors

Credit tranching (aka subordination): ABS has multiple classes (tranches), each with a different priority of claim

* Lower claims absorb losses first
* Waterfall structure: Subordinated tranches only receive overflow

Coupon payment is calculated using the outstanding tranche value

**Non mortgage ABS**

Can be backed by business loans, accounts receivable, autos loans

Credit card ABS

* Backed by pools of credit card debt
* Are non-amortising loans
* Has a lockout period/revolving period where ABS investors only get interest and fees (prepayments are used to buy more receivables keeping pool value constant)
* Once lockout period ends, it is amortised

Solar ABS: Backed by loans to homeowners to finance solar installation

**Collaterised debt obligations**

Collaterised Debt Obligations (CDO): Security issued by SPE where the collateral is a pool of debt obligations

Types:

* Collaterised Bond Obligations (CBO): If using corporate or EM debt
* Collaterised Loan Obligations (CLO): Supported by portfolio of leveraged bank loans (most common)

CDO vs ABS

* CDO have a collateral manager who actively buys and sells securities in the collateral pool to generate cash to make promised payments

Also have subordinated tranches

Since 2008, they have gotten less complex and tougher requirements on collateral

3 types of CLO:

* Cash flows: Payments generated through cash flows on collateral
* Market value: Payments generated through trading the market value of collateral
* Synthetic: Pool exposure is generated through credit derivative contracts. The CLO trust doesn’t take ownership of collateral

Collateral is subject to tests

* Coverage of payment obligations from cash flows
* Overpoliticization levels for each tranche
* Diversification in pool
* Limits to the amount of CCC debt in pool

**6.17 Mortgage backed security instrument and features**

**Prepayment risk**

Prepayments: Principal repayments in excess of scheduled repayments for amortising loans

Prepayment risk: Risk that prepayment speeds are different to the expectations of the MBS investors

* Extension risk: Slower than expected
* Contraction risk: Faster than expected

Prevailing interest rates drives prepayment

* When rates are lower, borrowers refinance at lower rates 🡪 Contraction
* When rates are higher 🡪 Extension

Negatives of contraction

* CFs come sooner and face lower reinvestment returns
* MBS asset price won’t rise much as the price already includes expectations for prepayments in low rate environment

Time tranching – MBS with different bond classes with different maturities

* Mitigates some risk by redistributing among the tranches

**Residential mortgage loan**

Residential mortgage loan: Loan where the collateral is residential real estate

Common features

* Prepayment penalty (common in Europe, rare in US)
* Recourse/non-recourse loans (recourse has claim of other assets, non-recourse specified property only)

**Default risk ratios**

Loan-to-value ratio: % of the value of collateral real estate that is loaned to the borrower

* The other part is borrower’s equity

Debt-to-income ratio: Monthly debt payments as a % of monthly pretax gross income

Prime loans: Good credit, good LTV and DTI

Subprime loans: Low credit, poor LTV and DTI

**RMBS – residential mortgage backed securities**

Agency RMBS: Guaranteed by gov or gov sponsored enterprise (GSE)

* Mortgages must meet minimum credit standards

Non agency RMBS: Issued by private entities with no gov or GSE guarantee

* Can include subprime mortgages

**Mortgage pass-through security**

Mortgage pass-through security: Claim on the CFs of a pool of mortgages, net of admin fees

Weighted avg maturity (WAM): Weighted avg of the final maturities of all the mortgages in the pool

* Weighted by each outstanding principal as a proportion of the total outstanding principal

Weighted avg coupon (WAC): Weighted avg of interest rates of all the mortgages in the pool

* Weighted in the same way as previous one

Investors in MPTS get the monthly cash flows net of servicing and insurance fees

* Pass through rates (coupon rate) is less than WAC

**Collateralised mortgage obligation**

Collaterised mortgage obligation (CMO): Securities collateralised by pass-through MBS and mortgage pools

* Each CMO has multiple tranches, with different exposures to prepayment risk
* Prepayment risk is reapportioned among the tranches

Common CMO structures:

Sequential pay: Principal payments flow to tranches in a prespecified order (flows to 2nd tranche once 1st has been paid off)

* Short tranche protects against extension risk, other tranche protects against contraction risk

Z-tranche: Receives no interest payments in specified accrual period

* Interest is accrued as extra principal during this period

Principal-only (PO): Only pay principal (like zero coupon bonds)

* The sooner principal is repaid, the better

Interest-only (IO): Only pay interest

* The sooner principal is repaid, the fewer coupon payments received

Floating rate: Coupon linked to MRR

Residual tranches: Are junior to all other tranches

Planned amortisation class (PAC) and support tranches:

* PAC are structured to make predictable payments as long as prepayment speeds remain within a certain range
* Support tranche receives prepayments if they are in excess, and used to top up if they slow down
* Protection is limited to how much support tranche can take

**Commercial mortgage backed securities**

CMBS: Backed by pools of commercial mortgages on income producing real estate

* Apartments, industrial property, offices, shopping centres, hotels

Have less diversification than RMBS

* Fewer mortgages in collateral pool

RMBS repaid by owners of the property

CMBS repaid by real estate investors who rely on tenants

Weighted avg proceeds from mortgages (WAMP): Regular income from CMBS collateral

* Same as WAC for RMBS

2 ratios mostly used for CMBS:

1) Debt service coverage ratio (DSC):

Net operating income is rental income less cash operating expenses and a noncash replacement reserve to represent depreciation

2) Loan-to-value ratio (LTV):

Call protection: Equivalent to prepayment protection

CMBS have call protection in 2 ways:

1. Loan level call protection – lockout period, penalty charge, defeasance (excess payments are used to buy gov securities that can make the remaining scheduled payments)
2. CMBS level call protection – sequential pay tranching

Balloon payment: Principal outstanding that needs to be paid at the end

* Balloon risk: Having to extend this by refinancing (extension risk)