CHAPTER III

CAPM AND ITS APPLICATIONS: A REVIEW

The mathematical basis of modern portfolio theory was first laid by Markowitz (1952) in his famous paper ‘Portfolio Selection’. He proposed a concrete measure for the risk of investments and provided theoretical justification for diversification. Though investors were aware of adages like “do not put all your eggs in one basket” even before this development, when Markowitz interpreted the risk of an asset as the variance of the returns distribution the theory of diversification became evident from the statistical principle ‘Variance of the sample mean tends to zero when sample size tends to infinity’.

In deriving the theory, Markowitz assumed that investors care only about the first two moments of the returns distribution. They are mean-variance optimisers in the sense that they always aim at holding portfolios that provide highest average returns for a given level of variance and lowest returns variance for given levels of average returns. Thus Markowitz’s mean-variance portfolio theory prescribed what investors should do to construct portfolios that provide highest possible expected returns for a given level of risk.

The CAPM of Sharpe (1964) is an equilibrium model built on the theoretical foundations of Markowitz’s mean-variance portfolio theory. It describes how the market clearing prices and returns of capital assets set if investors act according to the prescriptions of Markowitz’s theory. The model is developed under the assumption of the existence of an efficient capital
market where security transactions are costless and information is freely available to all investors instantaneously. CAPM, in such an idealised market environment, bifurcates total risks involved in investments into two orthogonal parts, risk associated with the overall market conditions called ‘market risk’ or ‘systematic risk’ and risk specific to the asset called ‘unique risk’ or ‘unsystematic risk’. The unsystematic portion of the risk can be eliminated by holding well-diversified portfolios but the systematic portion cannot be eliminated even if one virtually holds all assets in the economy.

The model predicts that the expected returns of capital assets depends only on the systematic risk, not on the total risk. The kernel of CAPM is that capital market does not reward the unsystematic portion of risk that can be diversified away. To quantify market risk, Sharpe considered a ‘Market Portfolio’ that in principle contains all assets in the economy. The market risk of an asset is measured in terms of the beta value of the asset: the covariance between the asset returns and the returns on the market portfolio scaled by the variance of the market portfolio. CAPM states that the expected returns of capital assets is a positive linear function of their market betas and market betas alone are adequate to explain cross sectional differences in the expected returns of assets.

The construction of such an equilibrium model is significant in theoretical finance in many ways. It allows determining the relevant measure of risk and the equilibrium relationship between expected returns and risk of assets. Further, it produces a benchmark rate of returns for evaluating the cost
of capital and for comparing the performance of managed portfolios. Although CAPM does not fully withstand empirical tests, it is widely used in applications because of the insight it offers about the relationship between returns and risk. The CAPM’s empirical problems are either because of the theoretical failures due to the simplifying assumptions or caused by difficulties in implementing valid tests of the model.

In the last four decades, theorists have extended and adapted the model to incorporate some of the real world phenomena that were assumed away and empiricists have subjected variations of the model to tests of increasing power. The following sections provide a detailed review of the empirical studies conducted in the world markets on the various capital market theories within the mean-variance framework.

3.1 Empirical Studies Conducted Abroad

3.1.1 Early Empirical Tests on CAPM

The first empirical test of CAPM was done by Lintner (1965), which resulted in the rejection of the model. He used a two-stage procedure on a sample of 631 stocks from New York Stock Exchange (NYSE) for 10 years from 1954 to 1963. The average of all stocks in the sample is taken as market proxy in the analysis. In the first stage he estimated the beta values of the sample stocks by running a first pass time series regression

\[ R_{it} = \alpha_i + b_i R_{mt} + e_{it} \]  \hspace{1cm} (3.1)
The $b_i$ values obtained from the first pass regression are used as inputs of the second pass cross sectional regression

$$\overline{R}_i = a_1 + a_2b_i + a_3S_{ei}^2 + \eta_i$$  \hspace{1cm} (3.2)

where $\overline{R}_i$ is the average returns of the asset $i$, $S_{ei}^2$ is the residual variance estimated from the first pass regression and $\eta_i$ the random error term. The variable $S_{ei}^2$ is introduced to examine if non-market risk has any influence in explaining the expected returns of assets.

Lintner obtained the estimates of all the three regression coefficients as significantly different from zero. Statistical significance of $a_3$ implies that in addition to beta non-systematic risk also contributes significantly to the observed average returns. This leads to the rejection of the model. He also found the intercept term $a_1$ as too large than any reasonable estimate of $R_f$, and the slope term $a_2$ significantly less than what could be reasonably expected. Douglas (1968) employed a similar methodology and found results similar to those of Lintner’s.

This initial empirical rejection of CAPM was disappointing to the finance community. Miller and Scholes (1972) investigated the methodological issues involved in the two-stage procedure adopted by Lintner and Douglas. They found that the negative results obtained by Lintner and Douglas could be expected even if CAPM is valid because of the statistical problems involved in the methodology. It is well known that any measurement error in the independent variable of a regression equation produces an upward bias in the
intercept term and a corresponding downward bias in slope term of the estimated regression equation. Another problem associated with the measurement error is that, it produces a positive correlation between the true beta value and the residual variance of the estimated equation. This makes the residual variance to serve as a proxy of the true beta and returns to be positively correlated with residual risk.  

Miller and Scholes found that it is in fact this measurement error that created problems in the second pass regression of Lintner.

To overcome the problems diagnosed by Miller and Scholes researchers such as Blume (1970), Black, Jenson and Scholes (1972) and Fama and MacBeth (1973) worked with portfolios rather than individual securities. Since expected returns and market betas combine in the same way in portfolios, if the CAPM explains security returns it also explains portfolio returns. Estimates of beta for diversified portfolios are more precise than the corresponding estimates for individual securities. Thus using portfolios in the cross-sectional regressions of average returns on betas reduces errors associated with measurement error problem.

Black, Jenson and Scholes (1972) conducted an in-depth empirical test of CAPM by using a time series regression methodology on NYSE data for the period 1926-1965. They estimated the following time series regression equation on ten beta-sorted portfolios

\[ R_{it} - R_{ft} = \alpha_i + \beta_{it} m \left[ R_{mt} - R_{ft} \right] + \epsilon_{it} \]  

(3.3)

\[^{12}\text{For details refer Mills (1999)}\]
This test resulted in the acceptance of the model on the basis of the explanatory power and the overall significance of the equations estimated. However the intercepts obtained were different from zero; for portfolios with $\beta$ greater than one the intercept found to be negative and for those with $\beta$ less than one intercept were found as positive. This, as explained below, is consistent with the zero beta form of CAPM rather than standard CAPM.

The implication of zero beta form of CAPM is that

$$ R_{it} = E\left(R_0\right)(1 - \beta_i) + \beta_i \mu_m + e_{it} $$  \hspace{1cm} (3.4)

The model tested is

$$ R_{it} = \alpha_i + R_{f}(1 - \beta_i) + \beta_i \mu_m + e_{it} $$  \hspace{1cm} (3.5)

Solving we get

$$ \alpha_i = \left\{E\left(R_0\right) - R_{f}\right\}(1 - \beta_i) $$  \hspace{1cm} (3.6)

Since expected returns on zero beta portfolios is assumed to be greater than risk-free rate the empirical results obtained are clearly consistent with the zero beta form of CAPM. Black, Jenson and Scholes repeat these tests for four sub periods and find, by and large, the same type behaviour as described for the overall period.

Following this Fama and MacBeth (1973) conducted a cross sectional test of CAPM by using monthly returns of all NYSE stocks for the period January 1926 to June 1968. They used the following equation for their test.
where $S_{ei}$ is the standard deviation of the residual risk, which is taken as measure of non-market risk. This regression equation is estimated in cross section, on twenty beta-sorted portfolios, one for each month for the period 1935-1968 and the time series means and standard errors of the estimated regression parameters were used to test the CAPM hypotheses. The results obtained were supportive to the zero beta form of CAPM. They also examined the regression coefficients to see if the market operates as a fair game and accepted the fair game hypothesis by making use of autocorrelations.

3.1.2 Problems and Criticisms

Roll (1977) discussed a fundamental problem associated with the empirical tests of CAPM. He proved mathematically that, if $P$ is any ex-post mean-variance efficient portfolio and if betas are calculated between this portfolio and individual assets in the sample, there exists exact linear relationship between the average returns and beta. Based on this he argues that, the only one testable hypothesis in CAPM is “Market Portfolio is Mean-Variance Efficient”. All other implications, such as the linear relationship between expected returns and beta and positive risk premium follow from the efficiency of market portfolio.

He argued that the empirical tests performed on CAPM are actually tests of whether the proxy chosen for the market portfolio is efficient or not. If one can find out a market proxy that is on the minimum variance frontier, it
can be used to describe variations in expected returns across securities. Roll also showed that even when different market proxies that are highly correlated with each other are used they could lead to different conclusions. This problem is referred to as ‘Benchmark Error’. Roll proceeds to show that, the choice between alternative forms of CAPM is extremely sensitive to the choice of market proxy.

The criticism of Roll was a serious blow to the empirical tests of CAPM. There is no reason to believe that a market proxy having a fraction of total assets in the system is mean-variance efficient, even when CAPM is the true underlying model. Shanken (1984) argued that it is not the fraction of the total market value of assets included in the proxy for the market that is important, rather the correlation between proxy returns and market portfolio returns is important. Even when the fraction is small, the correlation may still be high. He also argued that, those assets that are uncorrelated with the market portfolio need not be included in the market proxy. These arguments have to some extent reduced severity of Roll’s criticism.

Mayers and Edward (1979) respond to Roll’s criticism by exploring the worth of portfolio performance through various tests. The authors conclude that in spite of potential problems pointed out by Richard Roll these tests are valid. Regarding the testability of CAPM, the authors argue that almost no econometric study for that matter is entirely free from all criticism. As the CAPM tests provide some validity of the model, it cannot be rejected outright.
Stambaugh (1982) studied the sensitivity of results of CAPM to different market proxies. He tested CAPM using a range of market indices that include, in addition to U.S. common stocks, corporate and government bonds, real estate, and other consumer durables and found that the tests of the CAPM are not sensitive, to the various proxies obtained by expanding the market proxy beyond common stocks. Thus Roll’s contention that market portfolio in tests of CAPM should include all assets in the system is not so serious as he argues. Stambaugh concluded that this is because the volatility of expanded market returns is dominated by volatility of stock returns.

Roll and Ross (1994) once again considered Roll’s Criticism on CAPM and extended the arguments posed by Roll. They showed that tests that reject a positive relationship between average returns and beta does not refute theoretical expected returns beta relationship of CAPM, but points to the inefficiency of market proxy used in those tests. Further they analytically proved that even proxies that are nearly efficient need not necessarily support the expected returns beta relationship of CAPM.

Kendall and Stambaugh (1995) considered whether the use of a more sophisticated regression procedure, Generalized Least Squares (GLS), could overcome the problems identified by Roll and Ross (1994). They found that GLS procedure does help, but only to the extent that the researcher can obtain a nearly efficient market proxy. They showed that if a market proxy used in the place of the true market portfolio is nearly efficient and as well the more efficient GLS regression procedure is used for the estimation, the test of CAPM
will be well specified up to an extent of the relative efficiency of the market proxy.

3.1.3 CAPM Anomalies

Following Roll’s criticism several empirical contradictions of CAPM were reported from capital markets all over the world. The findings of most of these works have been that in addition to beta either the returns generating process depends on certain firm specific variables like size of the firm, earnings-to-price (E/P) ratio, book-to-market equity (BE/ME) ratio, debt-equity ratio or beta does not have a significant explanatory power in explaining the cross section of average returns. While a group of researchers argue that these firm specific characteristics serve as a proxy for omitted risk factors (Chan, Hamao, and Lakonishok, 1991; Fama and French, 1993) another group provides a behavioural explanation for the anomalies (Lakonishok, Shleifer and Vishny, 1994; Daniel and Titman, 1997; La Porta et al, 1997) and yet a third group argues that these are due to data snooping and sample selection biases (Black, 1993; MacKinlay, 1995; Kotharai et al, 1995; Campbel et al, 1997). However, the empirical research examining the sources of patterns in the expected returns of assets attracted the attention of researchers from capital markets all over the world.

Banz (1981) noticed the influence of size effect in the NYSE stocks for the period 1926-1977. He used a two factor model obtained by adding market equity (ME) to the CAPM equation and then applied a methodology similar to that of Fama and MacBeth (1973). The evidence based on this analysis
indicates that ME adds to the explanation of cross section of average returns provided by market betas. He found that excess returns would have been earned during the period by holding small (low ME) firms. The striking aspect of Banz’s analysis is that the size term had roughly the same statistical significance in explaining returns, as beta did. Furthermore, the differential returns from buying very small firms versus very large firms were 19.8 per cent per year. The real payoff from holding small stocks came from holding the smallest 20 per cent of the firms in Banz’s sample. The differential between other quintiles was quite small.

Hans and Robert (1983) examined the firm size effect by taking data from NYSE for the period January 1955 to December 1979 and found that portfolios consisting of small firms perform above average and portfolios consisting of large firms do below average. The authors also conducted tests for the effect of transaction costs and infrequent trading and proved that these are not adequate to explain excess returns for smaller firms.

Chan, Chen and Hsieh (1985) argue that small firm effect is not real but is due to the inappropriateness of asset pricing model. They found that the difference between returns of the smallest size portfolio and largest size portfolio reduced to 1.5 per cent from 11.5 per cent when APT model is used instead of CAPM. Thus they conclude that the size effect disappears when a more appropriate asset-pricing model is used.

Amihud and Mendleson (1986) proved that small firm effect is in part a compensation for ill liquidity. They argued that investors demand higher
expected returns for less liquid stocks since trading them involves higher transaction costs. Empirically small stocks have higher bid-ask spread and the price impact of larger purchases would be significant for such stocks. Thus illiquidity of stocks partially explains the small firm effect and the consequent miss-estimation of expected returns.

Chan and Chen (1991) call small firms as ‘marginal firms’ as they have low production efficiency and high leverage with lower probability of surviving economic hard times. Hence they argue that small firms are fundamentally riskier and claim size is serving as a proxy for this more fundamental risk.

Basu (1977) reports the earning-to-price ratio (E/P) effect in stock returns. Using a sample of 753 stocks from NYSE between September 1956 and August 1971, he tested the hypothesis that high E/P securities tend to outperform low E/P stocks. Based on this analysis, he argued that for the 14-year period studied, high E/P securities have higher expected returns than predicted by CAPM.

Reinganum (1981) in a study using 566 NYSE and AMEX stocks showed that single period CAPM is mis-specified. He argued that this mis specification of the equilibrium model is due to the impact of the omitted factors rather than market inefficiency. He identified firm size and E/P ratios as the omitted factors influencing the equilibrium model. Portfolios formed using E/P ratios indicate that high E/P portfolios consistently outperform low E/P portfolios.
Roll (1981) explained trading infrequency as the reason for the ‘small firm effect’ in stock returns. He found that because small firms are traded less frequently the risk measures of these firms were downward biased because of the auto correlation in portfolio returns caused by the infrequent trading in such firms. This bias is vary large in daily data and is also present in monthly data. According to the author this mis-assessment of risk has the potential to explain why small firms, high earnings-price ratio firms and high dividend yield firms display large excess risk adjusted returns.

Basu (1983) investigated the relation between E/P ratios, firm size and common stock returns using data taken from CRSP tape and COMPUSTAT file for the period between 1962 and 1978. This produced further evidence that small firms as well as firms with high E/P ratios have earned higher returns. The author suggested that this anomaly is probably due to mispecification of the asset pricing model. Both E/P and size variable may probably be proxy for some other macro economic variable not accounted for in the asset pricing model.

Another anomaly observed by researchers is the presence of seasonal patterns in security returns. Returns are systematically higher or lower depending on the time of the day, day of the week, and month of the year. Of these the most prominent is the monthly patterns; returns in January seem to be substantially higher than returns in other months. This is especially true of small stocks. Researchers provide microstructure explanations such as differences in bid-ask spread and tax-selling hypothesis for this January effect.
Branch (1977) and Reinganum (1983) observed that securities reached its annual low in the last week of December rose faster in the first four weeks of New Year. Branch (1977) analysed a trading rule that involved the purchase of a security that reached its annual low in the last week of December. He obtained an average returns eight per cent above the market returns for a four-week holding period. Reinganum (1983) also got similar results.

Gultekin and Gultekin (1983) looked into stock market seasonality in 17 countries including the United States. The null hypothesis of no seasonality was rejected for 12 of the 17 countries. The results were found to be supporting the tax selling and microstructure explanation for seasonality.

Tinic and Richard (1984) examined the seasonality in the basic relationship between expected returns and risks during the period 1935-82. The study reproduced and extended the study of Fama and MacBeth (1973). The results reveal that the positive relationship between returns and risks is unique to January. The risk premium during the rest of the eleven months is not significantly different from zero.

Jones, Pearce and Wilson (1987) found evidence that is against the tax-selling explanation for January effect. The presence of January effect was tested during a period 1821-1917 before the introduction of income tax in the U.S. They found January effect existed even before the introduction of income tax and there was no statistically significant change after taxation was introduced. Their study also confirms that January effect is closely related with small firm effect.
Corhay, Gabriel and Michel (1987) conducted an investigation about the seasonality in the risk-returns relationship in four stock exchanges: New York Stock Exchange, London Stock Exchange, Paris Stock Exchange and Brussels Stock Exchanges for the period January 1969 to December 1983. The study indicates that all the four markets have significantly positive January seasonal. In the U.S. significant positive returns existed only in January, in the U.K. April seasonal dominated January and in France July seasonal dominated January. To study the seasonality in risk-returns relationship, they adopted a methodology similar to Fama and MacBeth (1973). The results indicate that the coefficients of betas were not significantly different from zero, except in France where it was actually significantly negative. Thus, the investors in the U.S., the U.K. and Belgium are not compensated with higher returns for carrying higher risks. In fact investors in France were penalised for carrying higher risks.

Keim (1983) used data from CRSP\textsuperscript{13} daily stock files for a period between 1963 and 1979 to study the size and the January effect. The sample consisted of firms listed in NYSE and AMEX. The study supported strong January abnormal returns. He reports that difference in returns in January due to size are about half of the annual difference. Thus they argue that the size effect and the January effect are related.

Arbel and Strebel (1983) in their paper provide a ‘neglected firm effect’ for the small firm-in-January effect. Large ‘branded-name’ firms are subject to

\textsuperscript{13} Centre for Research in Security Prices, at University of Chicago.
considerable monitoring from institutional investors, which guarantee high quality information about such firms. But small firms tend to be neglected by large institutional investors; consequently, reliable information about such firms is less available. This information deficiency in small firms makes them riskier and command higher returns. Further Arbel (1985) divides firms into highly researched, moderately researched and neglected groups on the basis of the number of institutions holding the stock. He found January effect was the largest for the neglected firms.

Friend and Lang (1988) examined whether the small firm effect is due to the inadequacy of the risk measure used. To examine this, they considered three different measures of risk, namely, beta, variance of returns, and quality rating by S&P Guide. They tested the null hypothesis that size effect mainly reflects a risk effect and a significant part of the risk effect is not captured by usual measures of risk. The study reports that when quality rating was used as the risk measure, the size effect largely disappeared. Also, the size effect observed in monthly returns seems to be largely due to difference in January returns between large and small firms. This difference can also be completely explained by quality measure of risk. However, the authors could not find out a reason why quality rating plays such an important role in differentiating between large and small firms in January stock returns.

Ritter (1989) relates the small firm effect with January effect that is tied to tax-loss selling at the end of the year. Using daily buy/sell ratios of NYSE for a period of 15 years from December 17, 1970 through December 16, 1985, he
shows that the ratio reaches its annual low in late December and high in early January. This produces an unusual increase in the average returns of small stocks in early January. This phenomenon is termed as turn-of-the-year effect and Ritter proved that the year-to-year variation in the early January buy/sell ratio explains 46 per cent of the year-to-year variation in the turn-of-the-year effect during 1971-1985.

Keim (1989) provides a microstructure explanation for a part of January effect. He observes that CRSP tape calculates returns by using the closing price each month or the average of the bid and ask if the stock did not trade. He finds that the last trade in December was primarily at the bid, which causes returns to appear high in the first few days of January. Keim also observes that the tendency of stock to be at the bid price for the last trade in December was much more pronounced for small stocks. In addition, small stocks have a higher bid-ask spread and a lower price. Therefore the effect would be bigger for small stocks and would partially explain the difference in January effect between large and small stocks. He explains the tax-selling hypothesis as the reason for this.

Fama (1991) studied both size effect and January effect in the U.S stocks for the period 1941-1991. S&P 500 portfolio and CRSP small stock portfolio were used to represent large stocks and small stocks respectively. As per the results reported small stocks averaged a returns 8.06 per cent in January whereas large stocks had a January returns of 1.34 per cent only. In both cases, the January returns was higher than average returns in other months. However,
the difference of January returns and average returns of other months for small stocks are much larger than that for large stocks and thus he concludes that most of the January effect is associated with small stocks.

DeBondt and Thaler (1985) observed a long-term reversal effect, so that the best performing stocks in a given period tend to follow with poor performance in the following period, while poorly performing stocks in one period experience sizeable reversals over the subsequent period. They argued that this is because of the over reaction of investors. If a price increase is expected, they start buying, pushing up the prices beyond sustainable levels, but when they realize that the performance is against their expectation, they turn sellers and this will bring back price to normal levels. This kind of price reversals following a market over-reaction is called mean reversion. The authors have further reiterated this in their subsequent studies. (DeBondt and Thaler 1987, 1990)

In contrast to the long-term reversal effect, Jegadeesh and Titman (1993) suggest a short-term momentum effect. According to them short-term returns tend to continue; stocks with higher returns in the previous 3 to 12 months tend to have higher future returns. Accordingly, arbitrage strategies of buying stocks that have performed well in the past 3-12 months and simultaneously selling stocks that have performed poorly over the same period generate significant positive returns over the next 3 to 12 months holding periods in the U.S. equity markets. They argue that the profitability of these strategies is not due to the systematic risk or due to the delayed stock price reactions to common factors,
but due to the delayed price reactions to firm specific information. They further argue that longer-term performance of these past winners and losers reveals that half of their excess returns in the year following the portfolio formation date dissipate within the following two years.

Empirical works reported from capital markets outside the U.S. also produced mixed results regarding the empirical validity of CAPM. While Lau, Quay and Ramsay (1974) for Tokyo stock exchange and Levy (1980) for Israeli stock exchange support the validity of CAPM, Hawawini and Clade (1987) raise doubts about the validity of CAPM in the French capital market. His results show that in the French capital market the January returns exhibit size effect, but, for other months there was no significant size effect. Rubio (1988) found evidence of size effect in the Spanish capital market and he shows that around 47 per cent of size effect in the Spanish capital market was due to January effect. Hawawini (1989) rejects the validity of CAPM in the Tokyo stock exchange for the period 1955 to 1985 and Bark (1991) shows that the CAPM cannot be a valid model for Korean stock exchange between 1980 and 1987.

Chan, Hamao, and Lakonishok (1991) studied the impact of four firm specific variables size, earning-to-price ratio (E/P), book-to-market equity ratio (BE/ME) and cash flow-to-price ratio (C/P) on the cross sectional differences in returns in addition to the market beta on Japanese stocks. The data employed was monthly figures on stocks listed in Tokyo Stock Exchange from January 1971 to December 1988. They found that there existed significant relationship
between these variables and expected returns in Japanese stock market. Their results show that out of the four variables considered, the book-to-market ratio and cash flow price ratio have most significant positive impact on expected returns.

3.1.4 The Three-Factor Model

Fama and French (1992) studied the joint roles of market beta, size, earnings-to-price, debt-equity and book-to-market ratios in explaining the cross section of average stock returns in the U.S. stocks between July 1963 and December 1990. They found that when used alone or in combinations with other variables, beta had little information about average returns. When used alone firm size, book-to-market equity, debt-to-market equity and earning-to-price ratios have significant explanatory power. In the multivariate tests, the negative relation between size and average returns is found strong, even when these variables are used in combination with other variables. Similarly the positive relation between book-to-market equity and average returns also persists in competition with other variables. In combinations, size and book-to-market equity absorb the apparent roles of debt-to-market equity and earning-to-price ratios in average returns at least during the sample period.

Fama and French (1993) introduced a ‘Three Factor Model’ in the sprit of arbitrage pricing theory. They argued that the effects of size and book equity-to-market equity could be explained as manifestations of risk premiums. Using an arbitrage pricing type model they show that stocks with higher sensitivity on size or book-to-market factors have higher average returns. According to them
risk is determined by sensitivity of a stock to three factors (1) Market portfolio, 
(2) a portfolio that reflect relative returns of small verses large firms and, (3) a portfolio 
that reflects relative returns of firms with high verses low book-to-
market ratio firms. They argued that even though size and book equity -to-
market equity ratios are not direct factors affecting returns, they perhaps might be proxies for more fundamental determinants of risk. Thus they conclude that these patterns of returns are consistent with efficient market hypothesis in which expected returns depend solely on risk.

Lakonishok, Shleifer and Vishny (1994) provide a behavioural explanation for the relationship between returns and firm specific variables. They argue that value strategies of buying stocks that have low prices compared to earnings, dividends, book assets, etc produce higher returns not because these strategies are more risky, as argued by Fama and French (1993), but because these strategies exploit the sub-optimal behaviour of other naïve investors. Investors using naïve strategies extrapolate past performance too far into the future and therefore overprize firms with recent good performance and under prize firms with recent poor performance. Ultimately when market participants recognize their errors the prices reverse. This explanation is consistent with the reversal effect and also to a certain degree consistent with the small firm and book-to-market effect because firms with sharp price drop may tend to be small or have high book-to-market ratios.

La Porta (1996) also provides evidence against the risk story of Fama and French for the higher returns earned by value stocks. According to him, it is the
systematic errors in earnings expectations of analysts that produce higher returns in the value strategy. Based on survey data on forecasts by stock market analysts, taken from monthly IEBS\textsuperscript{14} tape, he argues that analysts are overly pessimistic about firms with low growth prospects, and overly optimistic about firms with high growth prospects. When these extreme expectations are corrected, low expected growth firms outperform high-expected growth firms. When portfolios are formed on the basis of expected growth rates in earnings, low expected earning growth rate stocks yield not only higher average returns, but also have significantly lower standard deviations and betas than high expected earning growth rate stocks. Accordingly he argues that low expected earning growth rate stocks could not be considered as more risky than high expected earning growth rate stocks. These arguments are consistent with the arguments of DeBondt and Thaler (1990), who also find systematic errors in the analyst’s expectations.

Fama and French (1996) show that the Three Factor Model introduced in Fama and French (1993) captures the CAPM anomalies associated with size, E/P ratio, C/P ratio, BE/ME ratio, past sales growth and long term past returns to a great extent. Based on data taken from NYSE, AMEX and NASDAQ for the period 1963-1993, they test the model using portfolios formed on (i) Fama French (1993) double sorted size-BE/ME portfolios, (ii) LSV\textsuperscript{15} deciles formed on BE/ME, E/P, C/P and five year sales rank sorts, (iii) LSV double sorted portfolios obtained by combining sorts on sales rank with sorts on BE/ME, E/P

\textsuperscript{14} Institutional Brokers Estimates System
\textsuperscript{15} Lakonishok, Shleifer and Vishny (1994)
and C/P, (iv) portfolios formed on long term past returns as suggested by DeBondt and Thaler (1985) and (v) portfolios formed on short term past returns as suggested by Jegadeesh and Titman (1993). They find that except for the continuation of short-term returns, all other patterns disappear in the three-factor model. Thus they conclude that factors such as E/P, C/P, sales growth, and long term past returns do not uncover dimensions of risks beyond those provided by size and BE/ME.

Loughran (1997) contradicts the arguments of Fama and French that the stocks with high BE/ME ratios consistently provide higher returns than low BE/ME ratio stocks. He argues with empirical evidence that, there is a remarkable conflict between the academic arguments of value story and the actual performance of fund managers.

Daniel and Titman (1997) provide a new behavioural explanation for the value premium, which is different from that given by the previous authors. According to them, investors like growth stocks and dislike value stocks. This specific characteristic of the investors produces the value premium due to the induced low price and the resulting high expected returns of the value stocks relative to growth stocks. Besides, they observed that the results of the Fama-French portfolios when separated for seasonality indicate that size effect is exclusively a January phenomenon and BE/ME effect occurs largely in January for bigger firms only.

Black (1993) and MacKinlay (1995) questioned the presence of value premium in the U.S. stocks documented by Fama and French and various other
authors by arguing that the phenomena are sample specific and their appearance in the past U.S returns need not recur in future returns. Fama and French (1998) strongly contradict these arguments by proving that the value premium is indeed pervasive. Using data from thirteen major markets both developed and developing (the U.S and other twelve markets), they showed that when sorted on BE/ME ratio value stocks outperform growth stocks in twelve markets out of the thirteen considered during 1975-1995. They got similar value premium when portfolios are formed on sorts of E/P, C/P and D/P\textsuperscript{16}.

Davis, Fama and French (2000) test the validity of the three-factor risk model for a long period of 68 years from July 1929 to June 1997. They proved that the value premium in the U.S stock returns is robust throughout this period. Further they contradict the arguments in favour of the characteristic model suggested by Daniel and Titman (1997) using the very same methodology. It is argued that the evidence in favour of characteristic model of Daniel and Titman (1997) is special to their short sample period. The more powerful tests done by the authors support the risk model against the characteristic model in explaining the relation between BE/ME ratio and average stock returns.

Bartholdy and Paula (2002) conducted a comparison of the performance of ‘Fama French Three Factor Model’ with that of CAPM in explaining the variations of the expected returns of individual stocks. They applied a

\textsuperscript{16} Dividend / Price
methodology based on two-pass regressions (similar to the one introduced in Fama and MacBeth, 1973) on a sample of stocks taken from CRSP tape for the period 1970 to 1996. Based on the analysis, they conclude that Fama French Model does not perform significantly better than CAPM when applied to individual stocks. They consider this as the possible reason why CAPM is used so extensively by practitioners despite the recommendations in favour of the three-factor model from the academic world; the additional cost associated with Fama French model is not justified.

Fama and French (2003) confirm the findings of earlier researchers about the flat relationship between market beta and average portfolio returns. They used a wider database of the U.S. common stocks involving NYSE, AMEX and NASDAQ stocks for a long period of 75 years from 1928 to 2003 taken from CRSP file. One-month U.S. Treasury bill rate and CRSP value weight portfolio of U.S. common stocks were respectively used as the risk-free rate and market proxy for the analysis. The analysis by using beta-sorted portfolios shows that though the relationship between beta and average returns is linear, it is much flatter than what is predicted by standard version of CAPM. In order to investigate the influence of price ratios on the risk-returns relationship, they repeat the analysis by using portfolios obtained by sorting stocks on their annual BE/ME ratio values. Though the average returns of these portfolios increase almost monotonically with the BE/ME ratio values, the relation between average returns and beta was not positive as predicted by CAPM. These results confirm the findings of Lakonishok, Shleifer and Vishny.
(1994) and Fama and French (1996,1998) that when portfolios are formed on price ratios, average returns are not positively related to market betas.

Ang and Chen (2003) questioned the findings of earlier researchers in favour of the existence of strong value premium that is left unexplained by CAPM over the post 1963 period. For the long period of 1926 to 2001 they found that standard CAPM performs remarkably well and explains the cross sectional variations in the expected returns of BE/ME portfolios. This, in contrast to the strong supporting evidence of the existence of value premium in the post 1963 period raises two possible statistical concerns. (1) The post 1963 period may not be long enough to use asymptotic standard errors for making inferences (2) The market betas may not be constant over time as assumed by the standard CAPM (the authors find that value stocks with high BE/ME ratios have high beta values in the early part of the 1900’s but have low beta values in the latter part). To address these two potential problems, they estimate a conditional CAPM with time varying betas similar to the one initially developed by Harvey (1989). Then, to make accurate inferences regarding the book-to-market effect in the post 1963 sample, they used the exact sampling distribution of the parameters estimated. Based on this analysis, they found that while deviations from CAPM due to BE/ME effects are highly significant in analysis using asymptotic standard errors, they are not at all significant when controlled for small sample biases. Hence they conclude that there is no need for additional risk factors to explain the book equity-to-market equity effect. However when the same methodology is applied to analyse the momentum
effect of Jegadeesh and Titman (1993) and the reversal effect of DeBondt and Thaler (1985), they found the existence of momentum effect, but failed to find evidence of any reversal effect.

Naughton and Madhu (2005) show that Fama French three-factor model is valid in three major Asia Pacific markets, Indonesia, Singapore and Taiwan during the period 1976 to 1996. They used the same methodology as of Fama and French (1993) for the formation of factor portfolios and for the empirical analysis. Among the three factors considered, the market factor was found to be the most significant in all the markets. The size and book-to-market factors also follow similar patterns across countries, but vary in terms of degrees of significance. The study rejects the claim that findings of the three-factor model can be explained by the turn-of-the-year effect. Thus based on the empirical findings the authors conclude that all the three factors put forward by Fama and French do a reasonable job in explaining the cross sectional variations in stock returns.

3.2 Empirical Studies Conducted in India

The empirical studies conducted in Indian capital market in connection with the efficiency of stock markets can generally be divided into three categories, studies on the random walk hypothesis (i.e. on the weak form of capital market efficiency), studies on the presence of seasonal patterns in the stock returns and studies on the empirical validity of asset pricing models.
3.2.1 Random Walk Hypothesis

One of the earliest empirical works in the area of stock price movements in India was done by Krishna Rao and Mukherjee (1971) on the randomness of the share price movements of Indian Aluminium Company. By taking weekly average of daily closing quotations of this share for the period 1955-1970, they show that the data is supportive of the hypothesis that the price movements are random. After this another work in this direction was done by Ray (1976). He constructed index series for six industries as well as for all industries together and examined the hypothesis of independence on these series. Even though he could not arrive at a definite conclusion, the tilt was towards the rejection of the null hypothesis of independence.

Barua (1981) examined weak form of ‘capital market efficiency’ by testing the ‘Random Walk Hypothesis’ (RWH). The sample he used consists of daily closing price quotations of 20 securities taken from Mumbai stock exchange and an Index (constructed as value weighted average of more than 150 securities) over a period of two years from July 1977 to June 1979. Though the variations in the index showed a non-random behaviour, the results of the individual securities were supportive of the null hypothesis of randomness. By using the arguments suggested by Moore (1964), Barua explained that this non-random behaviour of index movements cannot be considered as a symptom of inefficiency. As market index reflects the overall economic environment, it may show up non-random behaviour, if the economy shows a definite trend of growth or decline. Barua provides another possible
explanation for the observed index behaviour in terms of the ‘leader-follower relationships’ existing in capital markets. Thus the study concludes that Indian capital market is at least weakly efficient.

Sharma (1983) tested the market efficiency in Indian capital market by using a sample of 23 stocks listed in Mumbai stock exchange between the periods 1973 and 1978. The results indicate that Random walk hypothesis holds for Mumbai stock exchange during the period.

By taking the special case of Reliance issue of convertible debentures, Barua and Raghunathan (1986) argued that Indian capital market is inefficient. They established that an investor operating on rights issues and convertible debentures simultaneously in forward and cash markets can earn abnormal returns, compared to an investor operating in cash market alone. Gupta (1987) in response to this article criticised that the findings of Barua and Raghunathan are erroneous, as they were based on many assumptions and a hypothetical example of a particular investor. Barua and Raghunathan (1987) re-examined their risk-returns evaluation, based on the actual returns and by following different strategies. As per the results, they argued that their conclusion on market inefficiency remains valid.

Krishna Rao (1988) tested weak form of efficiency of Indian Capital Market using a sample of 10 blue chip companies listed in BSE for the period July 1982 to June 1987. The result of this study supports the hypothesis that Indian capital market is at least weakly efficient. Srinivasan, Mohapatra and

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17 The increase in the price of leader is followed by a rise in price of follower with a lag of k periods
Sahu (1988) have also reported strong supporting evidence that stock prices in India move like a random walk. But the study conducted by Maheswari and Vanjara (1989) on a sample of 142 securities during the period January 1980 to December 1986 concludes that Indian capital market is not very efficient.

Vaidyanathan and Gali (1994) examined whether Indian capital market is weakly efficient by using daily closing prices of 10 stocks actively trading in BSE. They have applied runs test, serial correlation and filter rule test and the evidence from all these tests supports the weak form of efficient market hypothesis.

Bhaumik (1997) found that the stock prices movements closely represent a random walk in BSE. He tested the market efficiency by using SENSEX data for 115 days starting from November 1996. Ramasastri (1999) also did not reject random walk hypothesis during the 1990s by using Dickey-Fuller unit root test.

Madhusoodanan (1998) argued that random walk hypothesis could not be accepted in Indian capital market, as there exists the tendency of ‘mean-reversion’ and ‘overreaction’ in the movements of stock prices (similar to that pointed out in DeBondt and Thaler, 1985). To investigate this, he applied ‘variance ratio test’ on both aggregate level market indices and disaggregate level of individual stocks for the period January 1987 to December 1995. In both these cases, he found a large number of significant autocorrelations that are positive at lower lags and negative at higher lags, indicating the possibility of long-term mean reversion. As the variance ratio test conducted under the
assumption of both homoscedasticity and heteroscedasticity provides similar results, he argued that heteroscedasticity does not play an important role in Indian stock markets.

Ramasastri (1999) applied the unit root test to examine the existence of weak form of capital market efficiency in India in the wake of recent capital market reforms. He used daily closing prices of SENSEX for a period of eight years from January 1991 to December 1998 for the analysis. The study concludes that Indian capital market is weakly efficient during the study period.

Pant and Bishnoi (2001) examined random walk hypothesis on five major stock market indices namely BSE SENSEX, BSE National Index, BSE 200, NSE Nifty, and NSE 500 between 1996 and 2001. Based on the variance ratio test they reject random walk hypothesis for all these indices on both daily and weekly returns. As the variance ratio test resulted in the rejection of the hypothesis on heteroscedastic and homoscedastic assumptions they arrived at the conclusion that heteroscedasticity is not a source of non-randomness of these indices. In the absence of heteroscedasticity and non-trading problems variance ratio test turns out to be a test of mean reversion behaviour (Lo & MacKinlay, 1988). Hence the results of the study confirm the mean reverting behaviour of stock indices.

obey random walk hypothesis. Samanta (2004) used daily data on BSE-100 to test weak form of efficiency for the period January 1993 to December 2001. He partitioned the entire period to various sub periods and tested separately each sub period. The study shows that the market was considerably inefficient till June 1996. It achieved high level of efficiency during July 1996 to December 1999 and showed relatively lower level of efficiency thereafter. Dhankar and Chakraborty (2005) also proved dependency in SENSEX series by using variance ratio test.

Bodla (2005) in his paper tested weak form of market efficiency for a period of three years from January 2001 to December 2003. They have applied two tests, namely the ‘run test’ and ‘serial correlation test’ on the daily closing prices of 47 scrips of S & P CNX Nifty. The study accepted the null hypothesis that stock prices are random walks and hence conclude that there is no possibility of continuously making extra profits by forecasting the security prices.

Ahmad, Ashraf and Ahmed (2006) examined the weak form of market efficiency in Indian stock markets for the period 1999 to 2004. To examine if the efficiency level improves over time they divide the period of analysis into two equal sub-periods, 1999-2001 and 2002-2004. Based on the empirical results, they reject random walk hypothesis for both the Nifty and SENSEX indices. The comparison of the efficiency level reveals that second period is more inefficient than the first period. Thus, based on the empirical results, the authors conclude that Indian stock markets are inefficient even after the recent
reforms, as a result of which the market players can earn higher than expected returns by using suitable trading strategies.

A latest study by Patrick and Francy (2008) shows that Indian capital market is at least weakly efficient. They have used variance ratio test to investigate the RWH both at the aggregated and disaggregated level for the period 2001 to 2007. The disaggregated level analysis made use of daily closing prices of a sample of individual securities and for the aggregated level analysis the closing price series of four popular stock market indices, CNX Nifty, Nifty Junior, CNX Midcap and CNX 500, of national stock exchange were used. While the results of aggregate level analysis indicate the existence of non-randomness in the movements of Nifty, the results of disaggregate level analysis were found to support the existence of random walk hypothesis, when the test statistic is adjusted for heteroscedasticity. They argue that Nifty being the most popular stock market index in India, it is expected to reflect the overall changes in the economy. Hence the non-randomness in its movements is not surprising. Thus they conclude that the appearance of stock price dependency on the past price data in Indian bourses is not real as claimed by a section of analysts, but because of the spurious correlation and the presence of heteroscedasticity.

3.2.2 Existence of Seasonal Patterns

The existence of seasonality in stock price movements is against the efficient market hypothesis, because in such markets investors would be able to earn abnormal returns by formulating suitable trading strategies based on the
observed seasonality. In Indian capital market several authors have documented evidence for the existence of seasonal patterns.

Mittal (1994), using daily returns data of BSE National Index for the period January 1990 to February 1993, shows that daily returns are most negative for Tuesday and most positive for Friday. Hence, investors can make use of this information to make excess returns by trading in National Index portfolio.

Poshakwale (1996) by using tests of first order autocorrelation on daily returns of BSE National Index series for the period January 1987 to October 1994 prove that there exists weekend effect in BSE during the period. Arumugam (1998) tested weekend effect on BSE SENSEX for the period April 1979 to March 1997 by using multiple regression analysis and found the existence of positive Friday returns and significant negative Monday returns. Anshuman and Goswami (1999) also documented weekend effect in BSE during April 1991 to March 1996. Using equally weighted portfolio constructed from 70 stocks listed in BSE, they show that there exist above average positive Friday returns and below average negative Tuesday returns during that period.

Madhusudan and Chakrborty (2000) examined the ‘Monthly Effect’ and ‘Turn-of-the Month Effect’ in Indian stock markets, which were first documented respectively by Ariel (1987) and Lakonishok and Smidt (1988) in

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18 The daily average returns during the first half of a month is significantly higher than that during the second half.
19 Average daily returns at the turn-of-the month are higher than average daily returns during the remaining days of the month.
the U.S. markets. Using continuously compounded returns calculated for the ‘Economic Times Index of Ordinary Share Prices’ for the period January 1981 to December 1985, they proved the existence of the two anomalies in India. They also considered various explanations for the observed anomalies including the problem of ‘data mining’, proxy for other anomalies, etc., but could not come up with adequate explanations.

Amanulla and Thiripalraju (2001) report inefficiency in Indian stock markets by producing evidence of the existence of day-of-the week effect during the period January 1990 to December 1999. They conducted an investigation of the day-of-the week effect on 82 individual securities listed in BSE, four beta sorted portfolios constructed using the 82 securities, BSE SENSEX portfolio, BSE National Index portfolio and S&P CNX Nifty portfolio. The study also points to the possibility that differing trading operations and settlement period between BSE and NSE that existed during the period of study have an impact on the day of the week effect.

Pandey (2002) investigated the existence of seasonality in stock returns in India using monthly closing prices of BSE SENSEX for the period April 1991 to March 2002. In order to address the econometrical issues such as autocorrelation and heteroscedasticity he has adopted a robust parametric methodology called ‘Mixed ARIMA-GARCH-in-Mean Model’ for the empirical analysis. The results of the study confirmed the existence of seasonality in India. The study also reports that Indian investors sell shares that have incurred loss in March to save tax, but they do not rush for buying shares.
immediately after the tax month as observed in some developed markets. Thus the evidence of the study partially supports tax-loss-selling hypothesis. The overall results of the study imply that in Indian stock markets investors can earn abnormal returns by timing their investments. Nath and Dalvi (2005) also arrived at a similar result by establishing the existence of the day-of-the-week effect on Nifty portfolio for the period 1999 to 2003.

3.2.3 Tests of CAPM

Despite the existence of an organised capital market for a long period, Indian capital market has not been researched much for evidence of applicability of asset pricing models. Gupta (1981) studied share price behaviour in Indian capital market for the period 1960-1976. A sample of 606 shares taken from Mumbai, Kolkata and Chennai stock exchanges were used in this study. The average rates of returns for securities were compared with returns on debentures, preference shares, company deposits, and long-term bank deposits and it was found that returns rates of securities were less most of the time. Though the author did not conduct a direct test of CAPM from the results obtained, he expressed his doubt regarding the applicability of CAPM in India.

The first detailed investigation of empirical validity of CAPM in India was done by Yalwar (1985) by using a sample of 122 actively traded shares from the Mumbai stock exchange for the period 1963-1982. An equally weighted index of the sample stocks and bank rate were respectively used as the proxy for market portfolio and risk free rate for testing the explanatory
power of CAPM. The results of the study show CAPM holds good in Indian capital market during the period of study. The study also examined the random walk hypothesis and it was found that BSE is efficient at least in the weak sense as far as pricing of actively traded shares is concerned.

Srinivasan (1988) using share prices of 85 firms listed in Mumbai and Kolkata stock exchanges and Economic Time Index of ordinary shares as market proxy conducted a simple empirical test of CAPM for the period 1982 to 1985. His study suggests that though CAPM is not holding exactly, the spirit of CAPM is holding good in India. Further, he notes the non-existence of fundamental assumptions of CAPM in Indian capital market as the possible reasons for the discrepancy observed and hopes “With the march of information technology, innovation in capital market and economic rationality in decision making, the empirical line is expected to close into CAPM line in the long run”. But, when Bansal (1988) used a larger sample of 200 firms and a broad market index provided by RBI (Reserve Bank of India Index of Ordinary Shares) as market proxy for the period 1972-84 got results supportive of the existence of CAPM in India.

Gupta and Sehgal (1993) using the monthly returns of 30 securities included in SENSEX examined the validity of CAPM in Mumbai Stock Exchange between the periods April 1979 to March 1989 by taking BSE SENSEX as the market proxy. Based on the results, they found that the CAPM hypotheses such as positive relation between returns and risk, equivalence of intercept and risk premium respectively with the risk free rate and excess
market returns seem to hold in general. But they found traces of non-linearity in the relation between risk and returns, which is against CAPM. Thus they conclude that even though the model is a good indicator of asset pricing, it cannot be considered as perfect because of the non-linearity in the risk-returns relation. The authors consider their research as only suggestive and not conclusive as the time period studied was limited and the number of stocks sampled was small.

Ray Subatra (1994) conducted a detailed investigation of empirical validity of CAPM in India for the period 1980-1991 using Fama-MacBeth methodology. He used data on monthly returns of 170 actively traded shares listed in BSE and three indices, Reserve Bank of India Index of ordinary shares, Economic Time Index and BSE SENSEX as market proxies for the study. The results with none of these indices were supportive of the existence of CAPM. He infers the non-validity of efficient market assumptions behind CAPM as the possible reason for the rejection of CAPM hypotheses. On the basis of a separate investigation, he finds that non-diversified portfolio holding, high level of speculation, lower liquidity levels and existence of insider trading as major factors that caused inefficiency in Indian capital market which in turn makes CAPM invalid in India.

Based on a sample of 120 stocks listed in BSE Madhusoodanan (1997) rejects the empirical validity of CAPM in India for the period 1987 to 1995. He used both BSE SENSEX and BSE National Index to study the relationship between beta and average returns and did not find any positive relation in both
the cases. His results show that the maximum risky portfolio gives only minimum returns while the minimum risky portfolio yields higher returns. Accordingly, he suggests that the high-risk high-returns strategy would not be rewarding in the Indian context. Sehgal (1997) also reports a negative relationship between beta and returns in his study for the period 1984 to 1993.

Vipul (1998) examined the explanatory power of CAPM in Indian capital market in comparison to two naive propositions of ‘zero valued’ betas and ‘unit valued’ betas across securities. Using the methodology of two pass regression, he arrived at the conclusion that CAPM is only marginally superior to ‘unit beta’ proposition which in turn is much stronger than ‘zero beta’ proposition. He also proved that the returns on zero beta portfolio is time variant in Indian capital market and it varies over a wide range. These two conclusions make CAPM is of limited applicability for forecasting returns in Indian capital market.

Rao, et al (1998) studied the impact of time interval and market proxy on the calculation of beta values for using in CAPM applications. The beta values of the sample stocks (the hundred stocks making up BSE100 index) were evaluated on daily, weekly, monthly and quarterly basis with reference to BSE SENSEX, NSE Nifty, BSE 200 and CRISIL 500 for the period between 1992 and 1995. They found that the time interval choice did not have a significant impact on the calculated values of beta, but the choice of market

\[ E(R_i) = E(R_0) \]

\[ E(R_i) = E(R_M) \]
proxy could significantly change the values of betas. Further they could not find out any evidence for one market proxy consistently giving higher/ lower betas vis-à-vis another. The second pass CAPM regression estimated on returns and stock betas calculated with BSE 200 was significant with quarterly returns, but insignificant with monthly and weekly returns. Hence the authors recommend quarterly returns calculations for CAPM applications. The paper also finds that the majority of stocks considered have not rewarded investors appropriately during the period of study.

Ansari (2000) investigated the applicability of CAPM in India over the period January 1990 to December 1996 using a sample of 96 stocks listed in BSE. They used BSE SENSEX as the proxy for market portfolio and term deposit rate with commercial banks as the surrogate for risk-free rate. Although the empirical evidence does not reject the model, the relationship obtained between beta and portfolio returns was very weak. Considering the limitations of the studies conducted on CAPM in India, including his own, he suggests that more rigorous tests are needed before taking any definite conclusion about the model. Narayana and Lakshmi (2001) also obtained that the relationship between systematic risk and returns is weak in Indian stock market.

The relevance of betas as a measure of systematic risk depends on its stationarity over time. Chawla (2001) examined this stationarity of betas in the Indian stock market. The data consists of monthly returns of 36 securities (belonging to nine industry groups) that form a part of BSE-100 index for the
period March 1996 to March 2000. The four year analysis period is further subdivided into four sub periods, each of one year length and beta values of the sample companies were evaluated with reference to BSE-100 index by using market model of Sharpe. The stability of beta was examined by using two alternative econometric methods, adding one more explanatory variable involving time to the market model and by using dummy variable technique. Both these tests resulted in the rejection of the stability of beta in a majority of cases; hence the author concludes that betas, in Indian stock market, are unstable over time.

Manickaraj and Lokanathan (2004) examined the stationarity of beta values in Indian capital market for the period 1990-1996, based on the weekly returns of 38 randomly selected securities listed in BSE. Both SENSEX and BSE-100 Index were used as market indices to see whether there is any significant difference between these two indices in this aspect. The empirical results suggest that betas of individual securities and small portfolios are not stable over time and hence cannot be used as a measure of future risk. Further the portfolio betas showed a regression tendency to move towards the mean beta one. It is also found that there is not much difference between SENSEX and BSE-100 in these aspects. As the sample size used is only 38 they could not study the behaviour of betas of portfolios of size 10 or more. Hence the authors suggested that a study with larger sample and longer time horizons is needed to arrive at definite conclusions about these concepts in Indian capital market.
3.2.4 Influence of Firm Specific Variables

In the late 1990s and early 2000s, several attempts were made in India to study the impact of firm specific variables on the average returns of assets. Mohanty (1998) examined the impact of P/E effect, book-to-market effect and size effect in Indian capital market by using two samples, a small sample of 112 scrips and a large sample of 2135 scrips. He finds that book-to-market effect and P/E effects are more dominant in India than size effect. Chaturvedi (2000) examined the existence of P/E effect in India by using a sample of 90 scrips for a six-year period 1990-1996. He concludes that significant P/E effect exists in India during his study period.

Mohanty (2002) examined the effect of a number of firm specific characteristics, such as size, book-to-market equity ratio, price-to-earning ratio, book leverage\(^{22}\), market leverage\(^{23}\), price-to-cash flow ratio, price-to-sales ratio, and market beta in explaining cross sectional variations of stock returns over the period 1991 to 2000. By using Fama MacBeth (1973) methodology on individual securities of the sample, he found variables size, market leverage, book-to-market ratio, and price-earning ratio are significant in explaining stock returns, of which size is the most significant variable. Moreover, he observed that variables other than size did not have any additional explanatory power, once the size effect had been adjusted for. This implies that size captures the effects of the other variables in Indian stock markets. The study also finds that

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\(^{22}\) Ratio of total book assets to total book equity

\(^{23}\) Ratio of market value of assets to market value of equity
the relationship between returns and market beta as weak during the analysis period. Sehgal (2002), Sehgal (2003) and Muneesh and Sehgal (2004) also report the existence of strong size effect in India.

Sehgal and Tripathi (2005) conducted an investigation of the existence of size effect in Indian capital market for the period 1990-2003 by using a sample of 482 companies forming a part of BSE 500 index. They used six alternative size measures, viz. market capitalisation, enterprise value, net annual sales, total assets and net working capital for the analysis. The study reports the existence of strong size effect in India, irrespective of the size measures used. When market capitalisation is used as size measure the size premium obtained as substantially high. Further, they observed that the size effect is not an outcome of any seasonality or business cycle effect and the size based investment strategy is economically feasible, as it provides extra normal returns in risk adjusted basis. This raises doubts about the semi strong form of market efficiency in India.

Deb, et al (2006) examined the existence of value premium in India for the period 1990-2005. The data consists of month end adjusted closing price and price-to-book ratio (P/B) values of stocks from the A and B1 group of BSE. The entire study period was divided into two sub periods: 1990-1996 and 1997-2005. They found that value premium existed in India particularly during the second phase of their study period. It is also observed that the value premium is considerable over a shorter holding period and it gradually declines as the holding period becomes longer.
Sehgal and Tripathi (2007) investigated value effect in the Indian stock market by using alternative value measures such as book equity-to-market equity (BE/ME), earnings-to-price (E/P), cash flows-to-price (C/P) and dividends-to-price (D/P). The basic data consists of month end adjusted prices of 482 companies forming part of BSE 500 equity index over the period 1990-2003. The study reports existence of statistically significant value effect on unadjusted as well as risk-adjusted basis on all the value measures used. The study also found operating profitability, size and financial leverage as the three important sources of value effect.

There is no much empirical work reported from Indian capital market on the validity Fama-French Three-Factor model. Connon and Sehgal (2003) is one of the available works in this area. Their analysis is based on monthly returns series of a sample of 364 companies that form a part of CRISIL 500 portfolio for the period 1989 to 1999. The results they obtained are generally supportive of the model; all the three factors market, size and value have pervasive influence on stock returns in Indian stock market. Of the three factors considered, the market factor ranks first in explanatory power, but they could not arrive at a clear ranking of the other two factors. Fama and French (1995) show that in the U.S. the market, size and value risk factors that are pervasive in stock returns are pervasive in earning growth rates also. Connon and Sehgal could not arrive at any significant evidence supportive of this linkage between risk factors in stock returns and earning estimates. However, based on the empirical evidences obtained, the authors conclude that the three-
factor model is applicable to Indian capital market and it captures a majority of cross sectional variations in stock returns missed by CAPM.

Sehgal and Balakrishnan (2004) examined momentum effect in security returns in Indian stock markets using the monthly returns of a sample of 364 stocks of CRISIL 500 portfolio for the period 1989 to 1999. To examine whether the momentum effect is pervasive in different types of portfolios, they formed momentum portfolios for the whole sample dividing the sample into two halves on the basis of size and book-to-market equity ratios. The results show that the mean monthly returns on these momentum portfolios are quite large, except in a very few cases. Moreover, the existence of momentum profits in portfolios formed on size and book-to-market equity ratios showed that momentum could not be solely attributed to firm specific returns. Further, they showed by fitting respective asset pricing models to the data that the momentum returns that are missed by CAPM are partially explained by the Fama-French Three-Factor model.

3.3 Conclusion

Though Capital Asset Pricing Model is a fundamental contribution to the asset pricing theory, studies evaluating its empirical validity conducted since 1980 in the U.S. and other developed markets have reported several anomalies of the model. Almost all these studies have argued that the returns generating process depends on certain firm specific characteristics in addition to the market beta. A critical evaluation of these studies together with Roll’s (1977)
criticism leads to the following conclusion. As an equilibrium asset-pricing model CAPM cannot be considered as a theoretical failure. Depending upon the existing market conditions and the market proxy used, the explanatory power of the model can vary from market to market and even from time to time. Identifying suitable factors and using a multifactor model obtained by adding these identified factors as additional explanatory variables the explanatory power of the model can be significantly increased.

Empirical studies conducted in India in connection with the stock market efficiency have produced mixed results. While a majority of the studies conducted up to the middle of the 1990s accepted the random walk hypothesis, studies conducted afterwards rejected capital market efficiency in its weak form itself. This rejection of capital market efficiency even after the massive stock market reforms has caused great concern among researchers. As Indian economy is now on the path of consistent growth, one has to be very careful in interpreting the rejection of random walk hypothesis as a symptom of capital market inefficiency.

It is well known that efficiency of capital markets is to be evaluated in terms of the existing risk-returns relationship. This can be evaluated only by testing the empirical validity of risk-returns models such as CAPM. The literature review shows that the number of studies conducted in India in this area is very limited and at the same time they have produced mixed results. A critical evaluation reveals that these studies have major limitations in terms of the length of the period of analysis, sample size used and methodology
adopted. Some aspects of inefficiency have been studied, using limited databases. But there is no comprehensive study analysing the empirical validity of asset pricing models, especially after the recent stock market reforms. While the present study is directed towards that goal, the immediate question will be: what should be the empirical methodology in the CAPM framework for such a study? The next chapter is a discussion about the empirical methodology adopted in the study.