Testing Capital Assets Pricing Model as a Tool for Predicting Stock Returns: An Empirical Study in the Indian Context

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Abstract

Capital Assets Pricing Model (CAPM) has always fascinated researchers' interest. It is the most researched as well as critically examined area in the field of finance. The concepts of Capital Market Line (CML) and Security Market Line (SML) are used as tools for the estimation of expected return on securities and portfolios. This study attempts to examine the applicability of CAPM on the Indian stock market.

The study was carried out on the sample of 12 companies representing 3 prominent sectors of the Indian economy i.e. Banking, IT and Automobile. These companies are analysed for the period of five years from 2009 to 2013.

Yearly Expected Returns as per CAPM are computed to compare them with Actual Returns. As per CAPM, expected return on risky securities is the product of risk premium and beta added with the risk-free rate. Most of the computations were performed using Microsoft Excel. The conclusions reveal weak correlation between realized excess returns (i.e. actual returns over and above the risk-free rate) and the expected return as per CAPM. However, higher R square statistics suggest higher importance of systematic factors on stock returns. The study further infers the need for modifying beta for better representation of systematic factors.

Key words: *Capital Assets Pricing Model, Expected Returns, Actual Returns*

Introduction

The stock market is known for its volatile nature, wherein numerous factors can affect prices. The uncertainty of reward from stock market investment is referred to as risk, which is to be borne by investors against the expectation of higher returns.

As risk is inherent in the investments made in the stock market, a good portfolio manager has to understand and acknowledge the components of risk. Unsystematic risk refers to industry / company specific factors while systematic risk refers to market factors. According to Markowitz (Markowitz, 1959), unsystematic risk can be managed and reduced through proper diversification. In this regard, it becomes obvious that investors investing in securities with high unsystematic risk cannot outperform the market. They will not receive any extra reward for including such securities in their portfolio. On the other hand, systematic risk cannot be reduced through diversification. On the foundations of Markowitz, Sharpe (1964) and Lintner (1965) raised a concept of Capital Assets Pricing Model which holds a linear relationship between systematic risk and expected return.

Being the area of interest for many researchers, empirically there are many varied results of CAPM. Initially, in the first two to three decades, CAPM was highly welcomed and accepted. During that period, CAPM was regarded as a proper tool for predicting stock returns. Later on, it was observed empirically that single beta cannot accurately predict stock returns as there are many other factors that can affect stock returns substantially. Changes in the market, changes in macro and micro fundamentals, emergence of competition, etc. are also factors that should be taken into serious consideration while predicting stock returns.

The main problem for investors and portfolio managers is to quantify the risk associated with securities and expected return on bearing this risk. The objective of this study is also targeting the doctrine of predicting stock returns by using CAPM and assessing how much beta contributes to the identification of associated risks.

Capital Assets Pricing Model:

CAPM introduced by Treynor (1961, 1962), Sharpe (1964), Lintner (1965) and Mossin (1965) builds upon the "Portfolio Theory" based on the work of Markowitz (1959). CAPM presents the basis for determining the required rate of return on all risky assets. The major factor that stimulated CAPM to develop is the concept of risk-free asset.

The inclusion of risk-free asset resulted in deriving a Capital Market Line (CML) which was referred to as the new efficient frontier (Leonard, Loli, Kralj and Vlachos, 2012). The required rate of return on a risky asset (Ri) was derived as a function of the risk-free rate (Rf) and risk premium of the individual asset. The risk premium is the product of systematic risk of the asset referred to as beta (βi) and the current market risk premium. Market risk premium is defined as the difference between return on the market (Rm) and risk-free rate (Rf). The CAPM equation is as follows:

$Ri = Rf + \beta i (Rm - Rf)$

CAPM implies that unsystematic risk can be managed and reduced. So, beta remains the only relevant measure of stock risk. Beta determines the sensitivity of the stock to the market i.e. how the price of the stock responds in relation to a specific change in the index.

Review of Empirical Studies:

Testing CAPM has remained an area of interest for many researchers world over. We found many quality studies pertaining to the area of applicability of CAPM.

Pettit and Westerfield (1974) focussed their research on the prediction of security returns. They used CAPM and market model to attain the objective. The data of monthly investment of all securities listed on the New York Stock Exchange during the period of January 1926 to June 1968 was selected for the study. The market model coefficients were estimated for each asset. Results showed that there was no great difference in goodness of fit in forming conditional predictors assuming either the validity of Market Model or the CAPM.

In the Indian context, Gupta (1981) studied share price data for a period of 16 years from 1960 to 1976. Each year's high and low price for the sample shares were considered. He covered 606 equity shares for the study and analysed the same for one or more holding periods. The data was collected from Bombay, Calcutta and Madras stock exchanges. The belief that equities provided a hedge against inflation was found to be irrelevant. The study concluded that the CAPM may not be applicable in the Indian context.

Yalwar (1985) also based his study in the Indian context where he analyzed 122 stocks for a period of 20 years - from 1963 to 1983. He adopted a distinct methodology of calculating monthly geometric mean returns by taking different holding periods of 1 year, 5 years, 10 years and 15 years. The study found that equity returns were positively correlated with market risk premium. The results inferred CAPM to be a good descriptor for the Indian capital market.

Bark (1991) undertook his study in Korea and used monthly stock returns for a period of 8 years - from January 1980 to December 1987. He bifurcated the time period into five periods of 4 years each. The study revealed negative market premium for the entire period. He concluded that CAPM could not be used as a predictor for the Korean market.

Tsopoglou, Papanastasiou and Mariola (2006) provided evidence against CAPM by studying the data of 100 companies listed on the Athens Stock Exchange for the period of 1998-2002. The CAPM's prediction that the intercept should be equal to zero was disproved in the study. Simultaneously they also found that the slope was not equal to the excess returns on the market portfolio. However, their findings did not present evidence in support of any alternative model.

Taneja (2010) examined Capital Assets Pricing Model and Fama French Model by taking a sample of 187 consistently present stocks for 10 years on the S&P CNX 500 index. The analysis was done for five years - from 2004 to 2009. He conferred that Fama French Model is a better predictor than CAPM. He cited that market beta, size and value explain the variation in stock returns better than market factor alone.

Ali, Tehseen, Imtiaz and Fahim (2011) studied the validity of Capital Assets Pricing Model on the Karachi stock exchange. The data of 387 companies bifurcated into 30 different sectors was tested for analysis on monthly, quarterly and semi-annual basis.

The paired sample t- test was applied to find the difference between actual and expected returns. The study conferred that Capital Assets Pricing Model (CAPM) predicted expected returns on short term investment more accurately as compared to long term investment.

Josipa, Dzaja and Aljinovic (2013) tested CAPM on emerging markets of Central and South-eastern Europe. Monthly stock returns of 9 countries for the period of Jan 2006 to Dec 2010 were taken. Stocks were selected in the sample according to their share in the official stock indices of the observed countries. 10 most liquid stocks were considered for each market. The regression analysis of expected returns was carried out. The cross sectional analysis of the obtained test results showed that CAPM was not adequate for assessing returns on the capital assets on observed Central and South-eastern European emerging markets.

Qamar, Rehman and Shah (2013) studied the applicability of CAPM in Pakistan. The analysis was carried out by taking a small sample of 10 stocks of well-performing companies from Karachi Stock Exchange (KSE-100). Price data of these companies was analysed for a 5-year period from 2006 to 2010. They concluded that CAPM did not give accurate results; however, in certain years, it gave partially correct results for a few stocks.

Avadhanam, Mamidi and Mishra (2014) analyzed returns of Central Public Sector Enterprises for the period of 10 years from 1994 to 2013. They took a sample of 46 companies to infer the significant difference between actual returns generated by the market and expected returns as per CAPM.

Alam, Chowdhury and Chowdhury (2015) applied CAPM on 30 stocks of Chittagong Stock Exchange for a period of five years from 2008 to 2012. They found no applicability of CAPM on stocks of CSE.

Research Methodology:

The study aims at testing CAPM empirically in the Indian context. The research is carried out on selected stocks listed on the National Stock Exchange from Banking, IT and Automobile Sectors. These sectors were selected based on their general prominence and potential in the Indian market. Four stocks from each sector based on market capitalization were selected to form the base of the analysis.

Exhibit 1 – Sample Stocks

Banking	IT	Automobile
ICICI Bank	Tata Consultancy Services	Bajaj Auto
HDFC Bank	Infosys	Mahindra & Mahindra
Axis Bank	Wipro	Maruti Suzuki
Punjab National Bank	HCL	Hero Motocorp

Expected returns on these stocks were calculated by using CAPM. Expected returns were compared with actual returns to analyse if the stock is undervalued. The stocks where actual returns were more than expected returns were termed as undervalued stocks, and vice-versa. Coefficient of Determination (R^2) and T-Test were computed to identify the impact of systematic factors on the stock returns.

These stocks were analysed for the period of 5 years from January 2011 to December 2015. The required data was sourced through the website of National Stock Exchange and by using ACE Equity Database. Calculations were made using Microsoft Excel. The expected returns were calculated by using the approach of Security Market Line of CAPM.

$$Ri = Rf + \beta i\,(Rm - Rf)$$

Where,

Ri = Expected Return on Risky Asset

Rf = Risk-Free Rate of Return (364-days Treasury Bills Rate, i.e. 8.12%)

βi = Beta on Risky Asset

Rm = Average Monthly Returns on Nifty-50

Results and Discussion

Exhibit 2 – Banking Sector's Actual Stock Returns alongside Expected Returns

Year	Market Return (Rm) (%)	Risk Premium (Rm – Rf) (%)	Beta	Expected Return as per CAPM (%)	Actual Return (%)	(Actual – Expected) (R-R^)%	Difference (%)	Analysis
2011	5.214	-2.906	1.174	4.708	6.418	1.710	36.314	Undervalued
2012	1.488	-6.632	1.124	0.668	2.719	2.051	306.908	Undervalued
2013	-2.154	-10.274	1.143	-3.620	-2.797	0.823	22.729	Undervalued
2014	2.179	-5.941	1.497	-0.773	3.889	4.662	603.207	Undervalued
2015	0.454	-7.666	1.495	-3.342	-0.220	3.121	93.409	Undervalued

The differences between actual returns and expected returns by using CAPM can be evidently observed in Exhibit 2. In 2011, actual return was 6.42 percent which was 36 percent higher as compared to the expected return of 4.71 percent. Thus, it can be said that the stocks of the banking sector were undervalued. Likewise in 2012, stocks were again undervalued and the market returns were 306.90 percent greater than expected returns. In 2013, the expected loss was -3.62 percent while the actual loss was –2.78 percent. Thus, actual loss was 22 percent lower than the expected loss. In 2014, there was an expected loss of -0.77 percent while the actual return was a gain of 3.89 percent which enabled banking stocks to give 603.21 percent higher returns than expected. In 2015, the actual loss was 93.41 percent lower than the loss predicted by the model. Thus, in all five years of the study, either banking stocks gave higher returns than the expected returns, or lower losses than the expected losses, or positive return against estimation of loss.

Exhibit 3 – IT sector's Actual Stock Returns alongside Expected Returns

Year	Market Return (Rm) (%)	Risk Premium (Rm – Rf) (%)	Beta	Expected Return as per CAPM (%)	Actual Return (%)	(Actual – Expected) (R-R^)%	Difference (%)	Analysis
2011	5.214	-2.906	0.855	5.636	9.781	4.145	73.542	Undervalued
2012	1.488	-6.632	0.876	2.314	2.534	0.220	9.503	Undervalued
2013	-2.154	-10.274	0.990	-2.047	-0.953	1.095	53.474	Undervalued
2014	2.179	-5.941	0.691	4.015	0.956	-3.059	-76.192	Overvalued
2015	0.454	-7.666	0.464	4.567	2.746	-1.821	-39.874	Overvalued

It can be seen from Exhibit 3 that the IT sector's actual returns were higher than expected returns in the three years of 2011, 2012 and 2013, while CAPM overvalued the stocks for two years (2012 and 2013). In 2011, the actual return was 9.78 percent against expected return of 5.64 percent. Thus the actual return was 73.54 percent higher than expected. Similarly, the actual returns exceeded the expected returns by 9.50 percent in 2010. In 2013, the model predicted a loss of -2.05%, while the actual loss was -0.95% which was 53.47 percent lower than the predicted loss.

However, in 2014, the actual return from the sector was 76.19% lower than expected. In 2015 also, the actual returns were 39.87 percent lower than expected. Thus, in the years of 2014 and 2015, IT stocks were overvalued.

Exhibit 4 – Automobile sector's Actual Stock Returns alongside Expected Returns

Year	Market Return (Rm) (%)	Risk Premium (Rm – Rf) (%)	Beta	Expected Return as per CAPM (%)	Actual Return (%)	(Actual – Expected) (R-R^)%	Difference (%)	Analysis
2011	5.214	-2.906	0.675	6.158	11.066	4.908	79.698	Undervalued
2012	1.488	-6.632	0.754	3.118	2.318	-0.800	-25.653	Overvalued
2013	-2.154	-10.274	0.779	0.121	-0.796	-0.918	-756.304	Overvalued
2014	2.179	-5.941	0.782	3.474	2.653	-0.821	-23.631	Overvalued
2015	0.454	-7.666	0.862	1.515	0.666	-0.849	-56.034	Overvalued

As against the Banking and IT sectors, Exhibit 4 indicates that the stocks of the Automobile sector were undervalued only in one year and overvalued thereafter for four years. In 2011, actual returns given by the stocks were 11.07 percent against expected returns of 6.17 percent. Thus, the actual returns were 79.70 percent higher than expected returns. In 2012, the actual returns generated were 25.65 percent lower than expected returns. In 2013, the IT stocks witnessed a loss of -0.79 percent against an expected profit of 0.12 percent which is 756 percent lower than expected returns. In 2014 and 2015, IT stocks gave 23.63 percent and 56.03 percent lower returns respectively than expected returns.

Exhibit 5 – Analytical Summary of all Stocks

COMPANY	2011	2012	2013	2014	2015
Banking Stocks					
ICICI Bank	Overvalued	Undervalued	Undervalued	Undervalued	Undervalued
HDFC Bank	Undervalued	Undervalued	Undervalued	Undervalued	Undervalued
Axis Bank	Undervalued	Undervalued	Undervalued	Undervalued	Undervalued
PNB	Undervalued	Undervalued	Overvalued	Undervalued	Undervalued
IT Stocks					
TCS	Undervalued	Undervalued	Undervalued	Overvalued	Undervalued
Infosys	Undervalued	Overvalued	Undervalued	Overvalued	Overvalued
Wipro	Undervalued	Overvalued	Overvalued	Overvalued	Overvalued
HCL	Undervalued	Undervalued	Undervalued	Undervalued	Undervalued
Automobile Stocks					
Bajaj Auto	Undervalued	Undervalued	Undervalued	Overvalued	Overvalued
M&M	Undervalued	Undervalued	Undervalued	Undervalued	Overvalued
Maruti Suzuki	Undervalued	Overvalued	Overvalued	Undervalued	Undervalued
Hero Motocorp	Undervalued	Overvalued	Overvalued	Overvalued	Overvalued

Exhibit 5 indicates that the CAPM undervalued banking stocks most of the time in the 5-year period. Stocks of ICICI Bank and Axis Bank generated higher returns than the expected returns as per CAPM and were undervalued in all the years. Stocks of HDFC Bank and PNB were undervalued in four years and gave lower returns only in one year out of five years.

The IT sector's stocks exhibited comparatively lower returns than the stocks of the banking sector. However, HCL performed better than expected in all the five years. TCS was overvalued only in 2014; in the rest of the years, the stock was undervalued.

Infosys was overvalued in 2012, 2014 and 2015; the stock gave higher returns only in two years. Wipro was overvalued in four years and actual return was higher than predicted only in 2011.

Returns from the automobile sector were lower than returns from the IT sector. Out of four stocks, M&M gave higher returns in four years out of five years. Bajaj Auto and Maruti Suzuki were undervalued in three years and Hero Motocorp was undervalued only in one year.

Exhibit 6 – Summary of Statistics

Sectors	Beta	R square	Std. Error	t-testsSig
Banking	1.286	0.845	0.289	4.0450.027
IT	0.775	0.713	0.348	2.7320.072
Auto	0.770	0.980	0.069	12.1850.001

Exhibit 6 displays the summary of key statistics with reference to all three sectors. It can be seen that the banking sector has a beta co-efficient of 1.29 and coefficient of determination, r-square is 0.85. Thus 85% of the share's total variability of returns is explained by systematic factors. The beta coefficient for the IT sector is 0.77 with r-square of 0.71, which means that 71% of the total variability of the returns is explained by systematic factors. The beta value for the Automobile sector is 0.77 and has r-square of 0.98. Thus, 98% of the observed variations are attributable to systematic factors.

In general, it is evident that the higher the value of r-square, the more weightage can be given to the unifactor model like CAPM, rather than using any multifactor models like APT (Arbitrage Pricing Theory). This further proves the implied assumption of CAPM - that unsystematic factors are less important as they can be managed and reduced. The only major factor contributing to the stocks' return is beta, which is the measurement of systematic risk. Higher r-square makes this study more useful for portfolio managers for making their purchase and sell decisions. In this context, this study aspires to raise the confidence of portfolio managers while selecting a stock for investment based on beta.

Conclusion:

Since the birth of CAPM in the 1960's as a model for determining the required rate of return on risky assets, numerous empirical studies have been carried out to analyze the applicability of CAPM in different economic contexts. Some empirical findings held CAPM as a valid tool for forecasting stock returns and also inferred that stock returns can be predicted based on beta only. But there are also many research studies that offer evidence against it. The major argument for the studies against CAPM was that there are many factors that can affect stock returns other than beta.

In this study, out of 60 observations, in 19 observations, the actual returns were less than expected returns as per CAPM (overvalued) and in 41 observations, actual returns were higher than expected returns as per CAPM (undervalued). Researchers found that majority of the times, the differences between actual returns and expected returns were very significant. However, higher r-square statistics imply that systematic factors are the major contributors to variability of returns. Thus, researchers cite that beta requires to be modified for representation of systematic factors.

The inferences were in line with the remarks made by Gupta (1981) and Ray (1994). Gupta raised a question on CAPM's applicability in the Indian context; Ray also conferred that CAPM did not hold applicability in the Indian markets. However, conclusions made by Yalwar (1985) contradict with the present study. There are two key limiting factors to this study – it is done in the Indian context and the model is applied on selected stocks of three sectors only. Future studies can cover more sectors and a wider economic set up.

Considering the fact that the nature of stock price movements is largely impulsive, any model trying to predict stock returns are difficult to generalize. However, comparing conclusions arrived at under this study with other studies conducted in different economic environments and time frames can enhance the ability of this model to be applicable in a more generalized manner. This is evident with the comparison of conclusions of this study with the studies by Bark (1991), Zubairi and Farooq (2011), Qamar, Rehman and Shah (2013). However, the study contradicts with the inferences made by Ali, Tehseen, Imtiaz and Fahim (2011), Josipa, Dzaja and Aljinovic (2013).

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