Analysis of Fixed Income Securities in Excel VBA

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Topics Covered

- **Bond Pricing**
- **Forward Rate**
- **Duration**
- **Convexity**
- **Yield Curve**
- **Par Yield Curve**

Bond Pricing

- The value of a bond should be equal to present value of future cashflows.

$$P = \frac{c_1}{(1+r)^1} + \frac{c_2}{(1+r)^2} + \ldots + \frac{c_n + RV}{(1+r)^n}$$

where

P = price of bond

c_i = coupon of i^{th} period

RV = redemption value

r = discount rate or YTM

Example:-

- Suppose that a bond with face value of Rs. 1,000 has a maturity of 5 years, and coupon of 10%. If YTM is 9%, then determine the price of bond.

$$P = \frac{100}{(1+9\%)^1} + \frac{100}{(1+9\%)^2} + .. + \frac{100+1{,}000}{(1+9\%)^5}$$
$$= \text{Rs.}1038.897$$

Forward rate

- Forward interest rates are the interest rate that are expected to exist in future but whose terms and conditions are determined today.
- Forward rate can be calculated from spot rates using the following formula.

$$(1+S_3)^3 = (1+S_1)(1+f_{12})(1+f_{23})$$
$$= (1+S_1)(1+f_{13})^2$$

Cont.

- If the one-year spot rate is 7 percent and the two-year spot rate is 12 percent , calculate f_{12} .
- $F_{12} = \frac{(1.12)^2}{(1.07)} - 1 = 17.23\%$

Duration of a Bond

The term duration is a measurement of how long in years it takes for the price of a bond to be repaid by its internal cash flows. Since a zero coupon bond doesn't pay any intermediate cash flows and the entire money is available only on maturity, duration of a zero coupon bond is equal to maturity period. On the same lines since coupon bonds, pays coupons, we get our price much earlier to maturity period. Therefore, duration of a coupon bond will always be less than maturity period.

Macaulay Duration

Macauley duration is the percentage change in the value of the bond from a small percentage change in its yield-to-maturity. We calculate this measure of duration using a time-weighting of cash flows.

Macauley's duration = Present value of time weighted cash flow / Present value of the bond

Cont.

Modified duration

- Modified duration is a measure of the average length of time of the bond's investment, considering that some cash flows are received every six months and the largest cash flow (the face value) is received at maturity. Modified duration requires an adjustment to Macauley's duration:
- Modified duration = Maclauley's duration / (1 + yield-to-maturity)

Cont.

Effective duration

- Effective duration is a measure of the impact on a bond's price of a change in yield-to-maturity. Though similar to Macauley duration in interpretation, its calculation is flexible to allow it to be used in cases when the bond has an embedded option (e.g., a callable bond).5
- Effective duration = PV- -PV+ / 2PV0 Δi where

➢ Δi = change in yield

➢ PV+ =Value of the bond if the yield went up by Δi

➢ PV- = Value of the bond if the yield went down by Δi

➢ PV0 =Value of the bond at the yield-to-maturity

Convexity Of A Bond

- Convexity measures the rate of change in modified duration as yield change. Convexity refers to the shape of the price-yield relationship and can be used to refine the modified duration approximation of the sensitivity of prices to interest rate changes.
- Bond Convexity is defined formally as the degree to which the duration changes when the yield to maturity changes.
- If we assume two bonds will provide the same duration and yield then the bond with the greater convexity will be less affected by interest rate change.

The Yield Curve

- It is graph depicting a relation between the yield-to-maturity as a dependent variable and time to maturity as an independent variable as on a particular date.
- It is a curve depicting the relationship between the maturity of default less bonds and their yield-to-maturity.
- It provides an estimate of the current term structure of interest rates and changes daily as yields to maturity change

Par Yield Curve

- A par yield curve is a graph of the yields on *hypothetical bonds* with prices at par.

- On the par yield curve, the coupon rate will be equal the yield-to-maturity of the security, which is why the bond will trade at par

THANK YOU