Lecture 2: Introduction to Bonds

Tanweer Akram, PhD

Jan 23, 2018, SANEM, Dhaka, BANGLADESH
IMPORTANT DISCLAIMER AND DISCLOSURE

• **Disclaimer:** The author’s institutional affiliation is provided solely for identification purposes. Views expressed are solely those of the author and the standard disclaimer applies. The views are not necessarily those of Thrivent Financial, Thrivent Investment Management, or any affiliates. This is for information purposes only and should not be construed as an offer to buy or sell any investment product or service.

• **Disclosure:** Tanweer Akram’s employer, Thrivent Financial, invests in a wide range of securities. Asset management services are provided by Thrivent Asset Management, LLC, a wholly owned subsidiary of Thrivent Financial for Lutherans.

Compliance Tracking # 1951997-111717
INTRODUCTION TO BONDS

• Standardized forms of loans
• Stock market and bond market
• Fixed maturity
• Fixed interest rate at inception
BASICS OF BONDS

- Bonds are standardized loans
- Standardized terms regarding repayment and interest
- Standardization allows more lending/borrowing and intermediation
- Sovereign bonds: U.S. Treasury Securities, UK gilts, Japanese government bonds (JGBs), Greek government bonds, and so on.
- Notional
- Coupon rate
- Maturity
- Price
- Face value
- On the run, off the run
RISKS EMBEDDED IN FIXED INCOME INSTRUMENTS

- Interest rate risk
- Credit risk
- Inflation risk
- Financing/liquidity risk
- Tax risk
- Regulatory risk
- Exchange rate risk
INTEREST RATE RISK

- Interest rate risks arise from the effect of changes in market interest rate have on fixed cash flows. Fixed cash flows become less (more) attractive when interest rates rise (fall).
- If a trader buys a bond paying 5% coupons and the interest rate rises to 8%, the bond becomes less attractive.
- Fixed interest rate bonds are sensitive to interest rate changes.
- Floating rates bonds are linked to some short-term interest rates. Coupon payments are reset accordingly.
CREDIT RISK

• Credit risk arises from the inability of the bond issuer (the borrow) to make timely repayment of its debt.
• In other words, the risk that the bond issuer will be unable to service interest payments and payback the principal is the credit risk.
INFLATION RISK

• The risk that occurs due to the erosion of the purchasing power of money.
• For bond investors it is the risk that the value of the cash payments that they will receive will decline.
• Inflation-indexed bonds, such as Treasury Inflation Protected Securities (TIPS), address these concerns. For TIPS the principal grows at the rate of Consumer Price Index (CPI) inflation.
TAX RISK

- Risks that arise due to change in tax regime and tax rates.
- Interest payments are taxable at income tax rate.
- Capital gains are taxable at capital gains tax rate.
- Differential tax treatment of municipal bonds in the U.S.

Disclosure: Thrivent Financial representatives and employees cannot provide legal, accounting, or tax advice or services. Work with your attorney and/or tax professional for additional information.
REGULATORY RISK

- Risk that arise due to change in regulations.
EXCHANGE RATE RISK

- Risk that arise from the depreciation of the currency in which the bond is denominated.
- For example, suppose the Bangladeshi taka (BDT) depreciates with respect to the US dollar (USD). The coupon and the principal of a government bond denominated in taka would be less valuable in terms of the US dollar.
THE BANGLADESHI TAKA HAS DEPRECIATED MARKEDLY SINCE MID 1990s
POSITIVE TIME PREFERENCE

• “Money today is more valuable than money tomorrow”
• “A bird in hand is worth two in the bush”
• Irving Fischer, and Ludwig von Mises, and others.
• Inter-temporal time preference
• Positive time preference => discounting function
• von Mises (1963), as cited in Edwards (1991), argues: “satisfaction of a want in the near future is, other thing being equal, preferred to that in the further distant future. Present goods are more valuable than future goods.”
DISCOUNTING

- Year 0: $1
- Year 1: $1(1+r)
- Year 2: $1(1+r)^2
- Year 3: $1(1+r)^3
- ...
- Year n: $1(1+r)^n
- Discounting formula: $X/1(1+r)^n
ZERO COUPON BOND AND ITS PRICING

- Zero coupon bond is a bond that pays no interest in the interim but instead pays a fixed amount at maturity.
- Consider a zero coupon bond that pays $1 in 10 years.
- \[ P_b = \frac{1}{(1+r)^{10}} \]
- Zero coupon bond provides a building block for the pricing of a standard bond.
CASH FLOW OF A 10 YR ANNUAL COUPON BOND

Source: Jha (2011)
BOND PRICING

- \[ P = \frac{c}{(1+r)} + \frac{c}{(1+r)^2} + \frac{c}{(1+r)^3} + \ldots + \frac{c}{(1+r)^n} + \frac{100}{(1+r)^n} \]

- \[ P = c\left[\frac{1}{(1+r)} + \frac{1}{(1+r)^2} + \frac{1}{(1+r)^3} + \ldots + \frac{1}{(1+r)^n}\right] + \frac{100}{(1+r)^n} \]

C = coupon rate, and maturity n years, P = bond price

With semi-annual compounding:
\[ P = \left(\frac{c}{2}\right)\left[\frac{1}{(1+r/2)} + \frac{1}{(1+r/2)^2} + \frac{1}{(1+r/2)^3} + \ldots + \frac{1}{(1+r/2)^{2n}}\right] + \frac{100}{(1+r/2)^{2n}} \]
The yield to maturity of a bond is the interest rate such that the sum of the discounted cash flow is equal to the price of the bond. Yield is the main parameter by which bonds are analyzed. Yield is the internal rate of return.
PRICE YIELD RELATIONSHIP OF A BOND

Source: Jha (2011)
INTUITION

• $P = \text{price of a bond}, \ r = \text{interest rate}, \ c = \text{coupon}$. 
• For a “consol” or a perpetual bond, $P = \frac{c}{r}$
• $P = \frac{c}{r} \Rightarrow Pr = c \ [\text{constant}]$
• $Pr = c \Rightarrow (P=F(r))$ will be a rectangular hyperbola in P-r space. Nice!
YIELD TO MATURITY

- The yield to maturity of a bond is the interest rate such that the sum of the discounted cash flow is equal to the price of the bond.

- For different maturity bonds, the **yield to maturity** will be different.

- The **yield curve** is the set of yields as a function of time (the tenor of various bonds).
THE YIELD CURVE

- The yield curve is the set of yields as a function of time (the tenor of the bonds)
- The yield curve of Treasury securities.
THE U.S. TREASURY YIELD CURVE (Jan 19, 2019)

Source: Bloomberg (2011)
THE SHAPE OF THE YIELD CURVE

• Flat
• Positively sloped
• Negatively sloped
SHIFTS OF YIELD CURVE

• Parallel Shifts
  • Upward parallel shift
  • Downward parallel shift

• Non-Parallel Shift: Change in Slope
  • Flattening
  • Steepening

• Non-Parallel Shift: Butterfly Shifts
  • Positive butterfly shift
  • Negative butterfly shift
NON-PARALLEL SHIFTS: CHANGE IN THE SLOPE OF THE YIELD CURVE

Source: Jha (2011)
DURATION

- **Duration** = \[\frac{P^- - P^+}{2(P_0)(\Delta y)}\]
- Where initial price = \(P_0\), change of yield = \(\Delta y\), \(P^-\) = price if yields decline by \(\Delta y\), \(P^+\) = price if yields rise by \(\Delta y\)

**Modified duration** = \(\frac{1}{P} \times \frac{dP}{dy}\)
CONVEXITY

- Convexity = \([P^- - P^+ - 2P_0]/[2(P_0)\Delta y^2]\)
- Where initial price = \(P_0\), change of yield = \(\Delta y\), \(P^-\) = price if yields decline by \(\Delta y\), \(P^+\) = price if yields rise by \(\Delta y\)

- Convexity is a measure of the curvature in the relationship between bond prices and bond yields. Convexity demonstrates how the duration of a bond changes as the yield changes.
REPO MARKETS

- Market for short-term loans
- Buying the bond – Repo
- Selling the bond – Reverse repo
- Repo collateralized loans
- Haircut
- Repo rate close to GC (general collateral) rate
- Repo fail
BID OFFER

- Dealers
- Bid
- Ask (or Offer)
- Bid/Ask spread = Price @ Bid - Price @ Ask = Bid - Ask
CALCULATING P/L OF A BOND

- \( \Delta P = D \times \Delta y \)
- \( \Delta P = D \times \Delta y + \frac{1}{2} \times C \times (\Delta y)^2 \)
- \( \Delta P = D \times \Delta y + \frac{1}{2} \times C \times (\Delta y)^2 + \ldots \) (Taylor series)

- \( \Delta P = \) change in price
- \( \Delta y = \) change in yield
- \( D = \text{dollar duration} = \) “The dollar duration measures the dollar change in a bond’s value to a change in the market interest rate.”
- \( C = \text{dollar convexity} = \) “The dollar convexity measure the dollar change in a bond’s dollar value due to convexity of the bond price relationship to market interest rate.”
FORWARD RATES

- Forward rate represents the yield of a bond that is purchased at a date in the future.
- Forward rate is denoted as $T_1 \times T_2$ rate, where $T_1 =$ date when the bond is purchased, $T_2 =$ maturity of the bond.

Source: Jha (2011)
FUTURES & FORWARDS II

- \( \$1 \times (1 + R_1)^T_1 \times (1 + F_{1,1})^{T_2} = \$1 \times (1 + R_2)^{(T_1 + T_2)} \)

Example: \( R_1 = 8\% = 0.08 \)
\( R_2 = 10\% = 0.10 \)
\( T_1 = 1, \ T_2 = 1. \)

\( (1 + R_1)(1 + F_{1,1}) = (1 + R_2)^2 \)
\( (1.08)(1 + F_{1,1}) = (1.10)^2 \)
\( (1 + F_{1,1}) = 1.21 / 1.08 = 1.12037 \)
\( F_{1,1} = 0.12037 = 12.04\% \)
**CURVES AND SPREAD**

- **Curve Trade**: View on trade with two legs or the relative performance between two securities.
- **For example**, Buying **10YR UST**, Selling **2YR UST**.
- **Steeper Curve or Flatter curve.**
- **Bear Flattener**: Yields are higher, the slope of the yield curve is lower
- **Bear Steepener**: Yields are higher, the slope of the yield curve is higher
- **Bull Flattener**: Yields are lower, the slope of the yield curve is lower
- **Bull Steepener**: Yields are lower, the slope of the yield curve is lower
- **Spread Trade**: Buying an asset in one market, while selling an asset in another market.
Butterflies and Condors

- Butterfly trade involves buying (selling) one maturity sector of the curve and selling (buying) two maturity sectors around, one of greater maturity and another of lesser maturity.
- Butterfly Trades: 2s/5s/10s.
- Belly Richer: Buying the Belly.
- Belly Cheaper: Selling the Belly.
BELLY RICHER, AND BELLY CHEAPER

**FIGURE 2.8** Different Yield Curve Curvature Scenarios

Source: Jha (2011)
SUMMARY OF LECTURE 2

Concepts related to bonds

• Time value of money
• Discounting
• Bonds = Package of zero coupon bonds
• Bond sensitivity to changes in interest rates
• Duration
• Convexity
• Risks