CHAPTER - IV

EVALUATION OF SYSTEMATIC RISK
4.1 **INTRODUCTION**

The objective of any investor is to maximize the returns from investments, subject to various constraints, primarily risk. Return is the motivating force, inspiring the investor in the form of rewards, for undertaking the investment. The importance of returns in any investment decision can be traced to the following factors:

- It enables investors to compare alternative investments in terms of what they have to offer the investor.
- Measurement of historical (past) returns enables investors to assess how well they have performed.
- Measurement of historical returns also helps in the estimation of future returns.

The rate of return is the total return the investor receives during the holding period (the period when the security is owned or held by the investor). In other words, it is the income from the security in the form of cash flows and the difference in the price of the security between the beginning and end of the holding period expressed as a percentage of the purchase price of the security at the beginning of the holding period. The general equation for calculating the rate of return is shown below:

\[ R = \frac{D_t + (P_t - P_{t-1})}{P_{t-1}} \]

Where,  
- \( R \) = Rate of return  
- \( P_t \) = Price of the security at time 't' i.e., at the end of the holding period.  
- \( P_{t-1} \) = Price of the security at time 't-1' i.e., at the beginning of the holding period or purchase price.  
- \( D_t \) = Dividend or Income receivable from the security at time 't'.

Rates of return are usually stated at an annual percentage rate to allow comparison of returns between securities. Risk and return go hand in hand in investments and finance. One cannot talk about returns without talking about risk because investment decisions always involve a trade-off between risk and return. Risk can be defined as the chance that the actual outcome from an investment will differ from the expected outcome. In simple terms, risk refers to the chance that some unfavorable
event will happen. In other words, risk can be defined as the uncertainty that an investment will earn its expected rate of return. It can also be defined as the probability that actual returns may deviate from expected returns. The probability that the actual returns may be lower than expected returns gives rise to investment risk. The higher the probability of actual returns being less than expected, the higher will be the investment risk.

The most famous definition of risk is provided by Frank Knight¹, who interpreted risk as 'situations where the decision-maker can assign mathematical probabilities to the randomness which he is faced with'. Knight showed some distinction between risk and uncertainty. He defined uncertainty as situations where randomness "cannot" be expressed in terms of specific mathematical probabilities.

Knight's definition can be interpreted simply as -- Risk refers to outcomes that can be insured against, whereas uncertainty refers to the outcomes that cannot be insured against.

Most people often use the terms risk and uncertainty interchangeably, though they are two very different terms. Toney Merna² debates that risk and uncertainty are not the same and he distinguishes them as 'A decision is said to be subject to risk when there is a range of possible outcomes and when known probabilities can be attached to the outcome'. "Uncertainty exists when there is more than one possible outcome to a course of action but the probability of each outcome is not known". On the whole, risk can be defined as deviation of actual returns from expected returns.

4.2 MEASURES OF RISK

The most common measures of riskiness of a security are standard deviation and variance of returns.

4.2.1 Standard Deviation and Variance of Returns

Standard deviation (commonly denoted as σ) of returns merely measures the extent of deviation of returns from the average value of return. Precisely put, standard deviation of returns is the square root of the average of squares of deviations of the observed returns from their expected value of return.
The square of standard deviation is called variance (commonly denoted by \( \sigma^2 \)). Thus, variance of security returns is the average value of the squares of deviations of the observed returns from the expected value of return.

4.2.2 Covariance

The measure of covariance\(^3\) examines the degree of variance to which the returns from the security (share) and market vary in relation to each other. Covariance can either be positive or negative and can also be weaker or stronger. Positive covariance indicates that the returns of shares and market are moves in the same direction whereas negative covariance stands to opposite direction.

4.2.3 Beta Coefficient

The beta coefficient represented by the Greek letter Beta (\( \beta \) or B), measures the market risk as a non-diversifiable risk of an asset such as a stock compared to the rest of the market. It also measures volatility of the asset compared to the general market. The beta of a stock shows the relationship of the change in the price of a stock to the market\(^4\).

4.3 CALCULATION OF BETA

Beta is calculated by regressing the asset’s return against the market portfolio. The relationship between the return for a particular asset and the market index can be expressed algebraically as,

\[
R_s = \alpha_s + \beta_s R_M + \epsilon_s
\]

Where,

\[
\begin{align*}
R_s & = \text{Estimated return on stock } s \text{ in time period } t. \\
\alpha_s & = \text{Estimated return on stock when the market return is } 0 \text{ (Alpha value).} \\
R_M & = \text{Estimated return on the market index in the time period } t. \\
\beta_s & = \text{Measure of stock’s sensitivity to the market index.} \\
\epsilon_s & = \text{Estimation error} \\
\text{Beta (} \beta_s \text{)} & = \frac{\text{Cov} (R_s, R_M)}{\text{Var} (R_M)}
\end{align*}
\]
Beta measures the covariance of return on the stock ($R_s$) with return on the market ($R_M$) divided by the variance of market return. The beta coefficient is frequently referred as the measure of a security's systematic risk or market risk. Beta is a measure of relative systematic risk, but the actual systematic risk of security (share) 's' is $\beta_s^2 \sigma_m^2$ where $\beta_s^2$ stands to square of beta coefficient of stock 's' and $\sigma_m^2$ stands to market variance.

Most stocks have a positive beta, which means that most stocks move in the same direction as the general market. If the beta is greater than 1, then the stock moves more than the market does in the same direction. If the beta is zero, there is no market risk to that stock.

4.4 SYSTEMATIC AND UNSYSTEMATIC RISK

The risks of the securities are classified into systematic and unsystematic risks based on the relationship with market or divisibility. Systematic risk is also known as market risk or undiversified risk. It is associated with aggregate market (Stock Exchange Index, or BSE Sensex or NSE Nifty) returns. It is the proportion of total risk of the security which cannot be reduced through diversification. In contrast, unsystematic risk is the company or industry specific risk that is inherent in each investment one makes. The amount of unsystematic risk present can be eradicated through appropriate diversification.

4.5 CALCULATION OF SYSTEMATIC RISK IN SELECT PHARMACEUTICAL COMPANIES.

As stated above, standard deviation and variance of returns explain the risk element of specific stocks in the secondary market. Covariance, coefficient of correlation, and coefficient of determination ($R^2$) indicate the level of relationship between stock returns and market returns. The analysis of systematic risk requires the above statistics. The statistics of select pharmaceutical companies are given in Table 4.1.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Average Return</th>
<th>SD of Return</th>
<th>Variance of Return</th>
<th>Covariance</th>
<th>Alpha</th>
<th>Beta</th>
<th>Coefficient of Correlation</th>
<th>( R^2 )</th>
<th>Standard Error of Beta</th>
<th>( \beta )</th>
<th>Average Return</th>
<th>SD of Return</th>
<th>Variance of Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Reddy's Laboratories Ltd.</td>
<td>0.0214</td>
<td>0.1178</td>
<td>0.0139</td>
<td>0.0041</td>
<td>0.0102</td>
<td>0.79</td>
<td>0.485**</td>
<td>0.24</td>
<td>0.13</td>
<td>0.143</td>
<td>0.0724</td>
<td>0.0052</td>
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<td>Divi's Laboratories Ltd.</td>
<td>0.0713</td>
<td>0.1709</td>
<td>0.0292</td>
<td>0.0064</td>
<td>0.0311</td>
<td>1.36</td>
<td>0.549**</td>
<td>0.30</td>
<td>0.27</td>
<td>0.0296</td>
<td>0.0686</td>
<td>0.0047</td>
<td></td>
</tr>
<tr>
<td>Biocon Limited</td>
<td>-0.0030</td>
<td>0.0876</td>
<td>0.0077</td>
<td>0.0030</td>
<td>-0.0185</td>
<td>0.64</td>
<td>0.508**</td>
<td>0.26</td>
<td>0.16</td>
<td>0.0243</td>
<td>0.0688</td>
<td>0.0047</td>
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<tr>
<td>Matrix Laboratories Ltd.</td>
<td>0.0647</td>
<td>0.2070</td>
<td>0.0429</td>
<td>0.0035</td>
<td>0.0552</td>
<td>0.67</td>
<td>0.232*</td>
<td>0.05</td>
<td>0.26</td>
<td>0.0143</td>
<td>0.0724</td>
<td>0.0052</td>
<td></td>
</tr>
<tr>
<td>Astrazeneca Pharma India Ltd.</td>
<td>0.0311</td>
<td>0.1693</td>
<td>0.0287</td>
<td>0.0038</td>
<td>0.0208</td>
<td>0.73</td>
<td>0.307**</td>
<td>0.09</td>
<td>0.20</td>
<td>0.0143</td>
<td>0.0724</td>
<td>0.0052</td>
<td></td>
</tr>
<tr>
<td>Aurobindo Pharma Ltd.</td>
<td>0.0443</td>
<td>0.2071</td>
<td>0.0429</td>
<td>0.0049</td>
<td>0.0310</td>
<td>0.94</td>
<td>0.326**</td>
<td>0.11</td>
<td>0.25</td>
<td>0.0143</td>
<td>0.0724</td>
<td>0.0052</td>
<td></td>
</tr>
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<td>Company Name</td>
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<td>Variance of Return</td>
<td>Covariance</td>
<td>Alpha</td>
<td>Beta</td>
<td>Coefficient of Correlation</td>
<td>$R^2$</td>
<td>Standard Error of Beta</td>
<td>Average Return</td>
<td>SD of Return</td>
<td>Variance of Return</td>
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<tr>
<td>Orchid Chemicals &amp; Pharmaceuticals Ltd.</td>
<td>0.0208</td>
<td>0.1620</td>
<td>0.0263</td>
<td>0.0059</td>
<td>0.0046 (0.35)</td>
<td>1.13 (6.42)</td>
<td>0.509**</td>
<td>0.26</td>
<td>0.18</td>
<td>0.0143</td>
<td>0.0724</td>
<td>0.0052</td>
<td></td>
</tr>
<tr>
<td>Suven Life Sciences Ltd.</td>
<td>0.0454</td>
<td>0.2157</td>
<td>0.0465</td>
<td>0.0044</td>
<td>0.0334 (1.73)</td>
<td>0.85 (3.21)</td>
<td>0.284**</td>
<td>0.08</td>
<td>0.26</td>
<td>0.0143</td>
<td>0.0724</td>
<td>0.0052</td>
<td></td>
</tr>
<tr>
<td>Bal Pharma Limited</td>
<td>0.0507</td>
<td>0.3145</td>
<td>0.0989</td>
<td>0.0035</td>
<td>0.0411 (1.417)</td>
<td>0.67 (1.71)</td>
<td>0.155NS</td>
<td>0.02</td>
<td>0.39</td>
<td>0.0143</td>
<td>0.0724</td>
<td>0.0052</td>
<td></td>
</tr>
<tr>
<td>Natco Pharma Limited</td>
<td>0.0265</td>
<td>0.2019</td>
<td>0.0408</td>
<td>0.0057</td>
<td>0.0110 (0.63)</td>
<td>1.10 (4.60)</td>
<td>0.390**</td>
<td>0.15</td>
<td>0.24</td>
<td>0.0143</td>
<td>0.0724</td>
<td>0.0052</td>
<td></td>
</tr>
</tbody>
</table>

NS = Not Significant  
* = Significant at 0.05 level  
** = Significant at 0.01 level  

Note: ‘t’ values are presented in bracket  
Source: Compiled from the respective share prices at the BSE after adjusting stock actions (Appendix III).
4.5.1 Calculation of Systematic Risk of Dr. Reddy's Laboratories Limited

The average monthly returns from the equity shares of Dr. Reddy's Laboratories Ltd., was 2.14 per cent (0.0214) in the secondary market during the study period. When the risk of return is expressed in terms of standard deviation and variance, the statistic numbers were 0.1178 and 0.0139 respectively. The movements in the share price of Dr. Reddy's Laboratories Limited, and the Sensex during the study period are illustrated in figure 4.1.

FIGURE 4.1
MOVEMENT OF DR. REDDY'S LABORATORIES LIMITED'S SHARE PRICE AND BSE SENSEX DURING THE STUDY PERIOD

Source: Compiled from the share prices of Dr. Reddy's Lab at the BSE after adjusting stock actions (Appendix III).

Dr. Reddy's Laboratories Ltd., has a beta of 0.79 based on the monthly returns during April 1998 to March 2008, which shows the slope of the monthly returns in relation to market returns (BSE Sensex returns). A beta of 0.79, which is less than 1, means that the fluctuations in returns from the shares of the company are less than the market returns. The standard error of beta coefficient (0.13) fixes the confidence range of the estimated beta of the company between 0.53 and 1.05.
Alpha Value is the intercept of the company's returns curve. It stands at 0.0102, which means the returns from the company's equity shares will be at 1.02, when the market return is zero. If it is assumed that the monthly returns from Sensex is 1 per cent, the expected monthly returns from Dr. Reddy’s Laboratories can be calculated with its beta of 0.79 as follows.

\[ R_{mt} = \alpha + \beta_m R_m \]
\[ = 0.0102 + (0.79 \times 0.01) \]
\[ = 1.81\% \]

The positive coefficient of correlation (0.485) which is significant at 0.01 level, is found between the monthly returns from Dr. Reddy’s Laboratories Ltd., and market returns. It means that the market returns and the returns from Dr Reddy’s Laboratories shares are moving in the same direction. Table 4.1 depicts the coefficient of determination (R²) of the company at 0.24. It indicates that the variance in the returns of Dr. Reddy’s Laboratories Ltd’s shares is explained by the changes in the market returns to the extent of 24 per cent. This is the proportion of systematic risk of the company which cannot be diversified. It means only 24 per cent of the variance of Dr. Reddy’s Laboratories Ltd., is systematic risk and the remaining 76 per cent variance is the proportion of unsystematic risk. Thus, the total risk of Dr. Reddy’s Laboratories Ltd., (0.0139) can be divided into systematic and unsystematic risks as under:

Total Risk = Systematic risk + Unsystematic risk

Systematic Risk = \( \beta^2_m \sigma_m^2 \)
\[ = 0.79^2 \times 0.0052 \]
\[ = 0.0032 \]

Unsystematic risk = \( \sigma^2 \)
\[ = \sigma_m^2 - (\beta^2_m \sigma_m^2) \]
\[ = 0.0139 - 0.0032 \]
\[ = 0.0107. \]
4.5.2 Calculation of Systematic Risk Of Divi’s Laboratories Limited

The average monthly returns from the equity shares of Divi’s Laboratories Ltd., was 7.13 per cent (0.0713) on the BSE during the study period. The risk of return is expressed in terms of standard deviation and variance. The standard deviation and variance were 0.1709 and 0.0292 respectively.

Beta shows the slope of the monthly returns in relation to the market returns (BSE Sensex returns). Divi’s Laboratories Ltd., has a beta of 1.36 based on the monthly returns during April 2003 to March 2008. A beta of 1.36 which is more than 1 means that the volatility in the returns from the company’s share price is more than the market returns. The standard error of beta coefficient at 0.27 fixes the confidence range of estimated beta of the company between 0.82 and 1.90.

Alpha Value is the intercept of the company’s returns curve. It stands at 0.0311, which means the returns from Divi’s Lab’s equity shares will be at 3.11 per cent when the market return is zero. The company’s calculated beta is 1.36; if it is assumed that the monthly returns from Sensex is 1 per cent, then the expected monthly returns from Divi’s Laboratories Ltd., will be as follows:

\[ R_x = \alpha + \beta_s R_m \]

\[ = 0.0311 + (1.36 \times 0.01) \]

\[ = 4.47\% \]

In a downward market, the return will be negative 1.75 %.

The positive coefficient of correlation (0.549) which is significant at 0.01 level, is found between the monthly returns of Divi’s Laboratories Ltd., and the monthly market returns. It means the market returns and the returns from the shares are moving in the same direction.

Table 4.1 depicts the coefficient of determination (R²) of the company at 0.30. It indicates that the variance in the returns of Divi’s Laboratories Ltd.’s share price is explained by the changes in the market return to the extent of 30 per cent. This is the proportion of systematic risk of the company which is undiversifiable. It means only
30 per cent of the variance of Divi’s Laboratories Ltd., is systematic risk and the remaining 70 per cent variance is the proportion of unsystematic risk. Thus, the total risk of Divi’s Laboratories Ltd., (0.0292) can be divided into systematic and unsystematic risks as under:

Total Risk = Systematic risk + Unsystematic risk
Systematic Risk = \( \beta^2 \sigma^2_m \)
= 1.36\(^2\) x 0.0047
= 0.0087
Unsystematic risk = \( \sigma^2 - (\beta^2 \sigma^2_m) \)
= 0.0292 - 0.0087
= 0.0205.

4.5.3 Calculation of Systematic Risk of Biocon Limited

The average monthly returns from the equity shares of Biocon Ltd., during the study period on the BSE was -0.3 per cent (-0.0030). The standard deviation and variance of the company stood at 0.0876 and 0.0077 respectively.

Beta shows the slope of the monthly returns in relation to the market returns (BSE Sensex returns). Biocon Ltd., has a beta of 0.64 based on the monthly returns during May 2004 to March 2008. A beta of 0.64, which is less than 1, means that the volatility in the returns from the company’s shares is less than the market return. The standard error of beta coefficient is 0.16 which fixes the confidence range of the estimated beta of the company between 0.32 and 0.96.

Alpha Value is the intercept of the company’s share price returns curve. It stands at -0.0185, meaning the returns from the company’s equity shares will be negative with 1.85, when the market return is zero. The company’s calculated beta is 0.64; if it is assumed that the monthly return from Sensex is 1 per cent, then the expected monthly return from Biocon Ltd., will be

\[ R_s = \alpha + \beta \cdot R_m \]
\[ = -0.0185 + (0.64 \times 0.01) \]
\[ = -1.21\% \]
Table 4.1 shows the coefficient of determination ($R^2$) of the company at 0.26. It indicates that variance in the returns of Biocon Ltd.'s share price is explained by the changes in the market return to the extent of 26 per cent. This is the proportion of systematic risk of the company which is undiversifiable. It means only 26 per cent of the variance of the company is systematic risk and the remaining 74 per cent variance is the proportion of unsystematic risk.

Thus, the total risk of Biocon Ltd., (0.0077) can be divided into systematic and unsystematic risks as under:

$$\text{Total Risk} = \text{Systematic risk} + \text{Unsystematic risk}$$

Systematic Risk = $\beta_s^2 \sigma_m^2$

= $0.64^2 \times 0.0047$

= 0.0019

Unsystematic Risk = $\sigma^2$

= $\sigma_m^2 - (\beta_s^2 \sigma_m^2)$

= 0.0077 - 0.0019

= 0.0058.

4.5.4 Calculation of Systematic Risk of Matrix Laboratories Limited

The average monthly returns from secondary market transactions for Matrix Laboratories Ltd., was 6.47 per cent (0.0647) during the study period (April 1998 - March 2008). The standard deviation and variance of returns of the company during the same period stood at 0.2070 and 0.0429 respectively.

Beta shows the slope of the monthly returns in relation to the market returns (BSE Sensex returns). Matrix Laboratories Ltd., has a beta coefficient of 0.67 based on the monthly returns during the period April 1998 to March 2008. A beta coefficient of 0.67, which is less than 1, means that the volatility in the returns from the company’s shares is less than the market return. The standard error of beta coefficient is 0.26 which fixes the confidence range of the estimated beta of the company between 0.15 and 1.19.
Alpha Value is the intercept of the company's returns curve. It stands at 0.0552, which means the return from Matrix Laboratories Ltd.'s equity shares will be at 5.52%, when the market return is zero. The company's calculated beta is 0.67; if it is expected that the monthly return from Sensex is 1 per cent, then the expected monthly return from Matrix Laboratories Ltd., will be:

\[ R_e = \alpha + \beta_s R_m \]
\[ = 0.0552 + (0.67 \times 0.01) \]
\[ = 6.19\% \]

The positive coefficient of correlation (0.232) which is significant at 0.05 level, is found between Matrix Laboratories Ltd.'s monthly returns and the monthly market returns. It means fluctuations in market returns and returns from Matrix Laboratories shares are in the same direction.

Table 4.1 shows the coefficient of determination (R^2) of the company at 0.05 which is a very small value. It means the variance in the returns from Matrix Laboratories Ltd.'s shares is explained by the changes in the market return only to the extent of 5 per cent. This is the proportion of systematic risk of the company which is undiversifiable. It means only 5 per cent of the variance of Matrix Laboratories Ltd., is systematic risk and the remaining 95 per cent variance is the proportion of unsystematic risk which can be diversified.

Thus, the total risk (Variance) of Matrix Laboratories Ltd., (0.0429) can be divided into systematic risks and unsystematic risks as given below:

Total Risk = Systematic risk + Unsystematic risk

Systematic Risk = \( \beta_s^2 \sigma_m^2 \)
\[ = 0.67^2 \times 0.0052 \]
\[ = 0.0023 \]

Unsystematic risk = \( \sigma_e^2 \)
\[ = \sigma_m^2 - (\beta_s^2 \sigma_m^2) \]
\[ = 0.0429 - 0.0023 \]
\[ = 0.0406. \]
4.5.5 Calculation of Systematic Risk of Astrazeneca Pharma India Limited

The average monthly returns from the equity shares of Astrazeneca Pharma India Ltd., was 3.11 per cent (0.0311) in the secondary market during the study period. The risk of return is expressed in terms of standard deviation and variance. The standard deviation and variance were 0.1693 and 0.0287 respectively.

Beta shows the slope of the monthly returns in relation to the market returns (BSE Sensex returns). Astrazeneca Pharma India Ltd., has a beta of 0.73 based on the monthly returns during the period April 1998 to March 2008. A beta of 0.79 means that the volatility in returns from the shares of the company is less than market returns. The standard error of beta coefficient which is 0.20, fixes the confidence range of the estimated beta of the company between 0.33 and 1.13.

Alpha Value is the intercept of the company’s returns curve. As it stands at 0.0208, it means the returns from Astrazeneca Pharma India’s equity shares stand at 2.08 per cent when the market return is zero. The company’s calculated beta is 0.73 and if it is assumed that the monthly return from Sensex is 1 per cent, then the expected monthly return from the company will be:

\[ R_u = \alpha + \beta_s R_m \]
\[ = 0.0208 + (0.73 \times 0.01) \]
\[ = 2.81\% \]

The positive coefficient of correlation (0.307) which is significant at 0.01 level, is found between the company’s monthly returns and monthly market returns. It means, the market returns and the returns from the shares of the company are moving in the same direction.

Table 4.1 depicts the coefficient of determination \( R^2 \) of the company at 0.09 which is very small. It means the variance in the returns of Astrazeneca Pharma India Ltd’s shares is explained by the changes in the market return only to the extent of 9 per cent. This is the proportion of systematic risk of the company which is undiversifiable. It means only 9 per cent of the variance of the company is systematic risk and the remaining 91 per cent variance is the proportion of unsystematic risk.
Thus, the total risk of Astrazeneca Pharma India Ltd., (0.0287) can be divided into systematic risks and unsystematic risks as under:

\[
\text{Total Risk} = \text{Systematic risk} + \text{Unsystematic risk}
\]

Systematic Risk = \( \beta_s^2 \sigma_m^2 \)

= \( 0.73^2 \times 0.0052 \)

= 0.0028

Unsystematic risk = \( \sigma_m^2 - (\beta_s^2 \sigma_m^2) \)

= 0.0287 - 0.0028

= 0.0259.

### 4.5.6 Calculation of Systematic Risk of Aurobindo Pharma Limited

The average monthly returns from the equity shares of Aurobindo Pharma Ltd., was 4.43 per cent (0.0443) in the secondary market during the period of study (April, 1998-March, 2008). The standard deviation and variance of returns of the company during the same period stood at 0.2071 and 0.0429 respectively.

Beta shows the slope of the monthly returns in relation to the market returns (BSE Sensex returns). Aurobindo Pharma Ltd., has a beta coefficient of 0.94 based on the monthly returns during April 1998 to March 2008. A beta coefficient of 0.94 means the fluctuations in the returns from the shares of the company is less than market returns. The standard error of beta coefficient is 0.25 fixes the confidence range of estimated beta of the company between 0.44 and 1.44.

Alpha Value is the intercept of the company’s returns curve. It stands at 0.0310, which means the returns from Aurobindo Pharma Limited’s equity shares will be 3.10%, when the market return is zero. The company’s calculated beta is 0.94; if it is assumed that the monthly return from Sensex is 1 per cent, then the expected monthly return from Aurobindo Pharma Ltd., will be:

\[
R_{mf} = \alpha + \beta_s R_m
\]

= 0.0310 + (0.94 \times 0.01)

= 4.04\%
The positive coefficient of correlation (0.326) which is significant at 0.01 level is found between Aurobindo Pharma Ltd's monthly returns and the monthly market returns. It means fluctuations in the market returns and the prices of shares of the company are in the same direction.

It is clear from Table 4.1 that the coefficient of determination \((R^2)\) of the company is at 0.11. It is a very insignificant value. It means the variance in the returns of Aurobindo Pharma Ltd's share price is explained by the changes in the market return only to the extent of 11 per cent. This is the proportion of systematic risk of the company which is undiversifiable. It means only 11 per cent of the variance of Aurobindo Pharma Ltd., is systematic risk and the remaining 89 per cent variance is unsystematic risk that can be diversified.

Thus, the total risk (Variance) of Aurobindo Pharma Ltd., \((0.0429)\) can be divided into systematic risk and unsystematic risk as given below:

\[
\text{Total Risk} = \text{Systematic risk} + \text{Unsystematic risk}
\]

\[
\text{Systematic Risk} = \beta_s^2 \sigma_m^2
\]

\[
= 0.94^2 \times 0.0052
\]

\[
= 0.0046
\]

\[
\text{Unsystematic risk} = \sigma_e^2
\]

\[
= \sigma_m^2 - (\beta_s^2 \sigma_m^2)
\]

\[
= 0.0429 - 0.0046
\]

\[
= 0.0383.
\]

### 4.5.7 Calculation of Systematic Risk of Orchid Chemicals & Pharmaceuticals Limited

The average monthly returns from the equity shares of Orchid Chemicals & Pharmaceuticals Ltd., was 2.08 per cent (0.0208) at the BSE during the study period. The risk of return is expressed in terms of standard deviation and variance. The standard deviation and variance were 0.1620 and 0.0263 respectively. The movements of Orchid Chemicals & Pharmaceuticals Limited's share price and Sensex during the study period is presented in figure 4.2.
Beta depicts the slope of the monthly returns in relation to market returns (BSE Sensex returns). Orchid Chemicals & Pharmaceuticals Ltd., has a beta of 1.13 based on the monthly returns during the period April 2003 to March 2008. A beta of 1.13, which is more than 1, means that the fluctuations in the returns from the company’s shares are more than the market returns. The standard error of beta coefficient which is 0.18, fixes the confidence range of estimated beta of the company between 0.77 and 1.49.

Alpha Value is the intercept of the company’s returns curve. As it stands at 0.0046, it means the returns from the company’s equity shares will be 0.46 per cent when the market return is zero. The company’s calculated beta is 1.13; if it is assumed
that the monthly return from Sensex is 1 per cent, then the expected monthly return from the company will be:

\[ R_{it} = \alpha + \beta_s R_m \]
\[ = 0.0046 + (1.13 \times 0.01) \]
\[ = 1.59\% \]

In a downward market, the return will be negative 0.67%.

The positive coefficient of correlation (0.509) which is significant at 0.01 level, is found between Orchid Chemicals & Pharmaceuticals Ltd's monthly returns and the monthly market returns. It means the market returns and the returns from the shares are moving in the same direction.

The coefficient of determination \((R^2)\) of the company is at 0.26. It indicates that the variance in the returns of Orchid Chemicals & Pharmaceuticals Ltd's share price is explained by the changes in the market returns to the extent of 26 per cent. This is the proportion of systematic risk of the company that is undiversifiable. It means only 26 per cent of the variance of the company is systematic risk and the remaining 74 per cent variance is the proportion of unsystematic risk.

Thus, total risk of Orchid Chemicals & Pharmaceuticals Ltd., (0.0263) can be divided into systematic and unsystematic risks as under:

Total Risk = Systematic risk + Unsystematic risk

Systematic Risk \(= \beta_s^2 \sigma_m^2\)
\[ = 1.13^2 \times 0.0052 \]
\[ = 0.0066 \]

Unsystematic risk \(= e^2\)
\[ = \sigma_m^2 - (\beta_s^2 \sigma_m^2) \]
\[ = 0.0263 - 0.0066 \]
\[ = 0.0197. \]
4.5.8 Calculation of Systematic Risk of Suven Life Sciences Limited

The average monthly returns from the equity shares of Suven Life Sciences Limited stood at 4.54 per cent (0.0454) in the secondary market during the study period. The standard deviation and variance of the company were at 0.2157 and 0.0465 respectively.

Suven Life Sciences Limited has a beta of 0.85 based on the monthly returns during the period May 2004 to March 2008. A beta of 0.85, which is less than 1, means that the volatility in the returns from the shares of the company is less than the market return. The standard error of beta coefficient is 0.26 which fixes the confidence range of estimated beta of the company between 0.33 and 1.37.

Alpha Value is the intercept of the company’s share price returns curve. As it stands at 0.0334, it means the returns from the company’s shares will be at 3.34% when the market return is zero. The company’s calculated beta is 0.85; if it is assumed that the monthly return from Sensex is 1 per cent, the expected monthly return from Suven Life Sciences Limited will be as follows:

\[ R_{st} = \alpha + \beta_s R_m \]
\[ = 0.0334 + (0.85 \times 0.01) \]
\[ = 4.19\% \]

The positive coefficient of correlation (0.284) which is significant at 0.01 level is found between the monthly returns from the shares and the monthly market returns. It means the market returns and share price returns both are moving in the same direction.

Table 4.1 shows that the coefficient of determination \( (R^2) \) of the company is at 0.08. It indicates that the variance in the returns from Suven Life Sciences Limited’s shares is explained by the changes in the market return to the extent of 8 per cent. This is the proportion of systematic risk of the company which is undiversifiable. It means only 8 per cent of the variance of the company is systematic risk and the remaining
92 per cent variance is unsystematic risk. Thus, the total risk of Suven Life Sciences Limited (0.0465) can be divided into systematic risk and unsystematic risk as under:

\[
\text{Total Risk} = \text{Systematic risk} + \text{Unsystematic risk}
\]

\[
\text{Systematic Risk} = \beta^2 \sigma_m^2 \\
= 0.85^2 \times 0.0052 \\
= 0.0038
\]

\[
\text{Unsystematic risk} = e^2 \\
= \sigma_m^2 - (\beta^2 \sigma_m^2) \\
= 0.0465 - 0.0038 \\
= 0.0427.
\]

4.5.9 Calculation of Systematic Risk of Bal Pharma Limited

The average monthly returns from the equity shares of Bal Pharma Ltd., was 5.07 per cent (0.0507) during the study period April 1998 to March 2008. The standard deviation and variance of returns of the company during the same period stood at 0.3145 and 0.0989 respectively which are higher when compared to other select pharmaceutical companies.

The company has a beta coefficient of 0.67 based on the monthly returns during the period April 1998 to March, 2008. A beta coefficient of 0.67 means that the fluctuations in the returns from the company's shares are less than the market returns. The standard error of beta coefficient is 0.39 which fixes the confidence range of estimated beta of the company between -0.11 and 1.45.

Alpha Value is the intercept of the company's returns curve. It stands at 0.0411, which means the return from the shares of Bal Pharma Ltd., will be 4.11 %, when the market return is zero. The company's calculated beta is 0.67; if it is assumed that the monthly return from Sensex is 1 per cent then the monthly return from Bal Pharma Ltd., will be:

\[
R_{st} = \alpha + \beta R_m \\
= 0.0411 + (0.67 \times 0.01) \\
= 4.78\%
\]
The positive coefficient of correlation (0.155), which is not significant, is found between Bal Pharma Ltd.'s monthly returns and monthly market returns.

The coefficient of determination (R²) of the company is at 0.02 which is very less compared to other select pharmaceutical companies. It means the variance in the returns of Bal Pharma Ltd's share price is explained by the changes in the market returns only to the extent of 2 per cent. This is the proportion of systematic risk of the company which is undiversifiable. It means, only 2 per cent of the variance of Bal Pharma Ltd., is systematic risk and the remaining 98 per cent variance is the proportion of unsystematic risk which can be diversified.

Thus, the total risk (Variance) of Bal Pharma Ltd., (0.0989) can be divided into systematic and unsystematic risks as under:

\[
\text{Total Risk} = \text{Systematic risk} + \text{Unsystematic risk}
\]

\[
\text{Systematic Risk} = \beta_s^2 \sigma_m^2
\]
\[
= 0.67^2 \times 0.0052
\]
\[
= 0.0023
\]

\[
\text{Unsystematic risk} = \sigma^2
\]
\[
= \sigma_m^2 - (\beta_s^2 \sigma_m^2)
\]
\[
= 0.0989 - 0.0023
\]
\[
= 0.0966.
\]

4.5.10. Calculation of Systematic Risk of Natco Pharma Limited

The average monthly returns from the equity shares of Natco Pharma Ltd., was 2.65 per cent (0.0265) during the study period. The risk of return is expressed in terms of standard deviation and variance which were 0.2019 and 0.0408 respectively.

Beta shows the slope of the monthly returns in relation to the market returns (BSE Sensex returns). The company has a beta of 1.10 based on the monthly returns during the period April 1998 to March 2008. A beta of 1.10, which is more than 1, means that the volatility in the returns from the company's shares is more than the market returns. The standard error of beta coefficient is 0.24 fixes the confidence range of estimated beta of the company between 0.62 and 1.58.
Alpha Value is the intercept of the company's returns curve. It stands at 0.0110, which means the returns from the company's equity shares will be 1.10 per cent, when the market return is zero. The company's calculated beta is 1.10; if it is assumed that the monthly return from Sensex is 1 per cent, then the expected monthly return from Natco Pharma Ltd., will be

\[ R_{et} = \alpha + \beta R_m \]
\[ = 0.0110 + (1.10 \times 0.01) \]
\[ = 2.20\% \]

The positive coefficient of correlation (0.390) which is significant at 1% level is found between Natco Pharma Ltd's monthly returns and monthly market returns. It means the market returns and returns from the shares are moving in the same direction.

The \( R^2 \) of the company is at 0.15. It indicates that the variance in the returns of Natco Pharma Ltd's share price is explained by the changes in the market returns to the extent of 15 per cent. This is the proportion of systematic risk of the company which is non-diversifiable. It means only 15 per cent of the variance of Natco Pharma Ltd., is systematic risk and the remaining 85 per cent variance is unsystematic risk. Thus, the total risk of Natco Pharma Ltd., (0.0408) can be divided into systematic and unsystematic risk as given below:

Total Risk = Systematic risk + Unsystematic risk

Systematic Risk = \( \beta^2 \sigma^2_m \)
\[ = 1.10^2 \times 0.0052 \]
\[ = 0.0063 \]

Unsystematic risk = \( \sigma^2 \)
\[ = \sigma^2_m - (\beta^2 \sigma^2_m) \]
\[ = 0.0408 - 0.0063 \]
\[ = 0.0345. \]

4.6 COMPARISON OF SYSTEMATIC RISK AND OTHER STATISTICS OF SELECT PHARMACEUTICAL COMPANIES

Table 4.2 depicts the beta coefficient, systematic risk and unsystematic risk of select pharmaceutical companies based on the historical data.
<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Beta Coefficient</td>
<td>0.79</td>
<td>1.36</td>
<td>0.64</td>
<td>0.67</td>
<td>0.73</td>
<td>0.94</td>
<td>1.13</td>
<td>0.85</td>
<td>0.67</td>
<td>1.10</td>
</tr>
<tr>
<td>2</td>
<td>Variance</td>
<td>0.0139</td>
<td>0.0292</td>
<td>0.0077</td>
<td>0.0429</td>
<td>0.0287</td>
<td>0.0429</td>
<td>0.0263</td>
<td>0.0465</td>
<td>0.0989</td>
<td>0.0408</td>
</tr>
<tr>
<td>3</td>
<td>$R^2$</td>
<td>0.24</td>
<td>0.30</td>
<td>0.26</td>
<td>0.05</td>
<td>0.09</td>
<td>0.11</td>
<td>0.26</td>
<td>0.08</td>
<td>-0.02</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>Systematic Risk</td>
<td>0.0032</td>
<td>0.0087</td>
<td>0.0019</td>
<td>0.0023</td>
<td>0.0028</td>
<td>0.0046</td>
<td>0.0066</td>
<td>0.0038</td>
<td>0.0023</td>
<td>0.0063</td>
</tr>
<tr>
<td>5</td>
<td>Unsystematic Risk</td>
<td>0.0107</td>
<td>0.0205</td>
<td>0.0058</td>
<td>0.0406</td>
<td>0.0259</td>
<td>0.0383</td>
<td>0.0197</td>
<td>0.0427</td>
<td>0.0966</td>
<td>0.0345</td>
</tr>
</tbody>
</table>

Source: Compiled from the respective share prices (Appendix III)
It is evident from the Table 4.2 that out of the ten select pharmaceutical companies, seven companies have less than one beta coefficient and three have more than one beta. But, for the three companies also, the beta coefficient is marginally higher than one. The proportion of systematic risk is more in Divi’s Laboratories Limited followed by Biocon Ltd., and Orchid Chemicals & Pharmaceuticals Limited. Bal Pharma Limited has very small proportion of systematic risk with 0.02. It means that less volatility in the returns can be observed from the pack of pharmaceutical stocks. It indicates that the pharmaceutical companies cannot give greater returns than market returns in a bull market and will not lose more than the market returns in a bear market. The investment in pharmaceutical stocks is defensive in nature. Overall, it can be concluded that investment in pharmaceutical stocks is more safe in volatile market conditions.
REFERENCES


