CHAPTER – II

CONCEPTS AND REVIEW OF LITERATURE

The contents of this chapter consist of the definitions of different key variables used in empirical analysis and different models employed along with the testable implications and hypothesis. Formulation of the ‘maintained hypothesis’ in business and economic research involves three stages viz., (1) definitions of the dependent and explanatory variables, (2) the a priori theoretical expectations about the sign and size of the parameters in the function and (3) the mathematical form of the models employed in empirical analysis.

As stated earlier in the chapters I, this work is concerned with an examination of the risk-return relationship in equity shares in India. Further, it is primarily concerned with identifying the different forms of risk specified in the finance theory and the linkages among such risk measures. For testing the risk-return associations both correlation and regression analysis have been employed. Particularly, in regression framework, most often, the expected rate of return on equity shares is the regress and the different risk measures are the regressors. Further, the time series of the rates of return on equity shares are the basic inputs in decomposing the covariance structure of equity returns. Hence, the key variables used in this work are the rates of return on sample stocks and the different risk measures. The major testable models used are the different forms of CAPM and the APM.

A.Koutsoyannis, op.cit, p.12
2.1 DEFINITION OF THE RATE OF RETURN

After adjusting for stock splits, stock consolidations, bonus shares and rights issues, the ex-post monthly returns on equity shares are computed as

\[ r_{jt} = \ln \left( \frac{P_{jt}}{P_{j,t-1}} \right) \]

The above equation can be rewritten as follows

\[ r_{jt} = \ln (n(P_{jt}) - \ln (P_{j,t-1})) \]

Where \( \ln (P_{jt}) \) and \( \ln (P_{j,t-1}) \) represent natural log prices of \( j^{th} \) firm’s equity share at the end month ‘t’ and ‘t-1’. It should be noted that the above formulae exclude the dividend term because the prices are adjusted for dividends also. The adjustment for dividends is done by adding \( (1/12)^{th} \) of the total dividend received in each calendar year to every month’s closing price during the same calendar year. This procedure removes the difficulties associated with differences in accounting periods for different firms\(^2\). The above formula yields continuously compounded rates of return and the log transformation will reduce the severity of the non-normality of the returns distributions.

However, for testing the Three Moment CAPM and to determine the statistical risk measures, the rates of returns are defined as follows:

\[ r_{jt} = \frac{(P_{jt} - P_{j,t-1})}{P_{j,t-1}} \]

\(^2\text{With effect from April 1989, financial year has been made the common accounting year for tax purposes.}\)
2.2 DEFINITION OF RISK MEASURES

Two types of risk measures have been used in Chapter III, viz., the statistical measures of risk and the accounting measures of risk.

2.2.A. DEFINITION OF STATISTICAL MEASURES

The monthly rates of returns were computed for the 112 sample stocks and employing these rates of return as inputs, 8 statistical risk measures were computed. These measures were computed for the overall period of 158 months and also for three sub-period 53, 53, and 52 months respectively. These eight risk measures are comprehensive enough to cover the range of risk proxies suggested in finance literature.

The statistical risk measures are defined as follows:

1. Standard Deviation ($\sigma$)
   \[
   \sigma = \sqrt{\frac{\sum (r_i - \bar{r})^2}{N}}
   \]

2. Range (R)
   \[
   R = r_{i,\text{max}} - r_{i,\text{min}}
   \]

3. Inter Quartile Deviation (IQD)
   \[
   \text{IQD} = \frac{(Q_3 - Q_1)}{2}
   \]

4. Mean Absolute Deviation (MAD)
   \[
   \text{MAD} = \frac{\sum |(r_i - \bar{r})|}{N}
   \]
5. Semi-Variance (SV)
\[
SV = \frac{\sum (BAR_i - r_i)^2}{N}
\]

6. Skewness (SK)
\[
Sk = \frac{[\sum (r_i - \bar{r_i})^3/N]}{\sigma^3}
\]

7. Kurtosis (Kurt)
\[
Kurt = \frac{[\sum (r_i - \bar{r_i})^4/N]}{\sigma^4}
\]

8. Beta (β)
\[
\beta_i = \frac{\text{Cov}(r_i, I)}{\sigma^2_i}
\]

β_i can also be obtained by regressing each stock’s returns against the returns from a stock index in a Single Index Model (SIM) framework. The SIM is defined at a later stage.

In the above formulae, \( r_i \) is the time series of rates of returns form the \( i^{th} \) stock, \( \bar{r}_i \) is the average return of the \( i^{th} \) stock, Q3 is the third quartile, Q_1 is the first quartile, \( r_{\text{max}} \) and \( r_{\text{min}} \) are the maximum rate of return and the minimum rate of return from \( i^{th} \) stock respectively, BAR is the below average returns for the \( i^{th} \) firm, i.e., \( r_i < \bar{r}_i \) and \( N \) is the number of observations per firm. The return from the stock index, \( r_I \), is computed as follows:
\[
r_I = \frac{(I_t - I_{t-1})}{I_{t-1}}
\]

The stock index was constructed by assigning equal weights to all the 112 sample stocks.
**Expected Theoretical Relationships**

Standard Deviation, range, inter-quartile deviation, mean absolute deviation and semi-variance are measures of total risk, and hence they should have a high degree of association among themselves and should be positively associated with the expected return. Skewness and kurtosis are inverse measures of risk. They should be negatively associated with other risk measures and also with the expected return. Beta is a proxy for systematic risk. Since total risk consists of systematic and unsystematic risks, beta should be positively associated with standard deviation, range, semi-variance, inter-quartile deviation and mean absolute deviation. Further, beta will be negatively associated with skewness and kurtosis. Expected return would be positively associated with the beats.

**2.2.B. ACCOUNTING MEASURES OF RISK**

Accounting data for 101 firms spread over a period of 10 years, from 2000-01 to 2009-10, was used to arrive at the different accounting measures of risk. The accounting measures of risk (also called financial measures of risk) have been classified into five groups, viz., the co-variances, variances, means, growth rates and others.

Totally 25 accounting measures of risk have been identified for use in this work.

In accounting measures of risk, it should be noted, only an attempt is made to proxy for certain type of risks such as business, leverage, liquidity, size and so on.
Each class of accounting risk measures has a basic formula for computing the individual risk measures belonging to that class. Individual risk measures are computed merely by substituting the relevant time series values in the basic formula.

i. **COVARIANCE MEASURES:** These measures are expected to account for any cyclicality in the earnings streams of the firms and are proxies for systematic risk in equity stocks. This study employed two such risk measures viz., the Earnings and sales covariances. Using raw covariances presents a problem which is that the covariances are affected by the measurement units of the underlying earnings and sales values. To overcome this problem, the covariances are transformed into regression coefficients by dividing each covariance by the concerned market variance. The basic formula for calculating the co-variant forms of risk measures is as follows:

\[
X\beta = \frac{\text{Cov}(X_i, X_m)}{\sigma^2(X_m)}
\]

Where, \(X_i\) is the earnings stream and the sales stream of the \(i^{th}\) firm to obtain the earnings beta and the sales beta respectively. \(X_m\) is the aggregated earnings or the sales streams of all the sample firms.

To give an example, the earnings beta is computed as follows:

\[
\text{Earnings } \beta = \frac{\text{Cov} (e_i, e_m)}{\sigma^2(e_m)}
\]

Sales betas are also computed in a similar fashion.
As proxies of systematic risk the covariance measures should be positively associated with the equity returns and the market risk measure ($\beta$).

There are two covariance accounting measures of risk. They are

1. Earnings Beta

2. Sales Beta

**ii. VARIANCE MEASURES:** The co-variant measures given above measure the systematic relationships between the accounting variables of the individual firms and the corresponding accounting measures for all the sample firms as aggregates. Another form of corporate risk variables are the variance forms. The finance theory considers the variance forms as proxies for the total risk. Variance forms are indicators of the volatility in the accounting variables and most managements attempt to avoid such volatility. For example, the variance in sales indicates the degree of volatility in sales and is viewed as a measure of risk. Since a part of the variations in accounting data could be due to economy wide forces, the variance forms should have a systematic risk component in them.

Statistically, variance is the squared value of the standard deviation. The basic formula for computing the variances is given below:

$$\sigma (X) = \frac{\sum_{t=1}^{T} (X_{it} - \bar{X}_i)^2}{T-1}$$

In the above formula, $X_{it}$ is the relevant accounting value for firm ‘$i$’ for year ‘$t$’ and $\bar{X}_i$ is the arithmetic mean of the relevant accounting values for the $i^{th}$ firm, for $t=1,2,\ldots,T$. 

43
The different variance form accounting measures of risk are:

1. Dividend payout ratio variance
2. Leverage variance
3. Dividend per share variance
4. Earnings variance
5. Earnings per share variance
6. Sales Variance

iii. MEANS: Arithmetic means of accounting variables have a long tradition in finance literature as indicators of expected values in historical data analyses. Mean values of certain accounting variables are also used to indicate the size measures. The general formula for computing the mean values of variables is

$$\bar{X}_i = \frac{\sum_{t=1}^{T} X_i}{T}$$

The means of accounting variables used in this study are:

1. Average Dividend payout Ratio
2. Average Assets (measured as the mean of the natural log of total assets)
3. Average Leverage
4. Average Net worth (measured as the mean of the natural log of total net worth)
5. Average Earnings per share (EPS)

6. Average sales (measured as the mean of the natural log of total sales)

Average of Total Assets, Sales and Net worth have been employed in this study under the assumption that they proxy for size of the firm. However, there is always a distinct possibility that Average sales may signify expected sales and the average of total assets may proxy for liquidity\textsuperscript{3}.

iv. GROWTH MEASURES: Growth measures are surrogates for measuring the trend or the rate of change in accounting variables. Prior research in the USA shows that many of the growth measures are surrogates for risk. However, the empirical performance of growth measures has been erratic. The basic formula for computing growth measures is

\[ G_i = \frac{\sum_{t=1}^{T} \log_e (X_{it}/X_{i,t-1})}{T} \]

Some of the growth measures used in this study are

1. Asset growth
2. Leverage growth
3. DPS growth
4. Earnings (EBIT) growth
5. Net worth growth
6. Sales growth

\textsuperscript{3} Prasanna Chandra, op.cit., p.28
v. OTHERS: In addition to the above mentioned risk measures, this study has also employed a few other accounting risk measures suggested by prior research. These variables have a sound theoretical backing and some of them are generally used to describe risks associated with leverage - operating, financial and total. These measures are defined as follows:

a. **Liquidity** as measured by the average of the current ratio. Current ratio has been computed by dividing total current assets by the total current liabilities for each year and thereafter averaging over the testing period of 10 years. Liquidity is a measure of safety and highly liquid firms are perceived to be less risky.

b. **Interest Coverage** as measured by the ‘times interest earned ratio’. It is computed by dividing, each year, the EBIT by the total interest paid to debt holders. A higher ratio is indicative of less riskiness because the firm after paying out the interest on debt would have adequate earnings to pay dividends to the share holders.

c. **Degree of Operating Leverage (DOL)** which is computed by dividing the percentage annual change in EBIT by the percentage annual change in sales. Each year’s values are then averaged over the testing period. Degree of operating leverage is a measure of business risk (total risk) which is associated with the investment decision. The reason for employing this variable arises mainly to verify if this variable is associated with the growth variables. Growth in the earnings of a firm over a long period of time is possible only if the firm has invested in expansion programs. Investment in new projects should affect the existing business risk. In other words growth in expansion form would appear to be risky because of an uncertain future.

d. **Degree of Financial Leverage (DFL)** is measured by dividing the percentage change in Earnings per share (EPS) by the percentage change in EBIT, every year. The annual values are then averaged over the testing period. When the DFL exceeds
unity the share holders are exposed to financial risk. DFL, being a measure of financial risk, should signify risks associated with high leverage.

**e. Degree of Total Leverage (DTL)** is measured by dividing the percentage change in EPS in each year by the percentage change in corresponding year’s sales. The annual values are then averaged over the testing period. DTL is a measure of total risk as it is a product of the DOL and DFL.

### 2.3 DEFINITIONS OF SOME KEY VARIABLES

1. **DIVIDEND PAYOUT RATIO (DPR)** = \( \frac{DPS_t}{EPS_t} \)

2. **LEVERAGE (DEBT-EQUITY RATIO)** = \( \frac{\text{Average long term debt}}{\text{Net worth}} \)

3. **NETWORTH** = Shareholders Equity Plus Reserves

4. **EPS** = Annual Earnings after taxes / total number of equity shares outstanding

5. **CURRENT RATIO** = Current assets / current liabilities

6. **PERCENTAGE CHANGE IN ANY VARIABLE (X)** = \( \frac{X_{it} - X_{it-1}}{X_{i, t-1}} \)
2.4 EXPECTED RELATIONSHIPS

Bowman\textsuperscript{4} and Meyers\textsuperscript{5}, among others, have attempted to establish a theoretical relationship between the accounting measures of risk and the systematic risk. While it has been shown that the systematic risk is directly (i.e., theoretically) associated with accounting measures of risk such as the Earnings beta and Leverage, there is no theoretical relationship between systematic risk and other financial risk variables such as growth, size, earnings variability and dividends. However, there is considerable amount of empirical evidence which has shown that there is a significant relationship between systematic risk and the variables mentioned above\textsuperscript{6}. Existence of such empirical relationships, despite lacking theoretical support, do not negate the theoretical relationships, they should only be interpreted as being proxies for some risk factor other than what they represent. For instance, Empirical evidence suggests that earnings variability is strongly associated with the systematic risk. While theoretically such relationship does not exist, the empirical relationship could be due to the earnings variability acting as a proxy for the true earnings beta.

It should be noted that most of the attempts to measure different risks are only likely to produce observed risk measures because the true risks are not really measurable. On the basis of the results of prior research it can be stated that all variance and covariance measures are expected to be positively associated with the rates of return and the systematic risk measure (\(\beta\)). Among the mean from variables, average DPR is expected to be negatively associated with the rates of return and the systematic risk measure. Size measures such as average of assets and net worth are also expected to be negatively associated with the rates of return and the \(\beta\). Leverage


\textsuperscript{6}See paragraph 2.8 for related literature
measures are indicators of financial risk and hence average leverage, leverage variance and leverage growth are expected to have positive association with the rates of return and the \( \beta \). However, prior research results published so far have indicated conflicting results. Ross's\(^7\) study supports the hypothesis that addition of debt to capital structure may not be viewed as a risky proposition by the shareholders. In fact, increasing use of debt may signal to the market that the firm has better future prospects. Under the circumstances it is possible that this variable may have a negative relationship with the rates of return and the \( \beta \).

Interest coverage is theoretically an inverse measure of risk because a higher value for this variable signifies greater safety for the investors and it may therefore be expected to have a negative relationship with the dependent variables. With regard to growth variables, a priori it may be said that they should have a positive association with the systematic risk and the rates of return. Much depends on the accuracy of the measures used, to proxy for real growth effect.

With regard to the dividend measures such as the Average DPR and DPS growth, past empirical results in Indian context show that Indian investors overwhelmingly prefer dividends to retention. Therefore, these measures are expected to have a negative association with the \( \beta \) and the expected rate of return on equity shares.

### 2.5 Basic Factor Model for Decomposing the Correlations

To decompose the cross sectional interdependencies displayed by the returns on equity shares, initially, the following factor analytic model is employed in Chapter IV.

\[
Y_j = a + \delta f_i + u_i
\]

Where, \( y_t \) is \((jx1)\) vector of realized returns on equity shares, ‘a’ is \((jx1)\) vector of means, \( f_t \) is \((mx1)\) vector of random factor scores, ‘d’ is \((jxm)\) matrix of factor loadings and \( u_t \) is \((jx1)\) vector of random unobservable uniqueness.

The above factor model has been used to extract the first principal factor which is hypothesized to be the market factor. To extract residuals for the decomposition of the residual correlations, a single Index Model (SIM) of following form is employed.

\[
R_{it} = \alpha_i + \beta_i R_{It} + e_{it}
\]

Where \( R_{it} \) is the return on \( i \)th equity share for time ‘t’, \( R_{It} \) is the return from a stock market index ‘I’ for the time ‘t’, \( e_{it} \) is the random residuals of stock ‘i’ which is not a linear function of the return from the index and \( \alpha_i \) and \( \beta_i \) are the intercept and slope coefficients associated with the linear relationship.

The interdependent structure of the residuals \( e_i \) for the 45 sub sample stocks have been analyzed, for possible extra-market influences, by Cluster Analysis and the Principal Components Analysis.

2.6 CAPITAL ASSET PRICING MODEL (CAPM)

In the tests of the CAPM, the first stage is the estimation of the betas from a process known as the first pass regressions. For this purpose, an excess returns market model is employed. In this regression equation the regress and is the time series of returns from the sample stocks and the regressor is the return from a market portfolio. Assuming that the average monthly returns computed for a portfolio of 112 sample stocks, assigning equal weights to each stock in the sample, are the monthly returns from a market portfolio, the betas are estimated from the following market model.

\[
R_{it} - R_{f} = \alpha_i + \beta_i (R_{mt} - R_{f}) + u_{it}
\]
Where, $R_{it}$ is the monthly return from the $i^{th}$ stock, $R_f$ is risk free return, $R_{mt}$ is the monthly return from the market portfolio, $\alpha_i$ is the intercept term, $u_{it}$ is the series of residual terms and the $\beta_i$ is the observed beta of $i^{th}$ stock. Tests of CAPM are subject to the market model satisfying certain conditions. These conditions are:

$$\sim
E (u_i) = 0
\sim \sim
Cov (R_{mt} u_{it}) = 0, \text{ and }
\sim \sim
Cov (u_i u_j = 0 \ (i \neq j))$$

If the above conditions are violated, it would mean that the subsequent tests of CAPM would be biased. Chapter IV of this study indirectly looks at this aspect.

The following different Capital Asset Pricing Models have been tested for suitability to Indian Capital market in this study.

2.6.A The STANDARD FORM CAPM (Also called the Sharpe, Lintner and Black (SLB) Model)

$$R_i = \delta_0 + \delta_1 \beta_i + \varepsilon_i$$

Where, the testable implications are

$\delta_0$ is the risk free return, and

$\delta_1 = R_{mt}-R_f$, i.e., the risk premium

In testing the above model and also the subsequent models in the CAPM environment, the betas are adjusted for measurement errors by the technique suggested by Vasicek\(^8\).

\(^8\)Vasicek. O., op.cit., pp.1233-1239
2.6.B THE CROSS SECTIONAL TWO FACTOR MODEL of Fama and Macbeth

Using the same portfolio formation techniques of Fama and Macbeth and allowing for both the stationarity and the non-stationarity of the regression parameters, the following models have been tested.

a) For individual stocks
\[
R_i - R_f = \delta_0 + \delta_1 \beta_i + \delta_2 \beta_i^2 + \delta_3 \sigma_{e,i}^2 + u_i
\]

b) For Portfolios of stocks
\[
R_p - R_f = \delta_0 + \delta_1 \beta_p + \delta_2 \beta_p^2 + \delta_3 \sigma_{e,p}^2 + u_p
\]

For the above models the testable hypotheses are

1. \( \delta_0 = 0 \) i.e. if SLB hypothesis is true, \( \delta_0=0 \)
2. \( \delta_1 > 0 \) i.e. there is a positive tradeoff between risk and return
3. \( \delta_2 = 0 \) i.e. there is a linear relationship between risk and return, and
4. \( \delta_3 = 0 \) i.e. non-systematic risk has no explanatory power.

2.6.C THE THREE MOMENT CAPITAL ASSET PRICING MODEL (TMCAPM)

The test of this model empirically examines the relevance of Systematic Skewness in asset pricing. For individual stocks the model tested is
\[
R_i = \gamma_0 + \gamma_1 \beta_i + \gamma_2 \delta_i + e_i
\]

Where, $\gamma_0$ is the risk free rate of return and $\delta_i$ is the systematic skewness measure. TMCAPM is essentially an extended form of the SLB model and hence the testable hypotheses are the same. The only additional condition is that the $\gamma_2$ should be greater than zero if the market prices the skewness in the returns distribution.

### 2.7 ARBITRAGE PRICING MODEL (APM)

To test for the relevance of the APM, the procedures adopted by Chen\textsuperscript{10} and Bower, Bower and Logue\textsuperscript{11} have been employed. Factor loadings were extracted by the Maximum Likelihood Factor Analysis (MLE Factor Analysis) technique and subsequently cross sectional regressions were run with the factor loadings as the independent variables. Allowing for both stationarity and the non-stationarity of the regression parameters, the APM tested is of the following form:

$$ R_i = \lambda_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + \ldots + \lambda_k b_{ik} $$

Where, $\lambda_0$ is the return from a risk free asset and $\lambda_1, \ldots, \lambda_K$ are the risk premia corresponding to the risk factors $b_1, b_2, \ldots, b_k$.

Before concluding this section it is necessary to mention about the risk free rate used for computing the excess returns from the equity stocks and the market portfolio. The risk free return in this study is assumed to be 12 percent per annum. Over the study period of 158 months the average annual rate of inflation was nearly 8 percent. Therefore, the nominal risk free return was taken to be 4 percent above the inflation rate. (The nominal risk less return = Risk Free Real Rate + Inflation Rate)

\textsuperscript{10}Chen, N.F., op.cit. pp.1393-1414
\textsuperscript{11}Bower, D, Bower. R and Logue, D., op.cit. pp.1041-1054
A large number of empirical studies have been carried out in the USA with regard to testing of the validity of the equilibrium asset pricing models, viz., the CAPM and the APT. Because of methodological and computational difficulties the APT has not been as extensively reached as was the CAPM. Perhaps that APT is a recent development may have also contributed to the lesser research output. However, the standard and the non-standard forms of the CAPM have been subjected to a very deep study not only in the USA but also elsewhere in the world. So far as India is concerned there have been a few studies on the applicability of CAPM to Indian conditions but APT does not seem to have attracted any researcher’s attention. In view of the need for brevity only some of the relevant works in the areas related to this study have been taken up for review. Similarly, there are not any major studies which attempted to decompose the interdependent structure in equity shares to unearth the latent risk factors. Studies of this kind are immensely useful in understanding the behavior of equity shares.

2.8 RISK AND ITS DIFFERENT FACETS

Risk is the axis around which the entire theory of capital market revolves. Risk is the major determinant of the rates of return on financial assets and as such a proper understanding of risk and its different facets is sine-qua-non for study of the valuation of risk assets.

Finance theory, generally, uses the different statistical measures of dispersion as proxies for evaluating the total risk in equity shares. One of the earliest methods of decomposing total risk was to segregate it into various components such as business, leverage, liquidity, and purchasing power (inflation) risks. Most often these risk components were proxied by firm specific accounting data. The advent of Modern Portfolio Theory (MPT) caused the total risk to be decomposed into two components,
viz., the systematic and the non-systematic risks. At this juncture it would appear as though there are different risks each uncorrelated with the other. However, finance theory interprets these different definitions of risk as essentially different facets of the one risk which is the total risk.

Many researchers have attempted to study these components of risk in equity shares and identify the risk-return relationship in equity shares. Some researchers also attempted to correlate the different aspects of risk so as to generate an integrated theory of risk and return. The literature in this area is truly voluminous and hence for the sake of brevity only some very important works are being reviewed here.

Cooley, Roenfeldt and Modani\textsuperscript{12} have presented empirical evidence on the performance of 11 statistical risk measures and found that these measures have a lot of informational overlap among them. They suggest that six of the measures used are very nearly substitutable and hence some of the measures are redundant. They presented evidence to suggest that many of the risk measures exhibited an inter-temporal stability in their associations.

Pinches and Kinney\textsuperscript{13} and Altman and Schwartz\textsuperscript{14} have examined the behavior of stock price volatility both cross sectionally and longitudinally. Using some of the commonly employed statistical measures, they present evidence of substitutability of the risk measures and reasonable inter-temporal stability of the risk proxies.

Francis\textsuperscript{15} conducted a detailed investigation into the inter-temporal behavior of important statistical risk measures computed from the monthly returns of 750 common stocks. He found sufficient evidence to support reasonable inter-temporal stability in these risk proxies. He, however, concluded that the betas of some stocks gyrated very wildly like random coefficients. He also presented a few models which are useful in forecasting the future values of betas, standard deviations and the correlations.

Among the many works which attempted to establish a relationship between market determined risk variable, beta, and the corporate risk variables derived from financial statements, the most notable work was the pioneering effort made by Beaver, Kettler and Scholes (BKS)\textsuperscript{16}. They identified six accounting measures of risk, viz., the dividend payout, growth, leverage, liquidity, variability of earnings and co-variability of earnings. BKS discovered significant association between the systematic risk measure, $\beta$, and the firm specific accounting measures like dividend payout, financial leverage, earnings variance and earnings beta. They also found that dividend payout, growth and earnings variability constitute dependable instrumental variables for providing better forecasts of future betas. The $R^2$ for their main regression equation was 0.45.

Logue and Merville\textsuperscript{17} identified nine financial variables and attempted to find the association between betas and the nine variables. They found that return on assets, asset size and financial leverage are significant and the $R^2$ value of their regression equation was 0.25.


Lev and Kunitzky\textsuperscript{18} found significant relationship between betas and dividend payout, sales and earnings. Their $R^2$ value was 0.45.

Hamada\textsuperscript{19} showed that the firm’s capital structure has an important influence on the systematic risk. Highly levered firms were subject to a high systematic risk. Hamada’s used a very complicated process of computing unlevered betas for each firm in his sample and grouped his sample firms into nine homogenous groups. This is mainly to preclude the influence of other factors on the systematic risk so that the effect of systematic risk on leverage could be discerned more clearly.

Rosenberg and Mckibben\textsuperscript{20} derived 32 variables from the financial statements and stock market data. Their results are very complex on account of a large number of variables used. In many cases the relationships they found did not match with their a-priori reasoning. However, their results do confirm the results of other researchers in several respects. First, Financial leverage is again found to have significant relationship with beta. Second, systematic risk is positively associated with the variability of earnings and thirdly, a strong positive association between systematic risk and sales growth and earnings growth has been found.


Thompson\textsuperscript{21} identified 43 financial data measures and classified them into co-variant, variant, mean and trend forms and computed the association between the betas and 43 risk measures. He found the co-variant forms to be more powerful in association with the betas than the other forms of risk measures. He chose 13 variables for final analysis in a progression framework. The $R^2$ values for three regression model ranged between 0.57 and 0.91. The most significant variables were dividend betas, earning betas, earnings multiple betas and asset growth.

An overview of the results of all the works reviewed above and those which have not been mentioned for the sake of brevity shows that earnings beta, dividend payout, size, growth and financial leverage are the most important sources of systematic risk and could therefore be considered as the real determinants of the systematic risk. So far as Indian evidence is concerned, there do not seem to be any major published findings in this area. Some of the financial variables were used by Chandra\textsuperscript{22} in his published work but his work was directed towards establishing the relationship between stock prices and financial variables.

2.9 EVIDENCE ON MARKET AND EXTRA MARKET FACTORS

The research works under review in this section mainly proceeded to decompose the equity stock returns structure into different components. Broadly two components common to the equity shares were identified, viz., the market related component (or factor) which was common to all the stocks and extra-market components (or factors) which were common to a subset of stocks. While all the studies clearly identified the market related component, there were differing opinions with regard to the identity of the extra-market component.

\textsuperscript{22}Prasanna Chandra, “Valuation of Equity Shares in India”, New Delhi, Sultan Chand, 1977
One of the earliest studies which examined the latent structure of the equity share price changes was by King\textsuperscript{23}. The main objectives of his study were

\begin{enumerate}
\item to discover and explain the degree of variance in the stock returns explained by the market factor,
\item to determine if the 2-digit classification of firms was supported by the empirical evidence and if so,
\item to explain the degree of variance that can be attributed to industry factors.
\end{enumerate}

King employed Factor Analysis, and Cluster Analysis as the main statistical tools along with Correlation Analysis. King’s sample consisted of 63 securities belonging to 6 different industries corresponding to a two-digit SEC classification.

King estimated the variance-covariance matrix of log stock price changes and factor analyzed the matrix. He found that a typical stock has about a half of its variance explained by an element of price change that affects the whole market. He extracted the residual co-variances of the sample stock price changes after removing the effect of the market factor and applied cluster analytic technique on the residuals matrix to see if the stocks clustered according to their industry classifications. He found that they did.

The mean variance explained by the industry factors for the overall period amounted to 11.2 percent and the total variance explained by the market factor and the industry factor came to 63.2 percent.

His results were compatible with the hypothesis that a common market factor and extra-market industry factors caused the co-movement of the stocks. His results also supported the applicability of Multi Index Models because the residuals of stock price changes, after the removal of the effect of the market factor, were not independent. His results over different sub periods indicate that there had been an ‘ex-post’ behavior of ‘togetherness’ of a sufficiently stationary nature among the sample stocks which was compatible with a theory of common effects in the formation of stock price changes.

One possible short coming in King’s study may be related to his choice of the sample firms. They appear to be too homogeneous with little product line diversification. This was evidenced by the neat manner in which the firms clustered into exactly hypothesized industry classifications. It is doubtful if such clustering results could be obtained, if more diversified firms had been chosen for analysis. This was what precisely Meyers\(^{24}\) found when he replicated King’s methodology to a different sample.

Meyers’s main objectives in his research paper were identical to those of king. He adopted the same methodology but chose two samples. The first sample was the same as that of king but in the second sample he chose firms belonging to a broader industry classification and the firms had diversified business interests. The second sample consisted of 60 stocks belonging to 12 industrial groups with 5 stocks from each industry. These 12 industries included that the 6 industries choose by king and another 6 industries, with all industrial classifications based on two-digit classification. However, firms belonging to the second 6 industry groups were of diversified nature.

Meyers’s analysis revealed that, for the first sample, the results obtained were in agreement with those obtained by King. Consistent results were obtained for the second sample also. However, with regard to the role of industry factors, Meyers reported different results. The cluster analysis revealed that for the second sample a neat straight jacket industry wise clustering took place only in case of the more homogeneous industry groups but not in case of other less homogeneous stocks. The more diversified firms crossed the industry lines and did not always cluster in the broad industry class to which they belonged.

Meyers’s study implies that industry factors were clearly discernible in the case of homogeneous stocks but such a thing did not happen unambiguously in the case of more heterogeneous and diversified firms.

Farrell extending the work done by King, concentrated on a study of homogeneous stock groupings and classification of stocks into pseudo-industry groups. The main objective of Farrell’s work was to develop stock groupings that are homogeneous with respect to co linearity characteristics and thus suitable for use as inputs in a Multi-Index Model. He hypothesized that an additional factor, apart from the market and industry factors, is the classification according to the Growth, Cyclical and stable characteristics of the stocks. These three groups can be taken as three pseudo-industry groups.

The methodology adopted by Farrell consisted of determining the residual stock returns after the removal of the market factor. This was achieved by running a regression procedure using a Single Index Model. Farrell computed pair wise bivariate correlation co-efficients. Step-wise Cluster Analysis of the residual returns

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revealed the presence of the hypothesized three groups plus an unexpected fourth group representing the Oil stocks. Farrell then constructed a Multi-Index Model using four indices each representing the four pseudo-industry clusters. A comparison of this Multi-Index Model with that of a Single Index Model produced results that favored the Multi-Index Model. He estimated that the extra-market factors present in the stock returns explained, over the study period, about 14 percent of the variance in stock returns.

Cohen and Pogue\textsuperscript{26} performed detailed tests on the performance of a Multi-Index Model and a Single Index Model. They Utilized standard industrial classification for grouping their sample stocks. Industry Indices were computed and used as independent variables along with the Market Index. Their tests of economic significance indicate that the Single Index Model was seen to have more desirable ex-ante properties than the more elaborate Multi-Index formulations. In particular, the ex-ante efficient portfolios produced by the Single Index Model had lower expected risks than those of the Multi-Index formulations for equivalent levels of return. The only possible drawback of the Cohen and Pogue formulations was the use of traditional industrial classification. Since many of the firms are multi product diversified firms, traditional classification of industries might have resulted in a loss of information about the risk characteristics of the firms appearing in an Industry Index.

Elton and Gruber\textsuperscript{27} on the other hand, found that on both statistical and economic grounds adding additional indices to the Single-Index model led to a decrease in the performance of the model. Though the Multi-Index Model explained the historical correlation matrix much better than Single Index Model, it resulted in a poorer forecasting of the ex-ante returns, and the selection of portfolios that at each risk level, tended to have lower returns. They felt that additional Indices introduced more random

\textsuperscript{27}E.Elton and M.Gruber, "Improved Forecasting Through Design of Homogeneous Groups", Journal of Business, October 1971
noise than real information into the forecasting process. Elton and Gruber also made use of pseudo-industry classifications rather than the standard industrial classifications.

The testing of the performance of Single and Multi-Index Models regained importance especially after the proposition of the Arbitrage Pricing Theory (APT). APT is a special case of a Multi-Index Model in the sense that it describes how equilibrium prices are formed through a Multi-factor Model.

2.10 REVIEW OF EMPIRICAL EVIDENCE ON CAPM

Two of the important tests on the Beta stationarity were by Blume\textsuperscript{28} and Levy\textsuperscript{29}. Vasicek\textsuperscript{30} suggested a technique for correcting the Betas to improve their predictability. Blume computed Betas using time series regressions on monthly data over non-overlapping seven year periods. Betas were computed for individual securities, 2 security portfolios, 4 stock portfolios and so on up to 50 stock portfolios. He then calculated for each individual security and each of the portfolios, over two successive sample sub-periods, the co-efficient of correlation between the Betas. He found that as the portfolio size increased the coefficient of correlation became larger indicating a strong association. For a 50 stock portfolio the coefficient correlation between two period Betas came to 0.98. He, thus, concluded that large portfolio Betas contains a great deal of information about future betas on the same portfolio and hence portfolio betas are highly predictable. The same inference did not hold for the Betas of individual securities.

The Portfolio Betas were measured with less error whereas the individual security Betas was measured with a greater random error. He has also found evidence to support the hypothesis that Betas tended to regress towards unity over successive time periods.

Levy conducted tests following the methodology similar to Blume taking for his sample 500 stocks over a period of 10 years. He conducted his tests using weekly returns. His tests also covered individual stocks and portfolios consisting of 5, 10, 25 and 50 stocks respectively. The portfolios were constructed by ranking security Betas in each period and partitioning the list into portfolios containing 5, 10, 25 and 50 stocks. His results were identical to those of Blume.

Klemkosky and Martin\textsuperscript{31} examined the adjusted or corrected Betas for their predictive powers. They adjusted individual security Betas and the Betas of 10 stock portfolios over a period of 15 years (divided into 3 sub periods of 5 years each) by the Blume and Vasicek techniques and then measured their forecasting ability. They found that adjusted Betas remained highly stationary while the unadjusted Betas did not. They also found that the two techniques yielded adjusted Betas whose predictive ability did not differ much.

In short it may be stated that the stationarity of Betas is one of the prerequisites in CAPM testing and the empirical evidence shows that individual security Betas are non stationary whereas portfolio Beta’s are quite stable overtime.

Jacob\textsuperscript{32} performed tests on the validity of the CAPM using 590 NYSE stocks over a sample period of 20 years from 1946 to 1965. She used both monthly and


annual stock returns. While she found that there was a positive relationship between average monthly or annual return and the risk (beta), the results did not support the validity of CAPM as both intercept and slope coefficients were different from the theoretical limits.

Miller and Scholes\textsuperscript{33} had subjected the methodology adopted in all earlier research works, related to standard CAPM, to a very exacting econometric scrutiny and found that most of the earlier works erred by considering, in the second pass regression, the observed Betas instead of true Betas. This, they found, affected the reliability of the regression coefficients. After their classic article was published, the subsequent research works on the CAPM adopted a more stricter methodology for testing the CAPM. One such work that immediately succeeded Miller and Scholes article was by Black, Jensen and Scholes (BJS)\textsuperscript{34}. BJS built on the research of Miller and Scholes to design a test that solved the problem of adequately measuring the Betas. In fact, the BJS methodology subsequently became the standard methodology followed by the later research papers.

BJS had adopted a technique akin to “instrument variables” technique whereby the selection bias in forming Betas ranked portfolios could be avoided. This meant that while testing the CAPM it would be better to use portfolios rather than individual stocks. When they formed portfolios, BJS used the Betas of securities in the previous time period as the “instrument variables” and ranked the stocks into decile portfolios. Each decile was then considered to be the portfolio in the next time period. BJS adopted this technique and each year they revised the Betas of individual stocks, ranked them into decile portfolios and used the deciles as the portfolios for the


next year. They, then, obtained the portfolio returns and regressed them against the market. This procedure was repeated each year over the sample period of 35 years. Their results, supported the two factor model of the CAPM (also called the Zero Beta Model). In their cross sectional test BJS found that the coefficient of determination (R) was 0.98 indicating a very highly significant relationship between portfolio Betas and the average monthly excess returns from portfolios.

Fama and Macbeth (FM)\textsuperscript{35} used the same procedure for forming portfolios as was done by BJS. There was, however, one significant difference in their methodologies. While BJS conducted a time services CAPM test, FM performed a cross sectional CAPM test. The work done by FAMA and Macbeth was yet another landmark test of the CAPM. Their cross sectional test allowed for portfolio formation using all the securities quoted on NYSE which met the data requirements. The study period was from January 1926 to June 1968. Their methodology was very rigorous and tackled many of the econometric problems encountered in the earlier studies. The market model was used to estimate the residuals and the standard deviation of residuals was used to proxy for the non systematic risk. To test for the linearity of the relationship between the risk and return the $\beta^2$ was computed as the average of the squared values of individual Betas in the portfolio.

The results of FM study indicate that:

1. Risk premium was positive and significant at 0.05 level. For the overall period the ‘t’ statistic was large. In all the sub periods also, excepting for the sub period 1956-60, the ‘t’ values were all positive but not all were significant at 0.05 level.

2. Coefficient of non-systematic risks had been, at random, positive or negative and the ‘t’ values had been consistently not significant, indicating that they were not different from zero. This meant that there had not been any other non systematic risk measures which explained the returns.

3. The results also did not reject the condition that the relationship between the expected return and Beta was linear in the study.

4. The intercept parameter was positive for the overall period and for various sub periods. However, its ‘t’ values were quite high and significant at 0.05 level indicating that the intercept is greater than the risk free rate of return. Further, since the risk premium was consistently less than the average difference between the return from the market and the risk free rate, it could be stated that the results were consistent with a Two Factor Model (Zero Beta Model) rather than with the standard CAPM.

5. FM also reports that the behavior of the time series of the different parameters trough time was also consistent with hypothesis that the capital market was efficient. The serial correlation of these parameters was always low in terms of explanatory power and generally low in terms of statistical significance.

Another important work relating to the cross sectional testing of CAPM was by Friend and Westerfield\(^\text{36}\). Their methodology was once again similar to that of BJS and FM. They considered a sample of stocks which satisfied the data requirements covering a period of 25 years from 1952 to 1976. The market index was constructed

on a composite index based on the relative values of common stocks, corporate debt and government bonds. The composite index was a valued weighted index. FW concluded that for individual stocks the variance of residuals was a meaningful measure of risk and the market portfolio was not ex-ante efficient. FW then conducted similar tests on grouped data consisting of portfolios. The procedure adopted by them was identical to that of BJS and FM. The results reported by FW for grouped stocks indicate that the variance of the residuals had not only significantly explained the risk differential in common stock portfolios and had the expected sign for three out of the five sub periods. These estimates were consistent with the hypothesis that variance was a meaningful measure of risk for individual and grouped stocks. In their predictive tests utilizing the Betas and the variance of residuals for both individual stocks and portfolios, FW found that neither Betas nor variances of the residuals had any explanatory power. In fact, the co-efficient of risk premium appeared in two out of five sub periods with a negative sign. This evidence did not support the normative property of the CAPM.

The CAPM postulates a simple linear relationship between the expected return and the market risk of a security, while the results of direct tests have been in conclusive because they have not been emphatically supportive of the CAPM, the evidence unearthed by subsequent research suggests the existence of additional factors which are relevant for asset pricing. The subsequent evidence points to the inability of Beta (systematic risk) to be the sole criterion in determining the asset prices. While this may be used to argue that the market may be inefficient, it can not be ignored that most of the tests conducted were often joint tests of efficient market hypothesis and a particular equilibrium model. Thus, some of the anomalies that have been attributed to a lack of market efficiency might well be the result of a misspecification of the pricing model.
The tests conducted by Black and Scholes\textsuperscript{37}, Litzenberger and Ramaswamy\textsuperscript{38}, Banz\textsuperscript{39}, Basu\textsuperscript{40} and Reinganum\textsuperscript{41} are supportive of the anomalies in the CAPM.

One of the most widely debated areas of financial research is the relationship between equity returns and the skewness in the returns distributions. Jean\textsuperscript{42}, Ingersoll\textsuperscript{43}, Kane\textsuperscript{44}, Samuelson\textsuperscript{45} and others have shown the importance of skewness in investors' utility functions. The theoretical arguments in favor of higher moments are that higher moments are appropriate if investors have cubic utility functions and additionally, since the returns distributions are non-normal, the introduction of skewness into the model better approximates the distribution. Any rational investor would prefer more to less. Thus a rational investor will accept, other things remaining the same, lower expected rate of return or to take a higher variability risk for a higher positive skewness.

Empirical tests of hypothesized relationships between equity's return and its second and third statistical moments were performed by Arditti\textsuperscript{46}, Levy and Sarnat\textsuperscript{47} and Francis\textsuperscript{48}. While Arditti and Levy and Sarnat found supporting evidence, Francis provided conflicting evidence which did not support skewness preference. It should be noted that all of them considered total skewness as an explanatory variable.

\textsuperscript{40}S.Basu, “Investment Performance of Common Stocks in Relation to Their Price Earnings, Ratios : A Test of Efficient Market Hypothesis”, Journal of Finance, June 1977
\textsuperscript{42}W.H.Jean, “The Extension of Portfolio Analysis to Three or More Parameters”, Journal of Financial and Quantitative Analysis, 6 (1971), pp 605-15
\textsuperscript{47}H.Levy and M.Sarnat, “Investment and Portfolio Analysis”, N.Y.Wiley, 1972
Simkowitz and Beedles have shown that much of the individual stock’s total skewness can be diversified away by forming portfolios of stocks. What stays in a portfolio is the systematic skewness which should be priced by the market, Kraus and Litzenberger (KL) have developed a Three Moment Capital Asset Pricing Model (TMCAPM) as a testable extension to the Standard CAPM. Their Empirical evidence is consistent with a three moment valuation model. The $R^2$ value for their model is 0.451. The intercept term was significantly different from zero as hypothesized by them. KL contends that standard CAPM would be mis specified unless the systematic skewness term is included in the model. They also argued that the $\beta^2$ used in the CAPM tests is essentially a proxy for systematic skewness.

Another rigorous test of TMCAPM was conducted by Friend and Westerfield. They used a much more representative market index which is value weighted and theoretically more sound. They used grouping techniques different from those of KL and their study period was more elaborate. The results for individual stocks indicate that in all the sub-periods the intercept term was significantly different from zero, the regression co-efficient of the co-skewness term is significant and has the correct sign but the evidence also suggests that the regression co-efficients may be non stationary over time. The results support, by and large, the TMCAPM’s validity.

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However, when portfolios of stocks are considered, Friend and Westerfield found the evidence contrary to that of KL. They conclude in their analysis that they did not find strong evidence to support the TMCAPM as a testable alternative to the standard CAPM. The model was subsequently subjected to a lot of testing by Scars and Wei\textsuperscript{52}, Tan\textsuperscript{53} and many others. The evidence is conflicting.

Returning to the Indian environment there are not many empirical reports published with regard to the applicability of the CAPM to Indian Stock Market. Srinivasan\textsuperscript{54}, Yalawar\textsuperscript{55} and Ramachandran\textsuperscript{56} have tested the CAPM with Indian data and their results are inconclusive. Srinivasan utilized a sample of 85 stocks covering a single period from July 1982 to October 1985. He chose Economic Times Index of Ordinary Share Prices (ET Index) as the proxy for Market Index. He computed quarterly rates of returns for the sample stocks and regressed the time series of returns against ET Index using the market model. The Betas computed in the I pass regressions were subsequently used in the II pass cross sectional regressions to test the CAPM. Portfolios were formed by ranking the Betas. 17 portfolios were formed with each portfolio consisting of 5 shares each.

The results obtained indicate that (i) the intercept term was not significant at 0.05 level with a ‘t’ statistic of 1.86. This implies that the intercept term was not different from zero as was requested for a simple CAPM, (ii) Betas of portfolio and


\textsuperscript{54}S.Srinivasan, “Testing of CAPM in Indian Environment”, Decision, Jan-March 1988, 51-59


\textsuperscript{56}G.Ramachandran, “Risk, Return and Equilibrium : Expectations Model (CAPM)”, Paper Presented at the 26th Indian Econometric Conference, Bombay, Jan 1989
observed excess returns from portfolios were tested for non linearity and the results indicate that the risk return relationship was linear and (iii) the slope coefficient was positive and highly significant. The interpretation of this result is that Beta was a significant explanatory variable. However, the slope coefficient is less than the theoretical value.

The possible deficiencies of this study are, first of all its very short period of study comprising of just 14 quarterly returns for each stock. Secondly, the Betas were assumed to be stationary over the period. Thirdly, there was no test performed to see if the residual had any explanatory power and finally the Beta ranked portfolios were not free from ‘order bias’ which might have resulted in a severe regression phenomenon.

Yalawar’s work examined the behavior of the Bombay Stock Exchange quoted ordinary shares over a period of 20 years starting from January 1963 to December 1982. His sample consisted of 122 common stocks. His tests concerning the relevance of the CAPM to Indian environment using monthly return data for each security and an equally weighted equity share price index as the proxy for the market. There were some stocks in the sample which did not have complete data and in respect of such shares the initial I pass Betas were estimated from the excess returns market model by utilizing a minimum of 5 years data. The cross sectional II pass regression test was performed only on individual Betas. No portfolio tests were performed and the individual Betas were not adjusted for their non stationarity and regressive tendencies.

His results show that (i) the intercept term was not significantly different from zero at 0.05 level and the slope co-efficient also was not significantly different from zero (ii) the slope coefficient was positive indicating that there was a positive relationship between the risk and average return and (iii) linearity tests were not
performed nor was the residual variance examined for its impact on the returns. Thus, his results indicate that the intercept term was equal to zero as is required by the simple CAPM theory but the risk premium was less than the required theoretical limits. These results supported those reported by Srinivasan.

Ramachandran adopted the BJS and FM methodology for his study of 132 common stocks drawn from 10 different industries covering a period of 8 years starting from 1979 to 1986. He computed monthly returns after adjusting the price data for bonus shares, stock-splits and stock consolidations. He, however, left out dividends while computing the returns data. He considered the RBI Index for Equity Share Prices as a proxy for market portfolio. Only the stocks quoted on BSE were taken up for testing the validity of CAPM in Indian environment. Allowing for the stochastic variability of the regression coefficients, he tested the cross sectional CAPM, in the Fama and Macbeth\textsuperscript{57} framework.

He tested for the possible misspecification of CAPM by considering the financial variables such as size, leverage, dividends per share (DPS), growth in dividends per share, absolute mean deviation of DPS, earnings per share (EPS), growth in EPS, retained EPS and mean absolute deviation in EPS for stocks belonging to three industry groups for each sub period. The financial variables were considered for overcoming the missing variables problem, if any, in the case of individual stocks under the non-predictive scheme. His results point to the rejection of CAPM for both the sub periods and the overall period. Similarly, the FM framework of testing CAPM under predictive scheme was also rejected with the Indian data. Under the predictive framework, the intercept was significant at 0.95 confidence level where as

\textsuperscript{57}E. Fama and J. Macbeth, op. cit. pp. 607-636
all other regression parameters were not statistically significant. Under the non-
predictive scheme, however, though all the parameters were not statistically
significant, risk premium was positive for all the periods. When the financial variables
were introduced into the equation (for individual stocks), the size effect was found to
be statistically significant for textiles and chemical industry groups. While it was
positive in case of textile group, it was found to be negative for the chemicals group.
The CAPM was found to be non-linear with the textiles sample. Both Beta and Beta
squared terms were found to be statistically significant. In the case of general
engineering group, size effect was, surprisingly, negative but not statistically
significant. Earnings retention policy seemed to be favored by the share holders of the
engineering group. Ramachandran concluded his report stating that the risk premium
was positive suggesting that there was risk-return trade off in Indian Capital market
over the study period.

When the three Indian works are compared, Ramachandran’s work emerges as
the most appropriate on account of the rigorous methodology followed by him. In the
other two cases, it is possible that the kind of econometric problems discussed by
Miller and Scholes\(^{58}\) might have affected the results. In any case, the Indian evidence
does support the spirit of the CAPM but does not support either the normative or the
positive theory of CAPM.

### 2.11 REVIEW OF EMPIRICAL EVIDENCE ON APT

The APT is very general and the generality of the theory is both its strength
and its weakness. While allowing for the description of equilibrium asset prices in
terms of a Multi-Index Model it does not provide any evidence as to what would be
the appropriate indices.

\(^{58}\)Miller and Scholes, loc.cit
It does not offer any explanation about the economic or firm characteristics that affect the stock returns. Further, it does not say anything about the size or the signs of the factor loadings. The utility of an APT model cannot be differentiated from the methodology used to estimate it. A test of the APT is a joint test of the theory and the methodology used to implement the theory. What this means is that if the APT holds good then the methodology used also holds good and if the APT is rejected then the methodology used is also rejected. At present the most commonly used statistical method to test APT is the Factor Analysis which is utilized to estimate simultaneously the factors that affect the equilibrium return and the sensitivity of firms to these factors.

The pioneering effort in subjecting APT to empirical testing was made by Roll and Ross\(^59\) and all other subsequent tests by others have followed their methodology with a few changes. Statistical difficulties and limits to computer capabilities have placed restrictions on testing of APT. Even today the methodological issues in testing APT have not been resolved fully if the objections raised by Shaken\(^60\) are taken into consideration. Roll and Ross (RR) utilized, for testing the APT, the Maximum Likelihood Factor Analysis on account of its statistical properties. RR selected a sample of all listed stocks available on the daily returns file of the CRSP tapes. The number of securities was 1260 over the study period 1962-1972. Because of the difficulty in applying Factor Analysis to cover all the 1260 stocks on account of computational difficulties, RR divided the sample into 42 sub groups of 30 stocks each at random and subjected these sub groups to Factor Analysis. RR proposed that five factors were adequate to explain the returns from stocks. The first pass Factor Analysis also provides a factor loading matrix \(B\) of the size \((30 \times 5)\) for each sub group.

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RR, thereafter, ran a cross sectional regression of the BJS and FM type, analogous to Generalized Least Squares method, day by day returns against the factor loadings. The results of the second pass regressions reveal that for 37 of the 42 groups at least one factor was statistically significant at the 0.05 level, for 24 of the groups at least 2 factors are significant, for 14 of the groups at least 3 factors are significant and for 7 of the groups at least 4 factors are statistically significant. RR concluded that the evidence supports for the presence of more than one factor and perhaps as many as four factors are important in asset pricing. RR also examined if ‘own’ standard deviation of daily return included in the II pass regression model had any significant relationship with the rate of return. If it did, then it amounts to rejecting APT because, then, APT model will not be parsimonious. They found that only 9 out of 42 groups the own standard deviation had a significant ‘t’ statistic at 0.55 level. This result indicated that APT model cannot be rejected on this ground. They also examined for the equivalence of factor structure across the 42 groups by statistical examination of the intercept term from each sub group. They conducted the Hotelling $T^2$ test and found that there was absolutely no evidence to suggest that the intercept terms were different across groups. One notable aspect about the RR study was that it was a pioneering study and as they admitted in their paper their tests are not without flaws and also they were weak tests. Most of the weaknesses arise on account of the use of the statistical tool Factor Analysis in testing APT. An alternative methodology better than the one used by RR has not been developed so far.

The second most important work on APT was by Chen\textsuperscript{61}. The major objectives of Chen’s work were to test the empirical performance of APT, compare the performance of APT with that of CAPM and to test whether the APT can explain some of the empirical “anomalies” related to the CAPM. Chen followed a unique procedure, which was later on followed by few others, for estimating the factor

\end{footnote}
loadings for a large number of securities, which otherwise would be very difficult to
do an account of computational difficulties. His technique was to do a Factor analysis
(MLE technique) on an initial portfolio of securities chosen at random and then
extend the factor structure of portfolio to the entire sample. This, he accomplished by
a mathematical programming exercise. Chen’s technique ensured an identical factor
structure for all stocks.

The cross sectional tests were performed following the scheme of BJS and FM
and the regression co-efficients were estimated allowing for the stochastic variability
of the co-efficients. The mean and the ‘t’ statistic were then derived from the time
series of the regression co-efficients. The results reported by Chen indicate that the
first factor loading of each security was highly significantly and positively correlated
with the Beta for each security. The results indicated that the APT is a better
descriptor of the equilibrium returns than the CAPM. Chen also performed two other
supplementary tests which could have, if the evidence could support such a
hypothesis, rejected the APT. The first test was a test of the APT against the “own
variance” effect. The second was the test of the APT against the “firm size” effect.
Chen did not find any compelling evidence to reject the APT in both the tests.

Bower, Bower and Logue\textsuperscript{62} examined the utility of the APT in measuring the
cost of equity capital as a specific alternative to the CAPM in respect of Utility
Industry. This paper examined the performance of APT vis-à-vis CAPM in estimating
the cost of equity capital. Towards this end they not only tested the APT model and
the CAPM model to determine which model is a better descriptor of the risk return
relationship of equity stocks, but also examined the forecasting power of each model.
Their sample consists of 942 stocks and four treasury security portfolios. The stocks
belonged to electric utilities, natural gas companies, telecommunication companies

Finance, 39(1984), pp 1041-1054
and industrials. The study period was from 1971 to 1979. Monthly returns from CRSP tapes were used in the study. Portfolios, rather than individual stocks, were used to reduce the noisiness of the data, minimize the econometric problems and overcome the computational difficulties. The results indicate that APT is a better descriptor of risk return relationship than the CAPM. While the $R^2$ in case of APT test were 0.425, it was only 0.274 in case of the CAPM test. Using the fitted equations of APT and CAPM, the returns were forecast and the estimated returns were examined. The Theil’s $U^2$ indicated that APT was better forecasting device than the CAPM, although the case for APT was still not decisive because more than 50 percent of the variance in returns remained unexplained by APT model.

Reinganum\textsuperscript{63} investigated empirically whether a parsimonious APT model could account for the differences in average returns between small firms and large firms, viz., the ‘size’ effect. Earlier research indicated that the CAPM failed to account for the ‘size’ effect. If the APT could explain the size effect then the APT could be a viable alternative to the CAPM. If it does not, the APT would be rejected. The results of the tests indicated that the evidence was inconsistent with the APT. The small firm portfolio possessed a positive and statistically significant average excess return. Therefore, Reinganum concluded that one cannot judge from the evidence that the APT was an adequate model of asset pricing.

An important work, in realms of the APT and imparting of economic meaning to the priced factors obtained in the APT test, has been produced by Chen, Roll and Ross\textsuperscript{64}. They attempted to study specific economic variables which influence returns from common stocks. They constructed set of economic state variables and empirically tested the time series relations between the state variables and the stock return.

market returns. Several of the macro-economic variables were significant in explaining the return on the factors, most notably, industrial production, changes in the risk premium, excess returns on long term bonds and unanticipated inflation. Chen, Roll and Ross do not presume that they have exhaustively covered the entire set of macro variables but only a few which they could theoretically associate with stock returns.

2.12 SOME METHODOLOGICAL OBSERVATIONS

The review of past empirical works has been highly illuminating for this study. The review has helped in identifying the kind of methodologies that were employed in consonance with the theoretical formulations and the possible weakness in the methodologies employed, especially, in those studies with Indian data. The utility of knowing, before kind, the kind of methodological pitfalls that are likely to be encouraged is immensely useful to any researcher and this study has enormously benefited from the works that have been reviewed here and also from those which for reasons of brevity have not been reported here. Such works, however, have been cited in the bibliography.

In the course of reviewing various research papers the following observations have been made:

a. USE OF PAST DATA

Both the CAPM and APT are essentially expectational or ex-ante models. They need to be expressed in ex-post form for empirical testing because expectations cannot be measured. This can be done by assuming that the returns from common stocks have fair game properties. When the rate of return is a fair game, it means that on an average realized returns are the expected returns.
Evidence provided by Gupta\textsuperscript{65} and Yalawar\textsuperscript{66} is consistent with the hypothesis that returns from equity shares in Indian stock market do follow a random walk and hence the fair game property is upheld. Under the circumstances use of historical data in this study is justified.

b. \textbf{STATISTICAL TOOLS EMPLOYED}

King\textsuperscript{67} and Meyers\textsuperscript{68} employed Factor Analysis and Principal Components Analysis for determining the degree of variance in common stocks caused by market and extra market factors. They also employed Cluster Analysis for grouping the residual returns into cohesive industry classifications. Farrell\textsuperscript{69} also employed Cluster Analysis for determining the pseudo industry classes. Regression analysis was used in all the tests of the CAPM. Both time series regressions using the Market Model and thereafter cross sectional regressions were used for testing the CAPM. Beta ranking technique was used to form portfolios is most of the tests. For testing the APT all the researchers have used MLE Factor Analysis. Cross sectional regressions were thereafter used period by period to derive a time series of cross sectional regression coefficients. ‘t’ test was used to test the significance of regression coefficients and ‘F’ test for testing the best fit of the equations. Chen\textsuperscript{70} used Davidson and Mckinnon test to compare the performance of the APT vis-à-vis the CAPM. Other statistical techniques such as the measures of central tendency and measures of dispersion were used to describe the different statistical measures of risk. Similarly averages and measures of variation were computed using accounting information.

\textsuperscript{66}Y.Yalawar, op.cit
\textsuperscript{67}B.King, op.cit
\textsuperscript{68}S.Meyers, op.cit,
\textsuperscript{69}J.Farrell, op.cit
\textsuperscript{70}N.F.Chen, op.cit
c. SAMPLE DATA AND PERIOD OF STUDY

Most of the research works have used a large number of securities for analysis. Only a fewer studies like King’s, Meyers’s and Farrell’s used securities less than 100. On the other hand all the works using Indian data have a sample size ranging between 100 and 130. The main reason for this is that, prior to 1995; it would be difficult to find more than 130 stocks that would satisfy the data requirements. Again, in so far as the period of study is concerned, most of the works using American data cover a very long span of time stretching over a period of 20 to 25 years. Well equipped data banks like the CRSP tapes facilitate such studies. In India such facilities are not available and most often the data has to be collected from published sources and time and cost constraints place a limitation on the period of study. This study also is no exception to this constraint.

d. NATURE OF THE SAMPLE STOCKS

Most of the works relating to the testing of the CAPM and the APT used a broad range of sample stocks from various industrial groups. Only Bower, Bower and Logue used stocks of a specific industry group (utilities). Also the research works of King and Meyers used stocks from a few well defined all homogenous industries to determine if the residual returns clustered into predetermined industry classifications. When the portfolios needed to be found for the CAPM or the APT testing, Beta or factor loading ranked portfolios were formed. Thus the grouping was based on risk characteristics rather than industrial classification. Among Indian works only Ramachandran used industry wise stocks to a limited extent.
2.13 SUMMARY OF MAJOR FINDINGS

To sum up this chapter, the major findings of the works reviewed in this chapter are mentioned below:

1. An examination of the correlation structure among stock returns reveals that there is a market factor common to all the stocks. With regard to industry factors the evidence is not very compelling. If the sample is drawn from a homogeneous stock group then industry classifications are clear but if the data is more heterogeneous pseudo industry classifications emerge. This result has an important implication to be utility of the equilibrium asset pricing models.

2. With regard to the CAPM, the major results are:

   i. The intercept term is significantly different from zero and the risk premium is less than the theoretical value. The implication is that low Beta securities would earn more than what the CAPM would predict and the high Beta stocks would earn less.

   ii. Models which included squared Beta and standard deviation of the residuals have shown that these terms are statistically not significant in most periods and that Beta dominates them as a measure of risk.

   iii. The risk-return relationship is linear and positive. There is a risk-return trade off, and
iv. There are some other factors such as size, P/E ratios and dividends that are successful in explaining that portion of security returns not captured by Beta.

3. With regard to the applicability of the APT, the major findings are:

i. There may be two to four priced factors that would explain the stock returns.

ii. There are conflicting reports regarding the APT’s ability to explain the size effect on stock returns.

iii. While APT could explain a statistically significant portion of the CAPM residuals, the CAPM could not explain the APT residuals.

iv. APT was able to forecast the stock returns more efficiently than the CAPM. However, the APT left a large part of the return variance unexplained, and

v. Research to identify economic meaning to the priced factors is yet to gain momentum. Work done so far indicates the priced factors may be returns from market (i.e. the market factor), changes in industrial production, changes in risk premium and the term structure of interest rates.

4. Systematic risk is significantly associated with some accounting measures of risk.
2.14 GAPS IN INDIAN EVIDENCE

From an examination of the published empirical literature available in respect of Indian Capital Market, it appears that there are no direct studies which have examined the role of market and extra market factors in explaining the rates of returns from equity shares. Similarly, it also appears that the APT model has not been tested for Indian conditions. There are also a very few studies which have exhaustively examined the utility of the CAPM to Indian Stock market. There are no major published papers which have established linkages between systematic risk and the accounting measure of risk.

2.15 PURPOSE AND FOCUS OF THIS STUDY

The main focus of this work is on risk as determinant of rates of return on equity shares. The main purpose of this work is to examine the different facets of risk and the linkages between them. More specifically the work proposes to:

1. Examine the degree of variance in equity share returns explained by the market and extra market factors.

2. Test whether the residual returns, after the removal of the market factor, conform to the predetermined industrial groupings indicating the presence of industry factors.

3. Investigate the utility of the CAPM to Indian Stock Market

4. Empirically evaluate the applicability of the APT to Indian data and compare the performance of the APT vis-a-vis the CAPM.

5. Identify the statistical measures of risk and determine their interdependent structure.