Reading 50: Fixed Inc. Securities: Defining Elements

* Basic features of fixed inc. security

Issuer of the bonds

- Corporations: Often corporate bonds are divided into those issued by financial comp. & those by non-fin. companies
- Sovereign national: Eg. US Treasury bonds, but many governments countries issue
- Non-sovereign governments: Issued by gov. entities that are not national gov. eg. state of California
- Quasi-government entities: Not a direct obligat" of country's gov or central bank. Eg. Federal National Mortgage Assoc.
- Supranational entities: Issued by government that operate globally such as World Bank.

Bond Maturity

- Tenor : Time remaining until maturity
- Perpetual bonds : No time to maturity
  Promise periodic payments but
  cant promise full repayment
- Money market : Maturities < 1yr
  securities
- Capital mkt : Maturities > 1yr
  securities

Par Value

- Principal amt repaid at maturity
- Premium to par : Bond selling for more than par val
- Discount to par : less
- At par : at

Coupon Payments

- Plain vanilla / conventional bond : Bond w/ fixed coupon rate
- Zero-coupn / Pure disc bond : Bonds paying no interest prior to maturity

* Interest rate for a given period is the rate at THE START OF THE PERIOD

Currencies

- Dual-currency bond :- Coupon payments in one currency & currency opt bond in another principal payment
- Currency option bond :- Coupon paymt & principal in same currency.

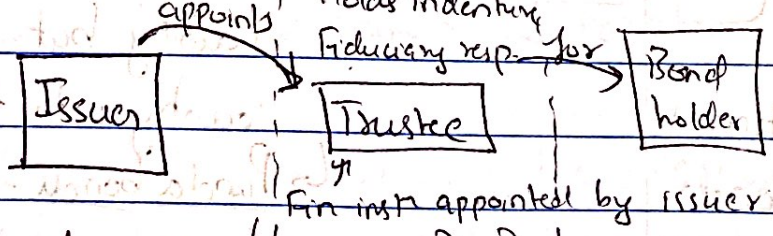
* Yield Measures

- Current yield or running yield

$$\frac{\text{Annual coupn}}{\text{Price}}$$

- Yield to maturity
  - ↳ Annual yield from the bond if held till maturity
  - ↳ Basically IRR

* Bond indenture



- Legal contract btw bond issuer (borrower) & bondholders (lenders).
- Trustee responsible for timely pmt to bondholders

- Covenants :- Provisions in bond indenture
  - ↳ Affirmative Covenants : (Issuer MUST DO)
    - ↳ Actions borrower promises to perform
    - ↳ Eg. make timely interest & princip pmt etc
  - ↳ Negative Covenants (Issuer MUST NOT DO)
    - ↳ Prohibitions on the borrower
    - ↳ Eg. Restrict on asset sales & additional borrowing
    - ↳ Protect bondholders.

Cheaper

* Effect of legal, regulatory & tax considerations on fixed inc sec

National Bonds mkt

- Domestic Bonds :- Bonds issued by firm domiciled in a country & also traded in that country's currency
- Notations
- Foreign Bonds :- Bonds issued by a firm in foreign country but traded in another country with that country's currency
  - ↳ Panda bonds :- If China is that country where foreign firm sells its bonds
  - ↳ Yankee bonds :- If USA ...

↗ Less regulated than national

- Euroband :- Issued outside juridiction of any one country & denominated in a currency diff from the currency of countries in which they are sold
  - ↳ Eg. Chinese firm, selling bonds in yen, outside Japan.
- Global bond :- Issued & traded in more than 1 mkt & denominated in one market's currency.

- Majority of Eurobonds issued in bearer form
- Bearer form :- Evidenced simply by possessing the bond (as bearer)
- Registered bonds :- Recorded
- Bearer more attractive to avoid taxes.

Issuing Entities

- Sovereign bonds - Issued by treasury of issuing country
- Corporate bonds - --- by well known corporations
- Special purpose entities / Special purpose vehicle / - Entity created with the sole purpose of owning assets & issuing bonds to purchase those assets.
- Securitized bonds - Bonds issued by SPV / SPE
- SPE interest rates are lower. (Also called bankruptcy remote vehicle)

Sources of Repayment

- Sovereign bonds :- Repaid by tax receipts of issuing country
- Non-sovereign gov. entities :- Repaid by either general taxes, revenues of specific projects
- Corporate bonds :- Cash generated by firm's operations
- Securitized bonds :- Cash flows of fin. assets owned by SPE
- Supranational bonds: Repaid from repayment of previous loans

Collateral & Credit Enhancement

- Secured bonds :- Backed by assets / fin. guarantees pledged to ensure debt repayments in case of default
  - ↑ They are senior
- Unsecured bond :- No explicit collateral backing but bondholders have claim on assets & CF
- Debentures :- Unsecured debt

- Equipment trust certificates : Debt sec backed by equipment like railroad cars etc
- Collateral trust bonds : Backed by fin. assets, stocks & bonds
- Mortgage-backed securities : Common type of securitized bond. Underlying assets are pool of mortgages & interest & principal pmt from mort. used to pay int & pmt. on MBS
- Covered bonds : Similar to asset-backed sec but when assets are non-perf., issuer must repl. w/ perf. assets. the underlying assets are included on balance sheet. No SPE is created. Provides more credit protection
- Credit Enhancement
  - ↳ Internal
    - ↳ Tranches :- Any loss is first absorbed by junior tranch & then by senior tranch
    - ↳ Overcollateralized :- Pmts from MBS > Pmts to be done to investors
    - Excess spread

↳ Overcollaterizatn - Amt of collateral pledged exceeds amt paid to Inv.

↳ Cash reserve fund - Cash kept aside to make up for credit loss (External)

↳ External

↳ Surety bonds :- Issued by insurance company

↳ Bank guarantee :- Same funct

↳ Letter of credit - Promise to lend money

Tax Considerations

- Two type of returns from bond
  - ↳ Coupon payments (Income)
  - ↳ Capital gain (If you by for 900 & sell for 1000, 100 is cap. gain)
- Inc. portn is generally taxed at ordinary tax rate
- Cap. gain tax → diff for long-term & short term invst

- In some countries, if you are to get $100 cap. gain over 3 years, instead of paying tax on $100 at the end of 3rd yr, you can pay prorated tax over the 3 years.

✳ Principal Repayment Structures

- Bullet Bond

Year	Inv CF	Int. Pay.	Principal Repay	Outst princip at end of yr
0	-$1,000			$1000
1	60	60	0	1000
2	60	60	0	1000
3	60	60	0	1000
4	60	60	0	1000
5	$1060	60	1000	0.0

- ↳ Will pay only coupon pmts every year & the principal amt will be paid at the end / maturity
  - ↳ Eg plain vanilla bond

- **Fully Amortized Bond** 5-yr 6% coupn rate

Year	Inv. CF	Int. Pmt	Princ Repmt	Outs. prin. at eoy
0	-$1,000			
1	237.40	$60	$177.40	$822.6
2	237.40	49.36	188.04	$634.5
3	237.40	38.07	199	435.2
4	237.40	26.11	211	223.9
5	237.40	13.44	223	0

↳ Equal amt paid every period
↳ Consider annuity

N = 5 I = 6 PV = 1000 FV = 0 PMT = ?

= 237.40

This is made of int. & principal

237.40

Interest = Coupn rate × Outst prin. amt at eoy = 6% × ( )

Principal = 237.40 - Interest

- Partially amortized bond

Year	Inv. CF	Int. pmt	Princ. Repmt.	Outst. princ. at eoy
0	-$1000			
1	201.92	60	141	858
2	201.92	51	150	707
3	201.92	42	159	548
4	201.92	32	169	379
5	401.92	22	379	0

↳ There is principal amt outstanding at the end which is relatively high as comp. to princip. repmt earliers.
↳ This relatively large pmt is called 'baloon pmt'.

- Sinking fund arrangements
↳ It specifies that the portion of the bond's principal outstanding must be repaid each year throughout the bond's life
↳ Reduced credit risk. (As the issuer doesn't have to pay a large amt at the end)
↳ Higher reinvstment risk
↳ Disadv. to bondholders when interest rate falls. as then comp. can buy back the bond @ lower price (sinking fund spec price) as mkt price would ↑

* ZCB / pure disc earns interest on implied basis

* Coupon Payment Structures

- Fixed periodic coupon
  - ↳ Pays fixed amt every year
- Floating rate notes eg. interest rate = LIBOR + 50 bps
  - ↳ Relative low interest rate impact
  - ↳ May include cap (good for issuer) or floor / floor (good for inv)
  - ↳ Inverse floating rate notes eg. 10 - LIBOR
  - ↳ Pay Quarterly coupons
- Change in interest rate will impact fixed cpn more than floating rate

↓ interest rate also called reference rate

Coupn pmt based on int rate @ the start of the period

- Step-up coupon bonds:
  - ↳ Coupon rate increases w/ time
- Credit-linked coupon bonds:
  - ↳ Coupon payments linked to the credit rating of the bond
  - ↳ Eg. if credit ↓, coupn pmt ↑
- Payment-in-Kind coupon bonds

↳ Issuer has the opt to pay interest in the form of additional amt of bond issued rather than making cash pmts (Beneficial for issuer)

c. Deferred coupon bonds / Split coupon bond
↳ Cpn pmts are deferred
↳ Eg. Issuer of 10-yr bond might start paying cpn pmts after 5 yrs but at a higher rate
↳ Beneficial for issuer

Eg. Zero Coupon Bond

Index-linked bonds
↳ Coupon payments are linked to some index
↳ Eg. TIPS → payments linked to CPI (Consumer Price Index)
↳ Capital-indexed bonds (TIPS)
↳ Principal amt changes proportionally w/ the index
↳ Coupon Interest-indexed bonds
↳ Coupon amt rate — " —
↳ Principal protected bonds
↳ Indexed bonds who won't pay < prin. pmt even when CPI ↓.
↳ Indexed-annuity bond
↳ Fully amortizing bonds w/ periodic pmt adjusted acc to inflat°/deflat°
↳ Indexed-ZCB:
↳ Pmt at maturity is adjusted.

* Bonds with contigency provisions

- Contingency provision
  - ↳ Describes an action that may be taken if an event actually occurs.
  - ↳ In bond indentures they are called embedded options
  - ↳ Bonds that do not have conting. prov. are called straight or option free bonds

Callable Bonds (If int rate ↓, price of callable bond ↑)

- A callable bond gives the issuer the right to redeem all or part of the bond before the specified maturity date
- Beneficial to the issuer because it protects against decline in interest rate
- Reasons for decline in int. rate
  - ↳ Generally mkt rates are down
  - ↳ Better credit quality

- Offers higher yield
- Sold at a lower price than non-callable
- American style :- Can be called anytime after the first call date
- European style :- Called only on call date specified
- Bermuda style :- Can be called on specific dates after the first call date

- Call protect period :- Period during which issuer cannot call the bonds
  lockout / cushion / deferment period

- Make-whole call prov :- Provision made by issuers to avoid higher int rate but still have an opt to redeem bonds
  - Call price not fixed
  - Penalizes issuer for calling the bond.

Putable Bonds

- Gives bondholder the right to sell the bond back to the issuer at predetermined price on spec. dates

- Beneficial for bondholder
  - ↳ Helpful if int rate ↑
  - ↳ Can be reinvested at a higher rates

- Offer lower yield
- Sell at higher price

Convertible Bonds

- Hybrid security w/ both debt & equity features
- Gives bondholder the right to exchange bond for a specified no. of shares
- Beneficial to bondholder
  - ↳ Able to participate in equity upside
  - ↳ Downside protectn
- Advantages to issuer
  - ↳ Reduced interest exp (Issuer can pay ↓ coupn rate)
  - ↳ Eliminiatn of debt if conversion optn exercised

Embedded optⁿ for bondholders : Put, Convert
Issuer : Call

- Conversion Price : Price per share at which the bond (at par val) can be converted to stocks.
- Conversion Ratio = Par value / Conv. price Eg. 25 shares per bond
- Conversion Value :- Current share price x Conv. Ratio
- Conversion premium :- Conv. Bond mkt price − Conv. value
- Conversion Parity :- Conv. Bond mkt price = Conv. val
  → If Conv. val < MKt val of bond
  Below Parity

Warrant

- Attached optⁿ
- Not embedded optⁿ

Contingent Conv. Bonds

- Bonds that convert debt to common equity automatically if a specific event occurs

Reading 51: Fixed Inc MKts - Issuance, Trading & Funding

✳ Overview of global fixed inc mKts

Classifcat of fixed inc mKts

- Type of Issuer
- Credit Quality
  - ↳ Ratings AAA, AA, A, BBB → Invst grade bonds
  - ↳ Ratings BA+ or lower → High-yied / speculative / junk bonds
- Maturity
- Type of coupon
  - ↳ Interbank offered rates reflect rates at which banks believe they could borrow unsecured funds from other banks for diff. currencies & diff maturities
- Currency

- Geography

- Indexing
  ↳ Index-linked bonds issued by government or corporations of high credit quality

- Tax status
  ↳ Municipal bonds are tax exempt
  ↳ Sold w/ lower yield

Primary Bond Markets

- MKts in which issuers first sell bonds to inv. to raise capital. Bonds can be sold via public offering or private placement

- Underwritten offering
  ↳ Bank buys the entire issue & takes the risk of reselling it to the inv.

Determinat° of funding needs → Selectn of underwriter → Structuring & announcement → Pricing → Issuance → Closing

- Best effort offering:
  ↳ Invst bank serves as a broker & sells the bond issue only if it is able to do so.

- Shelf registration
  ↳ Method for issuing securities in which issuer files a single document with regulators that describes a range of future issuance

- Auction (US Treasury bonds eg.)
  ↳ Public offering method that involves bidding which is helpful in price discovery & in allocating securities.
  ↳ Frequently used in issuance of sovereign bonds

* Secondary MKTs

- Trading of prev. issued bonds
- Majority trading done on dealer or OTC mkt
- Bid-ask spread is the dealers inc & is more for illiquid ~~sec~~ bonds

- Bond trades are cleared through clearing system
  - ↳ Sett. of government bonds
    - ↳ Day of trade or T+1
  - ↳ Sett. of corp. bonds
    - ↳ T+2 or T+3

* Security issued by sovereign governments

- Sovereign bonds
  - ↳ Bonds issued by national government backed by its taxing power.
- Bonds issued in the currency of issuing company has high risk credit quality
  - ↳ Taxing power
  - ↳ Ability to print currency
- Benchmark / on-the-run bonds (Lower yields than off-the-run)
  - ↳ Most recently issued government securities of a particular maturity
    - ↳ Trading is most active & prices most informative
- Issue fixed-rate, floating-rate & inflat°-indexed bonds

* Securities issued by Non-Sovereign gov., quasi-gov & supranational agencies

- Non-sovereign gov bonds
  - ↳ Issued by states, provinces, counties
  - ↳ Payments on bonds are supported by revenues of specific project, general taxes etc
  - ↳ Credit ratings
    - ↳ Vary widely cos of diff in credit & collateral quality
    - ↳ High credit ratings
    - ↳ Higher yield & lower prices than sovereign bonds
    - ↳ Additional yield is lowest for non-sov. bonds that have high credit quality, are liquid & guarantee by national gov.

- Agency or quasi-government bonds
  - ↳ Issued by entities created by national gov. for specific purposes.
  - ↳ Some q-bonds are backed by national gov. → ↑ credit quality
  - ↳ Yield marginally higher than sov bonds

- Supranational bonds
  - Issued by supranational agency (multilateral agency)
  - High credit quality &
  - Very liquid.

* Debt issued by Corporations

Bank Debt

- Bilateral loan :- When the loan involves only one bank
- Syndicated loan :- When a loan is funded by several banks

Commercial Paper

- It is a short term, unsecured promissory note
- Used by larger institutions
- Reduces funding costs
- Valuable source of flexible, readily available & relatively low-cost short term financing

- Used to
  - ↳ Raise working capital
  - ↳ Raise money when high demand for cash.

- CP is a source of bridge financing
  - ↳ When a comp. needs money for expansion, & it will take time to raise sufficient money. Then we can use CP to raise money.

- Yield (CP) > Yield (Short term sovereign bonds)
  - ↳ CP credit risk ↑
  - ↳ CP liquidity ↓

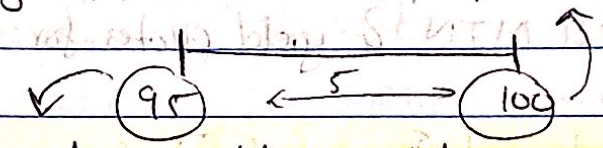
- In US, maturities are < 270 days to avoid SEC registration.

- Rolling over paper :- Issuing new CP at the maturity of older CP & using proceeds of new CP to pay back older CP.
  - ↳ 2 circumstances when comp. will face rollover difficulties
    - ↳ Deterioration in comp. actual or perceived ability to repay
      - ↳ Financial crisis.

- **Backup lines of credit/ liquidity enhancement/ backup liquidity lines** :- In order to get acceptable credit ratings from the ratings services, corporations maintain these

- **In US,**
  CP are issued as pure discount basis.
Interest is being compared with final par value

- **In Euro,**
  CP are issued as add-on yield



Interest will be based on the loan amount i.e. 95
↳ Maturity upto 365 days.

Corporate Bonds

- **Serial Bond Issue**
  ↳ Alternative to sinking fund
  ↳ Bonds are issued with several maturity dates so that portion of issue is redemed periodically
  ↳ Diff. in sinking & serial is in serial, investors know at issuance when specific bonds will be redeemed

- **Term maturity Structure**
  ↳ All bonds maturing on same date

- Maturities
  - ↳ < 5 → Short term
  - ↳ 5 ≤ 12 → Medium
  - ↳ > 12 → Long term.

- Medium term notes
  - ↳ Not necessarily medium in maturity
  - ↳ Issuers provide maturity ranges they wish to sell MTN & yield quotes for same

* Structured Financial Instruments

- Securities designed to change the risk profile
- Helps redistribute risk by combining debt w/ derivatives
- Eg. Asset backed securities

Capital Protect° Inst. (ZCB + Call Opt°)

- Offers a guarantee of minimum payment with some upside of stock gain
- Eg. Security promising $1000 at maturity + any gains on specified stock index

- Such can be created by
  - ↳ ZCB selling at $950 w/ $1000 par value
  - +
  - Call opt^n w/ strike price of $50.
- Guarantee certificate
  - ↳ When guaranteed payoff = initial cost
- Guaranteed payoff < initial cost
  - ↳ Greater potential for upside gains.

Yield Enhancement Inst (Note + CDS)

- Credit-linked note (CLN)
  - ↳ Makes regular coupon pmt, but redemptn val. depends on whether credit event occurs
    - ↳ If doesn't occur, redemptn val = par val.
    - does occur, <.
    - ↳ Coupon pmt > than for any inst as investor takes the risk of the underlying credit event
    - ↳ Similar to buying a note + credit default swap.

Participat" instruments

↳ Allows investors to participate in returns of underlying asset
↳ Eg. Floating Rate Bond wher cpn paymt is depended on interest rate. So investors are participating in interest rate
↳ Also used to give investors indirect exposure to equity index.

Leveraged instruments

↳ Eg. Inverse floater where the coupon rate = Coupon Rate C − L x LIBOR
if $0 < L < 1$, ⇒ de-leveraged inv. floater
$L > 1$ ⇒ leveraged inv. floater

* Short-term funding alternatives avail. to banks

- Retail Deposits
- Short-term wholesale funds

↳ Certificates of deposits
↳ Inst that represents specified amt of funds on deposited for a specified maturity at interest rate
↳ Non-negotiable
↳ Depositer not allowed to take out money before maturity.

↳ Central bank funds.
↳ Each bank has some reserves w/ central bank.
↳ So bank A can borrow funds from the reserve of bank B. for one day till one year

↳ Interbank funds
↳ Funds that are loaned by one bank to another.
↳ Unsecured
↳ Liquidity ↓ during fin. crises.

↳ Repurchase Agreement
↳ One party sells security to a counterparty with a commitment to buy back at a higher price
↳ Repo rate:- Int rate implied by two prices
↳ Overnight repo :- Repurch. agree. for one day
↳ Term repo :- Agree ov. longer period

- Eg. consider firm enters repo agree to sell 4% of 12 yr bond w/ par val $1 mill & mkt val = $970,000 for $940,000 & repurchase at $947050

  ↳ Implicit int rate = $\frac{947050}{947000} - 1 = 0.75\%$.

  ↳ Repo rate = equival. annual rate

  % diff btr repurch pric & amt borrowed

  ↳ Repo margin, haircut → % diff in mkt val & amt loaned

  $\frac{940000}{970000} - 1 = -3.1\%$.

- Repo rate
  - ↳ ↑ w/ ↑ repo term
  - ↳ ↓ w/ ↑ credit qual of coll. secnty
  - ↳ ↓ when collateral is delivered
  - ↳ ↑ when int rates for alt funds ↑

- Repo margin
  - ↳ ↑, w/ ↑ repo term
  - ↳ ↓ w/ ↑ credit qual of coll secu & borrower
  - ↳ ↓ w/ high demand for coll. secu

- Repo margin is negotiated btn counterparties.

Kaplan

- Sinking fund is a way to reduce credit risk
- US & Euro commercial paper are negotiable & can be traded in secondary mkt
- Corp bonds secondary mkt trading most often occurs on a book-entry basis
- Bond mkt sector w/ smallest amt of bonds outstanding is non-financial sector
- Reference rate for floating rate note should LEAST likely match maturity.

Reading 52: Introduction To Fixed Inc Valuation

{FOCUS ON PROBLEMS}

✳ Bond Prices & Time Value of Money

Bond Prices w/ MKt Discount Rate

- **Bond price**
  - ↳ PV (all future cash flows at mkt disc rate)

- **MKt Discount Rate / Required yield / Req. rate of return** = Rate of return required by investors given the risk of bond.

- **Eg** Coupon rate = 4%, Time to maturity = 5 yrs
  MKt disc rate = 6%. Bond price per 100 of par val?

n = 5, I = 6, PMT = 4, FV = 100 → PV = -91.575

- Coupon rate < mkt disc rate → Discount Bond
  Coupon rate > mkt disc rate → Premium Bond
  Coupon rate = mkt -"- → Par bond

Yield-To-Maturity

- It is the IRR on cash flows - uniform rate interest rate such that when future cash flows are discounted at that rate, the sum of present values equals the price of the bond.
- It is the implied mkt discount rate
- Eg. Cal. ytm for bond w/ coupn pmt per period 3.5, no. of periods to maturity 4. selling at 103.75. The prices are stated per 100 of par val.

→ n = 4 pmt = 3.5 PV = -103.75 FV = 100 →
I = 2.50%

- 3 assumptions
  - ↳ Inv. holds till maturity.
  - ↳ Issuer makes all payments
  - ↳ Investor reinvests at YTM rate

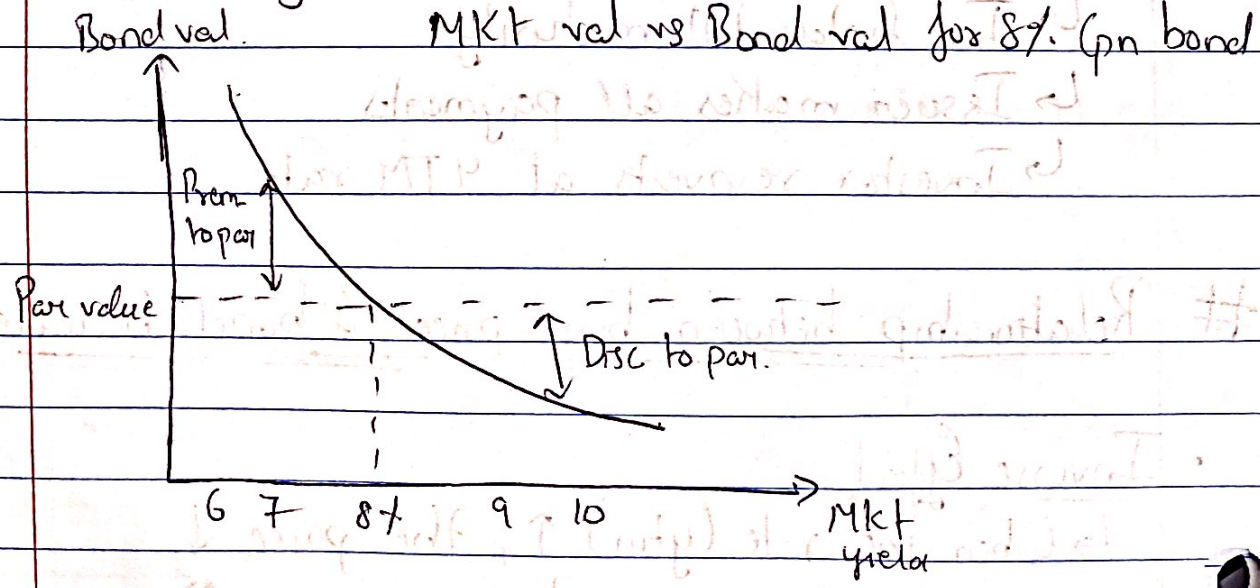
Relationship between bond price & bond characteristics

- Inverse Effect
  - ↳ When the rate (ytm) ↑, the price ↓
    ↓, ↑

- **Convexity Effect**
  ↳ Decrease in the price when the rate goes up by a const. amt is less than the increase in the price when the rate goes down by same const. %.

- **Coupon Effect**
  ↳ Keeping maturity constant, for lower coupon rate, the effect of change of interest rate is more. (Low coupon bonds → more sensitive)

- **Maturity Effect**
  ↳ Keeping cpn rate constant, whereas bonds w/ greater maturity will have more affected by interest rate (Long term bonds → more sensitive)



Spot Rates

- Spot rates are YTM on ZCB maturing at the date of each cash flow
- Bond price determined using spot rates is referred to as 'no-arbitrage value'.

Eg. Consider value of 3 yr, 5% annual coupon bond

Spot rates.

1 yr = 3%

2 yr = 4%

3 yr = 5%

$$\rightarrow \frac{50}{1.03} + \frac{50}{(1.04)^2} + \frac{1050}{(1.05)^3} = \$1,001.80$$

↳ YTM =

↳ N = 3 PMT = 50 FV = 1000 PV = -$1001.80

I/Y → 4.93%.

- Bonds w/ different sets of spot rates can have same YTM.

* Conventions for Quotes & Calculations

Flat Price, Accrued Interest & Full Price

- When a bond is btw 2 coupon payments dates, its price has 2 parts:
  - ↳ Flat Price (PV^{Flat}) / Quoted / Clean price
  - ↳ Accured Interest (AI)

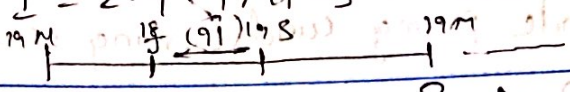
- Full Price / Invoice / Dirty Price $= PV^{Flat} + AI$

- ~~Eg. Consider a 2yr bond w/ 10% cpn rate~~
- ~~Eg. A 5% bo~~
- Two conventions
  - ↳ actual / actual → You consider normal 365 day calendary (Used w/ governance bonds)
  - ↳ 30/360 → where you consider each month has 30 days (Used w/ corporate bonds)

* Eg. A 6% corp bond is priced to settle on 18 June 15' Bond makes semi annual pmt on 19 March & 19 Sept Matures on 19 Sept 2026. Uses 30/360 convention.

Alternative to calculate PV^{Flat}

$n = 22\frac{91}{180}$ $I = 2.9$ $PMT = 3$ $FV = 100$ → $PV^{Flat} = 101.65$

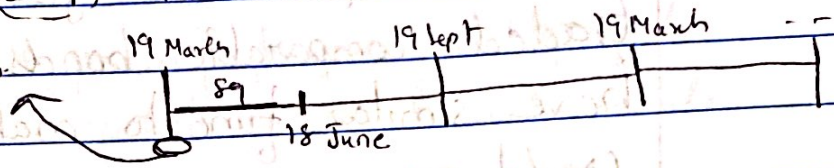


Has a YTM of 5.80% & $100 par value

→ **Step 1** Calculate present value

From 19th Mar '25 to 19th Sept '26 → $n = 23$, $I/Y = (2.9)$ ← $\frac{5.8}{2}$, $PMT = 3$, $FV = 100$ →

$PV = 101.66$



Step 2 Calculate PV^{Full}

(89/360) ← No. of day b/w 19th March & 18th June

$PV^{Full} = 101.66 \times 1.029$

$= 103.11$

Step 3 Calculate accrued interest

$AI = \frac{89}{360} \times (3) = 1.48$ → Cpn pmt

Step 4 Calculate PV^{Flat}

$= 103.11 - 1.48$

$= 101.63$

PV^{full} of bond $= PV \times (1 + YTM)^{t/T}$

Accrued Interest $= \frac{t}{T}$ mat $\times$ cpn pmt

t → time since last cpn pmt till settl. date

T → Total time b/w coupn pmts.

↗ Used while pricing underwriting new bonds

Matrix Pricing

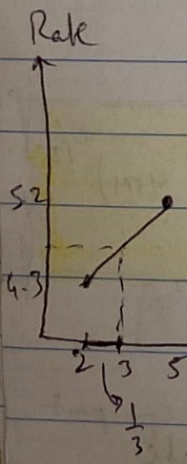
- If mkt price of the bond is not available, estimate the mkt discount rate & price based on quoted or flat prices of frequently traded comparable bonds. These comparables have similar time to maturity, cpn rates, credit qu.

Eg: Estimating value of non-traded 4% annual pay, A+ rated bond w/ 3 yrs remaining until maturity. He has obtained following yields

↳ A+ rated, 2yr annual pay, YTM = 4.3%
5yr YTM = 5.1%
5yr YTM = 5.3%

Step1: Take avg YTM of 5yr bond

$$\frac{5.1+5.3}{2} = 5.2\%$$



Step2: You have 2yr & 5yr bond YTM. To calculate 3yr YTM

$$4.3 + \frac{1}{3}(5.2-4.3) = 4.6\%$$

$\frac{1}{3}$ ↳ $\frac{3\text{yrs}-2\text{yrs}}{5\text{yrs}-2\text{yrs}}$

Step 3 :-

N = 3, PMT = 40 FV = 1000 I/Y = 4.6

→ PV = -983.54

- Variant of matrix pricing focuses on spreads b/t bond yields & yields of benchmark bonds.

Eg. Consider

5yr, US T Bond, YTM = 1.48%.

Corp. Bond = 2.64%.

7yr. US T. Bond, YTM = 2.15%.

Corp. Bond = 3.55%.

6yr US T Bond YTM = 1.74%.

Corp Bond = (?)

Step 1 : Spread on 5yr bond = 2.64 - 1.48 = 1.16%.

7yr = 1.40%.

Step 2 : Spread for 6yr = $\frac{1.16 + 1.40}{2}$ = 1.28%.

∴ YTM = 1.74 + 1.28 = 3.02%.

- Term structure of credit spread :- Different spread for diff. maturities of corporate bond

Consider 5yr 2CB priced @ 80 per 100 par val. What is stated annual rate for periodicity = 4, 2, 1?

→ Period rate = 4
↳ n = 5x4, PMT=0, PV= -80, FV=100 → I/4 = 1.12 $\xrightarrow{\times 4}$ 4.49

Period = 2
↳ n = 10, -"- -"- → I/4 = - $\xrightarrow{\times 2}$ 4.51

✳ Yield Measures for Fixed Rate Bonds

- **Effective yield:**
  ↳ Depends on how many coupon payments are made each year & is simply compound return

- **Periodicity**
  ↳ How frequently coupon paym are made each yr

✡ Eg. An atlas corp. bond is quoted with YTM of 4% on semi-annual bond basis. What yields should be used to compare it with
(i) Quarterly pay bond
(ii) Annual pay bond

→ 4% semiannual basis = 2% per 6 month period

Effective annual pay bond = $1.02^2 - 1 = 4.04\%$

For quarterly,
First find rate of each quarter
We know 2% for 6 month, each quarter has 3 month so rate each quarter = $1.02^{\frac{3}{6}} - 1 =$
0.995%

∴ For qe
Effective rate for quarterly coupon bond
= 4 × 0.995%
= 3.98%

If b coupon payments are made on 15th Jan 2028 & it's a Sunday then
↳ Street convention ∴ Consider 15th Jan as cpn pmt date
↳ True yield ∴ Consider 16th Jan as cpn pmt date as because 15th is Sunday.
∴ True yield slightly lower than street conv.

- Current yield
  ↳ Looks at only one source of return ∴ a bond's annual interest inc.

$$\text{Current yield} = \frac{\text{annual cash coupon pmt}}{\text{bond price}}$$

- Simple yield
  ↳ Takes into consideration discount & premium.
  ↳ It is sum of annual cpn pmt ± (−)

✱ Eg. A 3-yr 8% coupon, semi annual pay bond is priced at 90.165. Simple yield = ?

→ Disc = 100 − 90.165
= 9.835

Annual st. line amortizatn of disc = $\frac{9.835}{3}$ = 3.278

Simple yield = $\frac{8 + 3.278}{90.165}$ = 12.51 %

- Yield-to-call
  - ↳ Can be calculated for each possible call date & price

- Yield-to-worst
  - ↳ Lowest of yield-to-maturity & various yields-to-call s.

- Optn adjusted price
  - ↳ If a bond has a call optn then investors don't usually like it so to make it attractive, bond prices ↑
  - ↳ The price of the optn that would be there if there was no optn is called optn adj price

- Opt^r adjust yield
  - ↳ Bonds w/ call opt^r have higher yields
  - ↳ The yield of the bond once the call opt^r is removed is called opt^r adj. yield

* Yield Measures for Floating-Rate Notes

- FRN = LIBOR (reference rate) ± quoted margin.
- If FRN is issued by comp. that has more credit risk, a margin is added to LIBOR
- Liquidity & tax treatment can also affect the margin.
- Quoted margin
  - ↳ Margin used to calculate bond pmts.
- Rep. margin / Discount margin
  - ↳ Margin required to return FRN to its par val.
- If credit quality unchanged, quoted margin = Rep. margin
  - increases, >
  - decreases, <
- So use LIBOR + QM for coupon rate
  LIBOR + DM for disc. rate

* Yield Measures for Money Mkt Inst

- They are short term debt securities
- They range from overnight sale to repurchase agreement to one-yr bank cert. of depo.

Bond mkt yields	Money mkt yields
- Annualized & compounded	- Annualized & stated on simple interest basis
- Calc using std time val of money analysis	- Discount rates Add on rates
- Stated for common periodicity for all times-to-mat	- Instr w/ diff times to maturity have diff periodicity

- Discount basis yield

$$DR = \left(\frac{\text{Year}}{\text{Days}}\right) \times \frac{FV - PV}{FV}$$

- Add on rate / Bond eq. yield

$$AOR = \left(\frac{\text{Year}}{\text{Days}}\right) \times \left(\frac{FV - PV}{P.V.}\right)$$

- Comparing discount basis w/ add on yield

Eg: Suppose an investor is comparing 2 money mkt instr. (A) 90-day deposit quoted at discount rate of 5.76%. for 360 day yr
(B) 90-day CP add on rate 5.90%. for 365 day yr.
WHICH OFFERS HIGHER EXPECTED RATE OF RETURN

→ (A) $0.0576 = \frac{360}{90} \times \frac{100 - PV}{100}$

$PV = 98.56$

$AOR = \frac{365}{90} \times \frac{1.44}{98.56}$

$= 5.92\%$

∴ (A) > (B)

(Compare apples to apples)

Spot yield curve → derived from recently issued & actively traded gov. bonds

* Maturity Structure of Interest Rates

- Spot rate curve :
  - ↳ Plots diff. maturities on x axis & corresponding spot rates on y-axis
  - ↳ Spot rates are yield-to-maturity on zero coupon bonds maturing at the date of each cash flow, if bond is held to maturity (Ass. no cpn pmts)
  - ↳ Spot rate curve also called Zero or Strip curve

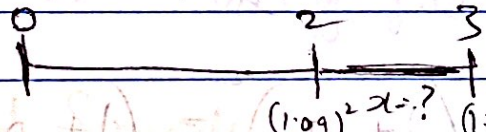
- Yield curve
  - ↳ Plots yields of bonds on y-axis vs maturity on x-axis
  - ↳ Diff. b/w yield & spot is yield curve considers coupon payments as well

- Par curve
  - ↳ Plots YTM for diff. maturities but bonds are assumed to be priced at par.
  - ↳ They also have same currency, credit risk, tax status etc
  - ↳ Constr from spot curve
  - ↳ Yield reflects cpn rate a bond at each maturity would need to have to be priced at par

* Forward Rate & Spot Curve

- **Forward Rate**
  - ↳ Interest rate on the money borrowed in the future
  - ↳ Written in this format: "2y1y" → Rate on 1yr loan starting 2yrs from now.

- **Implied fwd rate**
  - ↳ Calculated from spot rates.
  - ↳ Eg. Say 3-yr spot rate = 10%.
    2yr spot rate = 9%.
    What is implied 2y1y?



- $1 after 3yrs $= (1.10)^3 =$
  $1 after 2yrs $= (1.09)^2$

$$(1.09)^2(1+x) = (1.1)^3$$

$$x = 12\%$$

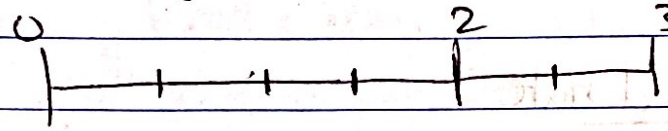
- Fwd rates are usually greater when spot rates are rising

Eg. Spot rates

1yr	2.548%
2yr	2.983%
3yr	2.891%

The prices are per 100 of par value. The YTM are stated on semiannual bond basis.

Compute 2y1y



$1 after 3yrs $= \left(1 + \frac{0.02891}{2}\right)^{3\times 2}$ — semi annual

$1 after 2yrs $= \left(1 + \frac{0.02983}{2}\right)^{2\times 2}$

$$\left(1 + \frac{0.02983}{2}\right)^{4} \times \left(1 + \frac{x}{2}\right)^{2} = \left(1 + \frac{0.02891}{2}\right)^{6}$$

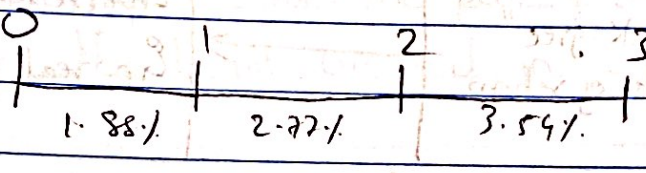
$$x = 2.7\%$$

Applications of Forward Rates

- Implied spot rates can be calculated as geometric avg of fwd rates.

- Bonds can then be priced using implied spot rates.

	Fwd Rate
Eg. 0y1y	1.88%
1y1y	2.77%
2y1y	3.54%
3y1y	4.12%



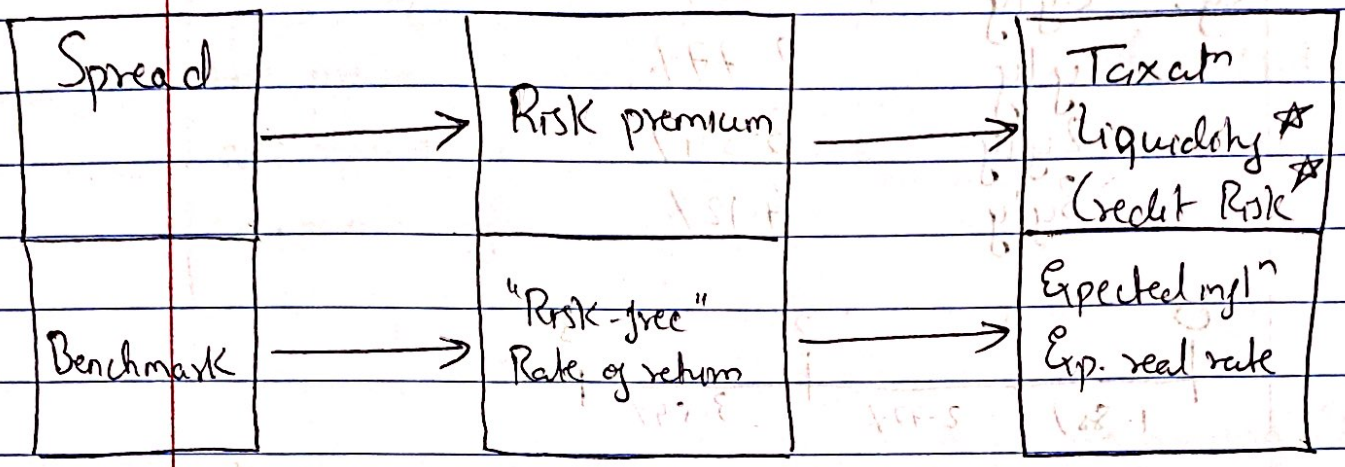
$$(1+S_2)^2 = (1+0.0188)(1+0.0277)$$

$\therefore S_2$ = GM of fwd rates.

* Yield Spreads

- Benchmark spread
  - ↳ Yield spread over specific benchmark such as LIBOR or Treasury bond yield
  - ↳ Eg. If yield on corp bond = 6%. & on T-bond = 5%. Then yield spread = 1%.
  - ↳ G-spread :- Yield spread over actual or interpolated government bond

- I-spread :
  ↳ Yield spread over standard swap rate (same currency, same tenor)



- Z-Spread (Zero Volatility Spread)
  ↳ Is based on entire benchmark spot curve
  ↳ It is constant spread that is added to each spot rate such that present val. of cash flow matches the bond price ☆

- Opt" Adjusted Spread
  ↳ OAS on a callable bond is the Z-spread - theoretical val. of embedded callable opt".

Reading 53: Introduct to Asset Backed Securities

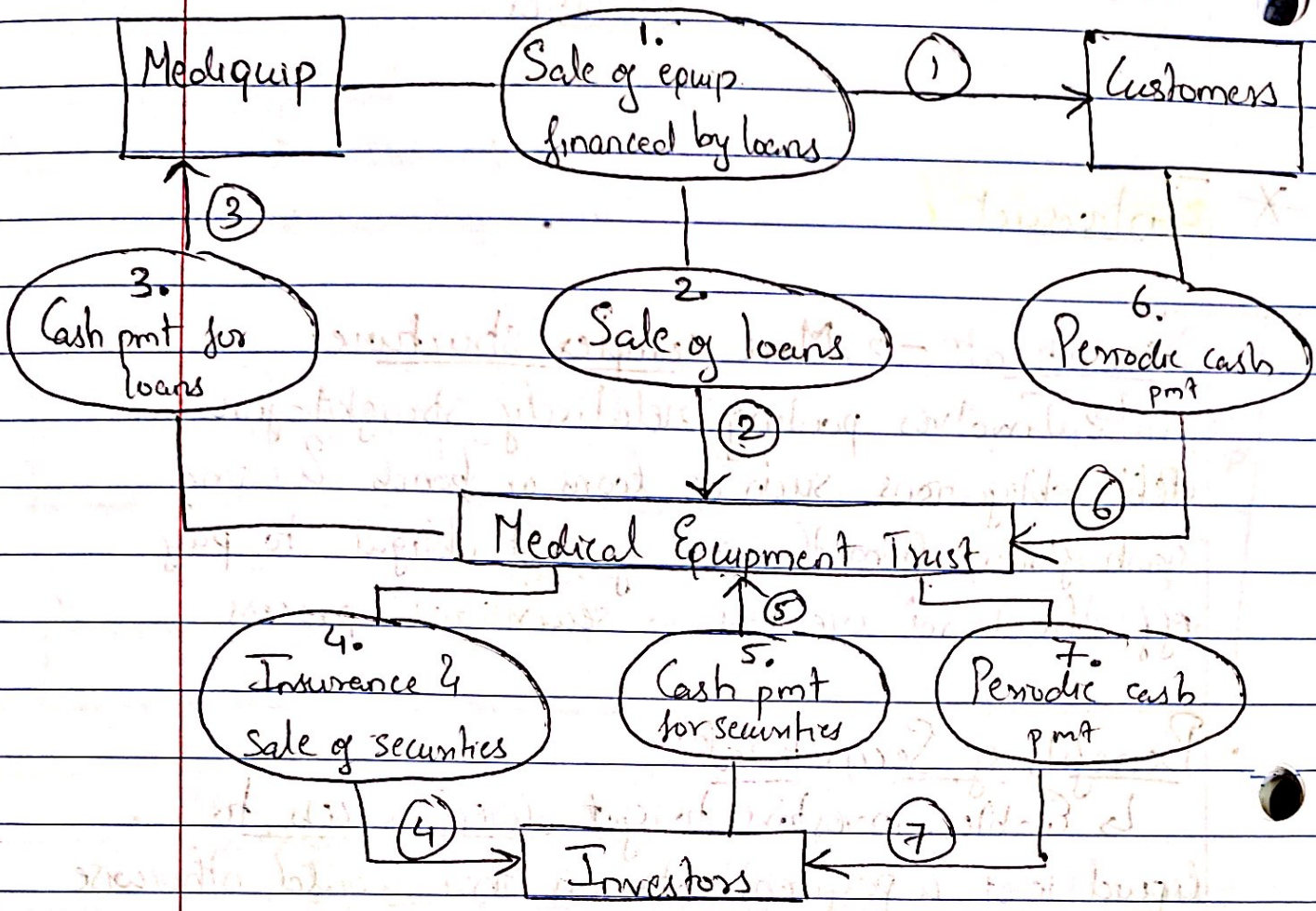
* Introduct

- Securitizat → More complex structure
  - ↳ Involves pooling relatively straight-forward debt obligations, such as loans or bonds & using cash flows from the pool of debt obligat to pay off the bond created in securitizat process.

- Benefits of Securitizat
  - ↳ Enables investors to get direct access to liquid inst & payment streams that would otherwise be unattainable
  - ↳ Enables banks to ↑ loan originat
  - ↳ lowering cost of borrowing for entities raising fund
  - ↳ Higher risk adjusted return
  - ↳ ↑ efficiency & profitability for banking sector

* How Securitizaton Works

An example of Securitizat Transact



- Special purpose vehicle → Medical Equip Trust aka Trust / Issuer
- Seller of pool of securities → Mediquip aka depositer
- Servicer → Mediquip
  - ↳ Who makes sure loans are paid on time etc.
  - ↳ Not necessary for servicer & seller to be the same

- Other parties
  - Accountants, lawyers, underwriters etc

* Structure of Securitizat°

- Motivat° to create diff types of structures is to redistribute payments prepayment & credit risk efficiently among diff bond class.

- Prepayment risk
  - Uncertainty that actual cash flows will be different from scheduled cash flows as set forth in loan agreements as customers might take adv of interest rate.
  - This risk cannot be avoided but can only be distributed

- They can be structured w/ multiple classes, each w/ diff. claim to cash flows. These classes are called 'tranches'.

Time tranches
- First tranche receives all principal repaymt upto the principal val.

↳ The second tranche would then receive all principle repmt after first tranche pmt have been met.

Credit tranching / Subordinat°

Bond Class	Par Value ($ mil)
A (senior)	180
B (subord)	14
C (subord)	6
Total	200

↳ Here, losses upto 6 mil will first be beared by C then if losses exceed 6 & are below 20, it will be beared by B also etc.

* **Residential Mortgage loan**

- A loan secured by the collateral of some specified real estate property which obliges the borrower to make a predetermined series of pmts to lender

- Cash flow of mortgage include
  ↳ Interest
  ↳ Scheduled princip pmt

↳ prepaymt (any principal repaid in excess of scheduled principal)

- Ratio of property's purchase price to amt of mortgage is called loan-to-value ratio

- ↓ LTV ratio → ↑ borrowers equity → ↓ risky for lender

- Prime loans
  ↳ Mortgages w/ higher LTV ratio made to borrowers w/ good credit.

- Subprime loans
  ↳ Mortgages to lower credit quality

Characteristics of Mortgage loans

- Maturity
  ↳ Time until final loan pmt is done
  ↳ In US, 15 to 30 yrs
  Europe, 20 to 40 yrs
  Japan, 100 yrs.

- Interest Rate
  - ↳ Fixed rate mortgage
  - ↳ Adjustable rate mortgage (ARM)
    - ↳ int. rate that can change over life of mort
  - ↳ Indexed reference mortage
    - ↳ Based on mkt determined ref. rate (LIBOR etc)
  - ↳ Hybrid mortgage
    - ↳ Loan that has fixed int rate & after some yrs changes to ARM.
  - ↳ Rollover or renegotiable
    - ↳ Loan that has fixed int rate & after some yrs changes to fixed int rate w/ diff value
  - ↳ Convertible mortgage
    - ↳ Based on the opt. of the borrower, the rates can change

- Amortizat° of principal
  - ↳ In fully amort, each pmt includes int. pmt & repayment of some principal. So there is no principal remaining at the end of the last pmt

- Prepmt & Prepmt penalty
  - ↳ If instead of paying $500 monthly, you pay $600 then the extra amt paid

is called prepmt.
↳ As this is not beneficial for the lender, there may be a prepmt penalty

- Foreclosure (Rights of lenders)
  ↳ Non-recourse mort. loans
    ↳ In case borrowers defaults, the bank has claim on only the property for which the loan was paid
  ↳ Recourse mort. loans
    ↳ In case ...., bank has claim to everything the the borrowers own.
  ↳ In Europe, its all recourse loans unlike US.

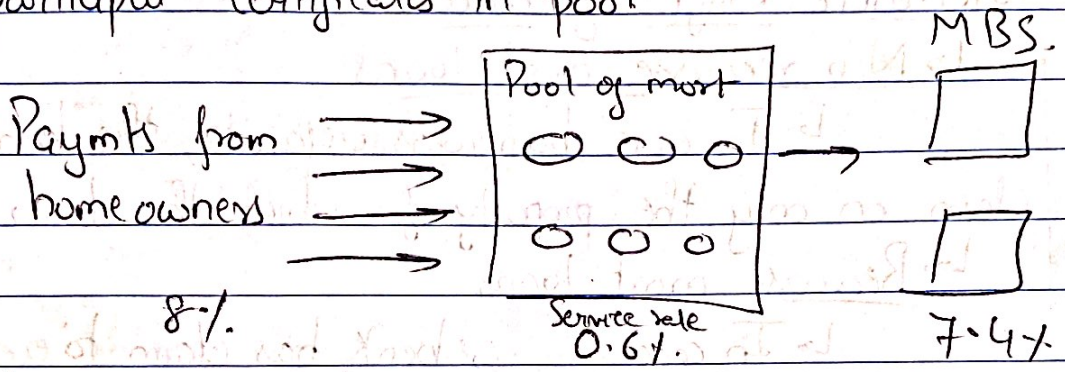
✳ Residential Mortgage-Backed Securities (RMBS)

- Three sectors for securities backed by residential mort.
  - Agency RMBS
    - ↳ Guaranteed by FEDERAL AGENCY (Ginnie Mae) whose securities are backed by full faith & credit of US government
    - ↳ Guaranteed by either of the two GSEs (gov. spons. ents) ie. Fannie Mae & Freddie Mac but not by US Government
  - Non agency
    - ↳ Issued by private entities that are not guaranteed by federal agency or GSE
- Loans that meet stds for inclusion in agency MBS are conforming loans

↗ Agency RMBS

Mortgage pass-through securities

- Created when one or more holders of mort form a pool of mortgages & sell shares or participation certificates in pool



- Cash flow characteristics
  - ↳ Pmts from homeowners include int., scheduled prepmts, prepmts
  - ↳ Pass-through rate
    - ↳ If homeowners pay 8% & 0.6% rate is charged as service/~~pay~~ rate in bt then 7.4% that investors receive is called pass through rate
  - ↳ Weighted avg coupon rate (WAC)
    - ↳ As each cpn in pool of mort are not the same, we take wght avg.
  - ↳ Weighted avg maturity (WAM)

Measures of pre-payment rate

↳ Single Month Mortality (SMM) measures prepmts in a month

↳ $SMM = \frac{\text{Prepmt for a month}}{\text{Beginning mort. bal for month} - \text{Sched. prin repmt for month}}$

↳ The conditional prepmt rate (CPR) is an annualized version of SMM

↳ CPR of 6% means approx 6% of outstanding mortgage balance at beginning of the year is expected to be prepaid by end of the year

↳ The 100 PSA prepmt benchmrk is expressed as monthly series of CPR

↳ PSA assumptn > 100 PSA → Prepmts faster than benchmrk
↳ ↓ durat^n

PSA assumptn < 100 PSA → Prepmts slower than bmark
↳ ↑ durat^n

(Int ↑)

↳ Extension risk : Re Prepmts slower than usual

Contraction risk : Prepmts faster than usual
(Int ↓) ↳ bos homeowners refinance at lower mtrst

Cash flow Construction

Consider monthly cash flow to bondholders for a $800 mill mort pass-thru sec w/ WAC of 6% & WAM of 357 months & 5.5% pass thru rate

Beginning of Month Mort = 800,000,000

SMM = 0.00111

Mort pmt = 4,810,844

→ Net int pmt = 3,666,667 — (4) $\leftarrow \frac{0.055}{12} \times 800\text{mil}$

→ Scheduled principal repmt = 810,844 — (1)

$\hookrightarrow 4810844 - \frac{0.06}{12} \times 800\text{mil}$

→ Prepmt = 884,472 — (2) → Using SMM form.

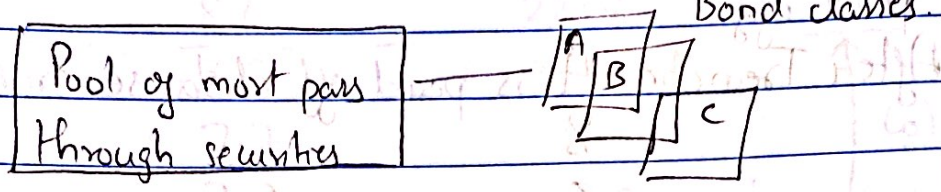
→ Total princ repmt = (1) + (2) — (3)

→ Cash flow = (4) + (3).

Collateralized Mortgage Obligations

- Creation of CMO can help manage prepaymt risk by distributing various forms of prepmt. risk among different classes of bondholders.

- The collateral is usually a pool of mortgage pass-through securities



- The creat° of CMO cannot eliminate prepmt risk.; It can only distribute various forms of this risk among various classes of bondholders.

- Major innovat° - Securities can be created to closely satisfy asset/liab needs of institut° investors.

- Sequential-Pay Structure w/ Four Tranches

Tranche	Par Amt (mil)	Coupn Rate (%)
A	398	5.5
B	72	5.5
C	193	5.5
D	146	5.5

↳ For paymt of monthly coupn interest - Distribute monthly coupon interest to each tranche on the basis of amt of princpl outstanding for each tranche

↳ For disbursement of principal pmts – Disburse principal pmt to Tranche A until completely paid off

After Tranche A is paid off, disburse tranche B

B → C

C → D

So Tranche A will have lowest duration.

Hence ↑ contract^n risk ↓ extension risk

Tranche D → ↑ durat^n

↳ ↑ extension risk ↓ contract^n risk

But at each tranche, there can be variability ± 10 yrs.

- Planned Amortizat^n Class (PAC) & Support Tranche
  - ↳ To avoid variability, we use PAC
  - ↳ PAC tranches offer greater predictability as long as prepayment rate is within specified band.
  - ↳ PAC offer protect^n against contract^n & extension risk
  - ↳ Greater certainty comes at the expense of non-PAC tranches (support tranches).

PSA	Life of PAC	Life of Support	
50	10.2	24.9	extension risk
75	8.6	22.7	
100	7.7	20.0	Collar
165	7.7	10.7	
250	7.7	3.3	
400	5.5	1.9	Contraction risk
600	4.0	1.4	

↳ If you look at the box b/n PSA 100 & 250, there is a great variability in support but they have fixed PAC.

↳ If repaymt are faster than expected → Support absorbs it

slower → Repmt to support is directed to PAC

↳ Collar : As long as repmt are within this collar PSA range, then LIFE OF PAC is predictable

↳ If support tranches are paid off quickly cos of faster-than-expected prepmt, they no longer provide any protectn for PAC tranches.

↳ Broken PAC :- If prepmt rate is outside collar range

↳ Support tranche have more risk hence more interest rate than PAC

Non-agency RMBS

- Credit risk major concern
- Credit quality of non-agency depends on issuer borrowers & characteristics of loan
- Credit Enhancement are used by the issuer w/ help of rating agency to ↑ credit quality
  ↳ Internal :- Senior/Subord struct, reserve fund, overcollat
- Credit tranching used to ↑ credit quality of senior RMBS securities.
- If prepmt or credit losses ↓ credit enhancement of senior securities, the shifting interest mechanism suspends pmts to subordinates until credit quality of senior securities is restored.

→ Call protect

* Commercial Mortgage-Backed Securities

- CMBS are backed by pool of commercial mortgage loans on income producing property (eg. office bldg)
- Generally commercial mortgage loans are non-recourse loans; hence credit analysis involves studying the cash flows from underlying properties
- Two Key indicators of potential credit performance
  - ↳ Debt-to-service-coverage ratio = $\frac{\text{Net op inc}}{\text{debt}}$
    - ↳ 1 is ideal
    - ↳ More the better, better credit rating, low credit risk
  - ↳ Loan-to-value ratio
    - ↳ High value → High credit risk
- First loss piece / Residual tranche / Equity tranche — The subordinate tranch who is first to bear all the losses.
  The tranch who gets the last pmt
- CMBS have call protect
  - Structure level
  - Loan level

- Eg. of call protect at structure level - Sep. pay tranches

- At loan level, 4 mechanism offer inv call protect
  - ↳ Prepayment lockouts
    - ↳ Contractual agreement that prohibits from prepaymt for a certain period.
  - ↳ Prepayment penalty points (penalty on)
    - ↳ There will be prepayment as pts which will be converted to %
  - ↳ Yield maintenance charge (make whole charge)
    - ↳ Makes refinancing for borrower uneconomical
  - ↳ Defeasance
    - ↳ Borrower providing funds (for) the servicer to invest in a portfolio of govt securities that replicates CF that would exists at the absence of prepmts.

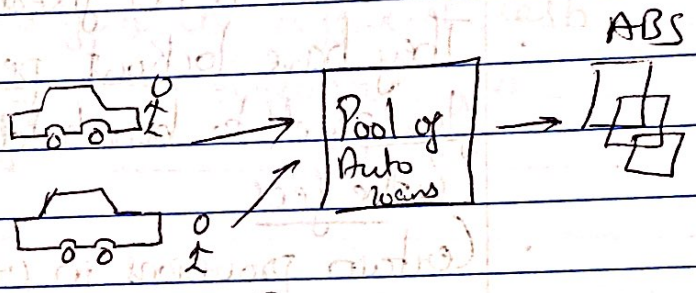
- Balloon loans
  - ↳ Commercial loans backing CMBS

- Balloon risk → Type of extension risk
  - ↳ Risk that borrower wont be able to make balloon pmt cos. either the borrower cannot arrange refin. or cannot sell the property

* Non-mortgage Asset Backed Securities

- Most popular are auto loan receivable-backed securities & credit card receivable backed securities.
- Collateral is amortizing for auto loan BS
- Collateral is non-amortizing for credit card BS
- Must offer credit enhancements

Auto loan ABS



- Cash flow consist of interest pmt, scheduled princ pmt & any prepmt
- Prepmts result from sales & trade-ins, repossession & subsequent resale of vehicles; insurance proceeds received upon loss of vehicle, refinancing loan on lower interest rate
- All auto loan-backed securities have some form of credit enhanc.

Credit card receivable ABS

- Cash flows consists of finance charges collected, fees & principal repayments.
- Finance charges represent periodic interest the borrower is charged on unpaid balance after grace period.
- Interest is paid to security holders periodically. Maybe fixed or floating
- They are non-amortizing loans (ie principal pmt schedule is not fixed)
- They have lockout periods during which cash flow paid to bondholders only depend on the interest & the fees
- Certain provisions in credit card receivables require early amortizat° of principal if certain events occur. Such provisions are referred to as "early amortizat°" or "rapid amortizat°" & are included to safeguard credit quality of issue.
- Early amort is the only way principal can be altered

✳ Collateralized Debt Obligat^{n} (CDO)

- Describes a security backed by a diversified pool of one or more debt obligat^{n} (eg corp bonds, ABS, RMBS, CMBS, CDO).

- CDO involves creat^{n} of SPV.

- In contrast w/ ABS, where CDO requires a collateral mngr to buy & sell debt obligat^{n} for & from CDO's portfolio of assets to generate sufficient cash flows to meet obligat^{n} of CDO & generate fair return for equity tranches

Summary

- How securitizat^{n} Works

- Structure of securitizat^{n}
  - ↳ Time tranching
  - ↳ Credit tranching

- Residential Mortgage loan
  - ↳ Characteristics - maturity, int rate, amort, foreclosure

- Residential Mortgage Backed Securities (RMBS)
  - ↳ Mortgage Pass through Securities
  - ↳ Collaterized mortgage obligat
    - ↳ Seq. pay struct
      - ↳ PAC & Support tranches
  - ↳ Non-agency RMBS

- Commercial Mortgage Backed Securities (CMBS)
  - ↳ Call protect

- Non-mortgage Asset Backed Securities
  - ↳ Auto loan ABS
    - ↳ Credit loan ABS

- Collaterized debt obligations

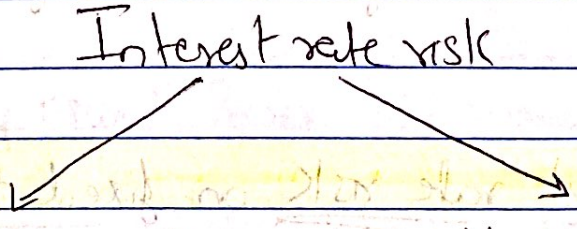
Reading 54: Understanding Fixed Inc Risk & Return

✳ Sources of Return

- Total return is the future value of reinvested coupon interest payments & sale price (or redemption of principal if bond is held to maturity).

- The horizon yield is the internal rate of return btn total return & purchase price of bond

- Sources of return
  - ↳ Receipt of promised cpn & principal pmt on scheduled dates
  - ↳ Reinvestment of coupon payments
  - ↳ Potential capital gains or losses on sale of bond prior to maturity



- Cpn reinvstment risk inversely correlated w/ mkt price risk

When interest rate ↑

Reinvstment income ↑

Price of bond wrt constant yield ↕

To decide which effect is greater, we look at the horizon.

∴ If horizon is ↑

↳ Reinvst inc dominates

If horizon is ↓

↳ Price will dominate

∴ If you ↓ interest rate, price & horizon is short then more emphasis on price & the price ↑ (as int rate ↓). ⇒ Hence more return. But if int rate ↑ with this short horizon then price ↓ and as price is given more weight, return is ↓.

* **Interest rate risk on fixed rate bonds**

Mac Dur for non-callable perpetual bond $= \frac{1+r}{r}$ → r = YTM

- Durat of bond measures sensitivity of bonds full price to changes in interest

- Yield durat (Sensitive to YTM)
  - ↳ Macaulay durat
  - ↳ Modified durat
  - ↳ Money durat
  - ↳ PVBP

- Curve Durat (Sensitive to MKt rate)
  - ↳ Effective durat

Macaulay duration

- Wghted avg of no. of years until each of the bonds promised cash flows is to be paid where wghts are PV of each cash flow as % of bonds full value

- Consider newly issued 3-yr 4% annual pay bond w/ 5% YTM.

$C_1 = 40$	$PV_1 = 40/1.05 = 38.10$	$w_1 = \frac{38.10}{972.77} = 0.0392$
$C_2 = 40$	$PV_2 = 40/1.05^2 = 36.28$	$w_2 = \frac{36.28}{972.77} = 0.373$
$C_3 = 1040$	$PV_3 = 1040/1.05^3 = 898.39$	$w_3 = 0.9235$
	972.77	1

∴ M durat^n = 0·0392(1) + 0·0373(2) + 0·9235(3)

= 2.884 yrs

Modified Durat^n — Do not confuse 4TM/Yp decimal

$$\text{Mod Dur} = \frac{\text{Mac Dur}}{1 + 4TM}$$

$$\text{Mod Dur}_{semi} = \frac{\text{Mac Dur}_{semi}}{1 + \frac{4TM}{2}}$$

- Provides an estimate of percentage price change for a bond given a change in its 4TM

$$\text{approx \% change in bond price} = -\text{Mod Dur} \times \Delta 4TM$$

- Provides LINEAR ESTIMATE
- Good estimates for small changes in yield

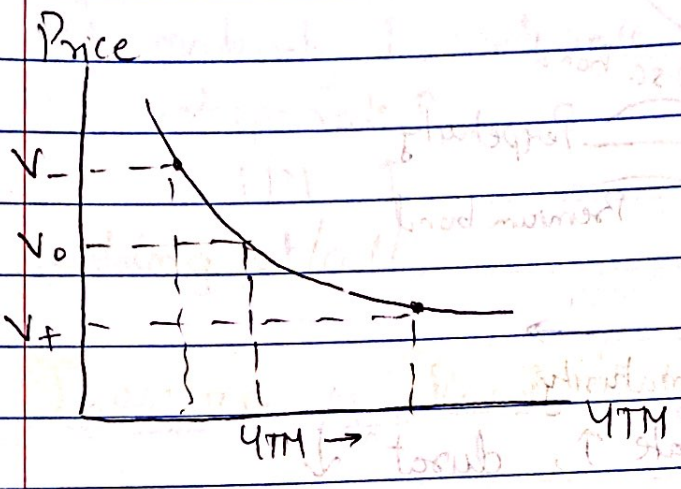
Approximate Modified Durat^n

- V_- = price of bond if 4TM is decreased
  V_+ = increased
  V_0 = current price of bond

• In rising int-rate, eff. durat of putable bonds relative to non-putable bond is lower

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

↳ Convert YTM% to decimal



- Provides CONVEX estimate

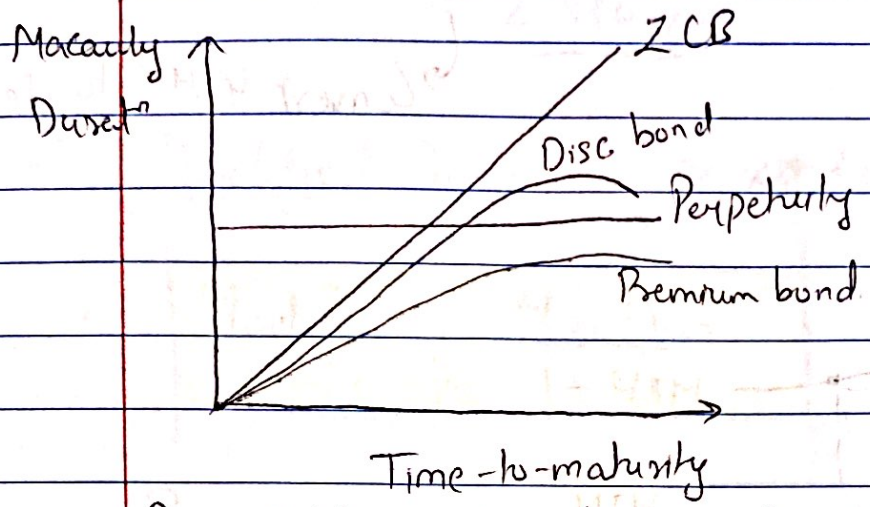
Effective Durat (Effective Dur = Mod Dur for opt free bonds if yield curve is flat)

- Bonds w/ embedded opt & mortgage back securities do not have a well defined YTM cos of prepayment risk
- Appropriate measure for these bonds is effective durat
- It is sensitivity of bonds price to change in benchmark yield curve

$$\text{Eff Dur} = \frac{PV_- - PV_+}{2 \times y_0 \times \Delta \text{curve}}$$

MacDur for long-term disc bond can be lower than short-term

Properties of Macauly Yield Durat^n



As coupn rate ↑, durat^n ↓.
YTM ↑ durat^n ↓

Key rate duration / Partial duration

- Impact of non-parallel shifts can be measured using this.

- Sensitivity of bond to changes in spot rate / yield curve for a particular maturity keeping rest of the spot rates constant

Effect of bond's maturity, coupn & yield to int rate risk

As maturity ↑, int rate risk ↑
int cpn rate ↑, ↓
YTM ↑ ↓
adding put/call, ↓

Duration of Bond Portfolio

Two Approaches

Wghted avg time to receipt of aggregate cash flows
↳ Theoretically ✓ but difficult to use
↳ Cash flow yield not used
↳ Amt & timing of CF not known
↳ Change in cashflow yield not same as change in YTM on individual bonds
↳ Doesn't work with bonds w/ embedded optn

Wghted avg of individual bond durat'n that comprise the portfol.
↳ Commonly used
↳ Easy to measure
↳ Assumes parallel shift
↳ Works w/ embedded optn
↳ Weights are just the individual mkt price ÷ by total mkt price
↳ LIMITAT'n – YTM of each bond must change by the same amt (Parallel shift in yield curve)

* Money Durn

- Measure of price change in units of currency in which bond is denominated

$$\text{Money Dur} = \text{Annual Modified dur} \times \text{full price of bond port}$$

$$\text{Change in the price} = -\text{Money Dur} \times \Delta \text{Yield}$$

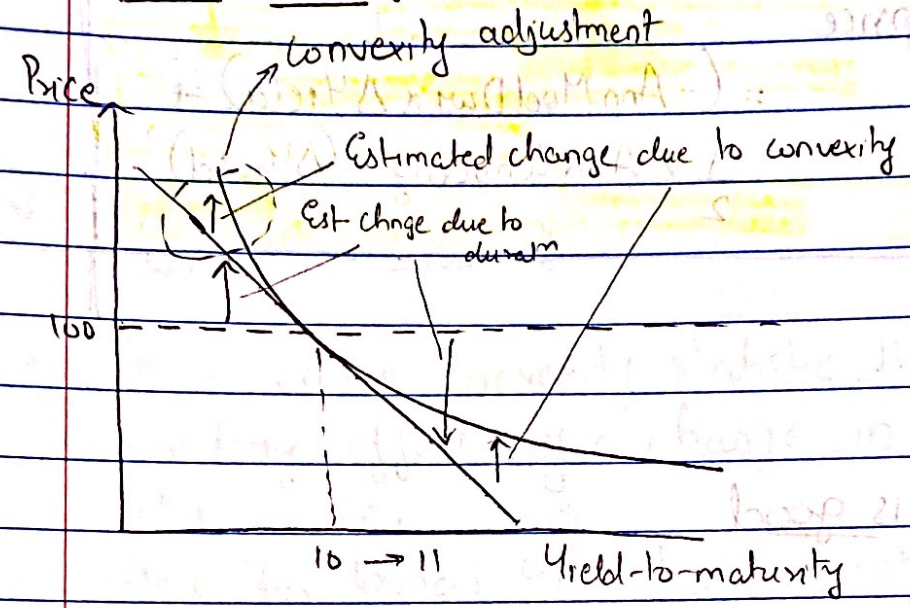
(Decimal)

* Price Value of Basis pt

- Estimate of change in full price given 1bp change in YTM

$$PVBP = \frac{V_- - V_+}{2}$$

* Bond Convexity



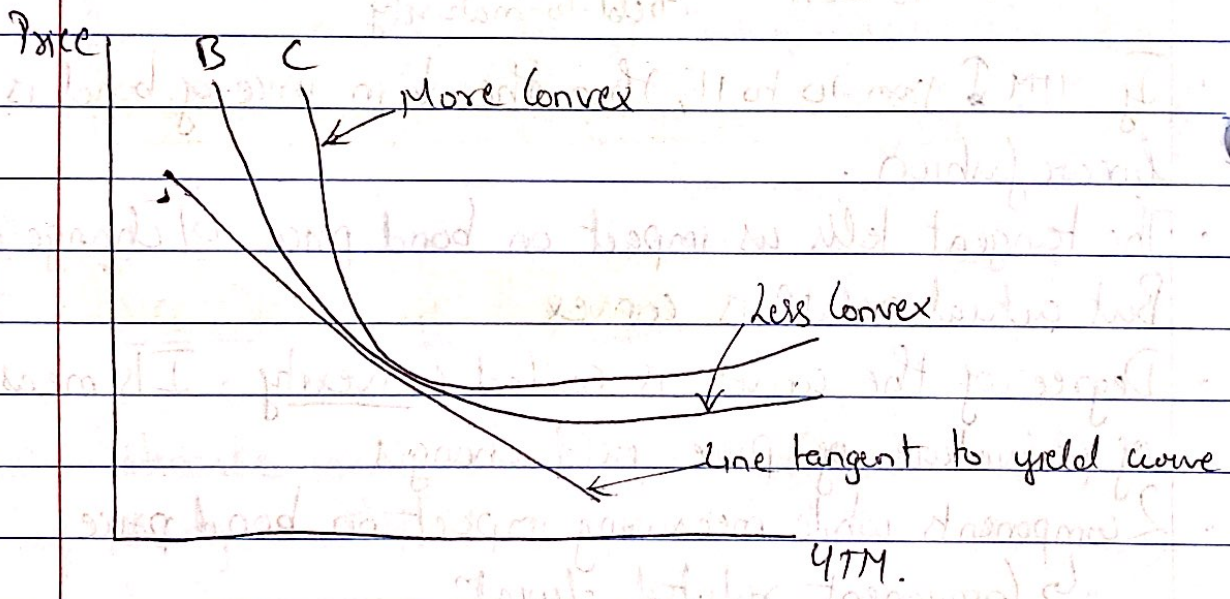
- If YTM ↑ from 10 to 11, then the ↓ in price of bond is in linear fashion.
- The tangent tells us impact on bond price w/ change in YTM But actual relatn is convex.
- Degree of the convex is called convexity. It's measure of curvature of price-yield changes.
- 2 components while meesuring impact on bond price
  - ↳ component related durat^n
  - ↳ -11- convexity

$$\text{Approx Convexity} = \frac{(PV_-) + (PV_+) - 2PV_0}{(\Delta \text{Yield})^2 \times PV_0}$$

% Change in full price = Durat^{n} + Convexity

$$= (-\text{Ann. Mod Dur} \times \Delta\text{Yield}) + \frac{1}{2} \times \text{Ann Convexity} \times (\Delta\text{Yield})^2$$

- Convexity is good



Convexity impacted by (Similar to durat^{n})

↳ Time to maturity ↑ → conv. ↑

↳ Coupon rate ↓ → conv ↑

↳ YTM ↓ → conv ↑

↳ Dispersion of cash flow ↑ → conv ↑

- When YTM ↓, more convex bond appreciates more ↑, depreciates less

So good for investor

* Effective Convexity

- It is curve convexity statistic that measures the secondary effect of a change in a benchmark yield curve.
- Used for bonds w/ embedded opt^n

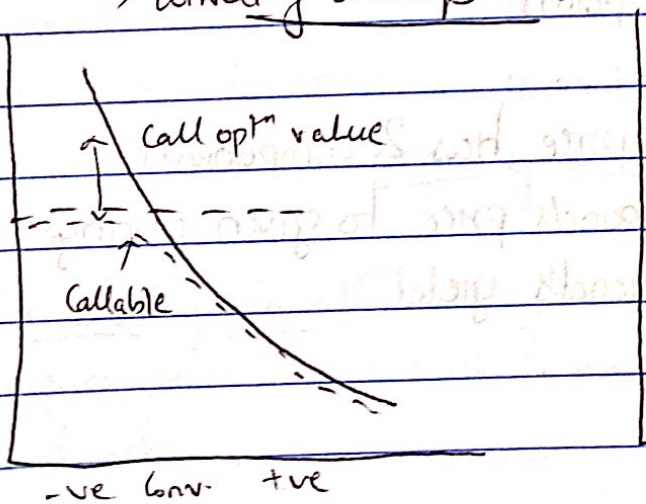
$$\text{Eff Con} = \frac{PV_- + PV_+ - 2PV_0}{(\Delta \text{Curve})^2 \times PV_0}$$

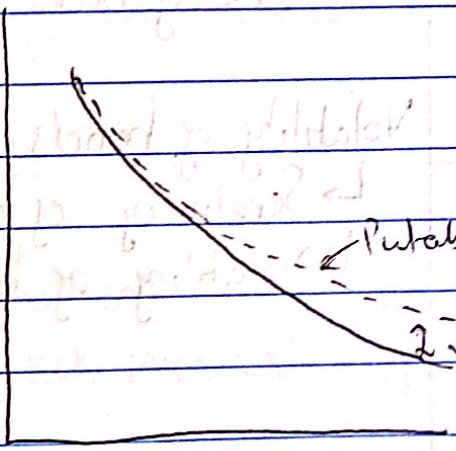
When int. rate ↓, issuer more likely to exercise CALL opt^n viz bad for bondholders so -ve convexity

YTM < Cpn rate

Callable bonds → NEGATIVE COMPLEXITY

Putable bonds greater conv. than normal bond
↳ convexity always +ve





- When YTM ↓, more convex bond appreciates more & depreciates less
  ↑,
  so good for investor

* Effective Convexity

- It is curve convexity statistic that measures the secondary effect of a change in a benchmark yield curve.
- Used for bonds w/ embedded opt^n

$$\text{Eff Con} = \frac{PV_- + PV_+ - 2PV_0}{(\Delta \text{Curve})^2 \times PV_0}$$

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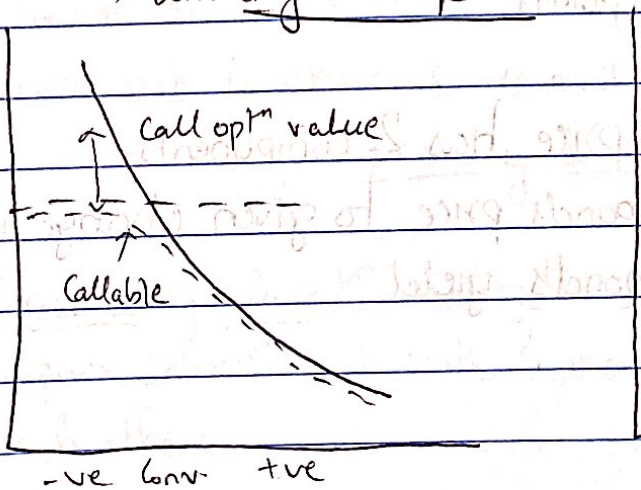
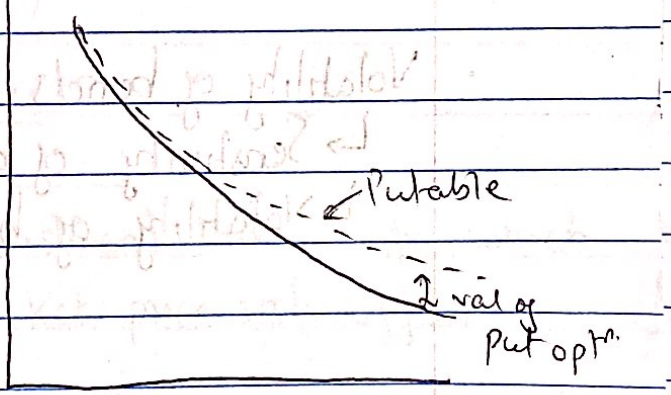




* Interest Rate Risk & Inst Horizon

- Short term investors are concerned w/ impact of flat price given sudden change in YTM
- Long term inv. are concerned w/ reinvestment of coupon interest

Yield Volatility → A downward sloping term struct of yield volat indicates ↑ volatility for short-term bonds

- Refers to volatility of bonds YTM
- Typically short term bonds have greater yield volatility than long term bonds
- Bond price changes depend on
  - ↳ PVBP
  - ↳ No. of basis points
- Volatility of bonds price has 2 components
  - ↳ Sensitivity of bonds price to given change in yield
  - ↳ Volatility of bond's yield

$$\%.\Delta PV = -\text{ModDur} \times \Delta\text{Yield} + \frac{1}{2} \times \text{Conv} \times (\Delta\text{yield})^2$$

Investment Horizon, Macauley Durat° & Int Rate Risk

- With longer term horizons we are concerned w/ price risk & reinvstment risk.
- Consider 10yr, 8% annual coupon bond priced at 85.50, YTM = 10.40%.
  - ↳ If invstment horizon = 10yrs, major concern reinvstment
  - ↳ = 4 yrs, price risk
- How to Know what is the cutoff. below which there is price risk & above is reinvst?
  - ↳ Using Macauley Durat°
- Macauley durat° indicates invstment horizon for which coupon reinvstment risk & market price risk offset each other.

Assumptn: One-time parallel shift in yield curve

1. If invst horizon > Mac Dur → coupn reinvst risk dominates
   < → Price risk dominates
   = → both offset each other

Duratn Gap = Mac Dur − Invst Horizon

↳ +ve → risk of higher int rate
-ve → risk of lower int rate

✳ Credit & Liquidity Risk

- Credit risk involves probab. of default & degree of recovery if default occurs
- Liq. risk refers to transactn cost associated w/ selling the bond (If bond is diff to sell)

4TM

Spread

Benchmk yield

- For traditional (optn free) bond, same durat. & convexity statistics apply if a change occurs in benchmk yield or in the spread
- Change in spread can result from change in credit or liq. risk

Reading 55: Fundamentals of Credit Analysis

✳ Credit risk

- It has 2 components:
  - ↳ Default risk (or default probab)
  - ↳ Loss severity (or loss given default) = 1 - Recov. Rate
    - ↳ Value of bond investor will lose if issuer defaults

- Expected loss = Default risk x loss severity

- Recovery rate = 1 - Expected/ loss loss severity

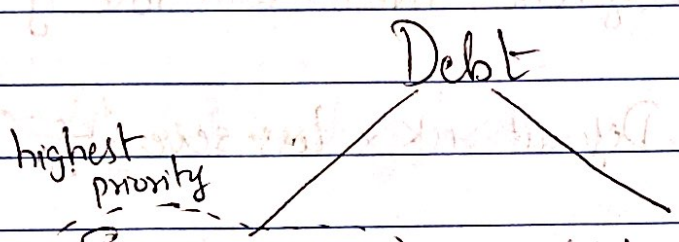
- If exp. loss = 0.05, that means for every 1$ default, inv. will lose 5 cents

- Spread risk
  - ↳ Inversely related to bond price
  - ↳ Will widen due to one or both of these factors
    - ↳ Credit migrat risk or downgrade risk
      - ↳ Prob. that spread will ↑ as issuer has become less creditworthy
    - ↳ Market liquidity risk
      - ↳ Risk of receiving less than mkt val when sell. bond
      - ↳ Reflected in bid-ask spread

* Capital Structure, Seniority Ranking & Recovery rates

Seniority Ranking

- Each category of debt from same issuer is ranked according to priority of claims



- Secured debt
  - ↳ First mortgage / First lien
  - ↳ Senior secured
  - ↳ Junior secured
- Unsecured debt
  - ↳ Senior
  - ↳ Junior
  - ↳ Subordinated

- Seniority rankings
  - ↳ First lien or first mortgage.
  - ↳ Senior secured debt
  - ↳ Junior —"—
  - ↳ Senior unsecured debt
  - ↳ Senior subordinated debt
  - ↳ Subordinated debt
  - ↳ Junior subord.

- Pari Passu
  ↳ All debts under same category
- Lower ranking → ↑ credit risk → ↑ returns

Capital Structure

- Composit° & distribut° of debt & equity
- Simple cap. struct
  ↳ If comp. values $100mil off which $5 Bank debt $35mil bonds, $60mil stocks
- Complicated cap. struct
  ↳ If there is one holding comp & has acquired many small comp w/ their own diff cap. struct

Recovery Rates

- Pari Passu
- Vary by seniority rankings ↑ → RR ↑
- Vary by industry

- Depend on when they occur in credit cycle
- High variability
- Priority of claims: not always absolute

* Rating Agencies

- Moody's, S&P & Fitch play a dominant role
  - ↳ Independent credit risk analysis
  - ↳ Easy comparison
  - ↳ Growth in industry
  - ↳ Regulatory comp. also rely on such ratings
- Rating agency rate both; issuer & issue
- Corporate family rating: Issuer credit rating
- Corporate credit rating :- Issue specific rating
- Issuer ratings are based on their creditworthiness of company & are rated on their senior unsecured debt

Moody's	S&P
Aaa	AAA
Aa1	AA+
Aa2	AA
Aa3	AA-
A1	A+
A2	A
A3	A-

From S&P. to Moody
∴ + ≈ 1 AA+ ≈ AA1
- ≈ 3 AA- ≈ AA3
≈ 2 AA ≈ AA2

- Investment grade ratings → Upper med. grade
  - ↳ AAA, AA+, AA, AA-, A+, A, A-, BBB+, BBB, BBB-, → Lower med. grade
  - ↳ Everything else are non-invest. grad / junk bonds

Higher quality ←

- Default bonds
  - ↳ D → S&P / Fitch
  - ↳ C → Moody's

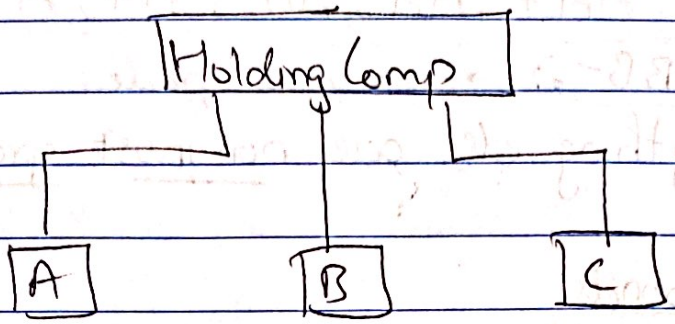
- Cross default provision
  - ↳ When comp. defaults on one of its outstanding bonds, provisions in bond indentures may trigger default on the remaining issues as well. That provision is called..

- Notching → For higher rating, less adjustment req.
  - ↳ Practice by rating agency to give different credit ratings to obligations of single entity
  - ↳ For eg. if XYZ issuer has B rating i.e. unsecured debt rating is B ∴ A senior secured debt will be ranked A for same issuer & is known to be notched up

Senior

  - ↳ Depends on various factors eg. if prob. of default ↓ → notched up,

- Structural subordination



Comp. C might say that I wont give HC the money till all my bondholders get paid & then only the extra will go to HC even though HC has senior debts. Thus HC's bonds are effectively subordinated to subsidiary bonds

- Risks in relying on ratings from these agencies
  - ↳ Credit ratings are dynamic
    - ↳ CR change over time
    - ↳ Higher ratings more stable
  - ↳ Rating agencies are not perfect
    - ↳ Mistakes occur time to time
  - ↳ Event risk is difficult to assess
    - ↳ Events difficult to anticipate are not easily captured.

↳ Credit ratings lag MKT pricing
↳ MKT prices change faster than CR
↳ 2 bonds w/ same ratings can trade at diff. yields
↳ MKT prices reflect expected loss
Credit rating ↔ default risk

* Traditional Credit Analysis (4 C's)

Capacity: company's ability to repay its debt obligat°
↳ Industry Structure (Credit Risk)
↳ Power of suppliers ↑ CR ↕
↳ Power of buyers / cust ↑ CR ↑
↳ Barriers to entry ↑ CR ↓
↳ Substitut° risk ↑ CR ↑
↳ Level of competⁿ ↑ CR ↑
↳ Degree of operating leverage ↑ CR ↓

↳ Industry fundamentals
↳ Cyclical vs non-cyclical
↳ Cyclical shd have ↓ debt as int pmt shd not be too ↑ during low phase
↳ Growth prospects: Slower comp, less creditworthiness

↳ Published ind. statistics

↳ Company Fundamentals
- ↳ Competitive posⁿ
- ↳ Track record (like sales, cash flows, cash exp. etc)
- ↳ Mngmt strategy exec
- ↳ Ratio & ratio analysis; shd be
  - ↳ EBITDA ↑ → Operat inc + Depr & Amort
  - ↳ Funds from ops ↑ → Net inc + Dep & Amort + deferred tax + non cash items
  - ↳ Free CF after div ↑ → Net inc + Dep & Amort − Cap. Exp − ↑ in work. cap − div
  - ↳ Leverage ratio
    - ↳ Debt / Capital ↓ (Capital = Total debt + Sharehold. Equity)
    - ↳ Debt / EBITA ↓
    - ↳ FFO / Debt ↑
  - ↳ Coverage ratio (Borrowers' ability to generate CF)
    - ↳ EBITDA / int exp ↑
  - ↳ Issuer liquidity, CR↓ if
    - ↳ Cash on bal sheet ↑
    - ↳ Net working cap ↑
    - ↳ Op. cash flow ↑
    - ↳ Committed bank lines

- If asked to calculate conservative int covg. ratio use EBIT else use EBITDA

Collateral: Imp for less creditworthy comp.

↳ Intangible assets

↳ Eg. goodwill, patents of no use

↳ Depreciat^n

↳ High depr. exp. relative to cap exp → not good

↳ Equity market capitalizat^n

↳ Bonds trading at lower than book val not a good sign cos inv think bond will downgrade

Covenants

↳ Are rules that company shd abide & those rules protect investors

↳ Analysts should include an assessment of whether the covenants protect the interest of bondholders w/o unduly constraining borrowers operating activities

Character

↳ Mngmt integrity & commitment to repay loan

↳ Strategy

↳ Track record

↳ Accounting polices & tax strat

- ↳ Fraud record
  - ↳ Prior treatment of bondholders

* Credit Risk vs Return: Yield & Spread

- As you know, with ↑ credit risk, return ↑
- Yield on corp bond = [Real risk free interest rate + Exp. inflat^n + Maturity premium + Liquidity premium + Credit Spread]

Yield spread = Liq. premium + Credit Spread

- Spreads on corporate bonds are impacted by
  - ↳ Credit cycle
    - ↳ Bottom of cycle → Spread ↑
  - ↳ Broader eco cond^n
    - ↳ Good eco cond^n → Spread ↓
  - ↳ Overall mkt perf
    - ↳ Good → Sp. ↓

↳ Broker-dealer willingness to provide capital
↳ Good → Sp ↓

↳ General mkt demand & supply
↳ Demand > Supply → Sp ↓

↳ Return impact (w/o convexity adj)

↳ Ret. impact (w/ conv. adj) → Inv. focus more on default risk & not spread risk

* Credit Analysis of High-Yield / Junk bonds

- Reasons for such ratings might be
  ↳ High leverage
  ↳ Unproven operating history
  ↳ Low / -ve cash flow
  ↳ High sensitivity to cycles
  ↳ Low confid in mngt
  ↳ Industry ↓

- Credit analyst must pay more attent to loss severity