Testing of Beta and Return in the Indian Capital Market

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Abstract

The study tests whether beta as envisaged in CAPM is the determinants of the security and portfolio returns. Further the study also tests whether the intercept of the CAPM is equal to the risk-free rate of return as envisaged in the standard form of theory. The study is based on BSE Sensex companies. The overall results, based on percentage and log returns show that the intercept is equal to the risk-free rate of return but the beta does not explain the variation in individual security returns and portfolio returns in Indian capital market. Therefore, we conclude that CAPM does not hold for the Indian market.

Keywords: CAPM, Intercept, Security/Portfolio returns, Beta, Risk-free Returns, Market Returns

JEL Classification: G12

1. Introduction

Security analysis is a pre-requisite for making investments. For making proper investments involving risk and return, it is imperative that an investor makes a study of the different avenues of investment that are available, their risk and return characteristics, and make proper projection and expectation of the risk and return of alternative investment under consideration. The process of analyzing the individual securities and the market as a whole and estimating the risk and return expected from each of the investments, with a view to identifying undervalued securities for buying and overvalued securities for selling is both an art and a science. Investment in securities market requires the study of the relationship between risks and returns. Capital Asset Pricing Model (CAPM) establishes the relationship between risks and returns in the efficient capital markets. A review of studies conducted for various markets in the world reveals that researchers have used a number of methodologies to test the validity of CAPM. While some studies have supported the validity of CAPM, some others have revealed that beta alone is not a suitable determinant of asset pricing and that a number of other factors could explain the cross-section of returns. The following paragraph deals with the literature review and need for the study.

1.1 Literature Review

Sharpe (1964), Lintner (1965) and Mossin (1968) have independently developed Capital Asset Pricing Model (CAPM). The studies conducted by the Black, Jensen and Scholes (1972), Black (1972; 1993), Fama and MacBeth (1973), Terregrossa (2001) have supported

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the CAPM. After 1970s, CAPM came under attack as striking anomalies were reported by Reinganum (1981), Bark (1991), Harris et al., (2003) and Fama and French (1992; 1993; 1996; 1998; 2002) show that CAPM's beta (β) is not a good descriptor of the expected return of securities/portfolios. But studies by Kothari et al., (1995), Kothari and Shanken (1995) argue in defense of CAPM's beta (β). While many studies have been conducted on CAPM in the western countries, there are a few studies in the Indian context. Studies by Varma (1988), Yalwar (1988) and Srinivasan (1988) have generally supported the CAPM theory. Studies by Gupta and Seghal (1993), Vaidyanathan (1995), Madhusoodanan (1997), Sehgal (1997), Ansari (2000), Rao (2004) and Manjunatha and Mallikarjunappa (2006; 2007; 2009) have questioned the validity of CAPM in Indian markets. Ansari (2000) has opined that the studies of CAPM on the Indian markets are scanty and no robust conclusions exist on this model. The above literature survey shows that, there are many research studies on the developed capital markets to conclude that Standard form of CAPM is not suitable for predicting the securities prices. In Indian capital market, there is less number of studies on the CAPM and no robust conclusions exist on this model. This view motivates the present study. Therefore an attempt is made in this paper to explore whether beta explain the cross-sectional variation in security/portfolio returns in Indian capital market. The paper is organized in four parts. Part 1 is the introduction; part 2 presents objectives, hypotheses, data and methodology; part 3 analyses the results; part 4 presents the summary and conclusions. References are given after part 4 and the Tables are presented after the references.

2. Objectives, Hypotheses, Data and Methodology

2.1 Objectives: This study is undertaken with the following objective:

- To ascertain the relationship between security/ portfolio returns and market returns.
- To test the empirical validity of the Standard Beta model in India.

2.2 Hypotheses: Based on the evidence on CAPM, the following hypotheses are formulated:

2.2.1 The Null Hypotheses Are

- Ho: Market betas are not the determinants of the cross-section of the expected security/portfolio returns.
- Ho: The intercept (Alpha) in the CAPM is not significantly different from zero.

The negations of the above null hypotheses are the alternate hypotheses.

2.3 Data and Sample

The study is based on BSE Sensex companies that were part of the index from the beginning to 30th June 2010. Sensex consists of 30 companies. However, other companies that replaced a number of companies and 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 selected based on two criteria: a) the companies selected should have been constituents of BSE Sensex and b) traded for minimum six months in a year during the study period. The BSE Sensex companies represent almost 49% of the BSE's total market capitalization {source; http://bseindia.com/mktlive/indiceshighlights.asp} and sample stocks come from 22 industry groups. These companies are heavily traded on the exchange and come from diverse industry groups. BSE-100 index is a 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 closing share prices and index from January 1, 1990 to June 30, 2010 are used for the study. The data were collected from CMIE (Prowess package), BSE, RBI, DCA, SEBI websites etc. Over the years, researchers have used quarterly, monthly, weekly data to study the empirical relationship in the CAPM. Brown & Warner (1985) suggest that the daily prices are better as quarterly, monthly, weekly data do not provide a very meaningful relationship between risk and return and, hence, daily price data are 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 dividends 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

We have used market model to calculate beta and alpha of the sample companies. This model is used by Black, Jensen and Scholes (1972) and other researchers.

2.4.1 Phase I: Time Series Regression

We have calculated percentage and log returns of the sample data and then calculated portfolio returns. Terregrossa (2001) methodology has been used for grouping of sample companies by using three-year period daily returns for the period of study and then computed the intercept (α_i) and beta (β) for each of the sample periods and companies. For example, the daily prices of the first three years from January 1, 1990 to December 31, 1992 are used for computing the parameters to test the CAPM for the ex-post returns of the year 1993. For the second set of three years, the first year is deleted and one additional year (1993) is added to test the ex-post returns of the year 1994 and so on for the study period up to June 30, 2010. The risk measures like beta, alpha are calculated using the following model.

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

Where,

R_i = Expected return on Security 'i'; α_i = Intercept of a straight line or alpha coefficient of security i; β_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 Univariate Regression using Individual Security's Beta

In Phase II of the study, to test the CAPM, the realized returns on each security for the period January 1, 1993 are used. A second pass regression is run for the following:

$$R_i - R_f = \alpha + \beta_1 \beta_2 + e_i \quad \ldots (2)$$

Where

R_f = risk free rate of return; α and β_1 are estimate for intercept coefficient and slope coefficient for security.

If the CAPM holds, we can expect α in the above model to be closer to zero and beta (β_1) to be significantly different from zero and to capture the cross-sectional variation in security returns. The summarised results of the Phase II regression are presented in Table 1 and Table 2.

Table 1. Cross-Sectional Regression Results of Security Percentage Returns

	ALPHA		*BETA*		*ANOVA (F-TEST)*	
1	1		3		3	
2		3		1		1
3	25		75		75	
4		75		25		25

Note 1. First row, following the header row, indicates the number of regressions in which the co-efficients are more than the chosen level of significance (cases of acceptance of Ho); Second row, following header row, indicates number of regressions in which the co-efficients are less than the chosen level of significance (cases of rejection of Ho); Third row, following the header row, indicates percentage of acceptance of Ho; Fourth row, following the header row, indicates percentage of rejection of Ho. The ANOVA (F-test) values are explained based on independent variable's values. For example in Table 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 75 percentages of the cases taking portfolio beta as an independent variable.

Note 2. Although all the independent variable values are reported in different columns, they are the results of the univariate regression taking each of them as independent variable separately. The reported results of the alpha co-efficients are the results of each individual regression (i.e four regressions for each of the independent variable as explained in the methodology and results section of the paper. See paras 2.4.4 to 2.4.6 and 3.1). Since the reporting of the individual values of the co-efficients would require a large number of tables, only the final results are reported here. The detailed values are available with the authors.

This explanation holds for all the Tables given below.

Table 2. Cross-Sectional Regression Results of Security Log Returns

	ALPHA		*BETA*		*ANOVA (F-TEST)*	
1	4		4		4	
2						
3	100		100		100	
4						

2.4.3 Test for Alpha, Beta of Portfolios Based on Cross-Section Regression

The study has further focused on testing CAPM and factor model by forming portfolios. A portfolio of 5 securities is made with equal weights as suggested by Lakonishok, Shliefer and Vishny (1994) considering non-overlapping securities. 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. 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. Similar method has been used for the rest of the test period January1, 1994 to December 2004 (for each year separately) and January 1, 2010 to June 30, 2010. 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 31, 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 31, 1994 (for each year separately) and January 1, 2010 to June 30, 2010. We use similar formulae defined in paragraph 2.4.2 to study the independent variables' effect on portfolio returns. A second pass regression is run for the following:

$$R_p - R_f = \alpha + \beta_1\ \beta_p + e_{pt} \qquad (3)$$

If the CAPM holds, we can expect α in the above model to be closer to zero and portfolio beta (β_p) to capture the cross-sectional variation in portfolio returns. The summarised results of the Phase II regression are presented in Table 3, 4, 5 and 6.

2.4.4 Company Attributes (Year *t* and Year *t*–1 Analysis)

To test for the ex-post returns of year *t*, we make two assumptions. In the first case we assume that investor can use values of book equity (BE) and market equity (ME) book –to-market equity ratio (BE/ME) of year *t*–1 and use this information to make estimation of the returns of year *t*. In the second case we assume that investors are able to anticipate the values of BE and ME (book –to-market equity ratio (BE/ME) of year *t* and based on these anticipated values the expected returns are estimated. Based on the above assumption we first test using year *t* values and later we test using year *t*–1 values of independent variables.

2.4.5 Cross Sectional Analysis: Year-wise Regression

The CAPM is tested by running regressions on the realized returns of the individual years, viz., 1993, 1994, 1995 and so on up to 2010. The security/portfolio's cross-sectional year- wise regression is done to test the extent of independent variable's influence on the security/portfolio returns.

2.4.6 Cross Sectional Analysis: Combined Years Regression

Since the number of observations was less in the cross-sectional year-wise regression, we run regression with pooled data of the year-wise regressions (combined years). The first combined year regression is run by taking the data of 1993. The second combined year regression is run by taking the pooled data of 1993 and 1994. The third combined year regression is run by taking the pooled data of 1993, 1994 and 1995. This process is repeated by adding one additional year for the data set to form combined years observations. The last combined year regression is run by taking the pooled data from 1993 to 2010.

Results and Analysis

3.1 Test For Intercept (Alpha), Beta (β) and the F Value (Phase Ii Test on the Basis of the Cross-Section Regression)

The determinants of security/portfolio returns can be studied in different ways. The present study has been conducted by choosing beta as independent variable. Univariate regression model is used independently to find out the extent of influence of beta variable on security/portfolio returns. The following paragraphs discuss whether the independent variables explain the variation in the dependent variable (portfolio returns). The results of the different securities/portfolios described in Part 2.4.2, 2.4.3, 2.4.4, 2.4.6 are presented in Tables (Table No.1, 2, 3, 4, 5 and 6). The intercept and slope co-efficient values are tested using the t-test and the overall fit of the regression is tested using the analysis of variance (ANOVA - F-test) at 5 percent level of significance.

We have a large number of cross-section regressions for beta independent variable. The total numbers of cross-sectional regressions for beta variable are 432**see end note**. Since these results have been classified under different categories like percentage returns, log returns, equal weights, market value weights, year *t* and *t*–1 weights, year-wise and combined years, there is a need to know the overall results of all these regressions. To take the overall results in all the regressions, we count the total number of intercepts and slope co-efficients by classifying these into two cases. In the first case, we take all the co-efficients whose p-values are less than the chosen level of significance (0.05) and in the second case we take the co-efficients whose p-values are more than the chosen level of significance (0.05). In both the first and the second cases we compute the percentage of cases whose co-efficients are less (more) than the chosen level of significance. Based on these the overall results and the consolidated interpretation are given below.

3.2 Cross-Sectional Univariate Regression Results of Percentage Returns: Case of Individual Securities

Table 1 shows the test for alpha and slope coefficients of securities beta for percentage returns. The cross-sectional regression results show that in 75 percentages of the cases, the α values are significantly different from zero. Therefore, we accept the alternate hypothesis that alpha is not equal to zero. This leads to the conclusion that α of the regression is not as expected by the CAPM. The p-values of the β_i slope co-efficient are more than the level of significance and ANOVA (F-test) indicate that regression is not a good fit in 75 percentages of the cases. Therefore, we accept the null hypothesis that beta is not a significant determinant of security returns.

3.2 Cross-Sectional Univariate Regression Results of Log Returns: Case of Individual Securities

Table 2 shows in 100 percentages of the cases, the α values are not significantly different from zero, therefore, we accept the null hypothesis that alpha is equal to zero. This leads to the conclusion that α of the regression is as expected by the CAPM. The *p*-values of the β_i slope co-efficients are more than the level of significance and ANOVA (F-test) indicates that regression is not a good fit in 100 percentages of the cases. Therefore, we accept the null hypothesis that beta is not a significant determinant of security returns.

3.3 Cross-Sectional Regression Results of Percentage Returns with Equal Weighted Portfolios

Table 3 shows the test for alpha and the slope coefficients of portfolio beta for percentage returns with equally weighted portfolios. The cross-sectional regression results show that in 100 percentages of the cases, the α values are significantly different from zero. Therefore, we accept alternate hypothesis that alpha is not equal to zero. The *p*-values of portfolio beta (β_p) slope coefficient and ANOVA (F-test) are more than the level of significance in 75 percentages of the cases. Therefore, we accept the null hypothesis that portfolio beta is not a significant determinant of portfolio returns.

Table 3. Cross-Sectional Regression Results of Percentage Returns with Equal Weighted Portfolios

	ALPHA		*BETA*		*ANOVA (F-TEST)*	
1		4	3		3	
2				1		1
3			75		75	
4		100		25		25

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

Table 4 shows that in 100 percentages of the cases, the α value is not significantly different from zero. Therefore, we accept the null hypothesis that alpha is equal to zero. The *p*-values of the β_p slope co-efficient are less than 0.05 and the F-test indicate that regression is a good fit in 75 percentages of the cases. Based on this, we reject the null hypothesis and accept the alternate hypothesis that portfolio beta independently explain the variation of portfolio returns.

Table 4. Cross-Sectional Regression Results of Percentage Returns with Market Value Weighted Portfolios

	ALPHA		*BETA*		*ANOVA (F-TEST)*	
1	4		1		1	
2				3		3
3	100		25		25	
4				75		75

3.5 Cross-Sectional Regression Results of Log Returns Equal Weighted Portfolios

Table 5 shows that in 100 percentages of the cases, the α value is not significantly different from zero. Therefore, we accept the null hypothesis that alpha is equal to zero. The p-values of the β_p slope co-efficients are more than 0.05 and the F-test indicates that regression is not a good fit in 75 percentages of the cases. Based on this, we accept the null hypothesis that portfolio beta does not independently explain the variation of portfolio returns.

Table 5. **Cross-Sectional Regression Results of Log Returns Equal Weighted Portfolios**

	ALPHA		*BETA*		*ANOVA (F-TEST)*	
1	4		3		3	
2				1		1
3	100		75		75	
4				25		25

3.6 Cross-Sectional Univariate Regression Results of Log Returns with Market Value Weighted Portfolios

Table 6 shows that in 100 percentages of the cases, the α value is not significantly different from zero. Therefore, we accept the null hypothesis that alpha is equal to zero. The *p*-values of β_p co-efficients are more than 0.05 and the F-test indicates that regression is not a good fit in 75 percentages of the cases. Therefore, we accept the null hypothesis that portfolio beta does not explain the variation in portfolio returns.

Table 6. **Cross-Sectional Regression Results of Log Returns with Market Value Weighted Portfolios**

	ALPHA		*BETA*		*ANOVA (F-TEST)*	
1	4		3		3	
2				1		
3	100		75		75	
4				25		25

4. Summary and Conclusions

Investments are made in stock markets in expectation of returns in excess of the risk-free rate. This paper has attempted to test the validity of market beta univariate regression in explaining the security/portfolio returns in Indian capital market. The result of the present study shows that intercept (alpha) is equal to the risk-free rate of returns. This leads to the conclusion that α of the regression is as expected by the CAPM theory. Beta explains the variation in portfolio returns only when portfolios are formed with market value weights using percentage returns. Securities beta does not significantly explain the variation in securities returns using percentage and log returns. Also portfolio beta do not significantly explain the variation in portfolio returns when portfolios are formed with equal weights using percentage and log returns and when portfolios are formed with market value weights using log returns. Therefore, we can conclude that while the intercept test of CAPM proves the theory, the beta test goes against the standard form of CAPM theory. Our study relating to beta confirm with studies undertaken by Reinganum (1981), Bark (1991), Harris *et al*., (2003) on the developed capital market. The results of the beta test also confirm with Indian studies undertaken by Gupta and Seghal (1993), Madhusoodanan (1997), Sehgal (1997), Ansari (2000), Rao (2004) and Manjunatha and Mallikarjunappa (2006; 2007; 2009). The empirical findings of this paper would be useful to investors and financial analysts as the results prove that beta is not enough in explaining the asset pricing in Indian capital market. The empirical findings of this paper would be useful to investors and financial analysts as the results prove that beta alone is not the determinant of security/portfolio returns in Indian capital market. As suggested by Pastor (2002), further research on the combination of market factors, firms' specific factors, and macroeconomic factors is needed to enlarge the understanding of modern finance and to cover fresh ground to unravel the mysteries and ramifications of the CAPM puzzle. There is also a need to test whether the asset growth rate as found by Cooper et al (2008) is a better determinant of the stock returns than the factors like the book-to-market ratio, excess market returns, beta, and other factors.

End Note

When we use percentage returns, the total numbers of regressions for each combination of variables is 72.

This is because, we have 18 regressions for year-wise (individual years, viz., 1993, 1994, 1995 … 2010) and 18 regressions for combined years when we take year *t* weights; 18 regressions for year-wise and 18 regressions for combined years when we take the weights of year *t*–1. Similarly, when we use log returns, the total numbers of regressions for each univariate variables is 72. So there are 6 types of cross-sectional regressions, we have a total of 432 (72 *6) regressions.

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