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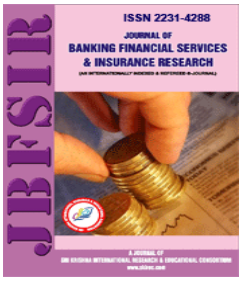

RELEVANCE OF CAPITAL ASSET PRICING MODEL – A REVIEW

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ABSTRACT

Though it is commonly said that higher the risk higher would be the returns, the questions that remain are, what type of risks are awarded and what is risk premium per unit of risk. A few equilibrium asset-pricing models attempted to answer these questions. Out of these, Capital Asset Pricing Model (CAPM) is the most popular and widely used model. It was independently developed by Sharpe (1964), Lintner (1965), and Mossin (1966). Fama (1968), Black, Jensen and Scholes (1972), Fama and Mac Beth (1973), and Fama and French (1992) and others proposed further refinements. The CAPM provides a precise prediction of the relationship between the risk of an asset and its expected return. In the Indian stock market the empirical studies on CAPM showed mixed results. Roll's critique has attracted attention of many researchers and resulted in popular articles such as "Is Beta Dead?" "Is Beta Dead or Alive?" "Are Reports of Beta's Death Premature? "Is Beta Dead Again?" that effectively reduced the popularity of CAPM in the world of finance in 1992. The debate regarding superiority of Asset Pricing Theory (APT) to CAPM is continuing. The empirical testing of APT is still in its early stage and concrete results in favour of APT or against CAPM do not exist. Till then, CAPM is expected to dominate the capital market as a measure to ascertain expected returns of risky securities.

KEYWORDS: *Asset pricing theory, Beta, Capital asset pricing model, Diversification, Risk.*

1. INTRODUCTION

A substantial portion of research in investment management is devoted to understand how investors evaluate the riskiness of securities and return associated to the risk. Though it

is commonly said that higher the risk higher would be the returns, the questions that remain are, what type of risks are awarded and what is risk premium per unit of risk. A few equilibrium asset-pricing models attempted to answer these questions. Out of these, Capital Asset Pricing Model (CAPM) is the most popular and widely used model. It was independently developed by Sharpe (1964), Lintner (1965), and Mossin (1966). Fama (1968), Black, Jensen and Scholes (1972), Fama and Mac Beth (1973), and Fama and French (1992) and others proposed further refinements. The CAPM provides a precise prediction of the relationship between the risk of an asset and its expected return. According to CAPM all investments carries two types of risks. First is the market risk, denoted by "beta". This is also called "systematic risk", cannot be diversified away. The second is unsystematic risk, which is related to the company and can be diversified away. Since unsystematic risk can be mitigated through appropriate diversification, Sharpe (1964) stated that a portfolio's expected return solely depend on its systematic risk or beta. The CAPM helps us to measure portfolio's risk and the return an investor can expect for taking that risk. It is the first model to present a testable hypothesis regarding risk - return relationship.

The CAPM relies on theoretical market portfolio, which includes all assets such as real estate, foreign stocks, etc. The identification of the true market portfolio is very difficult. Therefore in practice, the CAPM is analysed and tested by using some stock market index, which represents the market portfolio. The CAPM can be mathematically expressed as:

$$E(R_{jt}) = R_{ft} + \beta_j (R_{mt} - R_{ft})$$

Where,

$E(R_{jt})$=the expected return of security 'j' during time period 't'.

R_{ft} = the risk free rate during time period 't'

β_j = the beta of security 'j'

R_{mt} = the expected return on the market portfolio or expected return on index during time period 't'.

There is a linear relationship between risk and return. The risk premium on the stock or portfolio of stocks is a function of the risk premium on the market and varies directly with the level of beta or systematic risk. The expression R_{mt}-R_{ft} denotes premium per unit of risk. Thus, the investors holding risky security or portfolio is expected to receive risk free rate of return plus premium or compensation for each unit of risk taken by them. Therefore,

$$E(R_{jt}) = R_{ft} + \text{Risk premium.}$$

A number of simplifying assumptions lead to the basic version of the CAPM. CAPM is based on the following assumptions:

1. The market for capital assets is composed of risk averting investors, all of whom are one period expected utility of terminal wealth maximises and find it possible to make optimal portfolio decisions solely on the basis of the means and standard deviations of the probability distributions of terminal wealth associated with the various available portfolios.

2. All investors have the same decision horizon, and over this common horizon period the means and variances of the distributions of one period returns on assets and portfolios exist.

3. Capital markets are perfect in the sense that all assets are infinitely divisible, there are transactions costs or taxes, information is costless and available to everybody, and borrowing and lending rates are equal to each other and the same for all investors.

4. Expectations and portfolio opportunities are "homogeneous" throughout the market. That is, all investors have the same set of portfolio opportunities, and view the expected returns and standard deviations of return provided by the various portfolios in the same way.

2. REVIEW OF FOREIGN STUDIES

The empirical studies revealed that all these assumptions are not necessary for the derivation of the model. The model can be derived even when investors have heterogeneous expectations regarding the distribution of stock returns (Lintner, 1969), there are personal income taxes in particular differential rates on capital gains and dividends (Brennan, 1970), existence of transactions costs and considering a world without a risk free asset (Black, Jensen and Scholes, 1972), and non divisibility of assets (Mayshar, 1983). These modifications in the model are made to reflect the real world situations. But the linear relationship between risk and expected return hold good even today.

Sharpe (1964) said that in equilibrium there would be a simple linear relationship between the expected returns and standard deviation of returns for efficient combination of risky assets. In effect market presents two types of prices: the price of time or the pure interest rate and the price of risk, the additional expected returns per unit of risk. The CAPM in its pure form asserts that prices will adjust until there is a linear relationship between the magnitude of such responsiveness and expected return. Assets which are unaffected by changes in economic activity will return the pure interest rate; those which move with the economic activity will promise approximately higher expected rates of return. Lintner (1965) sets forth a simple logic that leads directly to the determination of explicit equilibrium prices of risky assets traded in competitive markets under idealized conditions. These equilibrium valuations of individual risky assets are shown to be explicitly and linearly related to their respective expected returns, variances and co-variances. Black, Jensen and Scholes (1972) studied monthly share price data of NYSE from 1926 to 1964. A regression equation was used to estimate the parameters, alpha (α) and beta (β). The estimates of beta were used to rank the stocks into 10 portfolios. The parameters for each 5-year period were calculated which in turn was used to test the realized returns for subsequent 12 months, thus obtaining a

set of monthly rates of return for the period 1931 to 1965 for each of the 10 portfolios. Time series method was used to estimate α and β for 420 months data and 4 sub-periods data. Both α and β for all sub-periods were found to be inversely related, except for the first sub-period. Cross sectional test of CAPM was estimated for the entire 35 years period as well as for the 4 sub-periods. The estimate of intercept term was significantly different from zero and estimate of slope was significantly less than the average excess return on market portfolio for all the sub-periods as well as for the 35year period. They argued that this could happen if zero beta CAPM is valid. However, they do not perform a separate test to examine this. Black (1972) found that the expected return on any risky asset is a linear function of its β, as there are no restrictions on borrowing. He states that if there is a riskless asset, the slope of the line relating to the expected return on a risky asset to its β must be smaller than what it could be when there are no restrictions on borrowing. He found that a model, in which borrowing is restricted, is consistent with the empirical findings reported by Black, Jensen and Scholes (1972). Fama and MacBeth (1973) studied the relationship between average return and risk for all common stocks of NYSE. The data used for this study was the monthly percentage returns including dividend and capital gains for the period January 1926 to June 1968. The theoretical basis of the tests is the "two- parameter" portfolio model and models of market equilibrium derived from the two-parameter portfolio model. They used three separate periods for portfolio formation, beta estimation and final testing. The results indicate that neither the squared value of beta nor the residual risk has any influence on stock returns. The performance of beta coefficient over the entire period indicates the relationship between expected returns and beta is linear and positive. Merton (1973) developed an intertemporal model for the capital market from the portfolio selection behaviour by an arbitrary number of investors who act in a way to maximize the expected utility of lifetime consumption and who can trade continuously in time. The explicit demand functions for assets are derived, and it is shown that, unlike the one-period model, current demands are affected by the possibility of uncertain changes in future investment opportunities. After aggregating demands and requiring market clearing, the equilibrium relationships among expected returns are derived, and contrary to the classical CAPM, expected returns on risky assets may differ from the risk-less rate even when they have no systematic or market risk. Blume and Friend (1973) estimate several types of risk-return trade-offs implied by stocks on the NYSE for three different periods after World War II and show that empirical results cast serious doubt on the validity of the market – line theory either in its original form or modified form. However, these results do confirm the linearity of the relationship of NYSE stocks. Pettit and Westerfield (1974) studied 839 stocks for the period July 1947 to June 1954 to test the validity of two widely used methods for forming conditional predicted portfolio returns. The first method relies on a one-period, mean-variance theory of equilibrium expected return, sometimes referred to as the CAPM. The second method is called the Market Model (MM). The MM bears a close resemblance to the *ex post* version of the CAPM, and both models posit a linear relationship between the returns on individual securities and the returns on a portfolio of all assets. The conditional predictions of the MM and CAPM provide nonstationary, biased estimates of actual returns. The relationship between predicted portfolio returns and actual portfolio returns fluctuates from sample period to sample period. These nonstationarities in the estimates suggest a breakdown in the diagonal assumption of the MM

and CAPM. The authors hypothesize that a substantial part of the nonstationarity in the estimates is traceable to non-zero realized values of additional market-wide factors.

The most of the empirical tests of CAPM have been conducted on developed capital markets and are based on the basic methodology adopted by Sharpe (1964), Lintner (1965), Mossin (1968), Black, Jensen, Scholes (1972), Fama and MacBeth (1973), Intertemporal Capital Asset Pricing Model (Merton,1973) Arbitrage Pricing Theory (Ross,1976), Tax version of CAPM (Elton and Grubber 1978), Consumption-based CAPM (Lin and Jen 1980), Conditional- CAPM (Jagannathan and Wang 1996,1998). Besides testing for CAPM, many of the studies have firm size effect, P/E effect, dividend effect, and problems due to misspecification in the CAPM model. In spite of the criticism of Roll (1977, 1981), Dimson (1979)**,** Fama and French (1992, 1996), Davis *et.al* (2000) on the validity of tests of CAPM, it is clear that the studies on CAPM have provided valuable insights to the stock returns behaviour in various markets across the world. If systematic risk and returns are linearly related and residual risk is unrelated to returns, it will have important implication for investors.

The empirical studies of Sharpe and Cooper (1972), Foster (1978), Sauer and Murphy (1992), and others supported the CAPM as a valid asset-pricing model. However, there is a growing body of empirical research, which showed that CAPM is not able to explain relationship between risk and return. The studies of Yosef and Kolodny (1976), Tinic and West (1984), Green (1990) and Hawawini (1993) questioned the validity of CAPM. Banz (1981), Reinganum (1981), Chan, Chen and Hsieh (1985) and Elton and Gruber (1996) empirically showed that small firms in terms of market capitaliation could earn more returns than what is prescribed by CAPM. Ball (1992) said that CAPM is a pure exchange model, ignoring properties of the supply of securities.

3. REVIEW OF INDIAN STUDIES

In the Indian stock market the empirical studies on CAPM showed mixed results. Yalawar (1988) took a sample of 122 actively traded shares between the periods 1963 to982. He calculated rates of return for each sample stock using geometric mean monthly return method for holding periods of 1year, 5 year, 10 year and 15 year periods. The study showed that the equity returns are high and consistent with the market risk premium. Beta estimates for all securities were positive and significant except for two samples. Second pass regression was tested on mean return. The results indicated that CAPM is a good descriptor of the Indian capital market. The results also indicated that the BSE is efficient at least in the weak form as far as pricing of actively traded shares are concerned. Varma (1988) carried out a test on asset pricing model in the capital markets with a database of over 30000 prices on 45 securities from the Bombay Stock Exchange. This study deals with the situation where the betas may change over time. Three alternative methods have been used to estimate these non-stationary betas: Kalman Filtering, Bayesian Detection of Structural Breaks and Mixed Model. The empirical results provide conclusive evidence for nonstationarity of betas in the Indian capital market; apart from statistical significance, the observed changes in the betas are substantial in magnitude. It is also empirically established that the nonstationarity of betas leads to very high estimation error in the value of the betas at any point of time. The

study does not reject the CAPM. However, as the author notes, replication on larger samples of securities is desirable to provide conclusive evidence in favour of the theory. Connon and Sehgal (2003) examine the Fama–French three-factor model for India. Authors found evidence for pervasive market, size, and book-to-market factors in Indian stock returns and empirical result shows that cross-sectional mean returns are explained by exposures to these factors, not by the market factor alone. Study found mixed evidence for parallel market, size and book-to-market factors in earnings and authors do not find any reliable link between the common risk factors in earnings and those of stock return. The empirical results, as a whole, are reasonably consistent with the Fama-French three-factor model. Srinivasan (1988), Dhankar (1996), Amanulla and Kamaiah (1998), Thiripalraju and Amanulla (2002) and others found support in favour of CAPM.

However, Gupta (1981) studied a large sample companies and computes average annual returns for thirty five-year periods between 1961and 1976. Each year's high and low price for the sample shares were considered. A total of 606 equity shares for one or more holding periods were considered in the study. The data was collected from Bombay, Calcutta and Madras stock exchanges. The long-term rates on equities were less than that on debentures, preference shares, Company deposits and long-term bank deposits, most of the time. The average annual returns were computed to be 3.21 per cent for 1961-66; 10.40 per cent for 1966-71; and 5.00 per cent for 1971-76. The belief that equities provided hedge against inflation was found to be unfounded. The author doubted the applicability of CAPM in the Indian capital market. A study by Obaidullah (1991a) reported that the stock price adjustment to release of value-relevant information is inaccurate. This implies that at any given point in time there are undervalued and overvalued stocks in the market. Prices are not equal to their fundamental intrinsic values. Hence, risk-return parity cannot be expected to hold good. Another study by Obaidullah (1991b) attributes abnormal returns to price-earnings ratios. The abnormal returns are also observed to persist. The so-called CAPM equilibrium is never reached. Palaha (1991) conducted the study on a sample of 419 stocks dividend into 11 industry groupings. Individual security betas of forty stocks as well as portfolio beta were estimated for the entire period of 1976to 1985 as well as its 5-year sub-periods. OLS was used in the estimation procedure. Over two sub-periods the betas showed a high degree of instability. Out of 40 individuals securities only in 5 cases the model had some degree of relevance. Gupta and Seghal (1993) tested CAPM over the period April 1979 to March 1989. They employed average monthly share prices of 30 shares forming BSE Sensitive index and 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. Ray (1994) conducted a test of CAPM using 170 actively traded scrips on the Bombay Stock Exchange. He used monthly data over the period 1980-91. He used three market indices, the RBI index, ET index and the BSE Sensitive index. He used the Fama-MacBeth methodology and found that CAPM does not seem to hold good for the Indian capital market. Obaidullah (1994) studied monthly stock price data for a period of sixteen years (1976to 1991) for a sample of thirty stocks. The results from the exercise, however, do not lend themselves to any supportive or contradictory interpretation.

The coefficients of $\beta_p{}^2$ are, in general, not statistically significant. This is in conformity with the CAPM. However, in the multiple regression models, the coefficients of β_p also in most cases become statistically insignificant which is contrary to what the CAPM predicts. Hence the author suggests that CAPM as a descriptor of asset pricing in Indian markets does not seem to rest on solid grounds. Vaidyanathan (1995) observed that CAPM probably could not explain the risk-returns relations in the Indian capital market. There could be several reasons like non-diversified portfolio holding, lack of liquidity, insider trading, lack of transparency, inadequate infrastructure etc. for the empirical data not supporting the model. 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 for testing 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 has analysed the relationship between beta and return in the Indian stock market based on three criteria – average returns, variance of returns and return per unit of risk. He did not find any positive relationship between beta 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 beta stocks. He conjectures that as more investors tilt their portfolio in favour of low beta stocks, a much tighter relationship between beta and return will emerge. This study is not only disturbing for CAPM but also casts doubt on the efficiency of the Indian stock market. Sehgal (1997) reports that, CAPM, is not a suitable descriptor of asset pricing for the Indian capital market. He has analysed data of the BSE National Index (Natex) and 80 individual securities over the period April 1984 to March 1993 and used logarithmic price changes. Tests for significance of skewness and kurtosis have found that for Natex skewness is not significant but is significant for kurtosis. For individual securities a vast majority had significantly positive kurtosis. Further, each of the randomly formed portfolios of eight securities is also found to significantly deviate from normality. He finds that the slope is negative but significant for the total period, implying absence of any significant relationship between beta and average return. However, the sample period includes the security scam period of February 1992 to May 1992 during which period there were extreme variations in the indices and stock prices. The effect of these could affect the outcome of the test.

While, all these accumulated evidence against CAPM remained largely within the academicians, Roll's (1977) article entitled "A Critique of the Asset Pricing Theory's Tests" shock the investors and analysts' world also. Roll (1977) argued that since the true market portfolio can never be observed, the CAPM is necessarily not testable. Roll (1977) concluded:

> "The two-parameter asset pricing theory is testable in principle; but arguments are given here that: (a) No correct and unambiguous test of the theory has appeared in the literature, and (b) there is practically no possibility that such a test can be accomplished in the future" (p.129-130).

Roll's critique has attracted attention of many researchers and resulted in popular articles such as "Is Beta Dead?" "Is Beta Dead or Alive?" "Are Reports of Beta's Death

Premature? "Is Beta Dead Again?" that effectively reduced the popularity of CAPM in the world of finance In 1992 Fama and French published an article that criticised CAPM in a harsh way. They claimed that once you control a set of widely followed characteristics of the firm, such as the size of the firm and its ratio of market value to book value, the firm's beta i.e. its systematic risk does not contribute thing any to the prediction of future returns.

Fama and French (1993, 1995 and 1996) and several other researchers have published many follow up studies on CAPM. These studies made it clear that beta does give full information related to risk. There seems to be risk factors that affect stock returns beyond beta's one factor measurement of market sensitivity. Fama (1991) rightly said that despite the anomalies, criticisms, and limitations, the CAPM still remains the most popular asset-pricing model among the researchers as well as practitioners. This is mainly because of simplicity and the absence of better alternative models.

4. BETA

Shareholders are bearing two types of risks - systematic or market risk, and unsystematic or unique risk. Risk in holding securities refers to the possibility that the realised returns will be less than the returns that were expected. The unsystematic risk i.e., the portion of total risk that is unique to a firm or industry - can be eliminated by diversification and it is unlikely that bearing unsystematic risk will be rewarded. Returns on securities are related to the systematic risk i.e., the portion of total risk that is not possible to diversify. The systematic risk is denoted by beta (β). Most of the researchers and practitioners accepted beta as a measure of systematic risk. There is a linear relationship between risk and return. According to Grinold (1993):

> "Beta splits a security's return into a part that is perfectly correlated with a market portfolio and a residual that is uncorrelated with the market. Beta is used to analyse performance, control risk, make conditional forecasts and set expected returns" (p.28)

It has wide ranging applications in financial economics including testing of asset pricing theories, estimation of the cost of capital, evaluation of portfolio performance and calculation of hedge ratios for index derivatives. Beta is the heart and soul of CAPM .In the CAPM beta says expected residual returns should be zero, which makes beta controversial.

During 1990s, the debate about "whether beta is dead or alive" has heated up once again. One school of thought led by Fama and French (1992,1993, 1995 and 1996), Roll and Ross (1996), and others demonstrated that beta is dead, or if it is not dead it is at least seriously ill, because beta fails to explain the behaviour of stock returns. Another school of thought led by Black (1993), Sharpe (1998), Kothari, Shanken and Sloan (1995), Kandel and Stambaugh (1995), Hsia, Fuller and Chen (2000) and others showed that beta is alive if annual returns instead of monthly or daily returns are used. There are a few researchers [Chan and Lakonishok (1993), Grinold (1993), Ashton and Tippett, (1998)] who are in a confused mind. The statement "beta is dead" created confusion among the academicians, practitioners, analysts and students of finance. However, the debate is still continuing.

In India Vipul (1999) examined the effect of size of the company (as measured by capitalisation of equity shares of respective companies), industry and liquidity of the stock on the beta. He selected a sample of 114 companies listed on the BSE during July 1986 to June 1993. He found that the size of the company affects beta value. Medium sized companies have lowest beta, which increases with increase or decrease in the size of the company. Chawla (2001) examined the stability of beta in the Indian stock market. He used monthly data on 36 stocks for the period from March 1996 to March 2000. The results of the study rejected the hypothesis of stability of beta in majority of the cases. Therefore, he concluded that the instability of beta has its implications on investment decisions. Narasimhan and Pradhan (2003) used conditional (information available to investors at the time of investment to form their expectations about expected returns, covariance and variances) CAPM method to test the risk return relationship by analyzing monthly stock price data for 100 stocks listed in Bombay Stock exchange during the period January 1990 to December 2001 and found that the betas of large stock portfolios vary over time where as betas of small stock do not. Also when betas are restricted to be constant over time, higher betas are associated with high returns. Besides, the price of risk varies inversely with the size of the portfolios. Madhusoodanan (1996) has analysed the relationship between beta and return in the Indian stock market and found out that the relationship is not what has been postulated by the theory. In fact, it has been observed that the highest beta cases gave lowest returns in general and lowest beta cases gave comparably higher return for lower levels of total risk. Ansari (2000) carried out CAPM testing on a sample of 96 stocks listed on the BSE pertaining to the period January 1990 to December 1996. 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. This paper used the methodology of portfolio technique and involved running time series and cross sectional regression in risk-premium form. The analysis of the results showed that the intercept is positive, which is indistinguishable from zero and slope is negative, insignificant for the entire as well as for other sub-periods. It is inferred that beta leaves returns unexplained in the Indian capital markets during the study period.

5. CONCLUSION

The debate regarding superiority of Asset Pricing Theory (APT) to CAPM is continuing. Many researchers found that both the models have their own strengths as well as weaknesses. An acceptable and possible solution would be to use a combined model that incorporates the strength of both the models. The empirical testing of APT is still in its early stage and concrete results in favour of APT or against CAPM do not exist. Till then, CAPM is expected to dominate the capital market as a measure to ascertain expected returns of risky securities.

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