# Capital Asset Pricing Model: Beta and Size Tests

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***Abstract:*** *The tests on CAPM have been conducted to test intercept, beta and a number of risk factors. This study tests intercept, beta and size coefficients for sample companies. The results of the study show that intercept is not significantly different from zero and neither beta nor size explain variation in portfolio returns. Therefore, we conclude that the intercept of the CAPM is equal to the risk-free rate of returns but the beta and size factors do not explain the portfolio returns in Indian market. The exception is market value weighted portfolios when percentage returns are used. In this case beta explains the portfolio returns.*

**Keywords**: CAPM, Intercept, portfolio Returns, Beta, Size

## 1. Introduction

Capital market has become an integral part of the economies of all countries. The manner in which securities are priced in capital market has attracted the attention of researchers for long. Investment in securities market requires the study of the relationship between risks and returns. It was with the development of the Markowitz' portfolio theory in the 1950s that the modern theory of investment commenced. The capital market theory is an extension of the portfolio theory of Markowitz (1952, 1959). Portfolio theory is a description of how rational investors should build efficient portfolios and the capital market theory indicates how assets should be priced in the efficient capital market. In security analysis we are concerned only with those assets whose prices can be estimated. The usual notion in economics is that the price of an asset is determined based on the demand for and supply of the asset. The same notion is used to describe a theory that explains how assets are priced in the securities market. Sharpe (1964), Lintner (1965) and Mossin (1968) have independently developed a standard form of general equilibrium model for asset returns in the securities market. This model has come to be known as Sharpe-Lintner-Mossin form of Capital Asset Pricing Model (CAPM) or standard form of CAPM. This model is based on many assumptions about capital market. However, it has been useful to understand the complex relationship between securities returns and risks. The studies conducted by the Brennan (1971), Black, Jensen and Scholes (1972), Black (1972), Fama and MacBeth (1973), Blume and Friend (1973), Brito (1977), Ross (1978), Gibbons and Ferson (1985), Handa *et al* (1993), Terregrossa (2001), Feldman and Riesman (2003), Koedijk and Vandijk (2004) are largely supportive of Standard form of CAPM. Research findings of these studies have been debated again and again. During the 1970s and thereafter, CAPM came under attack

as striking anomalies were reported by Blumes and Husic (1973), Pettit and Westerfield (1974), Roll (1977), Dimson (1979), Petit and Stanley (1979), Francis and Fabozzi (1979), Roll and Ross (1980), Cheng and Grauer (1980), Scott and Brown (1980), Reinganum (1981b), Nagorniak (1982), Harrington (1983), Levy (1983), Cho *et al.*, (1984), Elton and Gruber (1984), Grauer (1985),De Bondt and Thaler (1985, 1987), Merton (1987), Harlow and Ramesh (1989), Harvey (1989), Jaffe, Westerfield and Christopher, (1989), Lee *et al.*,(1990),Bark (1991), Grinold (1993), Chan (1997), Berglund and Johan (1999), Maximiliano (2001), Hwang and Satchell (2002) and Harris *et al.*, (2003) and it has therefore been labeled non-standard form of CAPM. There is considerable evidence in a developed security market that firm-specific characteristics such as size, book-to-market equity ratio, leverage, earnings-price ratios can explain the cross-sectional variation in security returns. There is a growing body of empirical research which shows that CAPM's β is not a good descriptor to explain the expected return of securities or portfolios. Prominent amongst the CAPM anomalies are those related to fundamental factors of securities such as size (natural logarithm of market capitalization) effect of {Banz (1981)}, leverage (debt/equity ratio) effect of {Bhandari(1988)}, book-to-market equity (BE/ME) effect of {Chan, Hamao, and Lakonishok(1991)}, price-earnings (P/E) ratio of {Basu(1977)}, and earnings-price (E/P) ratio of {Ball(1978), Basu(1983)}, Fama and French (1992, 1993,1995,1996,1998,2002). But studies by Black (1993), Kothari and Shanken (1995), Kothari *et al*., (1995), MacKinlay (1995), Barber and Lyon (1997), Loughran (1997) and Daniel and Titman (1997) argue in defense of CAPM's β. Researchers have extended the basic CAPM and developed theories like Arbitrage Pricing Theory, Consumption based CAPM, Conditional CAPM, Tax version of CAPM, Constant Elasticity of Substitution (CES) model, etc. The empirical evidence against CAPM by Fama and French (1992, 1996) has generated a lot of debate in the west and has called for major re-examination of the CAPM model. While many studies have been conducted on CAPM and factors model in the capital markets of the western countries, there are few studies in the Indian context. Indian capital market is grossly under-researched in the area of CAPM and other factors model. Studies by Varma (1988), Yalwar (1988) and Srinivasan (1988) have generally supported the CAPM theory. Studies by Gupta (1981), Rao & Bhole (1990), Barua and Raghunathan (1990), Agarwal (1991), Palaha (1991), Obaidullah (1991a, 1991b, 1991c, 1994), Gupta and Seghal (1993), Barua *et al.*, (1994), Ray (1994), Vaidyanathan (1995), Madhusoodanan (1996, 1997), Sehgal (1997), Rao *et al.*, (1998), Arumugam (1998), Ansari (2000) and Rao (2004) have questioned the validity of CAPM in Indian markets. Studies by Vaidyanathan and Chava (1997), Mohanty (1998), Marisetty and Vedpurishwar (2002), Mohanty (2002), Sehgal (2003) and Connon and Sehgal (2003) have supported the factors model. Ansari (2000) has opined that the studies of CAPM in the Indian markets are scanty and no robust conclusions exist on this model. This view motivates the present study. Therefore an attempt is made to see if beta and size as independent variables can explain the cross-sectional variation in security returns in the Indian capital market. The paper is organized in four parts. Part 1 is the introduction; part 2 deals with objectives, hypotheses, data and methodology; part 3 focuses on the analysis of the results; part 4 presents the summary and conclusions. References are given after part 4 and Tables are presented after the references.

## 2. Objectives, Data and Methodology

### 2.1 Objectives

This study is undertaken with the following objectives:

- To ascertain the relationship between returns of securities and market returns.
- To test the empirical validity of the standard CAPM in the Indian context.
- To ascertain the relationship between returns of securities and market capitalization (size).

### 2.2 Hypotheses

The early evidence of the model was largely supportive of CAPM in the western market. But more recent findings of Fama and French (1992, 1996), Davis (1994), Davis *et. al* (2000), Wang (2003) have doubted the validity of the CAPM. Researchers are still working to find reasons for contrary conclusions by Fama and French (1992, 1996). Studies by Varma (1988), Yalwar (1988) and Srinivasan (1988) have generally supported CAPM theory based on the test of the standard form of CAPM. Studies by Gupta (1981), Rao & Bhole (1990), Barua and Raghunathan (1990), Obaidullah (1991a, 1991b, 1991c, 1994), Gupta and Sehgal (1993), Madhusoodanan (1997), Sehgal (1997), and Ansari (2000) have questioned the validity of CAPM in Indian markets. Based on the available evidence on the Standard form of CAPM and Fama and French (1992) factors model the following hypotheses are formulated:

#### 2.2.1 The Null Hypotheses:

◆Ho: The intercept (Alpha) in CAPM is not significantly different from zero.
◆Ho: There is no significant positive relationship between the returns on portfolios and their betas.
◆Ho: Market capitalization (size) does not explain the cross-section of average portfolio returns.

The negations of the above null hypotheses are the alternate hypotheses. In this study the above hypotheses are tested in the Indian context.

### 2.3 Data and Sample

The study is based on BSE Sensex companies that were part of the index from the beginning upto 30th June 2005. The Sensex consists of 30 companies. However, other companies that replaced a number of companies that are/ were part of Sensex during different times in the history of the index have been included in the study. The final list of 66 companies is drawn up based on two criteria: a) the companies selected should have been constituents of BSE Sensex and b) traded for a minimum time of six months in a year during the study period. The BSE Sensex companies represent almost 50% of the BSE's total market capitalization and sample stocks come from 22 industry groups {see also Marisetty and Vedpurishwer (2003)}. These companies are heavily traded on the exchange and these come from diverse industry groups. BSE-100 index is taken as the market proxy and the weighted average yields of GOI securities are used as risk-free rate of returns for the respective years. The daily adjusted share prices and index from January 1, 1990 to June 30, 2005 are used

for the study. The independent variable, size, is based on the daily unadjusted closing prices and on the outstanding number of shares. The data was collected from the CMIE (Prowess package), BSE, NSE, RBI, DCA, SEBI websites, etc. Over the years, researchers have used quarterly, monthly, weekly data to study the empirical relationship in CAPM. Brown & Warner (1985) suggest that the daily prices are better for autocorrelation in event methodology and it is felt that quarterly, monthly, weekly data do not provide a very meaningful relationship between risk and return and, hence, daily price data is used in this study. Only capital gains component has been used in estimating returns, as dividend information of companies is not available for all companies for all the years of the study period. Moreover, ignoring dividends would not pose a serious estimation bias in the light of the fact that the Indian companies exhibit very low dividend yield ratios over the sample period. Further, the BSE-100 index that is used as proxy in the study does not incorporate dividends. Hence, including dividends while estimating security returns would have actually introduced a positive bias in the slope estimates of our time-series regression.

### 2.4 Methodology: Standard Form of CAPM

The relationship between risk and return has been analysed systematically by Black, Jensen and Scholes (1972). They have tested whether the relationship is linear and also tested whether any firm-specific volatility of a security's return has an impact on the return. They conclude that beta is an important determinant of security return. The methodology used in this study is more or less similar to that used by them. Ansari (2000) has used this methodology in his studies of the Indian capital market.

#### 2.4.1 Phase I: Time Series Regression

We have first calculated percentage daily returns of security, index and mean returns by using appropriate formulas. The natural logarithm of the daily price of companies and index is also used in this study. Terregrossa (2001) calculated intercept ($\alpha_i$) and beta ($\beta$) for each of his sample firms, by running regressions over a cross-section of firms for a five-year period horizons from 1982 to 1990. A similar methodology has been used to compute the intercept ($\alpha_i$) and beta ($\beta$) for each of the sample companies by using a three-year period daily returns for the entire period of study i.e. 1990 to 2004. The following market model is used to represent expected returns on security. The daily returns of the securities and the market for the period are regressed by taking the company returns as dependent variable and the market returns as the independent variable. The risk measures like beta and alpha are calculated using this model.

$$R_i = \alpha_i + \beta_i R_m + e_i \quad , for\ i = 1, \ldots N. \tag{1}$$

Where,

*$R_i$ = Expected return on Security 'i'; $\alpha_i$ = Intercept of a straight line or alpha coefficient of security i; $\beta$i = Slope of a straight-line or beta coefficient of security i; $R_m$ = Expected return on index m; $e_i$ = Error term with mean zero and a standard deviation which is constant. This term captures the variations in security i that are not captured by the market index m.*

**2.4.2 Phase II: Cross-Sectional Regression**

In Phase II of the study, all securities are arranged in descending order of their betas in order to form portfolios with low and high beta. A portfolio of 5 securities is made with equal weights and market value weights by considering non-overlapping securities. Portfolios have been formed with equal weights as suggested by Lakonishok, Shliefer and Vishny (1994). In this set, portfolio 1 has been formed by choosing the first five securities having highest beta values (securities 1, 2, 3, 4 and 5), Portfolio 2 is formed by choosing the next five securities (6, 7, 8, 9, and 10) and so on. Using this process, 10 portfolios have been formed with equal weightage to each security in the year 1993. Similar process is done for subsequent test periods from 1994 to 2005. Similarly, another set of portfolios has been formed with market value weights as suggested by Fama and French (1992). For the purpose of testing CAPM, the realized returns on each security for the period January1, 1993 to December 24, 1993, is used as a measure for expected portfolio returns. A similar method has been used for the rest of the test period January1, 1994 to December 2004 (for each year separately) and January 1, 2005 to June 30, 2005. Using portfolio betas as the independent variable and the difference between the individual portfolio returns and the risk free rate of returns ($R_p$-$R_f$) as the dependent variable, a second pass regression is run for the following:

$$R_p - R_f = \alpha + \beta_1 \beta_p + e_{pt} \quad \text{... (2)}$$

*Where*

$e_{pt}$ *= is the regression error term;*

$R_f$ *= risk free rate of return;* $\alpha$ *and* $\beta_1$ *are estimate for intercept coefficient and slope coefficient for each security.*

If CAPM holds, we can expect $\alpha$ to be closer to zero and beta to capture the cross-sectional variation in average portfolio returns. The summarised results of the Phase II regression are presented in Tables.

**2.4.3 Methodology: Size Factor**

The study uses Fama and French (1992) methodology to test for the impact of size as the independent variable on the cross-section of portfolio returns. Banz (1981), Reinganum (1981a), Mohanty (2002), Sehgal (2003) and Connon and Sehgal (2003) have used this methodology. Using size as the independent variable and the difference between the individual portfolio returns and the risk-free rate of returns ($R_p$-$R_f$) as the dependent variable, a regression is run for the following:

$$R_p - R_f = \alpha + \beta_2 R_{MEt-1} + e_{pt-1} \quad \text{.... (3)}$$

$e_{pt-1}$ *= is the regression error term;*

$R_f$ *= risk free rate of return;* $\alpha$ *and* $\beta_2$ *are estimate for intercept coefficient and*

*slope coefficient for size.*

If the Factors model holds, we can expect $\alpha$ to be closer to zero and size to capture the cross-sectional variation in average portfolio returns. The summarised results of the Phase II regression are presented in Tables at the end of the paper.

**2.4.4 Company Attributes (Year T and Year T-1 Analysis)**

Since size can be measured for portfolios, regression method is suitable to test the impact of size on the cross-section of portfolio returns in the Indian capital market. The equally weighted and value-weighted portfolios are formed for the years starting

from 1993 ending up with 2005. The weights are assigned in two different ways. In the first case, the weights are used by taking the weights of the year for which CAPM is to be tested (called Year t weights) and in the second case the weights of the year preceding the year for which the test is made (called Year t-1 weights). The price data and the independent variables data is collected for the year starting from January and ending with December for every year. The year t weights are used based on the assumption that the investors anticipate (predict) the future earnings, returns etc and form opinions on the expected returns. The year t-1 weights are used to ensure that investors' return estimation is done from January of year t based on the information available for the previous year.

### 2.4.5 Cross Sectional Analysis: Year-Wise Regression

The regression equations are estimated based on the data of the individual years, viz., 1993 to 2005. The security's cross-sectional year-wise regression is computed to test the extent of independent variables which influence the portfolio returns. The minimum number of observations in the year-wise cross-sectional regression is 10 for the year 1993 and the maximum is 13 for the year 2005.

### 2.4.6 Cross-Sectional Analysis: Combined Years Regression

Since the number of observations was less in the cross-sectional year-wise regression, we have computed regression with pooled data of the year-wise regressions (combined years). The first combined year regression is run by taking the pooled data of 1993 and 1994. The second combined year regression is run by taking the pooled data of 1993, 1994 and 1995 and so on. This process is repeated for each year to form combined years observations. The minimum number of observations in the cross-sectional combined years regression of the portfolios is 10 during 1993 and the maximum is 163 for the period 1993-2005.

## 3. Results and Analysis

### 3.1 Test For Intercept (Alpha), Slope Bp, Size And The F Significance (Phase II Test: On The Basis of Cross-Section Regression)

As we have already discussed in the literature survey, many factors influence security/portfolio returns. Various theories have been formulated based on the studies conducted on the determinants of security/portfolio returns. The determinants of security/ portfolio returns can be studied in different ways. The present study has been conducted by choosing two independent variables beta, size (*lnME*) for the sample data and it tests the portfolio risk-return relationship. Univariate regression model has been used to find out the extent of influence these variables have on portfolio returns. The present study attempts portfolio analysis as suggested by Markowitz (1959). The following paragraphs discuss whether the independent variables (portfolio beta and size) explain the variation in the dependent variable (portfolio returns). The results of the different portfolios described in Part 2.4.2 and 2.4.3 are presented in Tables. The intercept and slope co-efficient values are tested using the t-test and SigF values are tested using ANOVA (F-test) at 5 percent level of significance.

**Table 1** *Cross-Sectional Regression Results of Percentage Returns with Equally Weighted Portfolios*

| | | **P-value α** | | **P-value BetaP** | | **P-value α** | | **P-value ln(ME)** | |
|---|---|---|---|---|---|---|---|---|---|
| | | Accept Null hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp |
| N | 4 | | | | | | | | |
| EW T | Year wise | | 53.85< 0.05 | 92.31 >0.05 | | 92.31> 0.05 | | 92.31 >0.05 | |
| EW T | Comb ined | | 69.23< 0.05 | 76.92 >0.05 | | 100>0. 05 | | 100> 0.05 | |
| EW T-1 | Year wise | | 53.85< 0.05 | 92.31 >0.05 | | 92.31> 0.05 | | 92.31 >0.05 | |
| EW T-1 | Comb ined | | 69.23< 0.05 | 76.92 >0.05 | | 69.23> 0.05 | | 69.23 >0.05 | |
| N Accept | | | | 4 | | 4 | | 4 | |
| N Reject | | | 4 | | | | | | |
| % of Accept | | | | 100 | | 100 | | 100 | |
| % of Reject | | | 100 | | | | | | |

### 3.2 Cross-Sectional Regression Results of Percentage Returns with Equally Weighted Portfolios

Table 1 deals with the test for alpha and the slope coefficients of portfolio beta for percentage returns with equally weighted portfolios. The results indicate that in 100% of the cases, the alpha coefficient is significantly different from zero and therefore, we reject the null hypothesis that $\alpha$ is equal to zero. As discussed in 2.4.2, if CAPM holds, we expect portfolio beta to capture the cross-sectional variation in portfolio returns. We have therefore, tested whether the beta co-efficient explains the variation in portfolio returns.The *p*-values of $\beta p$ slope coefficient are more than the level of significance in 100% of the cases. Therefore, we accept the null hypothesis that portfolio beta is not a significant determinant of portfolio returns. The ANOVA (F-test) indicates that the regression is not a good fit in 100% of the cases. This leads to the conclusion that the portfolio beta does not explain the variation in the portfolio returns. Table 1 also shows the results for alpha and the slope coefficients of portfolio size for percentage returns with equally weighted portfolios. It exhibits that in 100% of the cases $\alpha$ value is not significantly different from zero and therefore, the null hypothesis is accepted. The *p*-values of ln(ME) slope co-efficient are greater than the level of significance in 100% of the cases. This indicates that the size variable does not significantly explain the variation in portfolio returns. Further, the ANOVA (F-test) also indicates that regression is not a good fit in 100% of the cases. The conclusion from this analysis is that size leaves the portfolio returns unexplained

**Table2** *Cross-Sectional Regression Results of Percentage Returns with Market Value Weighted Portfolios*

| | | **P-value α** | | **P-value BetaP** | | **P-value α** | | **P-value ln(ME)** | |
|---|---|---|---|---|---|---|---|---|---|
| | | Accept Null hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp |
| N | 4 | | | | | | | | |
| MW T | Year wise | 76.92 >0.05 | | | 53.85 <0.05 | | 53.85 <0.05 | | 61.54 <0.05 |
| MW T | Com bined | 84.62 >0.05 | | | 76.92 <0.05 | 61.54 >0.05 | | | 53.85 <0.05 |
| MW T-1 | Year wise | 84.62 >0.05 | | | 53.85 <0.05 | 53.85 >0.05 | | 53.85 >0.05 | |
| MW T-1 | Com bined | 84.62 >0.05 | | 84.62> 0.05 | | 92.31 >0.05 | | 84.62 >0.05 | |
| N Accept | | 4 | | 1 | | 3 | | 2 | |
| N Reject | | | | | 3 | | 1 | | 2 |
| % of Accept | | 100 | | 25 | | 75 | | 50 | |
| % of Reject | | | | | 75 | | 25 | | 50 |

### 3.3 Cross-Sectional Regression Results of Percentage Returns With Market Value Weighted Portfolios

When we use percentage returns with market value weighted portfolios the test results for alpha and the slope coefficients of portfolio beta are shown in Table 2. The results indicate that in 100% of the cases, the $\alpha$ value is not significantly different from zero and therefore, the null hypothesis is accepted. The *p*-values of $\beta p$ slope co-efficient are less than the level of significance in 75% cases. Therefore, we reject the null hypothesis and accept the alternate hypothesis that beta variable explains the variation in portfolio returns. Further, the ANOVA (F-test) also indicates that regression is a good fit in 75% cases. The conclusion from this analysis is that beta explains the portfolio returns as expected in CAPM. The test for alpha and the slope coefficients of portfolio size is also shown in Table 2. The results indicate that in 75% of the cases, the $\alpha$ value is not significantly different from zero and therefore, the null hypothesis is accepted.

**Table 3** *Cross-Sectional Regression Results of Log Returns with Equally Weighted Portfolios*

| | | **P-value α** | | **P-value BetaP** | | **P-value α** | | **P-value ln(ME)** | |
|---|---|---|---|---|---|---|---|---|---|
| | | Accept Null hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp |
| N | 4 | | | | | | | | |
| EW T | Year wise | 61.54 >0.05 | | 100> 0.05 | | 84.62 >0.05 | | 84.62 >0.05 | |
| EW T | Com bined | 61.54 >0.05 | | 76.92 >0.05 | | 92.31 >0.05 | | 92.31 >0.05 | |
| EW T-1 | Year wise | 61.54 >0.05 | | 100> 0.05 | | 76.92 >0.05 | | 84.62 >0.05 | |
| EW T-1 | Com bined | 61.54 >0.05 | | 76.92 >0.05 | | | 69.23 <0.05 | | 69.23< 0.05 |
| N Accep t | | 4 | | 4 | | 3 | | 3 | |
| N Reject | | | | | | | 1 | | 1 |
| % of Accep t | | 100 | | 100 | | 75 | | 75 | |
| % of Reject | | | | | | | 25 | | 25 |

The test for *ln(ME)* slope coefficient value shows that in 50% of the cases, the slope coefficient is equal to zero and in the remaining cases, the slope coefficients are more than zero.However, the total percentage of accepted results is more than that of the rejected results. From this analysis the final conclusion that can be drawn is that size does not explain the portfolio returns.

### 3.4 Cross-Sectional Regression Results of Log Returns with Equally Weighted Portfolios

When we use log returns with equal weights portfolios, the results of the test for alpha and the slope coefficients of portfolios are shown in Table 3. The results indicate that in 100% of the cases, the $\alpha$ value is not significantly different from zero and therefore, the null hypothesis is accepted. The *p*-values of $\beta p$ slope co-efficient are more than the level of significance in 100% of the cases. Therefore, we accept the null hypothesis that beta does not significantly explain the variation in portfolio returns. Further, the ANOVA (F-test) also indicates that regression is not a good fit in 100% of the cases. The conclusion from this analysis is that beta does not explain the portfolio returns as expected in CAPM. The results of the test for alpha and the slope coefficients of portfolio size are shown in Table 3. The results indicate that in 75% of the cases, the $\alpha$ value is not significantly different from zero and therefore, the null hypothesis is accepted.

**Table 4** *Cross-Sectional Regression Results of Log Returns with Market Value Weighted Portfolios*

| | | **P-value α** | | **P-value BetaP** | | **P-value α** | | **P-value ln(ME)** | |
|---|---|---|---|---|---|---|---|---|---|
| | | Accept Null hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp | Accept Null Hyp | Reject Null Hyp |
| N | 4 | | | | | | | | |
| MW T | Year wise | 92.31 >0.05 | | | 61.54 <0.05 | 61.54 >0.05 | | | 53.84 <0.05 |
| MW T | Com bined | 100> 0.05 | | 100>0 .05 | | 92.31 >0.05 | | 92.31 >0.05 | |
| MW T-1 | Year wise | 84.62 >0.05 | | 53.85 >0.05 | | 61.54 >0.05 | | 61.54 >0.05 | |
| MW T-1 | Com bined | 76.92 >0.05 | | 61.54 >0.05 | | 53.85 >0.05 | | | 53.84 <0.05 |
| N Accept | | 4 | | 3 | | 4 | | 2 | |
| N Reject | | | | | 1 | | | | 2 |
| % of Accept | | 100 | | 75 | | 100 | | 50 | |
| % of Reject | | | | | 25 | | | | 50 |

The test for *ln (ME)* slope coefficient value shows that in 75% of the cases, the slope coefficient is equal to zero. Therefore, we accept the null hypothesis that size variable does not significantly explain the variation in portfolio returns. Further, the ANOVA (F-test) also indicates that the regression is not a good fit in 75% of the cases. The conclusion from this analysis is that size leaves the portfolio returns unexplained.

**Note:** The ANOVA (F-test) values are explained based on independent variables values. For example in Table No. 1, the *p*-values of beta slope co-efficient are more than the level of significance in majority of the years. Based on this we accept the null hypothesis that portfolio beta is not a significant determinant of portfolio returns. The ANOVA (F-test) indicates that the regression is not a good fit in 100% of the cases. Similarly in Table No. 2, the *p*-values of Bp slope co-efficient are less than the level of significance in 75% of cases. Therefore, we reject the null hypothesis and accept alternate hypothesis that beta variable explains the variation in portfolio returns. The ANOVA (F-test) indicates that the regression is a good fit in 75% cases. Similar analysis holds for rest of the Tables.

### 3.5 Cross-Sectional Regression Results of Log Returns with Market Value Weighted Portfolios

When we use log returns with market value weighted portfolios, the tests for alpha and the slope coefficients of portfolio beta are shown in Table 4. The results indicate that in 100% of the cases, the $\alpha$ value is not significantly different from zero and therefore, the null hypothesis is accepted. The *p*-values of $\beta p$ slope co-efficient are more than the level of significance in 75% of the cases. This leads to the acceptance of the null hypothesis that the beta variable does not significantly explain the variation in portfolio returns. Further, the ANOVA (F-test) also indicates that regression is not a good fit in 75% of the cases. The conclusion from this analysis is that beta does not significantly explain the variation in portfolio returns as expected in CAPM. The test for alpha and the slope coefficients of portfolio size are shown in Table 4. The results indicate that in 75% of the cases, the $\alpha$ value is not significantly different from zero and therefore, the null hypothesis is accepted. The test for *ln (ME)* slope coefficient value shows that in 50% of the cases, the slope coefficient is equal to zero and in the remaining cases the slope coefficient is more than zero. However, the percentage of years for which the p-values of the slope coefficient are more than the level of significance is 153.84% while the total percentage of years for which the p-values of the slope coefficient are less than the level of significance is 107.68%. Based on this we accept the null hypothesis that the size does not explain the portfolio returns.

The CAPM asserts that unsystematic risk can be diversified and therefore, the only risk of concern to the investors is the systematic risk that cannot be avoided by diversification. Therefore, the theory says that the investors need to consider only the beta of the securities. Further, it posits that returns of the securities/portfolios are directly related to the beta of securities/portfolios. Therefore, we have tested for the relationship between the portfolio returns and their betas and also size which is one of the risk factors. The results of the study show that neither beta nor size significantly explain the variation in portfolio returns when portfolios are formed with equal weights in both percentage returns and log returns. When both percentage and log returns are used, size does not explain the portfolio returns, whereas beta seem to explain the portfolio returns when percentage returns with value weights are used. However, beta fails to explain the portfolio returns when log returns with value weights are used. The overall direction indicates that beta as well as size do not explain variations in portfolio returns. Further, the intercept (alpha) of CAPM is not significantly different from zero. Therefore, while the tests for alpha show that CAPM is valid, the test for beta and size is not a significant determinant of portfolio returns.

## 4. Summary and Conclusions

Investments are made in stock markets in expectation of returns in excess of the risk-free rate. Over the years, researchers have worked to find the relationship between risk and returns. One of the most important contributions by researchers in the securities market is the establishment of the relationship between returns and risks by way of CAPM. Ever since Sharp-Lintner-Mossin proposed CAPM, a large number of studies have been conducted to test CAPM. Although CAPM remains as one of the most popular models in both professional as well as academic parlance, a large

number of researchers have come up various extensions of the basic CAPM to include a number of risk factors such as size, book-to-market equity, EPS/Price, leverage and market factors to explain portfolio returns. This paper has attempted to test the validity of market and size factors in explaining portfolio returns in the Indian market.

This study reveals that beta explains the variation in portfolio returns if percentage returns are used by forming portfolios with market value weights, whereas in case of percentage as well as log returns when portfolios are formed with equal weights as well as log returns, beta does not significantly explain the variation in portfolio returns in the Indian context. The test for alpha leads to the acceptance of the null hypotheses that alpha is equal to the risk-free rate of return and the test for beta and size coefficients also leads to the acceptance of the null hypothesis. This leads to the conclusion that while alpha of CAPM is on the expected lines, beta does not significantly explain the variation in portfolio returns. This goes against the CAPM theory. Like Reinganum (1981), Fama and French (1992), Ansari (2000), we find that the relation between CAPM β and average returns disappears during the study period. Further, the study of the size factor reveals that the size does not significantly explain the variation in portfolio returns when portfolio are formed with equal weights as well as value weights in the Indian context. This leads to the conclusion that the size factor in CAPM is not as expected by the factor model. As in Fama & French (1992) and Mohanty (2002), we also find that size alone could not explain the variation in portfolio returns.

The overall conclusions of this study can be summarized as follows:

1. The tests for portfolios based on percentage and log returns indicate that alpha is not significantly different from zero. This supports the CAPM theory.
2. The test for portfolios based on percentage returns indicate that the beta of regression is as expected by *CAPM* only when we use market value weights.
3. The test for portfolios based on both percentage and log returns indicate that the beta of regression is not as expected by *CAPM* when we use equal weights.
4. The test for the size of regression goes against the factor model when portfolios are formed with equal weights as well as value weights.

**Table 5** *BSE Index and sample securities' brief profile*

| | **Index and sample securities name** | **Year of in corpn.** | **Share price data from** | **Effective date from** | **To** | **Industry Category** |
|---|---|---|---|---|---|---|
| 1 | BSE 100 Index | 1989 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | |
| 2 | Arvind Mills Ltd. | 1931 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Cloths & Yarns |
| 3 | Asian Cables & Inds Ltd. | 1979 | 1-Jan-90 | 1-Jan-90 | 28-Nov-97 | Electrical Cables & Wires |
| 4 | Associated Cement Cos. Ltd. | 1936 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Cement |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | Bajaj Auto Ltd. | 1945 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Light Vehicles |
| 6 | Ballarpur Industries Ltd. | 1945 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Paper |
| 7 | Bharat Forge Ltd. | 1961 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Automobiles |
| 8 | Bharat Heavy Electricals Ltd. | 1964 | 12-Oct92 | 4-Jan-93 | 30-Jun-05 | Prime Movers |
| 9 | Bharti Tele-Ventures Ltd. | 1995 | 18-Feb-02 | 18-Feb-02 | 30-Jun-05 | Basic Telephone Service |
| 10 | Bombay Burmah Trdg. Corpn. Ltd. | 1863 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Diversified |
| 11 | Bombay Dyeing & Mfg.Co.Ltd. | 1879 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Dimethyl Terephthalate(DMT) |
| 12 | Castrol India Ltd. | 1979 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Lube Oils & lubricants |
| 13 | Ceat Ltd. | 1958 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Tyres |
| 14 | Century Textiles & Inds. Ltd. | 1897 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Diversified |
| 15 | Cipla Ltd. | 1935 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Drug Formulation |
| 16 | Colgate-Palmolive (India) Ltd. | 1937 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Oral or Dentel Hygene |
| 17 | Crompton Greaves Ltd. | 1937 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Motors & Generators |
| 18 | Cummins India Ltd. | 1962 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Internal Combustion Engines |
| 19 | Dr. Reddy'S Laboratories Ltd. | 1984 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Drug Mediocines & Allied Products |
| 20 | Futura Polyesters Ltd. | 1960 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Polyesters Staple Fybres(PSF) |
| 21 | Glaxosmithkline Pharma Ltd. | 1924 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Drug Formulation |
| 22 | Grasim Industries Ltd. | 1947 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Diversified |
| 23 | G E Shipping Co. Ltd. | 1948 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Water Tranport Services (shipping) |
| 24 | Gujarat Ambuja Cements Ltd. | 1981 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Cement |

| | | | | | | |
|---|---|---|---|---|---|---|
| 25 | G S F C Ltd. | 1962 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Urea |
| 26 | H C L Technologies Ltd. | 1991 | 11-Jan-00 | 11-Jan-00 | 30-Jun-05 | Computer Software |
| 27 | H D F C Bank Ltd. | 1994 | 26-May-95 | 26-May-95 | 30-Jun-05 | Banking Services |
| 28 | Hero Honda Motors Ltd. | 1984 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Motors cycles |
| 29 | Hindalco Industries Ltd. | 1958 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Allumenium Unwrought |
| 30 | Hindustan Lever Ltd. | 1933 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | FMCG |
| 31 | Hindustan Motors Ltd. | 1942 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Passenger Car |
| 32 | H P C L. | 1953 | 11-Sep-92 | 4-Jan-93 | 30-Jun-05 | Petroleum Products(refineries) |
| 33 | H D F C | 1977 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Housing Finance Services |
| 34 | I C I C I Bank Ltd. | 1994 | 24-Sep-97 | 1-Jan-98 | 30-Jun-05 | Banking Services |
| 35 | I T C Ltd. | 1910 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Cigarettes |
| 36 | Indian Hotels Co. Ltd. | 1902 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Hotel & Restaurants Services |
| 37 | I P C L. | 1969 | 20-Nov-92 | 4-Jan-93 | 30-Jun-05 | Plastic in Primary Forms |
| 38 | Indian Rayon & Inds. Ltd. | 1956 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Diversified |
| 39 | I D B I | 1964 | 20-Sep-95 | 1-Jan-96 | 30-Jun-05 | Banking Sectors |
| 40 | Infosys Technologies Ltd. | 1981 | 14-Jun-93 | 14-Jun-93 | 30-Jun-05 | Computer S/W |
| 41 | Larsen & Toubro Ltd. | 1946 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Industrial Contracts & Turnkey |
| 42 | M T N L. | 1986 | 13-Apr-93 | 13-Apr-93 | 30-Jun-05 | Basic Telephone Service |
| 43 | Mahindra & Mahindra Ltd. | 1945 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Utility Vehicles incl.jeeps |
| 44 | Maruti Udyog Ltd. | 1981 | 9-Jul-03 | 9-Jul-03 | 30-Jun-05 | Passenger Car |
| 45 | Mukand Ltd. | 1937 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Flat Rold Products |
| 46 | N I I T Ltd. | 1981 | 24-May-93 | 24-May-93 | 30-Jun-05 | Computer Software |

| | | | | | | |
|---|---|---|---|---|---|---|
| 47 | Nestle India Ltd. | 1959 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Dairy products |
| 48 | Novartis India Ltd. | 1947 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Drug Formulation |
| 49 | O N G C | 1959 | 1-Aug-95 | 1-Jan-96 | 30-Jun-05 | Petroleum, oil |
| 50 | Philips India Ltd. | 1930 | 1-Jan-90 | 1-Jan-90 | 29-Aug-03 | Consumer Electronics |
| 51 | Premier Ltd. | 1944 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Machine Tools |
| 52 | Ranbaxy Laboratories Ltd. | 1961 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Drugs madicines & allied products |
| 53 | Reliance Energy Ltd. | 1929 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Electricity Energy |
| 54 | Reliance Industries Ltd. | 1966 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Petroleum products(refineries) |
| 55 | Satyam Computers Services Ltd | 1987 | 26-Nov-92 | 4-Jan-93 | 30-Jun-05 | Computer Software |
| 56 | Scindia Steam Navigation Co. Ltd. | 1919 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Water Tranport Services (shipping) |
| 57 | Siemens Ltd. | 1957 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Switching apparatus |
| 58 | State Bank Of India | 1955 | 1-Jan-90 | 4-Mar-94 | 30-Jun-05 | Banking Services |
| 59 | Steel Authority Of India Ltd. | 1954 | 1-Oct-92 | 4-Jan-93 | 30-Jun-05 | Finished stainless steel |
| 60 | Tata Chemicals Ltd. | 1939 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Fertilizers |
| 61 | Tata Iron & Steel Co. Ltd. | 1907 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Finished stainless steel |
| 62 | Tata Motors Ltd. | 1945 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Heavy Commercial vehicles |
| 63 | Tata Power Co. Ltd. | 1919 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Electricity Energy |
| 64 | Voltas Ltd. | 1954 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Diversified |
| 65 | Wipro Ltd. | 1945 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Computer Software |
| 66 | Zee Telefilms Ltd. | 1982 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Broadcasting Media |
| 67 | Zenith Computers Ltd. | 1960 | 1-Jan-90 | 1-Jan-90 | 30-Jun-05 | Diversified |

The conclusions are that the alpha of the CAPM is equal to the risk-free rate of returns, beta holds for percentage returns when portfolios are formed with market value weights, neither beta nor size variables explain the variation in portfolio returns when we use equal weights and beta does not explain portfolio returns when log returns with value weights are used. The overall conclusion drawn is that neither beta nor size explain the variation in portfolio returns. As suggested by Pastor (2002), further studies are needed on factor models, in which expected return depends on the stock's betas with respect to more factors than just the market. The factors can be macroeconomic variables {For example, a five factor model developed by Chen, Roll and Ross(1986)}, or portfolios formed based on companies characteristics {for example, a three factor model of Fama and French (1992,1993)} or even a return series constructed using statistical techniques such as factor analysis. Further work like the parsimonious model suggested by (Fama and French (1992) is needed in the Indian context by taking up a combination of beta and different independent variables.

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https://cdbmsi.reservebank.org.in/cdbmsi/servlet/login/statistics/Handbook of Statistics on Indian Economy/Table 119: Interest Rates on Central and State Governments Dated Securities.