

Introduction

Fixed income financial instruments which, traditionally, have been identified as a long-term source of funds for a corporate enterprise are the cherished conduit for investor's money. An assured return and high interest rate are responsible for the preference of bonds over equities. The year 1996-97 witnessed hectic trading in the debt market, as resource mobilisation reached a record level of almost Rs. 25,000 crores which was much above the equity segment. In the first seven months of the fiscal year 1998-99, the funds mobilised by ICICI (Four debt issues) and IDBI have accounted for 90 per cent of Rs. 3,175 crores mopped in the primary market. Financial institutions, banks and corporate bodies are offering attractive bonds like retirement bonds, education bonds, deep discount bonds, encash bonds, money multiplier bonds and index bonds. Knowing how to value fixed income securities (bonds) is important both for investors and managers. Such knowledge is helpful to the former in deciding whether they should buy or sell or hold securities at prices prevailing in the market.

Bond valuation-Terminology

A bond or debenture is a debt instrument issued by the government or a government agency or a business enterprise. Exhibit 1 describes briefly the variety of debt instruments in the Indian market.

Exhibit 1. Debt instruments

Type	Typical features
Central Government Securities	Medium- to long-term bonds issued by RBI on behalf of GOI. Coupon payments are semi-annual.
State Government Securities	Medium- to long-term bonds issued by RBI on behalf of the state government. Coupon payments are semi-annual.

Government-Guaranteed Bonds	Medium- to long-term bonds issued by government agencies and guaranteed by the central government or a state government. Coupon payments are semi-annual.
PSU Bonds	Medium- to long-term bonds issued by public sector companies in which the central or state government has an equity stake of 51 per cent or more.
Corporate Debentures	Short-to medium-term debt issued by private and public sector companies.
Money Market Instruments	Debt instruments like Treasury Bills (issued by GOI), Commercial Paper (issued by corporates) and Certificates of deposits (issued by banks and financial institutions) that have a maturity of less than a year.

In order to understand the valuation of bonds, we need to be familiar with certain bond-related terms.

Par Value- It is the value stated on the face of the bond. It represents the amount the firm borrows and promises to repay at the time of maturity. Usually the par or face value of bonds issued by business firms is Rs. 100. Sometimes it can be Rs. 1000.

Coupon Rate and Interest- A bond carries a specific interest rate which is called the coupon rate. The interest payable to the bond holder is simply par value of the bond \times coupon rate. Most bonds pay interest semi-annually. For example, a GOI security which has a par value of Rs. 1000 and a coupon rate of 11 per cent pays an interest of Rs. 55 every six months.

Maturity Period-Typically, bonds have a maturity period of 1-10 years; sometimes they have a longer maturity. At the time of maturity the par (face) value plus perhaps a nominal premium is payable to the bondholder.

The time value concept

The time value concept for money is that the rupee received today is more valuable than a rupee received tomorrow. The investor will postpone current consumption only if he could earn more future consumption opportunities through investment. Individuals generally prefer current consumption to future consumption. If there is inflation in the economy, a rupee today will represent more purchasing power than a rupee at a future date.

Interest is the rent paid to the owners to part their money. The interest that the borrower pays to the lender causes the money to have a future value different from its present value. The time value of money makes the rupee invested today grow more than a rupee in the future. To quantify this concept mathematically compounding and discounting principles are used. The one period future time value of money is given by the equation:

Future Value = present value (1 + interest rate). If hundred rupees are put in a savings bank account in a bank for one year, the future value of money will be:

$$\begin{aligned}\text{Future Value} &= \text{Rs. } 100 (1.0 + 6\%) \\ &= 100 \times 1.06 = \text{Rs. } 106.\end{aligned}$$

If the deposited money is allowed to cumulate for more than one time, the period exponent is added to the previous equation.

$$\text{Future value} = (\text{Present Value}) (1 + \text{interest rate})^t$$

t- the number of time periods the deposited money accumulates as interest. Suppose Rs. 100 is put for two years at the 6% rate of interest, money will grow to be Rs. 112.36.

$$\begin{aligned}
\text{Future Value} &= \text{Present value} (1 + \text{interest rate})^2 \\
&= 100 (1 + 0.06)^2 \\
&= 100 (1.1236) \\
&= 112.36.
\end{aligned}$$

To find out the values in a simple manner, the compound sum of Re. 1 at the end of a period FVIF_{1, /K, n} and compound sum of an annuity of Re. 1 per period FVIFA tables

The present value

The present value of money can be found simply by reversing the earlier equation.

$$\text{Present value} \times (1 + \text{interest rate}) = \text{Future value}$$

$$\text{Present value} = \frac{\text{Future value}}{1 + \text{interest rate}}$$

Here, the discounting principle is used. Today's worth of Rs. 100 to be received after a year at 10 per cent interest would be:

$$\begin{aligned}
\text{Present value} &= \frac{\text{Future value}}{1 + \text{interest rate}} \\
&= \text{Rs.} \frac{100}{1+0.10} = \frac{100}{1.1} = \text{Rs. } 90.90.
\end{aligned}$$

The multiple period of present value equation takes into account of the multiple periods.

$$\text{Present value} = \frac{\text{Future value}}{(1 + \text{interest rate})^t}$$

Valuation model

The value of a bond- or any asset, real or financial- is equal to the present value of the cash flows expected from it. Hence, determining the value of a bond requires:

- An estimate of expected cash flows
- An estimate of the required return.

To simplify the analysis of bond valuation we will make the following assumptions:

- The coupon interest rate is fixed for the term of the bond.
- The coupon payments are made every year and the next coupon payment is receivable exactly a year from now.
- The bond will be redeemed at par on maturity.

Given these assumptions, the cash flow for a non-callable bond comprises an annuity of a fixed coupon interest payable annually and the principal amount payable at maturity. Hence the value of a bond is:

$$P = \sum_{t=1}^n \frac{C}{(1+r)^t} + \frac{M}{(1+r)^n}$$

Where P = value (in rupees)

n = number of years

C = annual coupon payment (in rupees)

r = periodic required return

M = maturity value

t = time period when the payment is received.

Since the stream of semi-annual coupon payments is an ordinary

annuity, we can apply the formula for the present value of an ordinary annuity. Hence the bond value is given by the formula:

$$P = C \times PVIFA_{r, n} + M \times PVIF_{r, n}$$

To illustrate how to compute the value of a bond, consider a 10-year, 12 per cent coupon bond with a par value of Rs. 1000. Let us assume that the required yield on this bond is 13 per cent. The cash flows for this bond are as follows:

- 10 annual coupon payments of Rs. 120.
- Rs. 1000 principal repayment 10 years from now.

The value of the bond is:

$$\begin{aligned} P &= 120 \times PVIFA_{13\%, 10 \text{ yr}} + 1,000 \times PVIF_{13\%, 10 \text{ yr}} \\ &= 120 \times 5.426 + 1000 \times 0.295 \\ &= 651.1 + 295 = \text{Rs. } 946.1 \end{aligned}$$

Bond values with semi-annual interest

Most bonds pay interest semi-annually. To value such bonds, we have to work with a unit period of six months, and not one year. This means that the bond valuation equation has to be modified along the following lines:

- The annual interest payment, C, must be divided by 2 to obtain the semi-annual interest payment.
- The number of years to maturity must be multiplied by two to get the number of half-yearly periods.
- The discount rate has to be divided by two to get the discount rate applicable to half-yearly periods.

- With the above modifications, the basic bond valuation becomes:

$$P = C/2 (PVIFA_{r/2, 2n}) + M (PVIF_{r/2, 2n})$$

where P = value of the bond

$C/2$ = semi-annual interest payment

$R/2$ = discount rate applicable to a half-year

period M = maturity value

$2n$ = maturity period expressed in terms of half-yearly periods.
