

NPTEL ONLINE CERTIFICATION COURSES

Management of Fixed Income Securities

Prof. Jitendra Mahakud
Department of Humanities and Social Sciences
Indian Institute of Technology Kharagpur

Lecture 01: Introduction to Fixed Income Securities

CONCEPTS COVERED

- Types of fixed income securities
- Bond characteristics
- Preferred stock
- Structured products
- Fixed income derivatives

NPTEL

KEYWORDS

- Coupon
- Debentures
- Mortgage backed securities
- Asset backed securities
- Interest rate derivatives

NPTEL

What are Fixed Income Securities?

- Fixed income securities are the financial claims with regular cash-flow of fixed amount at fixed intervals /dates
- Broad categories of fixed income securities are:
  - Bonds
  - Preferred stock
  - Structured products
  - Fixed income derivatives

NPTEL

Bonds Defined

- Bonds impose fixed financial obligations on the bond issuers
- Owners of the bond are debt holders or creditors
- The fixed obligations are:
  - Payment of fixed amount of interest periodically to the bond holder
  - Repayment of fixed amount of principal at the end of maturity

NPTEL

Bond Characteristics

- Coupon
- Term to maturity
- Principal or par value
- Secured (Senior) Vs. Unsecured bonds (Debentures)
- Ownership: Bearer vs Registered bond
  - For bearer bond, the issuer does not keep the record of ownership
  - For registered bond, issuer maintains records of ownership and pay the interest directly to the owner's account

NPTEL

Classification of Bond Markets

- On the basis of maturity (i) Short Term (ii) Long-term
- Short-term bonds (Money market instruments)
  - Treasury bills
  - Commercial papers
  - Certificate of deposits
- Long-term bonds (Capital market instruments)
  - Government dated securities
  - Corporate bonds (debentures)

NPTEL

Classification of Bond Markets Cont…

- On the basis of issuer (India)
  - Government securities
  - Corporate bonds
  - Public sector unit bonds
- On the basis of issuer (USA)
  - Federal government and its agencies
  - Domestic corporations
  - Municipal bonds

NPTEL

Preferred Stock

- Fixed dividend payments
- No voting rights
- Different types of preferred stocks

NPTEL

Types of Preferred Stock

- Cumulative and non-cumulative: On cumulative preference shares, if dividend is skipped in any period/periods, it has to be paid subsequently
- Convertible and non-convertible: Convertible preference shares can be converted into ordinary shares on terms and conditions fixed at the time of issue of such shares
- Redeemable and non-redeemable: A redeemable preference share matures in a fixed period of time and for all practical purposes it is regarded as a debt security like a debenture
- Participating and non-participating: Participating preference shareholders can earn a higher dividend than the fixed one if the company makes good profits

NPTEL

Structured Products

- Residential mortgage backed securities: Cash-flow depends on the cash flow of an underlying pool of mortgages
- Types of mortgage-backed securities:
  - Mortgage pass-through securities
  - Collateralized mortgage obligations
  - Stripped mortgage-backed securities

NPTEL

Mortgage Cash Flows

- Mortgage is a pledge of real estate to secure the loan originated for the purchase of that real estate
- The mortgage provides the lender (mortgagee) the right to foreclose on the loan and seize the property in order to ensure that the loan is paid off if the borrower (mortgagor) fails to make the payments
- Categories of mortgages: Residential and non-residential
- Cash-flows: (i) interest (ii) scheduled repayment of principal (ii) prepayment of loan

NPTEL

Mortgage Pass-through Securities

- Mortgage pass through security is created when one or more holders of mortgages form a collection of mortgages and sell shares in the pool
- Cash flows from the pool are: interest, principal and prepayments
- Payments are made to security holders each month
- Agency pass-through securities: Securities associated with various specific agencies like Government National Mortgage Association, Federal Home Loan Mortgage Corporation and Federal National Mortgage Association
- Non-agency pass-through securities: Issued by thrifts, commercial banks and private channel

NPTEL

Collateralized Mortgage Obligation (CMO)

- CMOs are structured so that there are several classes of bond holders with varying maturities
- The different bond classes are called *tranches*
- Different classes of bonds are created that have different degrees of repayment and interest rate risk
- Bonds include sequential pay bonds, floating rate bonds, accrual bonds etc.

NPTEL

Stripped Mortgage-Backed Securities

- These are created by altering the distribution of principal and interest from a pro rata distribution to an unequal distribution
- Two types of stripped MBSs: Synthetic- coupon pass-through and interest-only (IO) or principal-only (PO) securities
- Synthetic coupon pass-through: unequal distribution of coupon and principal resulted in a synthetic coupon rate that was different from the underlying collateral
- PO class receives only the principal from the underlying mortgages and IO class receives only interest

NPTEL

Commercial Mortgage-Backed Securities

- Backed by pool of commercial mortgage loans on income producing property e.g. Shopping centers, hotels, warehouses, health care facilities etc.
- These loans are unsecured loans. The lender can only look to the income producing property backing the loan and principal payments
- Two Types: multi-property single borrowers and multi-property conduits
- Conduits are commercial lending entities that are established for the sole purpose of generating collateral to securitize

NPTEL

Asset-Backed Securities

- Collateralized by assets that are not mortgage loans
- Asset backed securities have been structured as pass-throughs and as structures with multiple bond classes called *pay-throughs*, which are similar to CMOs
- Common types of asset-backed securities are: (i) credit card receivables, (ii) home equity loans and (iii) automobile loans. Other asset backed securities are supported by: student loans, equipment leases etc.
- Collateralized debt obligation (CDO) is an asset backed security backed by a diversified pool of one or more of the following types of debt obligations: high yield corporate bonds, emerging market bonds, residential mortgage backed securities, asset backed securities, commercial mortgage backed securities

NPTEL

Fixed Income Derivatives

- Interest rate futures
- Interest rate options
- Interest rate swaps
- Credit derivatives

NPTEL

CONCLUSIONS

- Fixed income securities provide fixed cash flows in regular intervals
- These are more appropriate for the income maximization
- The broad types of fixed income securities include bonds, structured products and interest rate derivatives

NPTEL

REFERENCES

- Fabozzi, J. Frank and Mann, V. Steven (2005): The Hand Book of Fixed Income Securities, Tata McGraw-Hill, 7th Edition.
- Johnson, S. R (2010): Bond Evaluation, Selection and Management, John Wiley & Sons, 2nd Edition.
- Veronesi, P (2010): Fixed Income Securities: Valuation, Risk and Risk Management, John Wiley & Sons.

NPTEL



NPTEL ONLINE CERTIFICATION COURSES

Management of Fixed Income Securities

Prof. Jitendra Mahakud
Department of Humanities and Social Sciences
Indian Institute of Technology Kharagpur

Lecture 02: Risks in Fixed Income Securities Investments

CONCEPTS COVERED

- **Risks associated with fixed income securities investments**

NPTEL

KEYWORDS

- Market risk
- Bid-ask spread
- Currency risk
- Credit risk
- Inflation risk

NPTEL

Components of Fixed Income Securities Investments Returns

- Market value of securities at the time of sold
- Cash flows received from the security over the time period it is held
- Additional in come from reinvestment of periodic cash flows

NPTEL

Risks in Fixed Income Securities Investments

- Market risk
- Reinvestment risk
- Credit risk
- Maturity risk
- Inflation risk
- Liquidity risk
- Exchange rate risk
- Call risk
- Volatility risk
- Political risk
- Event risk
- Sector risk

NPTEL

Market or Interest Rate Risk

- Combination of price risk and reinvestment risk
- There is an inverse relationship between bond price and interest rate
- The variability of returns from reinvestment of periodic cash flows due to change in interest rate is called reinvestment risk
- Reinvestment risk is higher for long maturity and high coupon bonds.
- Price risk and reinvestment risk oppose each other

NPTEL

Credit Risk

- Default risk: Risk of default on issuers' obligations
- Credit spread risk: Risk attributable to an increase in the spread due to risk that the bond value will decline or bond performance will be worse than that of other bonds
- The risk attributable to lowering of the credit rating is called as downgrade risk

NPTEL

How to gauge the credit risk?

- Bond rating, credit watches and rating outlooks
- For long term bonds credit rating is a forward looking assessment of (i) probability of default, (ii) relative magnitude of loss should a default occur
- For short term bonds, credit rating is a forward looking assessment of probability of default
- Credit rating agencies provide information about (i) default rates and default loss rates
- Default rate: percentage bonds of a given rating at the beginning of the period that have defaulted at the end of the period
- Default loss rate: it is a measure of the magnitude of the potential of the loss that a default occur

NPTEL

Maturity Risk and Inflation Risk

- Interest rates vary across the different maturity of the bond
- Long-term bonds are risker than the short-term bonds
- Role of liquidity premium and risk premium
- Inflation risk arises due to the variations in the value of cash flows because of change in inflation
- Floating rate bonds have lower level of inflation risk

NPTEL

Liquidity Risk

- It the risk that the bond holder will have to sell a bond below its true value
- The measure of liquidity is bid-ask spread
- Wider bid-ask spread, greater is the liquidity risk
- From the overall market perspective, the market bid-ask spread is defined as the difference between best bid price (highest price at which the dealer is willing to buy the security) and lowest ask price (lowest offer price at which one of the dealers is willing to sell the security)

NPTEL

Exchange Rate or Currency Risk

- Non- home currency dominated bonds are exposed to currency risk
- The change in exchange rate affects the cash flows
- Link between interest rate and exchange rate also affects the value of bond investments

NPTEL

Volatility Risk and Political Risk

- Bonds having embedded options are more exposed to volatility risk
- Expected interest rate volatility increases the value of options
- The adverse impact of change in volatility on the price of security is called volatility risk
- Political risk includes tax risk and relation risk

NPTEL

Event Risk and Sector Risk

- Natural disaster
- Takeover or corporate restructuring
- Leverage buyout
- The possibility of adverse differential movement of particular sectors is known as sector risk. It may arise due to some external factors

NPTEL

CONCLUSIONS

- There are various types of risks which affect the returns from the investment in fixed income securities
- All these risks should be carefully measured and considered while making investment in the market

NPTEL

REFERENCES

- Fabozzi, J. Frank and Mann, V. Steven (2005): The Hand Book of Fixed Income Securities, Tata McGraw-Hill, 7th Edition.
- Johnson, S. R (2010): Bond Evaluation, Selection and Management, John Wiley & Sons, 2nd Edition.

NPTEL



NPTEL ONLINE CERTIFICATION COURSES

Management of Fixed Income Securities

Prof. Jitendra Mahakud
Department of Humanities and Social Sciences
Indian Institute of Technology Kharagpur

Lecture 03: Bond Valuation-I

CONCEPTS COVERED

- **Bond Valuation**

NPTEL

KEYWORDS

- Coupon
- Term to maturity
- Effective rate
- Continuous compounding

NPTEL

Bond Valuation

The value of a bond is the present value of its future cash flow (CF):

$$V_0^B = \sum_{t=1}^{M} \frac{CF_t}{(1+R)^t} = \frac{CF_1}{(1+R)^1} + \frac{CF_2}{(1+R)^2} + \cdots + \frac{CF_M}{(1+R)^M}$$

where:

CF_t = cash flow at t; principal and/or coupon

R = required return

M = term to maturity

NPTEL

Bond Valuation Cont…

Assume the bond makes fixed coupon payments each year and principal at maturity.

$$V_0^B = \sum_{t=1}^{M} \frac{C}{(1+R)^t} + \frac{F}{(1+R)^M}$$

where :

C = annual coupon

F = principal

NPTEL

Bond Valuation Cont…

$$V_0^B = \sum_{t=1}^{M} \frac{C}{(1+R)^t} + \frac{F}{(1+R)^M}$$

$$V_0^B = C \sum_{t=1}^{M} \frac{1}{(1+R)^t} + \frac{F}{(1+R)^M}$$

$$V_0^B = C[PVIF_a(R, M)] + \frac{F}{(1+R)^M}$$

$$V_0^B = C\left[\frac{1 - 1/(1+R)^M}{R}\right] + \frac{F}{(1+R)^M}$$

NPTEL

Semi-annual Coupon Payments

- When frequency of coupon payments is semi-annual following adjustments have to be made in the bond valuation equation (when bonds make annual coupons):
  - Number of periods should be doubled
  - Annual coupon rate is halved
  - Discount rate is halved
- The formula becomes

$$V_0^B = \sum_{t=1}^{2M} \frac{C^A/2}{(1+(R^A/2))^t} + \frac{F}{(1+(R^A/2))^{2M}}$$

Where, C^A = Annual coupon rate, R^A = Annual discount rate, M= Term to maturity in years and F = Face value

NPTEL

n-Coupon Payments Per Year

- The rule for valuing semi-annual bonds is easily extended to valuing bonds paying interest even more frequently. For example, to determine the value of a bond paying interest four times a year, we would quadruple the number of annual periods and quarter the annual coupon payment and discount rate.
- In general, if we let n be equal to the number of payments per year (i.e., the compounding per year), M be equal to the maturity in years, N = number of periods to maturity = nM, and, as before, R^A be the discount rate quoted on an annual basis, then we can express the general formula for valuing a bond as follows:

$$V_0^B = \sum_{t=1}^{nM} \frac{C^A/n}{(1+(R^A/n))^t} + \frac{F}{(1+(R^A/n))^{nM}}$$

$$V_0^B = C^A/n\left[\frac{1-1/(1+(R^A/n))^{nM}}{R^A/n}\right] + \frac{F}{(1+(R^A/n))^{nM}}$$

$$\text{Note: } M = \text{maturity in years}$$

$$n = \text{number of payments per year}$$

NPTEL

Compounding Frequency

- The 10% annual rate is the rate with one annualized compounding. With one annualized compounding, we earn 10% every year and ₹100 would grow to equal ₹ 110 after one years: ₹100(1.10) = ₹110

- If the simple annual rate were expressed with semi-annual compounding, then we would earn 5% every six months with the interest being reinvested; in this case, ₹100 would grow to equal ₹ 110.25 after one year: $₹100(1.05)^2 = ₹110.25$

NPTEL

Compounding Frequency Cont…

- If the rate were expressed with monthly compounding, then we would earn 0.8333% (10%/12) every month with the interest being reinvested; in this case, ₹100 would grow to equal ₹110.47 after one year: $₹\ 100(1.008333)^{12} = ₹\ 110.47$

- If we extend the compounding frequency to daily, then we would earn 0.0274% (10%/365) daily, and with the reinvestment of interest, a ₹ 100 investment would grow to equal ₹ 110.52 after one year: $₹\ 100(1+(0.10/365))^{365} = ₹\ 110.52$

NPTEL

Effective Rate

- The rate that includes the reinvestment of interest (or compounding) is known as the ***effective rate***.
- Effective Rate = $(1+(R^A/n))^n - 1$, Where, R^A= Simple annual rate

NPTEL

Continuous Compounding Cont…

- **The present value of a future receipt (FV) with continuous compounding is**

$$A = PV = \frac{FV}{e^{RM}} = FVe^{-RM}$$

- **Given continuous compounding, if R = 0.10, a bond paying ₹100 two years from now would currently be worth :**

$$PV = ₹\ 100\ e^{-(0.10)(2)} = ₹\ 81.87$$

- **Similarly, a bond paying ₹ 100 each year for two years would be currently worth:**

$$PV = \sum_{t=1}^{2} Rs.100e^{-(.10)(t)} = Rs.100e^{-(.10)(1)} + Rs.100e^{-(.10)(2)} = Rs.172.36$$

NPTEL

CONCLUSIONS

- Bonds are priced according to the mathematics of present value and future value
- The effective price and yield depend on the frequency of compounding. Greater the compounding frequency, greater is the amount of interest

NPTEL

REFERENCES

- Johnson, R.S. (2010), Bond Valuation, Selection, and Management, Second Edition, John Wiley & Sons, Inc., Hoboken, New Jersy.

- Bhole, L.M and Mahakud, J (2017), Financial Institutions and Markets, Sixth Edition, McGraw Hill Education (India) Private Limited, Chennai, India

NPTEL



NPTEL ONLINE CERTIFICATION COURSES

Management of Fixed Income Securities

Prof. Jitendra Mahakud
Department of Humanities and Social Sciences
Indian Institute of Technology Kharagpur

Lecture 04: Bond Valuation-II

CONCEPTS COVERED

- Zero Coupon Bond Valuation
- Valuation of bond at non-coupon dates
- Bond price quotation
- Discount yield

NPTEL

KEYWORDS

- Zero coupon bond
- Day count convention
- Clean price
- Accrued interest
- Full price

NPTEL

Valuation of Zero-Coupon Bond

- These type of bonds do not make any periodic coupon payments.
- The investor realizes interest as the difference between the maturity value and the purchase price.
- These bonds are called zero-discount bonds, zero coupon bonds (also called pure discount bonds).

$$V_0^B = \frac{F}{(1+R)^M}$$

Where, F = Maturing value, R = Required rate and M= Maturity period

NPTEL

Valuation of Zero-Coupon Bond having Maturity of Less than One Year

- Assume on March 1 a zero coupon bond promising to pay ₹1000 on September 1 and trading at an annual rate of 8%, What is the value of bond?
- Maturity period: 184 days

$$\text{Vale of bond} = ₹1000 / (1.08)^{(184/365)} = ₹\ 96.19$$

- The day count convention is defined as the way in which the ratio of the number of days to maturity (or days between dates) to the number of days in the reference period (e.g., year) is calculated.
  - A day count convention of actual days to maturity to actual days in the year (actual/actual)
  - A day count convention of 30-day months to maturity to a 360 days in the year (30/360)

NPTEL

Valuation of Bonds at Non-coupon Dates

- Investor who purchases the bond between coupon payments must compensate the seller for the coupon interest earned from the time of the last coupon payment to the settlement date of the bond. This amount is known as accrued interest.

$$\text{Accrued Interest} = \frac{\text{Days from last coupon date}}{\text{Total days between coupon dates}} (\text{Coupon})$$

- In trading bonds on a non-coupon date, the amount the buyer pays to the seller is the agreed-upon price plus the accrued interest. This is called the full price or dirty price.
- Full price = Clean price + Accrued interest

NPTEL

Method-1 for Valuation of Bonds at Non-coupon Dates

- Determine the number of days between the settlement and the next coupon date.
- Determine the number of days in the coupon period
- Compute the following:

$$v = \frac{\text{number of days between settlement and the next coupon}}{\text{number of days in the coupon period}}$$

- For a bond with N semi-annual coupon payment remaining, the value is

$$V_0 = \sum_{t=1}^{N} \frac{C}{(1+R)^{t-1+v}} + \frac{F}{(1+R)^{N-1+v}}$$

$$V_0 = \frac{C}{(1+R)^{v}} + \frac{C}{(1+R)^{1+v}} + \frac{C}{(1+R)^{2+v}} + \cdots + \frac{C}{(1+R)^{N-1+v}} + \frac{F}{(1+R)^{N-1+v}}$$

NPTEL

Method-2 for Valuation of Bonds at Non-coupon Dates

- Move to the next coupon date and determine the value of the bond at that date based on the future coupons.
- Add coupon at the next coupon date to the value of bond.
- Discount the bond value plus coupon back to the current date.

NPTEL

Bond Price Quotes

- Many traders quote bond prices as a percentage of their par value.
- For example, if a bond is selling at par, it would be quoted at 100 (100% of par).
- A bond with a face value of Rs.1000 and quoted at 80-1/8 would be selling at (0.80125)(Rs.1000) = Rs. 801.25

NPTEL

Basis Points

- Fractions on yields are often quoted in terms of basis points (bp).
- A bp is equal to 1/100 of a percentage point.
  - 6.5% may be quoted as 6% plus 50 bp or 650 bp
  - An increase in yield from 6.5% to 6.55% would represent an increase of 5 bp

NPTEL

Bid and Ask Price / Yield

- The ***bid price*** is the price the dealer is willing to pay for the bond.
- The ***ask price*** is the price the dealer is willing to sell the bond.
- The ***bid yield*** is the return expressed as a percent of the par value that the dealer wants if she buys the bond; this yield is often annualized.
- The ***ask yield*** is the rate that the dealer is offering to sell bonds.
- For Treasury bills and some other securities, bid and ask yields are quoted as a ***discount yield***.

$$\text{Annual Discount Yield} = R_D = \frac{F - P_0}{F} \frac{360}{\text{Days to Maturity}}$$

NPTEL

Bid and Ask Price / Yield

- Given the dealer's discount yield, the bid or ask price can be obtained by solving the yield equation for the bond's price, P_0. Doing this yields:

$$P_0 = F\left[(1 - R_D(\text{Days to Maturity}/360)\right]$$

NPTEL

CONCLUSIONS

- The Present value of zero coupon bond is the present value of the face value of the bond only.
- In the context of valuation of bonds at non-coupon dates, the price the buyer pays the seller is the full price.
- The buyer must compensate the seller for the portion of the next coupon interest payment the seller has earned but will not receive because the issuer will send the next coupon payment to the buyer. This amount is the accrued interest.

NPTEL

REFERENCES

- Johnson, R.S. (2010), Bond Valuation, Selection, and Management, Second Edition, John Wiley & Sons, Inc., Hoboken, New Jersy.

NPTEL



NPTEL ONLINE CERTIFICATION COURSES

Management of Fixed Income Securities

Prof. Jitendra Mahakud
Department of Humanities and Social Sciences
Indian Institute of Technology Kharagpur

Lecture 05: Bond Price Relations

CONCEPTS COVERED

- **Relationship among Bond Price, Interest Rate, Coupon, Maturity and Yield**

NPTEL

KEYWORDS

- Discount bond
- Premium bond
- Price-yield curve

NPTEL

Bond Price Relation-1

$$If\ C^R < R \Rightarrow V < F \Rightarrow discount\ \ bond$$

$$If\ C^R = R \Rightarrow V = F \Rightarrow par\ \ bond$$

$$If\ C^R > R \Rightarrow V > F \Rightarrow premium\ \ bond$$

C^R = Coupon rate, R = Discount Rate, V= Value of the bond and F = Par value of bond

NPTEL

Bond Price Relation-1 Cont…

- When yields in the marketplace rise above the coupon rate, the price of the bond adjust so that investors contemplating the purchase can realize some additional return.
- When the yield in the market is below the coupon, the bond must sell above its par value
- If the require rate does not change, what will happen to the value of the bond from the time the bond is purchased to maturity?
- For a bond selling at par, as the bond move closer to maturity, the bond will continue to sell at par; i.e., the price of the bond will remain constant as the bond moves toward maturity.
- The bond price will not remain constant if it is selling at a premium or discount.
- A discount bond increases in price as it moves towards maturity (assuming the required rate does not change).
- A premium bond decreases in price as it moves towards maturity (assuming the required rate does not change).

IIPTEL

Bond Price Relation-2 (Price Yield Curve)

- **Inverse relation between bond price (value) and rate of return.**

$$\text{If } R\uparrow \Rightarrow V\downarrow$$
$$\text{If } R\downarrow \Rightarrow V\uparrow$$
$$\frac{\Delta V}{\Delta R} < 0$$

NPTEL

Bond Price Relation-3

- The greater a bond's maturity, the greater its price sensitivity to interest rate changes

$$\text{Let} \quad \varepsilon = \left| \frac{\%\Delta V}{\%\Delta R} \right|$$

$$\text{Greater} \quad M \Rightarrow \text{Greater} \quad \varepsilon$$

- Investors will realize greater capital gains and capital losses on long-term securities than on short term securities when interest rate changes by the same amount

NPTEL

Bond Price Relation-4

- **The smaller a bond's coupon rate, the greater its price sensitivity to interest rate changes**

$$\text{Let } \varepsilon = \left| \frac{\%\Delta V}{\%\Delta R} \right|$$

$$\text{Lower } C^R \Rightarrow \text{Greater } \varepsilon$$

NPTEL

Bond Price and Interest Rate

- For a specific absolute change in interest rates, the proportionate increase in bond prices when rates fall exceeds the proportionate decrease in bond prices when rates rise.
- The proportionate difference increases with maturity and is larger the lower a bond's periodic interest payment
- For the identical absolute change in interest rates, a bondholder will realize greater capital gain when rates decline than capital loss when rates increase

NPTEL

CONCLUSIONS

- When interest rate changes, prices move inversely
- The proportionate price move is relatively greater when rate fall compared to when rates rise
- Proportionate magnitude of the price move increases with maturity and decreases with the size of the coupon payment
- The proportionate difference increases with maturity and is larger the lower a bond's periodic interest payment

NPTEL

REFERENCES

- Johnson, R.S. (2010), Bond Valuation, Selection, and Management, Second Edition, John Wiley & Sons, Inc., Hoboken, New Jersy.

NPTEL