The Capital Asset Pricing Model (CAPM) is one of the most important contributions in finance and arguably the most widely used (Ross, Westerfield, and Jordan, 1996). According to the model, expected stock returns are determined by their corresponding level of systematic risk or \( \beta \). In other words, the market does not reward the risks that are borne unnecessarily. The model has applications in a variety of settings like measuring cost of capital, event studies, and management and appraisal of portfolios. It has enabled economists to quantify risk and the reward for bearing it.

The portfolio theory of Markowitz (1952, 1959) (Box 1) provided the basis for CAPM. Markowitz cast the investor's portfolio selection problem in terms of expected return and risk and prescribed what investors should do. According to Modigliani and Pogue (1974), "CAPM is based on elementary logic and simple economic principles." CAPM relates expected return on any asset to market risk. It identifies two types of risk — the risk associated with market in general, systematic risk, and the risk specific to the company, unsystematic risk. The unsystematic risk can be eliminated by the investors by holding a diversified portfolio. However, the systematic risk cannot be eliminated even if one holds virtually all the stocks.

The kernel of CAPM is that risk that can be diversified away is not rewarded in the market place. It is the component of total risk that cannot be diversified away that matters and not the total risk. The systematic risk is measured by \( \beta \) — the sensitivity of a security's return to market return. These sensitivities differ from security to security. There are some securities that are more volatile than others. When the stock markets rise, these securities rise faster and higher than the market and when the stock market falls, they fall faster and further. CAPM states that differences in the expected return of any two assets are due to differences in \( \beta \) (market sensitivity). The securities with higher (lower) \( \beta \) or higher (lower) market sensitivity will offer higher (lower) return. (See Box 2 for details of the model and its applications).
market efficiency as noted by Fama, 1991. Among the most controversial aspects of debate on return predictability based on these characteristics is in return as the CAPM predicts. The evidence on words, differences in $\beta$ do not account for differences explaining cross-sectional variation in returns. In other performance have more explanatory power than $P$ in $\frac{B}{M}$, the ratio of book value of equity to market equity (MF.) (a stock’s price times shares outstanding) bolsters the explanation of the cross-section of average returns. Average returns on low ME stocks are too high given their $\beta$ estimates and average returns on large stocks are too low.

The early evidence of the model was largely supportive of CAPM, with Black, Jensen and Scholes (1972), Fama and Macbeth (1973), and Blume and Friend (1973) reporting findings consistent with the CAPM central prediction. Although some of the findings refuted the Sharpe-Lintner version of CAPM, this could be explained through no lending or borrowing version, i.e. zero $\beta$ CAPM (Black, 1972).

In the late 1970s, CAPM came under attack as striking anomalies of CAPM were reported. These anomalies underlined the fact that firm characteristics such as company size (measured by market capitalization of common stock), the ratio of book-to-market value, price-to-earning ratio, and prior return performance have more explanatory power than $P$ in explaining cross-sectional variation in returns. In other words, differences in $\beta$ do not account for differences in return as the CAPM predicts. The evidence on return predictability based on these characteristics is among the most controversial aspects of debate on market efficiency as noted by Fama, 1991.

One of the earliest anomalies as reported by Basu (1977) related to price-earning ratio effect. Firms with low price-earning ratio yielded higher sample return and firms with higher price-earning ratio produced lower returns than justified by $\beta$. Banz (1981) also reported the empirical contradiction of the SLB model in terms of size effect. He finds that market capitalization or market equity (MF.) (a stock’s price times shares outstanding) bolsters the explanation of the cross-section of average returns. Average returns on low ME stocks are too high given their $\beta$ estimates and average returns on large stocks are too low.

Fama and French (1992,1993,1996) reported that $\beta$ as a sole explanatory factor of the sample return is dead. They argued that portfolios formed on the basis of ratio of book value of equity to market value and size (market capitalization) earn higher returns than what is predicted by CAPM. Thus, size and book-to-market ratio can capture the cross-sectional differences in return better than $\beta$.

Fama and French (1992) reported two unfavourable conclusions about the empirical adequacy of CAPM.

(i) The univariate relation between $\beta$ and average return for 50 years (1941-1990) is weak. Further, the relation between $\beta$ and average return disappears during the most recent 1963-1990 period, even when $\beta$ alone is used to explain average return.

(ii) $\beta$ does not capture average returns. Size and book value to market ratio help explain differences in average returns that are missed by $\beta$.

Thus, their findings are at variance with the central prediction of the SLB model that average stock returns are positively related to market ps. According to Fama and French (1992), "variables that have no special standing in asset pricing theory show reliable

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**Box 1: Portfolio Theory**

The birth of modern theory of investment can be traced to 1950s when Markowitz developed the portfolio theory. Before he came up with his theory, investors did not have a concrete measure of risk and return, although they were not unaware of adages like "don't put all your eggs in one basket." It goes to the credit of Markowitz that he developed mathematically the concept of diversification. Portfolio means a mix of assets (both real and financial) invested in and held by an investor. Diversification is the act of holding many securities to lessen risk. Markowitz proved that if investors balanced their investment among several securities, it was possible to reduce risk. This possibility of risk reduction emerges if securities do not move in lock-step fashion. The risk of a portfolio is diversified if stocks added to portfolio do not covary (i.e. move together) too much in concordance with other stocks in the portfolio. This helps investors constitute portfolios that attain the highest possible expected return for a given level of risk or minimum risk for a given level of expected return.

The Markowitz’s theory is based on the assumption that investors care only about the mean and variance of return. That is why his theory is also known as mean-variance analysis. The investors are mean-variance optimizer, and therefore, they seek and prefer portfolio with lowest possible return variance for a given level of mean (expected return). Simply put, it implies that investors prefer portfolios that produce greatest amount of wealth with lowest amount of risk. This also suggests that variance-dispersion in possible return outcomes is an appropriate measure of risk.
Thus, the total risk (variance) of an asset itself is not the unsystematic portion of risk that can be diversified away. A will have higher expected return because A has more systematic risk. In the world of CAPM, B rather than more total risk, while on the contrary, B has more and a systematic risk of 1.5. It is evident that A has and a systematic risk of .5, B has a total risk of 20% determining expected return. For instance, if there are undiversifiable (systematic) portion is pertinent in matter how much total risk an asset has, only the there is no reward for bearing it. The corollary is, no any asset. Since the diversifiable risk can be eliminated, is relevant in the determination of expected return on The core idea of CAPM is that only undiversifiable risk 

### Box 2: The Capital Asset Pricing Model

The core idea of CAPM is that only undiversifiable risk is relevant in the determination of expected return on any asset. Since the diversifiable risk can be eliminated, there is no reward for bearing it. The corollary is, no matter how much total risk an asset has, only the undiversifiable (systematic) portion is pertinent in determining expected return. For instance, if there are two assets A and B, A has a total risk (variance) of 40% and a systematic risk of .5, B has a total risk of 20% and a systematic risk of 1.5. It is evident that A has more total risk, while on the contrary, B has more systematic risk. In the world of CAPM, B rather than A will have higher expected return because A has more unsystematic portion of risk that can be diversified away. Thus, the total risk (variance) of an asset itself is not an important determinant of the asset’s expected return.

The systematic risk is measured by \( \beta \). The \( \beta \) coefficient tells us how much systematic risk a particular asset has relative to a portfolio that contains all assets in the economy. The portfolio that contains all assets in the economy is called market portfolio. This portfolio plays a central role in CAPM. The market portfolio is unobservable, and therefore, it has to be proxied by some index like stock market. Technically speaking, \( \beta \) is the covariance of a stock’s return with the return on a market index scaled by variance of that index. It is also measured as slope in the regression of a stock’s return on market.

To derive the risk-return relation depicted by CAPM, let us consider two investments, one in the treasury bill and the other in the market portfolio. The investment in treasury bill has a guaranteed return, \( R_t \) (risk-free return), and contains no systematic risk or has a \( \beta \) of 0. The market portfolio (proxied by index) has a \( \beta \) of one by definition ( \( \beta \) is the ratio of covariance to variance. The covariance of a variable [market portfolio] with itself is the variable’s variance. Therefore, \( \beta \) of the market portfolio has to be 1). Those who make investment in market portfolio take average systematic risk, and therefore, require higher return than the treasury bill. The difference between the return on market and interest rate is termed as market risk premium. The treasury bill has a \( \beta \) of 0 and its risk premium is zero. The market portfolio has a \( \beta \) of 1 and risk premium \( R_p - R_t \). This gives two benchmarks for calculating expected returns on any asset in the economy. CAPM predicts that risk premium varies in direct proportion to \( \beta \).

The return between expected return and \( \beta \) posited by CAPM can be stated in the following equation.

\[
R_i = R_t + (R_m - R_t) \beta
\]

- \( R_i \) = Expected return on security \( i \)
- \( R_t \) = Risk-free interest rate
- \( R_m \) = Expected rate of return on market portfolio
- \( R_m - R_t \) = Market risk premium or

**Expected return** = Price of time + Price of risk \( \times \) Amount of risk

The first expression is the reward for waiting, i.e. delaying consumption without taking risk. It amounts to investing in treasury bill, the least risk investment that provides guaranteed return and has a \( \beta \) of zero. The second expression is the reward per unit of risk borne. This component is return required due to risk.

\( R_m - R_t \), is the reward market offers for bearing average systematic risk in addition to waiting. The amount of systematic risk present in a security is presented by \( \beta \). Thus, the return on any asset is risk-free rate plus the \( \beta \) multiplied by the market risk premium.

CAPM assumes existence of risk-free asset. Black (1972) derived a more general version of CAPM in which it is not necessary to assume existence of risk-free asset. This does not alter the risk-return equation depicted earlier. The only difference is that risk-free return (\( R_t \)) is replaced with another value \( R \) - expected return of a portfolio with a \( \beta \) of zero. This portfolio has no correlation with the market portfolio. This model is also known as zero-\( \beta \) model.

CAPM has a variety of applications. The tools of CAPM are helpful not only for allocation of capital for real investment (machineries and factories) but also for allocation of funds for financial investment (bonds, stocks, etc). CAPM can be used for decisions concerning capital expenditure, corporate restructuring, financing, investment, and evaluation of portfolio performance.

The capital expenditure decisions require estimation of cost of capital (required rate of return) for discounting of future cash flows. CAPM helps in determination of cost of capital. To calculate the cost of capital, the model requires three inputs: the stock’s \( \beta \), the market risk premium, and risk-free return.

CAPM helps determine the risk implications of product mixes, mergers, acquisitions, and carve out. For example, a corporate diversification strategy can create value for a corporation only if diversification increases the expected returns of real investment of the corporation. A diversification that merely reduces the variance of a firm’s future cash flows is unlikely to improve the firm value. In other words, diversification per se does not increase the firm value. Pure diversification is much easier and cheaper for stockholders than for corporations. One of the lessons of CAPM is that market does not reward for bearing the risk which investors themselves can diversify away.

Firms are confronted with decisions relating to financing new investment. CAPM can provide guidelines about the fair price of the issue. The equity as a source of financing is generally avoided by the firm if they believe that their equity is undervalued. CAPM can be used to determine the expected rate of return on stock to value the equity. CAPM is one of the most widely used methods to determine this.
power to explain the cross-section of average return." They also state that stock risks are multidimensional and one dimension of risk is proxied by size and ME and another by BE/ME. The authors do not offer any theory but conjecture that it is possible that risk explained by BE/ME is the relative distress factor.

Fama's and French's verdict has generated a heated debate on the empirical validity of CAPM as an asset pricing model. Although Reinganum (1982), Lakonishok and Shapiro (1986), and Ritter and Chopra (1989) reported weak relationship between P and average return for the recent period 1963-1990, the findings of Fama and French have resulted in a major empirical re-examination of CAPM.

Data Snooping

While Black (1993) calls the negative findings of CAPM as data mining, Lo and MacKinlay (1990) call this 'data snooping.' Less formally, it can be called 'hindsight.' "Data snooping biases refer to those in statistical inferences that result from using information from data to guide subsequent research with the same or related data" (Campbell et al., 1997). These biases stem from the non-experimental nature of economics, as it is not possible to run another experiment to create a new data set. Consequently, a given set of data is used more than once for drawing inferences or model selection. Black (1993) observes that a researcher is indulging in data mining when he tries many ways to do a study including various combinations of explanatory factors, periods, and models and reports the successful sequence that advocates his conclusions. Merton (1987a) discusses the problem of data snooping and warns that researchers may find anomalies because they are too close to data. If countless hours are spent trying to unearth strategies, one is bound to find some strategy that yielded higher returns historically just by accident. However, there is no reason to believe that such a strategy would repeat in the future. Thus, the data reuse may induce the possibility that "some satisfactory results may simply be due to chance rather than to any merit inherent in the method yielding the results." (Sullivan et al., 1999). Lo and MacKinlay (1990) illustrate the effect of data snooping biases in the tests of Sharpe-Lintner version of CAPM by grouping stocks into portfolios based on characteristics (e.g. size or price earning ratio). The grouping of stocks is not guided by theory but by previous observation of mean stock returns using related data. They find that the magnitude of data snooping can be immense. Data snooping biases can be dealt with by verifying whether similar findings can be obtained using other data covering other periods or different countries. Data snooping offers one explanation of the deviations from the model.

Sample Selection Bias

Another explanation for anomalies is based on the sample selection bias. "Sample selection biases can arise, when data availability leads to certain subsets of stocks being excluded from the analyses" (Campbell et al., 1997). The data vendor is more likely to provide data on successful firms and, as a consequence, the failing stocks are excluded from the sample. Kothari et al., (1995) argue that since failing (excluded from the sample) stocks would be expected to have low returns and high book market ratios, the average return of the included (in the sample) high book-market ratio stocks would have an upward bias. They assert that selection bias in the construction of book-to-market portfolio could be the cause of premium reported by Fama and French. However, Chan et al., (1995) report that selection bias is not large. Cohen and Polk (1996) form portfolios that are completely free of selection bias and report identical evidence. Davis (1994) also shows the presence of book-to-market effect by constructing portfolios that purge sample of selection bias. However, Davis' sample relative to Fama and French is out of sample as he chose the 1940-1963 period. Fama and French (1996) also discuss the issue of survivorship bias and refute it. Barber and Lyon (1997) examine the issue by including financial firms which were excluded by Fama and French from their analysis and find results that confirm their conclusions. The above results demonstrate that selection bias does not dramatically affect the conclusion of Fama and French. Rather, what it has highlighted is that researchers must take cognizance of the sample selection bias.

Behavioural Factors

Lakonishok et al., (1994) investigated the role of behavioural factors in explaining anomalies. They argue that superior returns on value stocks (stocks with low P/E ratio or low market value-to-book value ratios, glamour [growth] stocks are converse of it) are due to expectation error made by investors. Investors have a proclivity to extrapolate past growth rates too far into the future. They suggest various possibilities that can explain these differences in average returns:

- Investors may have a tendency to invest in "good" companies with high level of profitability and superior management. In the eyes of unsophisti- cated investors, "a good" company may be synony mous with investment irrespective of the price and even view such stocks to be less risky.
Sophisticated institutional investors may tilt their portfolios towards well-known glamour stocks because they can easily justify it to their clients. This may push up the prices of these stocks and lower the expected return.

La Porta et al. (1997) examined the hypothesis that superior returns to so-called value stocks are the result of expectation errors made by investors. They studied the stock price reaction around five years after portfolio formation. They concluded that a significant portion of the return differences between value and glamour stocks is attributable to earning surprises that are systematically more positive for value stocks. Their evidence also does not support the risk-based explanation of return differentials correlated with state variables representing consumption or production opportunities.

The investor's tendency to overreact and underreact is well documented in winner-loser effect (De Bondt and Thaler, 1985, 1989) and momentum strategy (Jegadeesh and Titman, 1993) respectively. The winner-loser effect (reversal) demonstrates that past losers become winners and vice-versa over both long-term horizons (three to five years) as well as short-term periods (a month and less). The momentum effect indicates the presence of opposite effect over the horizon of intermediate length (three to 12 months). Thus, past winners continue to outperform past losers and vice-versa. As the winners and losers retain their characteristics, there is a momentum rather than reversal.

The development in behavioural economics seeking to understand the influence of human behaviour and psychology in the determination of stock prices in the financial market has greatly enriched our understanding of drivers of stock returns. Thus, behavioural explanation has the potential to capture what is not capturable by (3. This is an active area of research and future researches will refine our understanding.

Characteristics as a Compensation for Factor Risk

Daniel and Titman (1997) examined the arguments of Fama and French (1993) that firm size and book-to-market ratios are highly correlated with average return of common stocks and association between these characteristics and returns arises because the characteristics are proxies for non-diversifiable factor risk. They addressed the fundamental questions of whether the return pattern of characteristic-sorted portfolios can be explained by factor model at all specifically; whether there are pervasive factors that are directly associated with size and book-to-market, and whether there are risk premia associated with these factors.

They investigated whether the high rates of return of high book-to-market and small size stocks can be attributed to their factor loadings. Their results indicate that:

- There is no evidence of any discernible risk factor associated with high or low book-to-market (characteristic) firms.
- There is no return premium associated with any of the three factors identified by Fama and French (1993).

According to them, it is the characteristics rather than covariance structure of returns that appear to explain the cross-sectional variation in stock returns. Thus, their results cast doubt on the suggestion of Fama and French (1993) that return premia can be viewed as compensation for factor risk.

Lakonishok et al., (1994) also do not dispute the possibility that there may be priced factors associated with value (or growth) stocks. They argue that the covariance of these portfolios with macro factors is too low and in some cases negative to be considered as compensation for systematic risk. It is worth noting that in the asset pricing theories, the covariance structure of returns determines the expected returns. This covariance may be with some index or with some macro (economy-wide) factors.

Market Proxy

Most tests of CAPM use a market proxy, whereas, theoretically, the market portfolio contains all assets. Roll (1977) emphasized that the true test of CAPM is only possible if true market portfolio is observable. Several approaches have been suggested to consider if inferences are sensitive to the use of a proxy in place of market portfolio. Mayers (1972), Stambaugh (1982), Campbell (1996), and Jagannathan and Wang (1996) have examined this issue. Stambaugh (1982) investigated the sensitivity of tests by considering a number of broader proxies for market portfolio. He shows that inferences are insensitive whether one uses stock-based proxy, a stock-and-bond proxy, or stock-bond and real-estate proxy. Thus, the results are insensitive to market proxies.

Borrowing Restrictions

The standard or pure CAPM developed by Sharpe and Lintner is based on restrictive assumption of unlimited borrowing. Black (1972) showed that in the presence of borrowing restrictions (like margin re-
requirements), low β stocks may perform relatively better than the CAPM predicts. Black based his argument by taking into account feasible investment strategies to be followed by different types of investors. Suppose an investor wants to undertake a high β management strategy. In standard (or pure) CAPM world he could attain this objective either by buying high β stocks or buying low β stocks and leveraging this position (borrowing at the risk-free rate). If investors face borrowing restriction, they must buy high-risk stock outright. Consequently, this will bid up the price of high β stock and expected return should be lower than in the pure CAPM world. These renders low β stocks attractive and high β stocks unattractive to investors who have low-risk portfolios or who are inclined to borrow. This result known as zero-β version of CAPM states that compensation for β risk is lower than in a pure CAPM world. This version predicts that slope of the line relating expected return and β is positive but flatter than what standard CAPM suggests.

**Arbitrage Argument**

Shleifer and Vishny (1997) take a different approach to resolve these anomalies reported by Fama and French (1992). They point out that proponents of efficient market theory argue that higher return must be the reward for higher systematic risk and if asset pricing model fails to explain anomalies, it must be mis-specified. The underlying assumption behind efficient market approach is that most investors see and exploit the arbitrage opportunities. Another assumption behind efficient market approach is that there are many diversified arbitrageurs. In reality, arbitrage resources are heavily specialized in a few assets and are not diversified. Thus, these investors bother about total risk and not just systematic risk. Therefore, the explanation that only systematic risk determines return is inappropriate. Idiosyncratic risk may act as a deterrent for arbitrageurs to correct the mis-pricing. Shleifer and Vishny further point out the cost of arbitrage, especially total volatility of arbitrage return, and the relatively long horizon it elies on to secure positive returns may act against the elimination of glamour/value mis-pricing.

It is suggested that anomalies reported will wane in the long run. It is expected that more investors will come to know about the anomalies publicized by the media, and tilt their portfolios in their favour. Thus, the action of a large number of investors will diminish the superior returns given by these stocks. Shleifer and Vishny also identify anomalies that are likely to persist. They observe that "these anomalies must have a high degree of unpredictability, which makes betting against them risky for specialized arbitrageurs."

**Non-Linear Dynamics**

CAPM is a linear model of expected returns. In reality, many aspects of economic behaviour do not fit neatly into the straitjacket of linear structure. The evidence both from casual introspection and experimental evidence suggests that investor's attitude to risk and expected returns are non-linear (Campbell et al., 1997).

The subject of chaos theory in the domain of non-linear model has attracted a lot of attention. The economic theory rests on the pillar of equilibrium. By contrast, chaos theory suggests that lack of equilibria (chaos) rather than equilibria characterizes the economic system. The proponents of chaos theory state that both exogenous and endogenous factors shift a system away from equilibrium. Disequilibrium also characterizes the financial market and it may depart from stable condition associated with order to chaotic conditions. A chaotic system can produce random-looking results. However, chaos theory warns us that random behaviour may not be random at all. It presents the possibility that this seemingly random behaviour might actually be described by simple rules and might, therefore, be forecastable. The goal of chaos theory lies in mapping this phenomena (Chorafas, 1994).

The efficiency of the market is central to the validity of CAPM. Efficiency implies that forecasting asset returns is not possible. The chaos theory posits that markets are forecastable to some degree. This is tantamount to the rejection of market efficiency. The predictability of asset returns is an affront to those who view technical analysis with suspicion. As a matter of fact, the chaos theory and other developments have brought the debate over market efficiency in turmoil. Undoubtedly, the question of market efficiency is one of the most enduring questions (Campbell et al., 1997).

**Empirical Studies of CAPM in India**

Barua et al., (1994) observed that studies on the Indian capital market, in general, and asset pricing theories like CAPM, arbitrage pricing theory, option pricing theories, in particular, are either too little or non-existent.

Srinivasan (1988) finds that CAPM relationship is valid but a much larger sample is warranted to draw inferences. This study covered a time period of 1982-1985. Yalwar (1988) covered a period of 1963-1982, consisting of 1922 common stocks. He finds that CAPM is a good descriptor of security return. Yalwar’s study was based on individual security return and not on portfolio return. Varma (1988) also finds results supportive of CAPM.

Gupta and Sehgal (1993) tested CAPM over the period April 1979-March 1989. They employed 30 stocks forming BSE sensitive index and used portfolio method constructing three equally-weighted and three value-weighted portfolios. They also explicitly addressed questions of non-linearity and the role of residual risk in explaining returns. They concluded that CAPM did not seem to be a suitable descriptor of asset pricing in the Indian capital market during the study period. The risk-return relation over the period is positive but weak.

Madhusoodanan (1997) carried out his testing on a sample of 120 scrips traded on the BSE pertaining to the period January 1987 to March 1995. He used the portfolio technique testing over several holding periods. In order to check the sensitivity of the result to the choice of index, he employed both BSE index and Natex. He did not find any positive relationship between P and return. The maximum risky portfolio gave the minimum return while the minimum risky portfolio yielded comparably higher return. He suggested that high risk and high return strategy will not be rewarding in the Indian context and it is better to opt for low P stocks. He conjectures that as more investors tilt their portfolio in favour of low p stocks, a much tighter relationship between P and return will emerge. Madhusoodanan’s study is not only disturbing for CAPM but also for the efficiency of the Indian capital market.

Sehgal (1997) reports that CAPM is not a suitable descriptor of asset pricing on the Indian capital market for the period April 1994 to March, 1993. He finds the slope negative but insignificant for the total period, implying absence of any significant relationship between P and average return.

Further Evidence on CAPM in India

We investigated the CAPM applicability further. The data used in the sample consisted of 96 stocks listed on the BSE over the period January 1990 - December 96. The return on BSE sensitive index was taken as a proxy for return on market portfolio and the term deposit rates with commercial banks were used as a surrogate for risk-free rate. Five equally weighted portfolios were created out of these stocks. The study pursued Black, Jensen, and Scholes (1972) methodology. This methodology uses portfolio technique and involves running time series and cross-sectional regression in risk-premium form. For every calendar year starting in 1990, ß of each stock was estimated using 24 months of past-return data and BSE sensitive index as a market proxy. The β estimated was used to rank stocks into portfolios. Portfolio 1 was the highest risk portfolio and portfolio 5 the lowest risk portfolio. Then the return on each of these portfolios for the next 12 calendar months was computed. This procedure was repeated for each calendar year. This gave a time series of monthly returns (January 1992 - December 1996 i.e. 60 observations) for each of the five portfolios. Each of the five portfolio returns was regressed against market and intercept, ß, and correlation coefficient was computed. Finally, cross-sectional regression for the entire period (January 1992-December 1996) as well as for two sub-periods (January 92-June 94 and July 1994 - December 96) was run by regressing excess return for five portfolios against ß for each portfolio.

Table 1 presents the cross-sectional estimates for the overall period (January 1992 - December 1996) as well as for two sub-periods (January 1992 - June 1994 and July 1994 - December 1996). Table 2 reports the estimated slope (compensation per unit of risk), mean excess monthly return on market, and T value of $y = R_M - R_F$. If CAPM stacks up with the reality, then empirical test should demonstrate that $y_0$ (intercept) should be equal to zero and $Y_1$ (slope) should be positive. Moreover, slope ($Y_1$) should be identical to mean excess return on market ($R_M - R_F$).

The intercept ($Y_0$), positive for the overall as well as for two sub-periods, however, is indistinguishable from zero. The slope ($Y_1$) is negative insignificant for the entire as well as for other sub-periods. Likewise $Y = R_M - R_F$ is also insignificant for the sub-periods and the entire period. The $R$ values for the entire period is 0.22. In contrast with this, it is .06 for January 92 - June 94 and .57 for July 94 - December 96 sub-periods.

These findings seem to suggest that all three null hypotheses stand vindicated. CAPM postulates a linear positive relationship between p and average return. Thus, the interpretation of the hypotheses $Y_i = R_M - R_F$ revolves around the results of Y: 0. The results show that the slope is insignificant negative. Thus, it can be inferred that P leaves returns unexplained in India during the study period. The perusal of the hypothesis $Y_i = R_M - R_F$ is meaningless in the backdrop.
investment tools. In the wake of this, there is some market attained some sophistication in the use of liberalization in early 1990s that the Indian capital market. It was only with the onset paradoxical taking into account the developments in worked well before the 1990s. The results seem an asset pricing model in India. It seems that CAPM present study cast doubt on the validity of CAPM as (1993) Madhusoodanan (1997), Sehgal (1997), and the supportive of CAPM. The study by Gupta and Sehgal Srinivasan (1988), and Yalwar (1988) are generally scanty. The early period studies of Varma (1988), Srinivasan (1988), and Yalwar (1988) are generally supportive of CAPM. The study by Gupta and Sehgal (1993) Madhusoodanan (1997), Sehgal (1997), and the present study cast doubt on the validity of CAPM as an asset pricing model in India. It seems that CAPM worked well before the 1990s. The results seem paradoxical taking into account the developments in the Indian capital market. It was only with the onset of liberalization in early 1990s that the Indian capital market attained some sophistication in the use of investment tools. In the wake of this, there is some hint of β gaining currency as a concept. What is absent is the evidence on its practical application in investment settings. Merton (1987b) cautioned "...empirical studies that use large historical time series to test financial market hypothesis should take care to account for the evolutions of institutions and information technologies during the sample period." Thus, it would be wrong to conclude that CAPM was alive during any period in India. It will be interesting to note that in the US, the period before Markowitz's formulation of mean-variance framework underlying CAPM is highly supportive of CAPM. On the contrary, the recent period is unfavourable to CAPM despite the fact that β has witnessed widespread use (Chan and Lakonishok, 1993).

The validity of CAPM hinges on the efficient market hypothesis. Amanulla and Kamiah (1995-96) in their survey article report that evidences on market efficiency in India are mixed in both weak and semi-strong form. Although virtually all tests of CAPM involve testing for efficiency, the testability of market efficiency suffers from the joint hypothesis problem. Campbell et al., (1997) point out that "any test of efficiency must assume an equilibrium model that defines normal security returns. If efficiency is rejected, this could be because the market is truly inefficient or because an incorrect equilibrium model has been assumed." The upholders of efficient market hypothesis reject the model of asset pricing like CAPM as mis-specified if it makes evidences look anomalous. The trouble with this approach is that it assumes that market is efficient. The efficient market itself is based as mis-specified if it makes evidences look anomalous. The trouble with this approach is that it assumes that market is efficient. The efficient market itself is based on several theoretical underpinnings which may not be present (see arbitrage argument discussed earlier).

The foregoing discussion brings out that the validity of CAPM and efficiency of market are two distinct issues. Market efficiency requires that available information is fully, quickly, and unbiasedly reflected in security prices. But it does not specify that CAPM is the correct description of equilibrium relationship. Succinctly, the empirical failure of CAPM is not a verdict on Market efficiency. On the other hand, the violation of efficient market hypothesis impairs the validity of CAPM.

Keeping in view these caveats and the limited number of studies conducted on CAPM in India, it seems too early to take a stand on the performance of CAPM as an asset pricing model in India. More rigorous tests are warranted in this regard.

**Conclusions**

The evaluation of these studies questions the sufficiency of evidence to bury β. It is difficult to take a

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**Table 1: Summary Statistics of Cross-sectional Regressions**

<table>
<thead>
<tr>
<th>Period</th>
<th>Intercept $y_0$</th>
<th>Slope $y_1$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 92-December 96</td>
<td>0.0208</td>
<td>-0.0184</td>
<td>0.22</td>
</tr>
<tr>
<td>(1.08)</td>
<td>(-0.94)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>January 92-June 94</td>
<td>0.0391</td>
<td>-0.00933</td>
<td>.066</td>
</tr>
<tr>
<td>(199)</td>
<td>(-0.46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 94- December 96</td>
<td>0.0267</td>
<td>-0.05235</td>
<td>.57</td>
</tr>
<tr>
<td>(1.0394)</td>
<td>(-2.00)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The figures in parentheses show T' values. Benchmark "T value at 0.05 level of significance is 3.182.

**Table 2: Estimated Slopes and Average Excess Monthly Return on Market (%)**

<table>
<thead>
<tr>
<th>Period</th>
<th>Return on Market</th>
<th>Slope</th>
<th>$T'$-Test for $Y_t = R_m - R_f$</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 92-December 96</td>
<td>0.2</td>
<td>-1.84</td>
<td>-1.05</td>
</tr>
<tr>
<td>January 92-June 94</td>
<td>2.46</td>
<td>-0.93</td>
<td>1.68</td>
</tr>
<tr>
<td>July 94- December 96</td>
<td>-2.06</td>
<td>-5.23</td>
<td>-1.21</td>
</tr>
</tbody>
</table>

Benchmark $T'$ value at 0.05 level of significance is 3.182.

of no relationship. Similarly, any inference about positive insignificant intercept will be misleading in this context as no verdict can be arrived at about the validity of various versions of CAPM (Sharpe-Limmer or Black) in India.

The above mentioned inferences should be interpreted with caution. There are reasons to suspect that findings are sensitive to several factors. It is possible that apparent empirical failure of CAPM is due to bad proxy for market portfolio. The sensitivity of the results to holding periods cannot be ruled out. A much larger sample and longer period of study may cast aside the empirical failure. Thus, robustness check needs to be done before one makes any conclusion.

**Assessment of Empirical Performance of CAPM in India**

It is evident that testing of CAPM in India is very scanty. The early period studies of Varma (1988), Srinivasan (1988), and Yalwar (1988) are generally supportive of CAPM. The study by Gupta and Sehgal (1993) Madhusoodanan (1997), Sehgal (1997), and the present study cast doubt on the validity of CAPM as an asset pricing model in India. It seems that CAPM worked well before the 1990s. The results seem paradoxical taking into account the developments in the Indian capital market. It was only with the onset of liberalization in early 1990s that the Indian capital market attained some sophistication in the use of investment tools. In the wake of this, there is some hint of β gaining currency as a concept. What is absent is the evidence on its practical application in investment settings. Merton (1987b) cautioned "...empirical studies that use large historical time series to test financial market hypothesis should take care to account for the evolutions of institutions and information technologies during the sample period." Thus, it would be wrong to conclude that CAPM was alive during any period in India. It will be interesting to note that in the US, the period before Markowitz's formulation of mean-variance framework underlying CAPM is highly supportive of CAPM. On the contrary, the recent period is unfavourable to CAPM despite the fact that β has witnessed widespread use (Chan and Lakonishok, 1993).

The validity of CAPM hinges on the efficient market hypothesis. Amanulla and Kamiah (1995-96) in their survey article report that evidences on market efficiency in India are mixed in both weak and semi-strong form. Although virtually all tests of CAPM involve testing for efficiency, the testability of market efficiency suffers from the joint hypothesis problem. Campbell et al., (1997) point out that "any test of efficiency must assume an equilibrium model that defines normal security returns. If efficiency is rejected, this could be because the market is truly inefficient or because an incorrect equilibrium model has been assumed." The upholders of efficient market hypothesis reject the model of asset pricing like CAPM as mis-specified if it makes evidences look anomalous. The trouble with this approach is that it assumes that market is efficient. The efficient market itself is based on several theoretical underpinnings which may not be present (see arbitrage argument discussed earlier).

The foregoing discussion brings out that the validity of CAPM and efficiency of market are two distinct issues. Market efficiency requires that available information is fully, quickly, and unbiasedly reflected in security prices. But it does not specify that CAPM is the correct description of equilibrium relationship. Succinctly, the empirical failure of CAPM is not a verdict on Market efficiency. On the other hand, the violation of efficient market hypothesis impairs the validity of CAPM.

Keeping in view these caveats and the limited number of studies conducted on CAPM in India, it seems too early to take a stand on the performance of CAPM as an asset pricing model in India. More rigorous tests are warranted in this regard.

**Conclusions**

The evaluation of these studies questions the sufficiency of evidence to bury β. It is difficult to take a
definitive stand on this issue in view of the inconclusive nature of debate (Chan and Lakonishok, 1993). It seems that pronouncing the death of β would be premature. Daniel and Titman (1997) summarize this debate as follows: "Thus, while the literature does not directly dispute the supposition that the return premia of high book-to-market and small size stock can be explained by a factor model, the debate centres on whether the factors can possibly represent economically relevant aggregate risk." Fama and French do not provide a theory and only conjecture that return premia can be captured by a factor model. Their arguments against p suffer from any supporting theory to justify choice of factors. Black (1993) remarks that "lack of theory is tip off: watch out for data mining." Nevertheless, collectively, they pose a challenge to CAPM.

Another related issue is whether returns are indeed based on risk or whether some other behavioural factor unrelated to risk is at work in return-generating process. Lastly, if returns are indeed driven by characteristics and a characteristics-based model is correct in explaining returns, then it will bring about a totally different perspective of corporate finance. The competing explanations and ambiguities surrounding empirical evidence against CAPM suggest that the game is not lost for CAPM. This may be the reason why CAPM survives and is still the most preferred tool in corporate finance. However, one must recognize and understand its limitations while using it.

References


