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# SHARE VALUATION

Fundamental analysis is based on the premise that each share has an intrinsic worth or value which depends upon the benefits that the holder of a share expects to receive in future from the share in the form of dividends and capital appreciation. The investment decision of the fundamental analyst to buy or sell a share is based on a comparison between the intrinsic value of a share and its current market price. If the market price of a share is currently lower than its intrinsic value, such a share would be bought because it is perceived to be underpriced. A share whose current market price is higher than its intrinsic value would be considered as overpriced and hence sold.

The fundamental analyst believes that the market price of a share is a reflection of its intrinsic value. Though, in the short run, the market price may deviate from intrinsic value, in the long run the price would move along with the intrinsic value of the share. The investment decision of the fundamental analyst is based on this belief regarding the relationship between market price and intrinsic value.

The market price of a share and its intrinsic value are thus the two basic inputs necessary for the investment decision. Market price of a share is available from the quotations of stock exchanges. The intrinsic value is estimated through the process of stock or share valuation.

## CONCEPT OF PRESENT VALUE

The present value concept is a fundamental concept used in the share valuation procedure. An understanding of this concept is necessary for studying the share valuation process.

Money has a 'time value'. This implies that a rupee received now is worth more than a rupee to be received after one year, because the rupee received now can be deposited in a bank at 10 per cent interest rate to receive Rs. 1.10 after one year. The time value of money suggests that earlier receipts are more desirable than later receipts, because earlier receipts can be reinvested to generate additional returns before the later receipts come in.

If an amount $P$ is invested now for $n$ years at $r$ rate of interest, the future value $F$ to be received after $n$ years can be calculated using the compound interest formula.

$$F = P(1 + r)^n$$

For example, if Rs. 1000 is invested in a bank for three years at 10 per cent interest, the amount to be received after the three year period would be calculated as:

$$F = 1000(1.1)^3 = \text{Rs. } 1331$$

Thus, the future value of a present sum can be calculated by the compounding process. Similarly, the present value of a sum to be received in future can be calculated by a reverse process known as **discounting**. For example, we may want to know what amount is to be deposited in the bank at 10 per cent to receive Rs. 500 after one year.

This can be calculated by the formula, namely:

$$P = \frac{F}{(1 + k)^n}$$

where

$F$ = Amount to be received after $n$ years.

$n$ = Number of years to maturity.

$k$ = Discount rate.

$P$ = Present value of the sum to be received in the future.

For example, if Rs. 500 would be received after two years and if the discount rate is 10 per cent, the present value can be calculated as follows:

$$P = \frac{500}{(1.1)^2} = \text{Rs. } 413.22$$

The present value of a future sum is the amount to be invested now to accumulate to that sum in the future. Rs. 413.22 invested now at 10 per cent interest would grow to Rs. 500 by the end of two years. Obviously, the present value of future sums would be lower than those future sums.

## SHARE VALUATION MODEL

The valuation model used to estimate the intrinsic value of a share is the present value model. The intrinsic value of a share is the present value of all future amounts to be received in respect of the ownership of that share, computed at an appropriate discount rate.

The major receipts that come from the ownership of a share are the annual dividends and the sale proceeds of the share at the end of the holding period. These are to be discounted to find their present value, using a discount rate that is the rate of return required by the investor, taking into consideration the risk involved and the investor's other investment opportunities. Thus, the intrinsic value of a share is the present value of all the future benefits expected to be received from that share.

## One Year Holding Period

It is easy to start share valuation with one year holding period assumption. Here an investor intends to purchase a share now, hold it for one year and sell it off at the end of one year. In this case, the investor would be expected to receive an amount of dividend as well as the selling price after one year. The present value of the share may be expressed as:

$$S_0 = \frac{D_1}{(1+k)^1} + \frac{S_1}{(1+k)^1}$$

where

$D_1$ = Amount of dividend expected to be received at the end of one year.
$S_1$ = Selling price expected to be realised on sale of the share at the end of one year.
$k$ = Rate of return required by the investor.

For example, if an investor expects to get Rs. 3.50 as dividend from a share next year and hopes to sell off the share at Rs. 45 after holding it for one year, and if his required rate of return is 25 per cent, the present value of this share to the investor can be calculated as follows:

$$S_0 = \frac{3.50}{(1.25)^1} + \frac{45}{(1.25)^1}$$

$$= \text{Rs. } 2.80 + \text{Rs. } 36 = \text{Rs. } 38.80$$

This is the intrinsic value of the share. The investor would buy this share only if its current market price is lower than this value.

## Multiple-year Holding Period

An investor may hold a share for a certain number of years and sell it off at the end of his holding period. In this case, he would receive annual dividends each year and the sale price of the share at the end of the holding period. The present value of the share may be expressed as:

$$S_0 = \frac{D_1}{(1+k)^1} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \cdots + \frac{D_n + S_n}{(1+k)^n}$$

where

$D_1, D_2, D_3, \ldots, D_n$ = Annual dividends to be received each year.
$S_n$ = Sale price at the end of the holding price.
$k$ = Investor's required rate of return.
$n$ = Holding period in years.

For example, if an investor expects to get Rs. 3.50, Rs. 4 and Rs. 4.50 as dividend from a share during the next three years and hopes to sell it off at Rs. 75 at the end of the third year, and if his required rate of return is 25 per cent, the present value of this share to the investor can be calculated as follows:

$$S_0 = \frac{3.50}{(1.25)^1} + \frac{4.00}{(1.25)^2} + \frac{4.50}{(1.25)^3} + \frac{75}{(1.25)^3}$$

$$= 2.80 + 2.56 + 2.30 + 38.40$$

$$= \text{Rs. } 46.06$$

In order to use the present value model for share valuation, the investor has to forecast the future dividends as well as the selling price of the share at the end of his holding period. It is not possible to forecast these variables accurately. Hence, this model is practically infeasible. Modifications of this model have been developed to render it useful for practical purposes of stock valuation.

In the case of most equity shares, the dividend per share grows because of the growth in earnings of a company. In other words, equity dividends grow and are not constant over time. The growth rate pattern of equity dividends have to be estimated. Different assumptions about the growth rate patterns can be made and incorporated into the valuation models. Two assumptions that are commonly used are:

1. Dividends grow at a constant rate in future, i.e. the constant growth assumption.
2. Dividends grow at varying rates in future, i.e. multiple growth assumption.

These two assumptions give rise to two modified versions of the present value model of share valuation: (a) Constant growth model, and (b) Multiple growth model.

## CONSTANT GROWTH MODEL

In this model it is assumed that dividends will grow at the same rate ($g$) into the indefinite future and that the discount rate ($k$) is greater than the dividend growth rate ($g$). By applying the growth rate ($g$) to the current dividend ($D_0$), the dividend expected to be received after one year ($D_1$) can be calculated as:

$$D_1 = D_0(1 + g)^1$$

The dividend expected to be received after two years, three years, etc. can also be calculated from the current dividend as:

$$D_2 = D_0(1 + g)^2$$
$$D_3 = D_0(1 + g)^3$$
$$D_n = D_0(1 + g)^n$$

The present value model for share valuation may now be written as:

$$S_0 = \frac{D_0(1+g)^1}{(1+k)^1} + \frac{D_0(1+g)^2}{(1+k)^2} + \cdots + \frac{D_0(1+g)^n}{(1+k)^n}$$

When '$n$' approaches infinity, this formula can be simplified as:

$$S_0 = \frac{D_1}{k-g} \text{ or } \frac{D_0(1+g)}{k-g}$$

Thus, according to this model, the intrinsic value of a share is equal to next year's expected dividend divided by the difference between the appropriate discount rate for the stock and its expected dividend growth rate.

The constant growth model is also known as **Gordon's share valuation model**, named after the model's originator, Myron J. Gordon. This is one of the most well-known and widely used models because of its simplicity. The model does not require forecasts of future dividends and future selling price of the share. All that the model requires is a dividend growth rate assumption and a discount rate. Both of these can be estimated without much difficulty. The growth rate may be estimated from past growth rates of dividends and earnings. The discount rate is the investor's required rate of return which is somewhat subjective and would depend upon the investor's alternative investment opportunities and his perception of risk involved in purchasing the share.

To illustrate the application of Gordon share valuation model, let us consider an example. A company has declared a dividend of Rs. 2.50 per share for the current year. The company has been following a policy of enhancing its dividends by 10 per cent every year and is expected to continue this policy in the future also. An investor who is considering the purchase of the shares of this company has a required rate of return of 15 per cent.

The intrinsic value of the company's share can be calculated as:

$$S_0 = \frac{D_0(1+g)}{k-g} = \frac{\text{Rs. } 2.50(1.10)}{0.15-0.10} = \frac{2.75}{0.05}$$

$$= \text{Rs. } 55$$

The investor would be advised to purchase the share if the current market price is lower than Rs. 55.

## MULTIPLE GROWTH MODEL

The constant growth assumption may not be realistic in many situations. The growth in dividends may be at varying rates. A typical situation for many companies may be that a period of extraordinary growth (either good or bad) will prevail for a certain number of years, after which growth will change to a level at which it is expected to continue indefinitely. This situation can be represented by a **two-stage growth model.**

In this model, the future time period is viewed as divisible into two different growth segments, the initial extraordinary growth period and the subsequent constant growth period. During the initial period growth rates will be variable from year to year, while during the subsequent period the growth rate will remain constant from year to year. The investor has to forecast the time $N$ upto which growth rates would be variable and after which the growth rate would be constant. This would mean that the present value calculations will have to be spread over two phases, where one phase would last until time $N$ and the other would begin after time $N$ to infinity.

The intrinsic value of the share is then the sum of the present values of two dividen flows: (a) the flow from period 1 to $N$ which we will call $V_1$, and (b) the flow from perio $N + 1$ to infinity, referred to as $V_2$. This means,

$$S_0 = V_1 + V_2$$

The growth rates during the first phase of extraordinary growth is likely to be variable from year to year. Hence, the expected dividend for each year during the first phase may be forecast individually. The multiple year holding period valuation model may be used for this first phase, using the dividend forecasts developed for each of the years in the first phase. Then

$$V_1 = \frac{D_1}{(1+k)^1} + \frac{D_2}{(1+k)^2} + \cdots + \frac{D_N}{(1+k)^N}$$

This may be summarised as:

$$V_1 = \sum_{t=1}^{N} \frac{D_t}{(1+k)^t}$$

The second phase present value is denoted by $V_2$ and would be based on the constant growth model, because the dividend growth is assumed to be constant during the second phase. The position of the investor at time $N$, after which the second phase commences, can be viewed as a point in time when he is forecasting a stream of dividends for time periods $N + 1$, $N + 2$, $N + 3$ and so on, which grow at a constant rate, $g$. The second phase dividends would be:

$$D_{N+1} = D_N (1 + g)^1$$

$$D_{N+2} = D_N (1 + g)^2$$

$$D_{N+3} = D_N (1 + g)^3$$

and so on to infinity.

The present value of the second phase stream of dividends from period $N + 1$ to infinity can be calculated using Gordon share valuation model as:

$$\frac{D_N(1+g)}{k-g}$$

It may be noted that this value is the present value at time $N$ of all future expected ividends from time period $N + 1$ to infinity. When this value has to be viewed at time ero', it must be discounted to provide the present value at 'zero' time for the second ase dividend stream. When so discounted the present value of the second phase dividend eam viewed at 'zero' time may be expressed as:

$$V_2 = \frac{D_N(1+g)}{(k-g)(1+k)^N}$$

The present values of the two phases, $V_1$ and $V_2$, may be added to provide the intrinsic value of the share that has a two-stage growth.

The summation procedure of the two phases may be expressed as:

$$S_0 = \sum_{t=1}^{N} \frac{D_t}{(1+k)^t} + \frac{D_N(1+g)}{(k-g)(1+k)^N}$$

To illustrate the two-stage growth model, let us consider an example.

A company paid a dividend of Rs. 1.75 per share during the current year. It is expected to pay a dividend of Rs. 2 per share during the next year. Investors forecast a dividend of Rs. 3 and Rs. 3.50 per share respectively during the two subsequent years. After that it is expected that annual dividends will grow at 10 per cent per year into an indefinite future.

If the investor's required rate of return is 20 per cent, the intrinsic value of the share can be calculated as shown below.

In this, the dividend growth rate is variable upto the third year. From the fourth year onwards dividend growth rate is constant. $V_1$ would be the present value of dividends receivable during the first three years and can be calculated as:

$$V_1 = \frac{2}{(1.2)^1} + \frac{3}{(1.2)^2} + \frac{3.50}{(1.2)^3}$$

$$= \text{Rs. } 5.78$$

Now, $V_2$ would be the present value at time 'zero' of dividends receivable from the fourth year to infinity. This is calculated as:

$$V_2 = \frac{3.50(1.1)}{(0.20-0.10)(1.2)^3} = \frac{3.85}{(0.10)(1.2)^3}$$

$$= \text{Rs. } 22.28$$

The intrinsic value of the share is the sum of the two present values $V_1$ and $V_2$

$$S_0 = V_1 + V_2$$

$$= 5.78 + 22.28$$

$$= \text{Rs. } 28.06$$

## DISCOUNT RATE

The discount rate used in the present value models is the investor's required rate of return. This has to take into consideration the time value of money as well as the risk of the security in which investment is proposed to be made. The time value of money is represented by the risk-free interest rate such as those on government securities. A premium is added to this risk-free interest rate to take care of the risk to be borne by the investor by investing in the particular share. The more risky the investment, the greater the risk premium that the investor will require. The assessment of risk and the estimation of risk premium required are usually done by investors on a subjective basis. Though other objective methods are available for the purpose, they are not popularly used. Thus, the investor's required rate of return would comprise the risk-free interest rate plus a risk premium.

The present value models discussed above are also known as **dividend discounted valuation models** because they discount the stream of dividends expected to be received from a share in the future.

## MULTIPLIER APPROACH TO SHARE VALUATION

Many investors and analysts value shares by estimating an appropriate multiplier for the share. The price-earnings ratio (P/E ratio) is the most popular multiplier used for the purpose.

The price-earnings ratio is given by the expression:

$$\text{P/E ratio} = \frac{\text{Share price}}{\text{Earnings per share}}$$

The intrinsic value of a share is taken as the current earnings per share or the forecasted future earnings per share times the appropriate P/E ratio for the share. For example, if the current EPS of a share is Rs. 8 and if the investor feels that the appropriate P/E ratio for the share is 12, then the intrinsic value of the share would be taken as Rs. 96. Investment decision to buy or sell the share would be taken after comparing this intrinsic value with the current market price of the share.

The major difficulty for the analyst using the multiplier approach to share valuation is the determination of an appropriate price-earnings ratio for the share. Different approaches may be adopted for the determination of the appropriate P/E ratio. It may be arrived at by the analyst on a subjective basis based on his evaluation of various fundamental factors relating to the company. The major factors considered would be growth rate in earnings and the risk factor. The higher the expected growth and the lower the risk, the greater would be the appropriate price-earnings ratio for the share.

Another approach would be to use the historical P/E ratios of the company itself or the P/E ratios of other companies in the same industry. In the first case, the mean of the historical P/E ratios of the company in the past may be taken as the appropriate P/E ratio for share valuation. In the latter case, the median P/E ratio of companies in the same industry may be taken as the appropriate P/E ratio.

## REGRESSION ANALYSIS

Still another approach to the determination of an appropriate P/E ratio is a statistical approach. The broad determinants of share prices such as earnings, growth, risk and dividend policy may be used to estimate the appropriate P/E ratio with the help of statistical analysis. The analyst identifies the factors (known as independent variables) which influence the share price (the dependent variable) and then ascertains the relationship between these factors and the share price. The relationship that exists at any point in time between the share price or price-earnings ratio and the set of specified determining variables can be estimated using multiple regression analysis. The resulting regression equation measures the simultaneous impact of the determining variables on the price-earnings ratio. This equation can be used to arrive at the appropriate P/E ratio for the share. By substituting the values of the determining variables for a share, the appropriate P/E ratio for the share can be easily calculated.

One of the earliest attempts to use multiple regression to explain price-earnings ratios, which received wide attention, was **Whitbeck-Kisor model.** Whitbeck and Kisor set out to measure the relationship of the P/E ratio of a stock to its dividend policy, growth and risk. They used dividend pay outs, earnings growth rates and the variation (standard deviation) of growth rates to measure the determining variables. Then, using multiple regression analysis to define the average relationship between each of these variables and price earnings ratios, they found (as of June 8, 1962) that

$$\begin{aligned} \text{P/E ratio} &= 8.2 + 1.5\ (\text{earnings growth rate}) \\ &\quad + 0.067\ (\text{dividend pay out rate}) \\ &\quad - 0.2\ (\text{standard deviation in growth rate}) \end{aligned}$$

The numbers in the equation are the regression coefficients. 8.2 is the constant term and the other numbers represent the weightage of the respective independent variables or factors influencing the P/E ratio.

This equation could be used to determine the appropriate P/E ratio of a stock. For example, if there is a share with a growth forecast of 7 per cent, dividend pay out of 40 per cent and standard deviation in growth rate amounting to 12, the appropriate P/E ratio for this share would be

$$8.2 + 1.5(7) + 0.067(40) - 0.2(12) = 18.98$$

Many models of this nature have been developed since then. But the major drawback of these regression models is that they are appropriate only for the time period used and the sample used.

Share valuation is an integral part of fundamental analysis. It was Benjamin Graham and David Dodd who pioneered the development of systematic methods of security evaluation in their book *Security Analysis* published in 1934. Share valuation deals with the determination of the theoretical or **normative price** of a share, the price that a share should sell for, better known as the **intrinsic value** of the share. This price is then compared with the actual price of the share prevailing in the market to arrive at the appropriate investment decision. Share valuation, however, is a difficult exercise. Different approaches may be adopted for the purpose, but all of them require forecasts of fundamental data about companies. No valuation model can produce good results if the forecasts on which it is based are of poor quality.

***Example 1*** Consider five annual cash flows (the first occurring one year from today)

| Year: | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Cash flow (Rs.): | 5 | 8 | 12 | 15 | 16 |

Given a discount rate of 10 per cent, what is the present value of this stream of cash flows?

***Solution*** Present value of a stream of cash flows can be calculated as follows:

$$PV = \frac{C_1}{(1+k)^1} + \frac{C_2}{(1+k)^2} + \cdots + \frac{C_n}{(1+k)^n}$$

$$= \sum_{t=1}^{n} \frac{C_t}{(1+k)^t}$$

where

$C_1, C_2, \ldots, C_n$ = Future cash flows at time periods 1, 2, ..., $n$.

$k$ = Appropriate discount rate.

Here,

$$PV = \frac{5}{(1+0.1)^1} + \frac{8}{(1+0.1)^2} + \frac{12}{(1+0.1)^3} + \frac{15}{(1+0.1)^4} + \frac{16}{(1+0.1)^5}$$

$$= 4.545 + 6.612 + 9.016 + 10.245 + 9.935$$

$$= 40.353$$

***Example 2*** A share is currently selling for Rs. 65. The company is expected to pay a dividend of Rs. 2.50 on the share at the end of the year. It is reliably estimated that the share will sell for Rs. 78 at the end of the year.

1. Assuming that the dividend and price forecasts are accurate, would you buy the share to hold it for one year, if your required rate of return were 12 per cent?
2. Given the current price of Rs. 65 and the expected dividend of Rs. 2.50, what would the price have to be at the end of one year to justify purchase of the share today, if your required rate of return were 15 per cent?

***Solution***

1. The share valuation model for one-year holding period is:

$$S_0 = \frac{D_1}{(1+k)^1} + \frac{S_1}{(1+k)^1}$$

Given

$D_1$ = Rs. 2.50 $\quad S_1$ = Rs. 78 $\quad k$ = 12 per cent

Hence,

$$S_0 = \frac{2.50}{(1+0.12)^1} + \frac{78}{(1+0.12)^1}$$

$$= 2.23 + 69.64 = \text{Rs. } 71.87$$

Since the current price of the share (Rs. 65) is lower than the intrinsic value of the share (Rs. 71.87), the share is underpriced and can be bought.

2. Given

Current price = Rs. 65

$D_1$ = Rs. 2.50

$k$ = 15 per cent

We have to determine the selling price at the end of the year ($S_1$) which will give the intrinsic value of the share as Rs. 65.

Hence,

$$65 = \frac{2.50}{(1+0.15)^1} + \frac{X}{(1+0.15)^1}$$

$$65 = 2.17 + \frac{X}{(1.15)}$$

$$65 - 2.17 = \frac{X}{(1.15)}$$

Cross multiplying,

$$1.15\ (65 - 2.17) = X$$

Therefore,

$$X = 1.15(62.83) = \text{Rs. } 72.25$$

A selling price of Rs. 72.25 at the end of the year would justify the purchase of the share at the current price of Rs. 65.

*Example 3* You have decided to buy 500 shares of an IT company with the intention of selling out at the end of five years. You estimate that the company will pay Rs. 3.50 per share as dividends for the first two years and Rs. 4.50 per share for the next three years. You further estimate that, at the end of the five year holding period, the shares can be sold for Rs. 85. What would you be willing to pay today for these shares if your required rate of return is 12 per cent?

***Solution*** The share valuation model for multi-year holding period is:

$$S_0 = \frac{D_1}{(1+k)^1} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \cdots + \frac{D_n + S_n}{(1+k)^n}$$

Given

$D_1$ and $D_2$ = Rs. 3.50

$D_3$, $D_4$ and $D_5$ = Rs. 4.50

$S_5$ = Rs. 85

$k$ = 12 per cent

Hence,

$$S_0 = \frac{3.50}{(1+0.12)^1} + \frac{3.50}{(1+0.12)^2} + \frac{4.50}{(1+0.12)^3} + \frac{4.50}{(1+0.12)^4} + \frac{4.50}{(1+0.12)^5} + \frac{85}{(1+0.12)^5}$$

$$= 3.125 + 2.790 + 3.203 + 2.860 + 2.553 + 48.231 = 62.762$$

The maximum price to be paid for the shares would be Rs. 62.76 per share.

*Example 4* A company paid a cash dividend of Rs. 4 per share on its stock during the current year. The earnings and dividends of the company are expected to grow at an annual rate of 8 per cent indefinitely. Investors expect a rate of return of 14 per cent on the company's shares. What is a fair price for this company's shares?

***Solution*** The valuation model to be applied in this case is the constant growth model which is:

$$S_0 = \frac{D_0(1+g)}{k-g}$$

Given

$D_0$ = Rs. 4

$g$ = 8 per cent

$k$ = 14 per cent

Hence,

$$S_0 = \frac{4(1+0.08)}{(0.14-0.08)} = \frac{4.32}{0.06} = \text{Rs. } 72$$

The fair price for the company's shares would be Rs. 72.

***Example 5*** A company paid dividends amounting to Rs. 0.75 per share during the last year. The company is expected to pay Rs. 2 per share during the next year. Investors forecast a dividend of Rs. 3 per share in the year after that. Thereafter, it is expected that dividends will grow at 10 per cent per year into an indefinite future. Would you buy/sell the share if the current price of the share is Rs. 54? Investor's required rate of return is 15 per cent.

***Solution*** The valuation model to be applied in this case is the two-stage growth model.

$$S_0 = V_1 + V_2$$

$$V_1 = \frac{D_1}{(1+k)^1} + \frac{D_2}{(1+k)^2} + \cdots + \frac{D_N}{(1+k)^N}$$

$$V_2 = \frac{D_N(1+g)}{(k-g)(1+k)^N}$$

Given

$D_1$ = Rs. 2

$D_2$ = Rs. 3

$N = 2$

$g$ = 10 per cent

$k$ = 15 per cent

Hence,

$$V_1 = \frac{2}{(1+0.15)^1} + \frac{3}{(1+0.15)^2}$$

$$= 1.74 + 2.27 = 4.01$$

$$V_2 = \frac{3(1+0.10)}{(0.15-0.10)(1+0.15)^2}$$

$$= \frac{3.3}{(0.05)(1.15)^2} = 49.91$$

$$S_0 = 4.01 + 49.91 = 53.92$$

The current market price of the share (Rs. 54) is equal to the intrinsic value (Rs. 53.92). As the share is fairly priced, no trading is recommended.

*Example 6* A chemical company paid a dividend of Rs. 2.75 during the current year. Forecasts suggest that earnings and dividends of the company are likely to grow at the rate of 8 per cent over the next five years and at the rate of 5 per cent thereafter. Investors have traditionally required a rate of return of 20 per cent on these shares. What is the present value of the stock?

*Solution* The valuation model to be applied in this case is the two-stage growth model

Given

$D_0$ = Rs. 2.75

$N = 5$

$k$ = 20 per cent

$g$ (for the first five years) = 8 per cent

$g$ (after five years) = 5 per cent

Hence,

$$D_1 = D_0\ (1+g)^1 = 2.75\ (1+0.08)^1 = 2.97$$

$$D_2 = D_0\ (1+g)^2 = 2.75\ (1.08)^2 = 3.21$$

$$D_3 = D_0\ (1+g)^3 = 2.75\ (1.08)^3 = 3.46$$

$$D_4 = D_0\ (1+g)^4 = 2.75\ (1.08)^4 = 3.74$$

$$D_5 = D_0\ (1+g)^5 = 2.75\ (1.08)^5 = 4.04$$

$$V_1 = \frac{2.97}{(1+0.2)^1} + \frac{3.21}{(1+0.2)^2} + \frac{3.46}{(1+0.2)^3} + \frac{3.74}{(1+0.2)^4} + \frac{4.04}{(1+0.2)^5}$$

$$= 2.48 + 2.23 + 2.00 + 1.80 + 1.62$$

$$= 10.13$$

$$V_2 = \frac{D_N(1+g)}{(k-g)(1+k)^N}$$

$$= \frac{4.04(1+0.05)}{(0.20-0.05)\ (1+0.20)^5}$$

$$= \frac{4.24}{(0.15)\ (1.2)^5} = 11.36$$

$$S_0 = V_1 + V_2 = 10.13 + 11.36 = 21.49$$

The present value of the stock is Rs. 21.49.

*Example 7* Cement products Ltd. currently pays a dividend of Rs. 4 per share on its equity shares.

1. If the company plans to increase its dividend at the rate of 8 per cent per year indefinitely, what will be the dividend per share in 10 years?
2. If the company's dividend per share is expected to be Rs. 7.05 per share at the end of five years, at what annual rate is the dividend expected to grow?

***Solution***

1. $D_0$ = Rs. 4
   $g$ = 8 per cent
   Hence,
   $$D_{10} = D_0(1 + g)^{10} = 4(1 + 0.08)^{10} = 8.64$$
2. $D_0$ = Rs. 4
   $D_5$ = Rs. 7.05
   We have to determine the growth rate, that is, $g$.
   $$D_5 = D_0(1 + g)^5$$
   $$7.05 = 4(1 + g)^5$$
   $$\frac{7.05}{4} = (1 + g)^5$$
   $$1.7625 = (1 + g)^5$$
   $$(1 + g) = 5\sqrt{1.7625}$$
   $$1 + g = 1.12$$
   $$g = 1.12 - 1 = 0.12 \text{ or } 12 \text{ per cent}$$

Hence, dividend growth rate is 12 per cent.

## EXERCISES

1. An IT company currently pays a dividend of Rs. 5 per share on its equity shares. The dividend is expected to grow at 6 per cent per year indefinitely. Stocks with similar risk currently are priced to provide a 12 per cent expected return. What is the intrinsic value of the stock?
2. Alfa Ltd. paid a dividend of Rs. 2 per share for the current year. A constant growth in dividend of 10 per cent has been forecast for an indefinite future period. Investor's required rate of return has been estimated to be 15 per cent. The current market price of the share is Rs. 60. Would you buy the share?

# 10

# BOND VALUATION

Bonds are long-term fixed income securities. Debentures are also long-term fixed income securities. Both of these are debt securities. In India, debt securities issued by the government and public sector units are generally referred to as **bonds**, while debt securities issued by private sector joint stock companies are called **debentures**. The two terms, however, are often used interchangeably. The term 'bond' is used in this chapter to include debentures also.

The two major categories of bonds are *government bonds* and *corporate bonds*. Government bonds represent the borrowings of the government. Since they are backed by the government, they are considered free from default risk. Corporate bonds represent debt obligations of private sector companies. Corporate bonds are backed by the credit of the issuing companies. It is the company's ability to earn money and meet the debt obligations that determines the bond's default risk.

In the case of bonds, both the cash flow streams (interest and principal) and the time horizon (maturity) are well specified and fixed. This makes bond valuation easier than stock valuation. Nevertheless, certain special features of bonds such as callability and convertibility may make bond valuation complex. In the case of *callable bonds*, the bonds may be called for redemption earlier than its maturity date. As the right to call rests with the companies, callable bonds must offer a higher interest to compensate for disadvantageous calls. *Convertible bonds* are those that can be converted into equity shares at a later date either fully or partly. Because the option to convert often rests with the bond holder, the interest offered on the bond can be less as part of the return is the value of the option.

Bond valuation is less glamorous than stock valuation for two reasons. First, the returns from investing in bonds are less impressive and fixed. Second, bond prices fluctuate less than equity prices. As the uncertainty associated with the cash flows occurring to a bond holder is less, the emphasis is more on fine-tuned calculations and analysis. An investor in bonds should be on the look out for even small differentials in prices and returns.

## BOND RETURNS

Bond returns can be calculated and expressed in different ways. It is necessary to understand the meaning of each of these expressions.

### Coupon Rate

It is the nominal rate of interest fixed and printed on the bond certificate. It is calculated on the face value of the bond. It is the rate at which interest is payable by the issuing company to the bondholder. For example, if the coupon rate on a bond of face value of Rs. 1000 is 12 per cent, Rs. 120 would be payable by the company to the bondholder annually till maturity.

### Current Yield

The current market price of a bond in the secondary market may differ from its face value. A bond of face value Rs. 100 may be selling at a discount, at say Rs. 90, or it may be selling at a premium at Rs. 115.

The current yield relates the annual interest receivable on a bond to its current market price. It can be expressed as follows:

$$\text{Current yield} = \frac{I_n}{P_0} \times 100$$

where

$I_n$ = Annual interest.

$P_0$ = Current market price.

For example, if a bond of face value Rs. 1000 and a coupon rate of 12 per cent, is currently selling for Rs. 800, the current yield of the bond can be calculated as follows:

$$\text{Current yield} = \frac{120}{800} \times 100 = 15 \text{ per cent}$$

The current yield would be higher than the coupon rate when the bond is selling at a discount as in our example. Current yield would be lower than the coupon rate for a bond selling at a premium.

The current yield measures the annual return accruing to a bondholder who purchases the bond from the secondary market and sells it before maturity, presumably at the same price at which he bought the bond. It does not measure the entire returns accruing from a bond held till maturity. More specifically, it does not consider the reinvestment of annual interest received from the bond and the capital gain or loss realised on maturity of the bond. The bond holder in our example would realise a capital gain of Rs. 200 on maturity, as the bond which was purchased from the market for Rs. 800 would be redeemed at the face value of Rs. 1000 on maturity.

### Spot Interest Rate

Zero coupon bond is a special type of bond which does not pay annual interests. The return on this bond is in the form of a discount on issue of the bond. For example, a two-year bond of face value Rs. 1000 may be issued at a discount for Rs. 797.19. The investor who purchases this bond for Rs. 797.19 now would receive Rs. 1000 two years later. This type of bond is also called **pure discount bond** or **deep discount bond**. The return received from a zero coupon bond or a pure discount bond expressed on an annualised basis is the spot interest rate. In other words, spot interest rate is the annual rate of return on a bond that has only one cash inflow to the investor.

Mathematically, spot interest rate is the discount rate that makes the present value of the single cash inflow to the investor equal to the cost of the bond. In other words, the cash inflow from the bond when discounted with the spot interest rate becomes equal to the cost of the bond. Thus, in the case of a two year bond of face value Rs. 1000, issued at a discount for Rs. 797.19,

$$797.19 = \frac{1000}{(1 + k)^2}$$

The equation can be rearranged as:

$$(1 + k)^2 = \frac{1000}{797.19}$$

$$(1 + k)^2 = 1.2544$$

$$(1 + k) = \sqrt{1.2544} = 1.12$$

$$k = 1.12 - 1 = 0.12 \text{ or } 12 \text{ per cent}$$

The spot interest rate is 12 per cent per annum. This is an annual rate.

To understand the calculation of spot interest rate, let us take another example. Consider a zero coupon bond whose face value is Rs. 1000 and maturity period is five years. If the issue price of the bond is Rs. 519.37, the spot interest rate can be calculated as shown below:

$$519.37 = \frac{1000}{(1 + k)^5}$$

$$(1 + k)^5 = \frac{1000}{519.37} = 1.9254$$

$$(1 + k) = \sqrt[5]{1.9254} = 1.14$$

$$k = 1.14 - 1 = 0.14 \text{ or } 14 \text{ per cent.}$$

The spot interest rate in this case is 14 per cent.

## Yield to Maturity (YTM)

This is the most widely used measure of return on bonds. It may be defined as the compounded rate of return an investor is expected to receive from a bond purchased at the current market price and held to maturity. It is really the internal rate of return earned from holding a bond till maturity.

The yield to maturity or YTM depends upon the cash outflow for purchasing the bond, that is, the cost or current market price of the bond as well as the cash inflows from the bond, namely the future interest payments and the terminal principal repayment. YTM is the discount rate that makes the present value of cash inflows from the bond equal to the cash outflow for purchasing the bond.

The relation between the cash outflow, the cash inflow and the YTM of a bond can be expressed as:

$$MP = \sum_{t=1}^{n} \frac{C_t}{(1 + \text{YTM})^t} + \frac{TV}{(1 + \text{YTM})^n}$$

where

$MP$ = Current market price of the bond.

$C_t$ = Cash inflow from the bond throughout the holding period.

$TV$ = Terminal cash inflow received at the end of the holding period.

Through a process of trial and error the value of YTM that equates the two sides of the equation may be determined.

Let us consider a bond of face value of Rs. 1000 and a coupon rate of 15 per cent. The current market price of the bond is Rs. 900. Five years remain to maturity and the bond is repaid at par. Then:

$$900 = \sum_{t=1}^{5} \frac{150}{(1 + \text{YTM})^t} + \frac{1000}{(1 + \text{YTM})^5}$$

What is required is a value of YTM that makes the right hand side of the equation equal to Rs. 900. Since the market price is lower than the face value, it indicates that YTM would be higher than the coupon rate.

We may start with 20 per cent as the value of YTM. The right hand side of the equation then becomes

Rs. 150 × present value annuity factor (5 yrs, 20%) + Rs. 1000 × present value factor (5 yrs, 20%) = (150 × 2.9906) + (1000 × 0.4019) = 448.59 + 401.90 = Rs. 850.49

Since the value obtained is lower than the current market price of Rs. 900, a lower discount rate has to be tried. Taking YTM as 18 per cent, the right hand side of the equation becomes

$$(150 \times 3.1272) + (1000 \times 0.4371) = 469.08 + 437.10 = 906.18$$

The value obtained is higher than the required amount of Rs. 900. Hence, YTM lies between 18 per cent and 20 per cent. It can be estimated using interpolation as shown below.

$$\text{YTM} = 18 + \left[\frac{906.18 - 900}{906.18 - 850.49}\right](20 - 18)$$

$$= 18 + \left[\frac{6.18}{55.69} \times 2\right]$$

$$= 18 + 0.22 = 18.22 \text{ per cent}$$

The YTM concept is a compound interest concept. It is assumed that all intermediate cash inflows in the form of interest are reinvested at YTM. The investor is thus assumed to earn interest on interest at YTM throughout the holding period. Hence, when the intermediate inflows are reinvested at a rate lower than YTM, the yield actually realised by the investor would be lower than YTM.

The tedious calculations involved in determining YTM can be avoided by using the following formula which gives an approximate estimate of YTM.

$$\text{YTM} = \frac{I + [MV - C]/n}{[MV + C]/2}$$

where

$I$ = Amount of annual interest.
$MV$ = Maturity value at the end of the holding period.
$C$ = Cost or current market price of the bond.
$n$ = Holding period till maturity.

Using this formula, YTM for the bond in the example given above can be calculated as follows:

$$\text{YTM} = \frac{\text{Rs. } 150 + (\text{Rs. } 1000 - \text{Rs. } 900)/5}{(\text{Rs. } 1000 + \text{Rs. } 900)/2}$$

$$= \frac{150 + 20}{950} = 0.1789$$

$$= 17.89 \text{ per cent}$$

### Yield to Call (YTC)

Some bonds may be redeemable before their full maturity period either at the option of the issuer or of the investor. Such option would be exercisable at a specified period and at a specified price. If the option is exercised, the bond would be called for redemption at the specified call price on the specified call date. For example, a company may issue fifteen year bonds which can be redeemed at the end of five years, at the option of either the investor or the issuer, at a premium of five per cent on face value.

How do we calculate the yield on such bonds? In such cases, two yields may be calculated: (a) **yield to maturity** assuming that the bond will be redeemed only at the end of the full maturity period (fifteen years in the above example); (b) **yield to call** assuming that the bond will be redeemed at the call date (five years in the above example).

The yield to call is computed on the assumption that the bond's cash inflows are terminated at the call date with redemption of the bond at the specified call price. The present value of the 'cash flows to call' can be calculated using different discount rates. The yield to call is that discount rate which makes the present value of 'cash flows to call' equal to the bond's current market price or the cost of purchase of the bond.

If the yield to call is higher than the yield to maturity, it would be advantageous to the investor to exercise the redemption option at the call date. If, on the other hand, the yield to maturity is higher, it would be better to hold the bond till final maturity.

## BOND PRICES

All investments, including bonds and shares, derive value from the cash flow they are expected to generate. Because the cash flows will be received over future periods, there is need to discount these future cash flows to derive a present value or price for the security. In general terms, the theoretical price of any security can be established as the present value of a future stream of cash flows, as described by the following formula:

$$P_0 = \sum_{t=1}^{n} \frac{CF_t}{(1+k)^t}$$

The model indicates that the present value or, alternatively, current price $P_0$ of a security is the cash flows (*CF*) received over the time horizon '*n*', discounted back at the rate '*k*'.

The value of a bond is equal to the present value of its expected cash flows. The cash flows from a bond consist of the annual or semi-annual interest payments as well as the principal repayment at maturity. In the case of a bond, these cash flows as well as the time period over which these flows occur are known. These cash flows have to be discounted at an appropriate discount rate to determine their present value. The present value calculations are made with the help of the following equation:

$$P_0 = \sum_{t=1}^{n} \frac{I_t}{(1+k)^t} + \frac{MV}{(1+k)^n}$$

where

$P_0$ = Present value of the bond.
$I_t$ = Annual interest payments.
$MV$ = Maturity value of the bond.
$n$ = Number of years to maturity.
$k$ = Appropriate discount rate.

For using the above equation, the appropriate discount rate has to be determined. The current market interest rate which investors can earn on other comparable investments is the proper discount rate to be used in the present value model.

Let us consider an example. A bond of face value Rs. 1000 was issued five years ago at a coupon rate of 10 per cent. The bond had a maturity period of 10 years and as of today, therefore, five more years are left for final repayment at par. If the current market interest rate is 14 per cent, the present value of the bond can be determined as follows:

$$P_0 = \sum_{t=1}^{5} \frac{\text{Rs. } 100}{(1.14)^t} + \frac{\text{Rs. } 1000}{(1.14)^5}$$

= (100 × *PV* factor for 5 year annuity at 14 per cent) + (1000 × *PV* factor at 14 per cent for year 5)

= (100 × 3.4331) + (1000 × 0.5194)

= 343.31 + 519.40 = Rs. 862.71

Most bonds pay interest at half-yearly intervals. Where interest payments are semi-annual, the PV equation has to be modified as follows:

$$P_0 = \sum_{t=1}^{2n} \frac{I_t/2}{(1+k/2)^t} + \frac{MV}{(1+k/2)^{2n}}$$

Assuming semi-annual interest payments in the above example, the value of the bond can be determined as shown below:

$$P_0 = \sum_{t=1}^{10} \frac{\text{Rs. } 50}{(1.07)^t} + \frac{\text{Rs. } 1000}{(1.07)^{10}}$$

$$= 859.48$$

## BOND PRICING THEOREMS

Bonds are generally issued with a fixed rate of interest known as the coupon rate. This is calculated on the face value of the bond and remains fixed till maturity. At the time of issue of the bond its coupon rate will generally be equal to the prevailing market interest rate. As time passes, the market interest rate may change either upwards or downwards. If the current market interest rate rises above the coupon rate of a bond, the bond provides a lower return and hence, becomes less attractive. The price of the bond declines below its face value. This can be seen in the example considered above. The current market interest rate (14 per cent) is higher than the coupon rate of 10 per cent. The price of the bond is below its face value.

If the market interest rate declines below the coupon rate, the bond price will increase and the bond will begin to be sold at a premium on its face value. Thus, bond prices vary inversely with changes in market interest rates. The amount of price variation necessary to adjust to a given change in interest rates is a function of the number of years to maturity. In the case of long-maturity bonds, a change in market interest rate results in a relatively large price change when compared to a short-maturity bond. In other words, the long-term bond is more sensitive to interest rate changes than the short-term bonds, i.e. the long-term bonds generally have greater exposure to interest rate risk.

The relation between bond prices and changes in market interest rates have been stated by Burton G. Malkiel in the form of five general principles. These are known as Bond pricing theorems.[1] They explain the bond pricing behaviour in an environment of changing interest rates.

The five principles are:

1. Bond prices will move inversely to market interest changes.
2. Bond price variability is directly related to the term to maturity; which means, for a given change in the level of market interest rates, changes in bond prices are greater for longer-term maturities.
3. A bond's sensitivity to changes in market interest rate increases at a diminishing rate as the time remaining until its maturity increases.

4. The price changes resulting from equal absolute increases in market interest rates are not symmetrical, i.e. for any given maturity, a decrease in market interest rate causes a price rise that is larger than the price decline that results from an equal increase in market interest rate.
5. Bond price volatility is related to the coupon rate, which implies that the percentage change in a bond's price due to a change in the market interest rate will be smaller if its coupon rate is higher.

These theorems were derived and proven from the basic bond pricing equation.

## BOND RISKS

Bonds are considered to be less risky than equity shares; nevertheless they are not entirely risk free. Two types of risk are associated with investment in bonds, namely **default risk** and **interest rate risk.**

Risk is the possibility of variation in returns. The actual returns realised from a bond may vary from the expected returns either because of a default on the part of the issuer to pay the interest or principal, or because of changes in market interest rates. The investor has to assess the impact of these two sources of risk on the returns from a bond before investing in the bond.

### Default Risk

Default risk refers to the possibility that a company may fail to pay the interest or principal on the stipulated dates. Poor financial performance of the company leads to such default. A part of the interest and principal may not be received at all or may be received after a long delay. In either case the investor suffers a loss which goes to reduce his return from the bond.

Credit rating of Debt securities is a mechanism adopted for assessing the default risk involved. The credit rating process involves a qualitative analysis of the company's business and management and a quantitative analysis of the company's financial performance. It also considers the specific features of the bond being issued.

Credit rating services have developed rapidly in India. Now there are different institutions engaged in credit rating of debt securities. An investor may rely on the rating provided by these credit rating agencies or, alternatively, do his own credit rating, to assess the default risk of a bond.

### Interest Rate Risk

Another reason for variation in the returns from bonds is the change in market interest rates. An investor in bonds receives interest annually or semi-annually. He reinvests these interest amounts each year at the market interest rate. Thus, interest is earned on the interest received from the bonds each year. Finally, at the end of a certain holding period, the investor may sell off the bond at a price which is equal to its face value.

During the holding period of a bond, meanwhile, the market interest rates may change. If the market interest rate moves up, the investor would be able to reinvest the annual interest received from the bond at a higher rate than expected. He would gain on his reinvestment activity. But, as bond price and market interest rate are inversely related, future bond price will decline below its face value when the market interest rate moves up. Consequently, he would suffer a loss while selling the bond. If the gain on reinvestment is less than the loss on sale, the investor will suffer a net loss on account of the rise in market interest rate.

The opposite would be true when the market interest rate moves down. The investor would be able to reinvest the interest only at lower rate than what was expected. However, the bond price will move above its face value as the market interest rate declines. The investor loses on reinvestment of interest but gains on selling the bond.

Thus, an investor in bonds faces variations in his returns due to changes in the market interest rate during his holding period. This is referred to as the interest rate risk. This variation occurs on account of two factors—the reinvestment of annual interest and the capital gain or loss on sale of bond at the end of the holding period. When market interest rate rises, there is a gain on reinvestment but a loss on sale of bond. The converse is true when the market interest rate falls.

Thus, the interest rate risk is composed of two risks: reinvestment risk and price risk. The reinvestment risk and the price risk derived from a change in the market interest have an opposite effect on the bond returns. For any bond there is a holding period at which these two effects exactly balance each other. What is lost on reinvestment is exactly compensated by a capital gain on sale of bond and vice versa. For this holding period there is no interest rate risk. This particular holding period at which interest rate risk disappears is known as the **duration** of the bond.

An investor can, therefore, eliminate interest rate risk of a bond by holding the bond for its duration. Where the desired holding period of an investor is significantly different from the duration of the bond, the bond is subject to interest rate risk.

## BOND DURATION

Duration is the weighted average measure of a bond's life. The various time periods in which the bond generates cash flows are weighted according to the relative size of the present value of those flows.

The formula for computing duration $d$ is:

$$d = \left[1\frac{I_1}{(1+k)^1} + 2\frac{I_2}{(1+k)^2} + 3\frac{I_3}{(1+k)^3} + \cdots + n\frac{I_n + MV}{(1+k)^n}\right] / P_0$$

The equation consists of setting out the series of cash flows, discounting them and multiplying each discounted flow by the time period in which it occurs. The sum of these cash flows is then divided by the price of the bond obtained using the present value model.

The formula for calculating duration may be expressed in a more general format as follows:

$$d = \frac{\sum_{t=1}^{n} \frac{(t)(C_t)}{(1+k)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+k)^t}}$$

where

$C_t$ = Annual cash flow including interest and repayment of principal.

$n$ = Holding period.

$k$ = Discount rate which is the market interest rate.

$t$ = The time period of each cash flow.

To understand the computation of duration, let us consider an example.

A bond with 12 per cent coupon rate issued three years ago is redeemable after five years from now at a premium of five per cent. The interest rate prevailing in the market currently is 14 per cent. The duration of this bond can be calculated as shown below:

| *Year* | *Cash flow (Rs.)* | *PV factor @ 14 per cent* | *Present value* | *PV multiplied by year* |
|---|---|---|---|---|
| 1 | 12 | 0.8772 | 10.5264 | 10.5264 |
| 2 | 12 | 0.7695 | 9.2340 | 18.4680 |
| 3 | 12 | 0.6750 | 8.1000 | 24.3000 |
| 4 | 12 | 0.5921 | 7.1052 | 28.4208 |
| 5 | 12 | 0.5194 | 6.2328 | 31.1640 |
| 5 | 105 | 0.5194 | 54.5370 | 272.6850 |
| Total | | | 95.7354 | 386.0402 |

The cash flows for each year are discounted at 14 per cent which is the market interest rate. The sum of these discounted cash flows or present values is the price of the bond and it constitutes the denominator of the duration formula. Each present value is multiplied by the year in which the cash flow occurs. The sum of these figures constitutes the numerator of the duration formula. Thus,

$$\text{Duration} = \frac{386.0402}{95.7354} = 4.03 \text{ years}$$

The maturity of this bond is five years, while its duration is only 4.03 years. If this bond is held for 4.03 years the interest rate risk on the bond can be eliminated. The impact of reinvestment risk and price risk would offset each other exactly to reduce the interest rate risk to zero. Duration of a bond is thus the time period at which the price risk and the reinvestment risk of a bond are of equal magnitude but opposite in direction.

Let us consider another example where a new bond is issued by a company. The coupon rate is 15 per cent and maturity period is five years. The bond has a face value of

Rs. 100 redeemable after five years at par. As the bond is newly issued, the coupon rate will be the same as the market interest rate and the price of the bond will be equal to the face value. The duration of this bond is calculated below:

| Year | Cash flow (Rs.) | PV factor @ 15 per cent | PV | PV multiplied by year |
|---|---|---|---|---|
| 1 | 15 | 0.8696 | 13.0440 | 13.0440 |
| 2 | 15 | 0.7561 | 11.3415 | 22.6830 |
| 3 | 15 | 0.6575 | 9.8625 | 29.5875 |
| 4 | 15 | 0.5718 | 8.5770 | 34.3080 |
| 5 | 115 | 0.4972 | 57.1780 | 285.8900 |
| Total | | | 100.0030 | 385.5125 |

$$\text{Duration} = \frac{385.5125}{100} = 3.855 \text{ years}$$

Investors generally pay less attention to debt securities as an investment avenue. Bond returns are less than stock returns, but then bond investment involves less risk. Historically, there has been a low correlation between the returns from stocks and corporate bonds. This implies that combining stocks and bonds in a portfolio can help to reduce the portfolio's risk as a whole. Thus, bonds can play a strategic role in portfolio management. Moreover, investors can capitalise on bond price movements by trading in bonds. For this the investor needs to have a proper understanding of bonds, their returns, risks and valuation or pricing procedures.

*Example 1* Jaya Ltd. has a 14 per cent debenture with a face value of Rs. 100 that matures at par in 15 years. The debenture is callable in five years at Rs. 114. It currently sells for Rs. 105. Calculate each of the following for this debenture:

1. Current yield
2. Yield to call
3. Yield to maturity

***Solution***

1. Current yield

   The formula to be applied is:

$$\text{Current yield} = \frac{In}{P_0} \times 100$$

$$= \frac{\text{Rs. } 14}{\text{Rs. } 105} \times 100 = 13.33 \text{ per cent}$$

2. Yield to call

The yield to call (YTC) is that discount rate which makes the present value of cashflows to call equal to the debenture's current market price.

The relationship between the cash outflow, the cash inflow and the YTC of a debenture can be expressed as follows:

$$MP = \sum_{t=1}^{n} \frac{C_t}{(1+YTC)^t} + \frac{TV}{(1+YTC)^n}$$

In this case

$$105 = \sum_{t=1}^{5} \frac{14}{(1+YTC)^t} + \frac{114}{(1+YTC)^5}$$

We have to find the value of YTC that makes the right hand side of the equation equal to Rs. 105. This has to be done through a process of trial and error. We can use the present value tables for calculation purposes. We may start with 15 per cent as the value of YTC.

The right hand side of the equation then becomes:

Rs. 14 × present value annuity factor (5 years, 15%) + Rs. 114 × present value factor (5 years, 15 %)

$$= (14 \times 3.3522) + (114 \times 0.4972) = 46.93 + 56.68 = 103.61$$

Since the value obtained is lower than the current market price of Rs. 105, a lower discount rate has to be tried. Taking YTC as 14 per cent, the right hand side of the equation becomes:

Rs. 14 × present value annuity factor (5 years, 14%) + Rs. 114 × present value factor (5 years, 14%)

$$= (14 \times 3.\ 4331) + (114 \times 0.5194) = 48.03 + 59.21 = 107.24$$

Hence, YTC lies between 14 and 15 per cent. It can be estimated using interpolation as shown below:

$$YTC = 14 + \left[\frac{107.24 - 105}{107.24 - 103.61}\right](15\text{–}14)$$

$$= 14 + \left(\frac{2.24}{3.63} \times 1\right) = 14 + 0.62$$

$$= 14.62 \text{ per cent}$$

3. Yield to maturity

The relation between cash outlfows, cash inflows and YTM can be expressed as:

$$MP = \sum_{t=1}^{n} \frac{C_t}{(1 + YTM)^t} + \frac{TV}{(1 + YTM)^n}$$

In this case

$$105 = \sum_{t=1}^{15} \frac{14}{(1 + YTM)^t} + \frac{100}{(1 + YTM)^{15}}$$

Taking 15 per cent as value of YTM,

Rs. 14 × present value annuity factor (15 years, 15%) + Rs. 100 × present value factor (15 years, 15%)

$$= (14 \times 5.8474) + (100 \times 0.1229) = 81.86 + 12.29 = 94.15$$

Taking 13 per cent as value of YTM,

Rs. 14 × present value annuity factor (15 years, 13%) + Rs. 100 × present value factor (15 years, 13%)

$$= (14 \times 6.4624) + (100 \times 0.1599) = 90.47 + 15.99 = 106.46$$

Hence, YTM lies between 13 and 15 per cent. Using interpolation, YTM can be estimated.

$$\text{YTM} = 13 + \left[\frac{106.46 - 105}{106.46 - 94.15}\right](15 - 13)$$

$$= 13 + \left(\frac{1.46}{12.31} \times 2\right) = 13 + 0.24$$

$$= 13.24 \text{ per cent}$$

***Example 2*** A person owns a Rs. 1000 face value bond with five years to maturity. The bond makes annual interest payments of Rs. 80. The bond is currently priced at Rs. 960. Given that the market interest rate is 10 per cent, should the investor hold or sell the bond?

***Solution*** The intrinsic value of the bond has to be calculated and compared with the current market price. The value of a bond is equal to the present value of its expected cash inflow. It can be calculated with the following formula:

$$P_0 = \sum_{t=1}^{n} \frac{I_t}{(1+k)^t} + \frac{MV}{(1+k)^n}$$

$$P_0 = \sum_{t=1}^{5} \frac{80}{(1+0.10)^t} + \frac{1000}{(1+0.10)^n}$$

= (80 × present value annuity factor (5 years, 10%)

+ (1000 × present value factor (5 years, 10%)

$$= (80 \times 3.7908) + (1000 \times 0.6209)$$

$$= 303.26 + 620.90 = 924.16$$

The current market price of the bond (Rs. 960) is higher than its intrinsic value of Rs. 924.16. As the bond is overpriced, the investor may sell it.

***Example 3*** An investor purchases for Rs. 5555 a zero coupon bond whose face value is Rs. 7000 and maturity period is three years. Calculate the spot interest rate of the bond.

***Solution*** Spot interest rate is the discount rate that makes the present value of the single cash inflow equal to the cost of the bond, that is,

$$5555 = \frac{7000}{(1+k)^3}$$

This equation can be rearranged as:

$$(1 + k)^3 = \frac{7000}{5555}$$

$$(1 + k)^3 = 1.2601$$

$$(1 + k) = 3\sqrt{1.2601} = 1.08$$

$$k = 1.08 - 1 = 0.08$$

$$= 8 \text{ per cent}$$

The spot interest rate is 8 per cent.

***Example 4*** A bond pays interest annually and sells for Rs. 835. It has six years left to maturity and a par value of Rs. 1000. What is its coupon rate if its promised YTM is 12 per cent?

***Solution*** The annual interest payments on the bond can be determined using the formula for calculating YTM of a bond.

$$MP = \sum_{t=1}^{n} \frac{C_t}{(1+\text{YTM})^t} + \frac{TV}{(1+\text{YTM})^n}$$

$$835 = \sum_{t=1}^{6} \frac{C_t}{(1+0.12)^t} + \frac{1000}{(1+0.12)^6}$$

$$835 = \text{C} \times \text{present value annuity factor (6 years, 12\%)} + (1000 \times \text{present value factor (6 years, 12\%)})$$

$$835 = (\text{C} \times 4.1114) + (1000 \times 0.5066)$$

$$835 = 4.1114\text{C} + 506.6$$

$$835 - 506.6 = 4.1114\text{C}$$

$$4.1114\text{C} = 328.4$$

$$\text{C} = \frac{328.4}{4.1114} = 79.88$$

Annual interest on the bond can be taken as Rs. 80 (on the face value of Rs. 1000) Hence, coupon rate of interest is

$$\frac{80}{1000} \times 100 = 8 \text{ per cent}$$

***Example 5*** Find the duration of a 6 per cent coupon bond with a face value of Rs. 1000 making annual interest payments, if it has 5 years until maturity. The bond is redeemable at 5 per cent premium at maturity. The market interest rate is currently 8 per cent.

***Solution*** The formula for calculation of the duration of the bond is as follows:

$$d = \frac{\sum_{t=1}^{n} \frac{(t)(C_t)}{(1+k)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+k)^t}}$$

**Calculation of Duration of the Bond**

| *Year* | *Cash flow (Rs.)* | *PV factor (8 per cent)* | *Present value (PV)* | *PV multiplied by year* |
|---|---|---|---|---|
| 1 | 60 | 0.9259 | 55.55 | 55.55 |
| 2 | 60 | 0.8573 | 51.44 | 102.88 |
| 3 | 60 | 0.7938 | 47.63 | 142.89 |
| 4 | 60 | 0.7350 | 44.10 | 176.40 |
| 5 | 60 | 0.6806 | 40.84 | 204.20 |
| 5 | 1050 | 0.6806 | 714.63 | 3573.15 |
| Total | | | 954.19 | 4255.07 |

$$\text{Duration} = \frac{4255.07}{954.19} = 4.46 \text{ years}$$

The duration of this bond is 4.46 years

# 11

# TECHNICAL ANALYSIS

Prices of securities in the stock market fluctuate daily on account of continuous buying and selling. Stock prices move in trends and cycles and are never stable. An investor in the stock market is interested in buying securities at a low price and selling them at a high price so as to get a good return on his investment. He, therefore, tries to analyse the movement of share prices in the market. Two approaches are commonly used for this purpose. One of these is the **fundamental analysis** wherein the analyst tries to determine the true worth or intrinsic value of a share based on the current and future earning capacity of the company. He would buy the share when its market price is below its intrinsic value. The second approach to security analysis is called **technical analysis.** It is an alternative approach to the study of stock price behaviour.

## MEANING OF TECHNICAL ANALYSIS

A technical analyst believes that share prices are determined by the demand and supply forces operating in the market. These demand and supply forces in turn are influenced by a number of fundamental factors as well as certain psychological or emotional factors. Many of these factors cannot be quantified. The combined impact of all these factors is reflected in the share price movement. A technical analyst therefore concentrates on the movement of share prices. He claims that by examining past share price movements future share prices can be accurately predicted. **Technical analysis** is the name given to forecasting techniques that utilise historical share price data.

The rationale behind technical analysis is that share price behaviour repeats itself over time and analysts attempt to derive methods to predict this repetition. A technical analyst looks at the past share price data to see if he can establish any patterns. He then looks at current price data to see if any of the established patterns are applicable and, if so, extrapolations can be made to predict the future price movements. Although past share prices are the major data used by technical analysts, other statistics such as volume of trading and stock market indices are also utilised to some extent.

The basic premise of technical analysis is that prices move in trends or waves which may be upward or downward. It is believed that the present trends are influenced by the past trends and that the projection of future trends is possible by an analysis of past price trends. A technical analyst, therefore, analyses the price and volume movements of individual securities as well as the market index. Thus, technical analysis is really a study of past or historical price and volume movements so as to predict the future stock price behaviour.

## Dow Theory

Whatever is generally being accepted today as technical analysis has its roots in the Dow theory. The theory is so called because it was formulated by Charles H. Dow who was the editor of the *Wall Street Journal* in U.S.A. In fact, the theory was presented in a series of editorials in the *Wall Street Journal* during 1900–1902.

Charles Dow formulated a hypothesis that the stock market does not move on a random basis but is influenced by three distinct cyclical trends that guide its direction. According to Dow theory, the market has three movements and these movements are simultaneous in nature. These movements are the primary movements, secondary reactions and minor movements.

The primary movement is the long range cycle that carries the entire market up or down. This is the long-term trend in the market. The secondary reactions act as a restraining force on the primary movement. These are in the opposite direction to the primary movement and last only for a short while. These are also known as corrections. For example, when the market is moving upwards continuously, this upward movement will be interrupted by downward movements of short durations. These are the secondary reactions. The third movement in the market is the minor movements which are the day-to-day fluctuations in the market. The minor movements are not significant and have no analytical value as they are of very short duration. The three movements of the market have been compared to the tides, the waves and the ripples in the ocean.

According to Dow theory, the price movements in the market can be identified by means of a line chart. In this chart, the closing prices of shares or the closing values of the market index may be plotted against the corresponding trading days. The chart would help in identifying the primary and secondary movements.

Figure 11.1 shows a line chart of the closing values of the market index. The primary trend of the market is upwards but there are secondary reactions in the opposite direction. Among the three movements in the market, the primary movement is considered to be the most important.

The primary trend is said to have three phases in it, each of which would be interrupted by a counter move or secondary reaction which would retrace about 33–66 per cent of the earlier rise or fall.

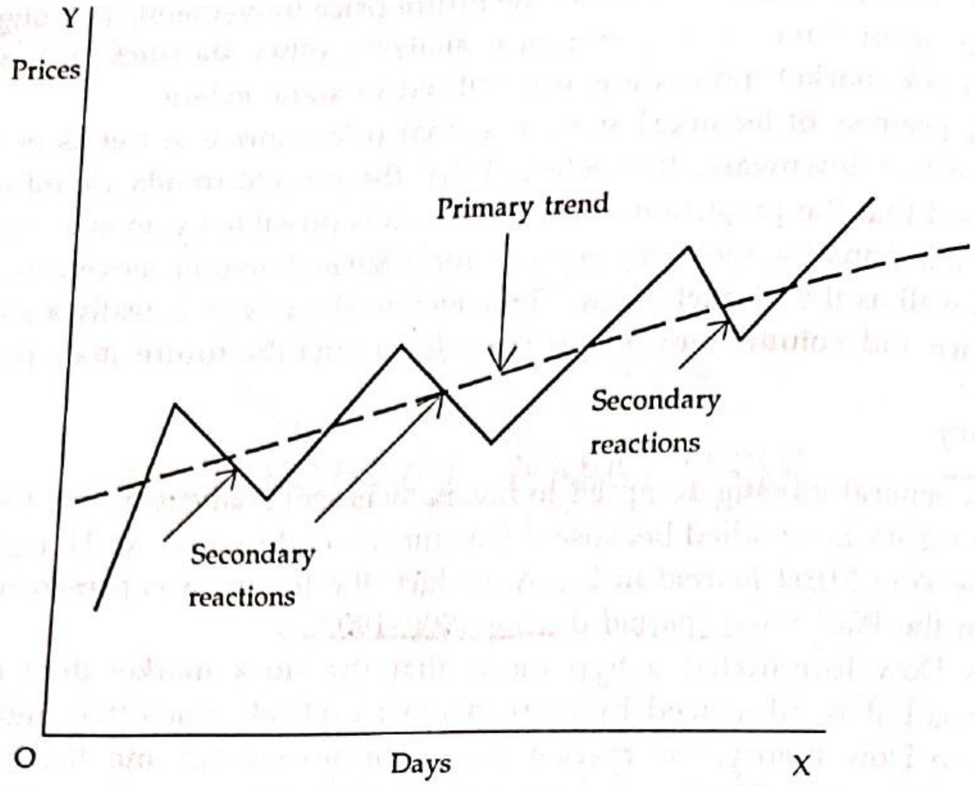


**Fig. 11.1 Primary trend and secondary reactions.**

***Bullish Trend***

During a bull market (upward moving market), in the first phase the prices would advance with the revival of confidence in the future of business. The future prospects of business in general would be perceived to be promising. This will prompt investors to buy shares of companies. During the second phase, prices would advance due to the improvements in corporate earnings. In the third phase, prices advance due to inflation and speculation. Thus, during the bull market, the line chart would exhibit the formation of three peaks. Each peak would be followed by a bottom formed by the secondary reaction. Each peak would be higher than the previous peak, each successive bottom would be higher than the previous bottom. According to Dow theory, the formation of higher bottoms and higher tops indicates a bullish trend. The three phases of a bull market are depicted in Fig. 11.2.

***Bearish Trend***

The bear market is also characterised by three phases. In the first phase, prices begin to fall due to abandonment of hopes. Investors begin to sell their shares. In the second phase, companies start reporting lower profits and lower dividends. This causes further fall in prices due to increased selling pressure. In the final phase, prices fall still further due to distress selling. A bearish market would be indicated by the formation of lower tops and lower bottoms.

The three phases of a bear market are depicted in Fig. 11.3.

The Dow theory laid emphasis on volume of transactions also. According to the theory, volume should expand along the main trend. This means that if the main trend is bullish,

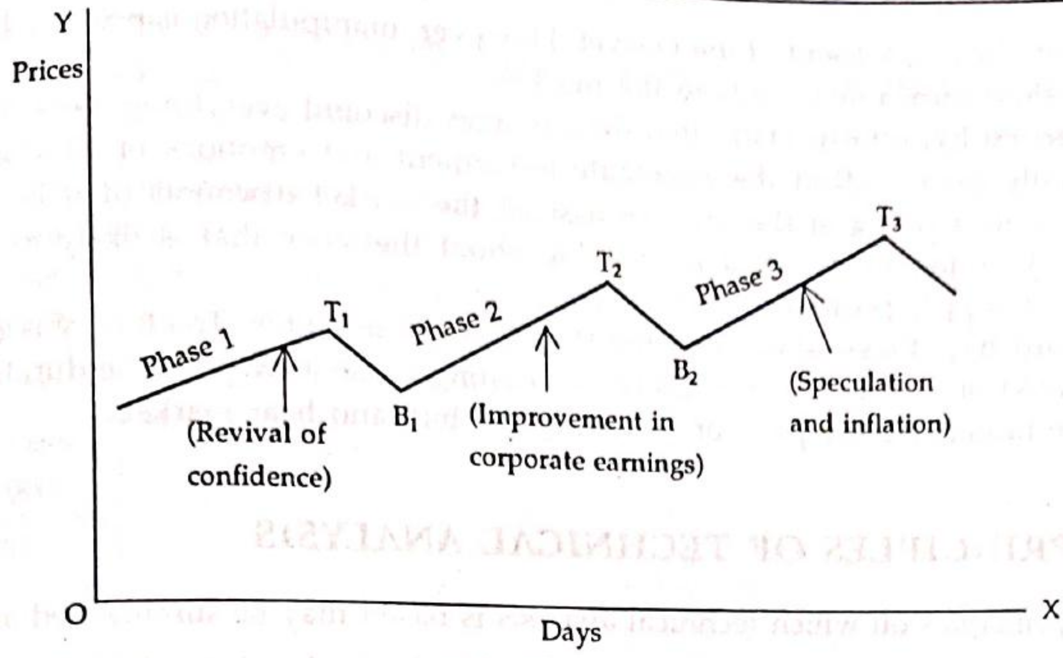


**Fig. 11.2 Three phases of a bull market.**

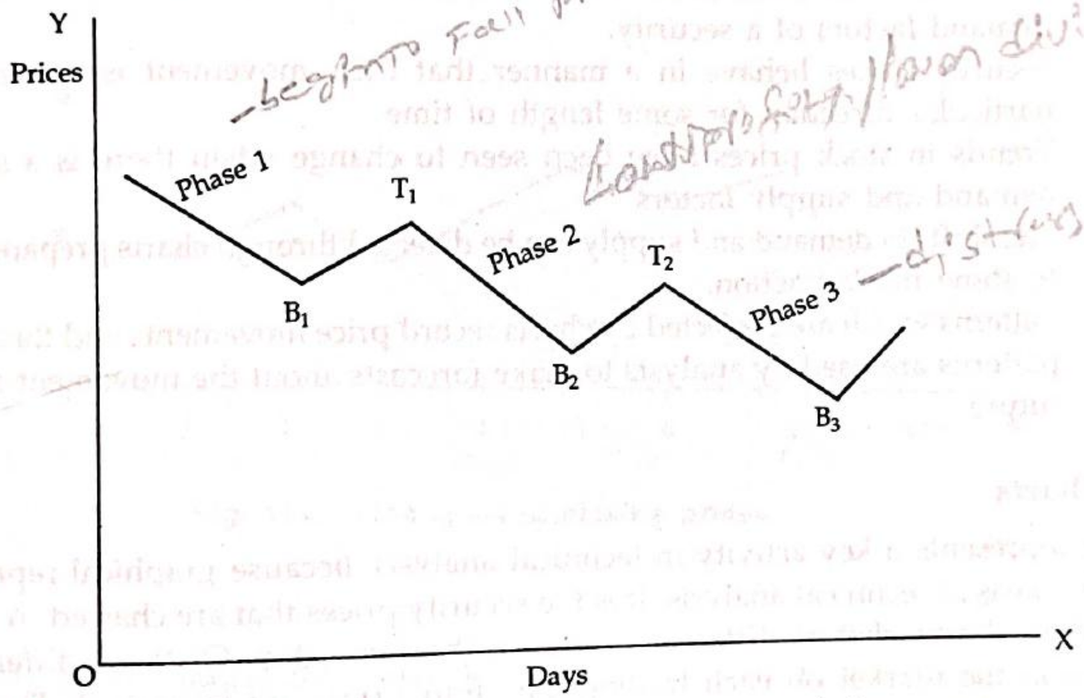


**Fig. 11.3 Three phases of a bear market.**

the volume should increase with the rise in prices and fall during the intermediate reactions. In a bearish market when prices are falling, the volume should increase with the fall in prices and be smaller during the intermediate reactions.

The theory also makes certain assumptions which have been referred to as the hypotheses of the theory.

The **first hypothesis** states that the primary trend cannot be manipulated. It means that no single individual or institution or group of individuals and institutions can exert influence on the major trend of the market. However, manipulation is possible in the day-to-day or short-term movements in the market.

The **second hypothesis** states that the averages discount everything. What it means is that the daily prices reflect the aggregate judgement and emotions of all stock market participants. In arriving at the price of a stock the market discounts (that is, takes into account) everything known and predictable about the stock that is likely to affect the demand and supply position of the stock.

The **third hypothesis** states that the theory is not infallible. The theory is concerned with the trend of the market and has no forecasting value as regards the duration or the likely price targets for the peak or bottom of the bull and bear markets.

## BASIC PRINCIPLES OF TECHNICAL ANALYSIS

The basic principles on which technical analysis is based may be summarised as follows:

1. The market value of a security is related to demand and supply factors operating in the market.
2. There are both rational and irrational factors which surround the supply and demand factors of a security.
3. Security prices behave in a manner that their movement is continuous in a particular direction for some length of time.
4. Trends in stock prices have been seen to change when there is a shift in the demand and supply factors.
5. The shifts in demand and supply can be detected through charts prepared specially to show market action.
6. Patterns which are projected by charts record price movements and these recorded patterns are used by analysts to make forecasts about the movement of prices in future.

### Price Charts

Charting represents a key activity in technical analysis, because graphical representation is the very basis of technical analysis. It is the security prices that are charted. A share may be traded in the market at different prices on the same day. Of these different prices prevailing in the market on each trading day, four prices are important. These are the highest price of the day, the lowest price of the day, the opening price (first price of the day) and the closing price (last price of the day). Of these four prices again, the closing price is by far the most important price of the day because it is the closing price that is used in most analysis of share prices.

The price chart is the basic tool used by the technical analyst to study the share price movement. The prices are plotted on an *XY* graph where the *X* axis represents the trading days and the *Y* axis denotes the prices.

The oldest charting procedure was known as the **point and figure (P & F) charting**. It is now out of vogue. Three types of price charts are currently used by technical analysts. These are the line chart or the closing price chart, the bar chart and the Japanese candlestick chart.

***Line Chart***

It is the simplest price chart. In this chart, the closing prices of a share are plotted on the XY graph on a day to day basis. The closing price of each day would be represented by a point on the XY graph. All these points would be connected by a straight line which would indicate the trend of the market. A line chart is illustrated in Fig. 11.4.

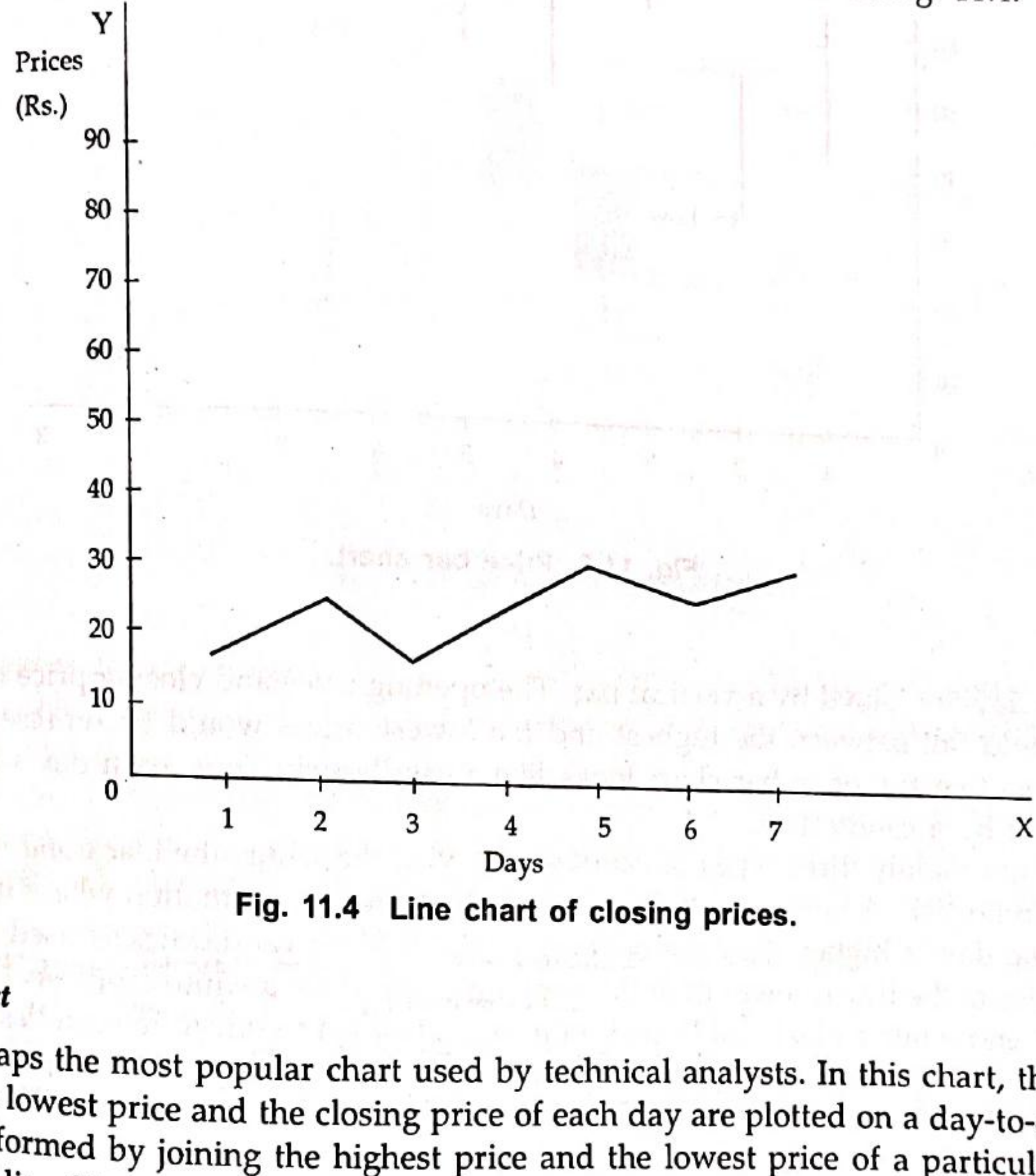


**Fig. 11.4 Line chart of closing prices.**

***Bar Chart***

It is perhaps the most popular chart used by technical analysts. In this chart, the highest price, the lowest price and the closing price of each day are plotted on a day-to-day basis. A bar is formed by joining the highest price and the lowest price of a particular day by a vertical line. The top of the bar represents the highest price of the day, the bottom of the bar represents the lowest price of the day and a small horizontal hash on the right of the bar is used to represent the closing price of the day. Sometimes, the opening price of the day is marked as a hash on the left side of the bar. An example of a price bar chart is shown in Fig. 11.5.

***Japanese Candlestick Charts***

The Japanese candlestick chart shows the highest price, the lowest price, the opening price and the closing price of shares on a day-to-day basis. The highest price and the lowest