AN EMPIRICAL TEST OF THE CAPITAL ASSET PRICING MODEL (CAPM) IN THE INDIAN STOCK MARKET

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ABSTRACT

CAPM is a model that links the expected return of a stock or portfolio to its market risk, measured by beta. Although this model has been widely tested in developed markets, it hasn't been explored as much in developing countries like India. This study explores how well the Capital Asset Pricing Model (CAPM) works in the Indian stock market during the period from April 2023 to March 2025. To test its relevance, the study looked at data from the top 30 companies listed on the Bombay Stock Exchange (BSE), which make up the Sensex index. The findings showed that CAPM did not hold true during this period. This suggests that other factors besides market risk may also affect stock prices and portfolio performance in India. Overall, the results raise doubts about the reliability of CAPM in the Indian market for this time frame. The empirical findings of the study conclude that CAPM is not valid in BSE Sensex Index.

KEYWORDS: *Empirical, Developing, Empirical, Diversification.*

1. INTRODUCTION

A fundamental principle often followed by prudent investors is: "Don't put all your eggs in one basket," highlighting the importance of diversification. Wise investors inherently understand that spreading investments across different assets helps minimize risk. The first formal explanation of this concept was introduced by Harry Markowitz in the 1950s through his portfolio theory. This theory demonstrated how risk-averse investors could construct optimal portfolios to maximize expected returns for a given level of risk (Chandra, 2008). Building on Markowitz's work, William Sharpe made a notable advancement by developing the Capital Asset Pricing Model (CAPM). This model outlines the relationship between an asset's risk and its expected return. CAPM further enhances capital market theory by enabling investors to assess the risk-return balance not only for well-diversified portfolios but also for individual securities (Reilly & Brown, 2012).

The Capital Asset Pricing Model (CAPM) addresses two fundamental questions: first, what is the relationship between risk and return for an efficient portfolio? And second, how does this relationship apply to an individual security? CAPM has gained prominence due to its practical use in setting a benchmark for investment evaluation and its ability to estimate the expected return on various assets. It has become a cornerstone of modern investment theory, widely utilized to determine a firm's cost of capital and assess portfolio performance.

The development of CAPM laid the groundwork for the field of financial economics, and its creator, William Sharpe, was awarded the Nobel Prize in Economics for his pioneering contributions. CAPM models the connection between risk and return using historical data and extends portfolio theory by providing a framework for pricing all types of risky assets. It enables investors to calculate the required rate of return for any investment that involves risk (Reilly & Brown, 2012).

Risk associated with securities can broadly be categorized into two types: **systematic risk** and **unsystematic risk**. Systematic risk, also known as market risk, arises from macroeconomic factors such as changes in GDP, fiscal policy, interest rates, inflation, and other broad economic indicators. Since these factors impact the entire market, they cannot be completely avoided. Systematic risk measures how closely a security's return is aligned with overall market movements (Hagin, 2004).

On the other hand, unsystematic risk is specific to an individual company or industry. It may result from internal events such as product development, labor strikes, or emerging competitors. This type of risk can be mitigated through diversification of the investment portfolio (Chandra, 2008).

According to CAPM, only systematic risk is rewarded in the market. Diversifiable or unsystematic risk, being avoidable, does not command a risk premium (Hagin, 2004). Systematic risk is quantified using **beta (β)**, a coefficient that indicates the sensitivity of a particular asset's returns in relation to the market portfolio, which represents all investable assets in the economy (Ansari, 2000). CAPM further states that the expected excess return on an asset is directly proportional to its covariance with the overall market return (DeFusco, McLeavey, Pinto, & Runkle, 2007).

Developed in the mid-1960s, the Capital Asset Pricing Model (CAPM) gained widespread acceptance due to its straightforward structure and practical applicability. It provides a theoretical framework that describes how the risk associated with an asset influences its expected return. According to the model, the return on a portfolio is linearly related to the excess return attributable to the systematic risk it bears—this risk is measured by the beta coefficient, which reflects the sensitivity of the asset's returns in comparison to market returns. CAPM is based on a set of key assumptions, which must hold true for the model to be valid.

1. Efficient Markets: All investors have access to the same information and act rationally.
2. Risk-averse Investors: Investors prefer higher returns for a given level of risk and avoid unnecessary risk.
3. Single-period Investment Horizon: All investors plan for the same single investment period.
4. Homogeneous Expectations: Investors have identical expectations about returns, variances, and covariances of securities.
5. No Taxes or Transaction Costs: There are no taxes, transaction fees, or restrictions on buying/selling assets.

6. Unlimited Borrowing and Lending at Risk-free Rate: Investors can borrow or lend any amount at a constant risk-free interest rate.
7. Divisible Assets: All assets can be bought or sold in any fraction.
8. Perfect Competition: No investor can influence market prices individually.

Although the assumptions underlying CAPM are often considered unrealistic, many of them can be adjusted to better reflect real-world market conditions, allowing the model to retain its relevance in financial theory. The mathematical representation of the CAPM, as proposed by Sharpe (1964), is expressed as:

$R_{it}=R_{ft}+\beta_i(R_mt-R_{ft})+u_t$

Where:

- R_{it} = Return on asset or portfolio *i* at time *t*
- R_{ft} = Risk-free rate of return at time *t*
- R_{mt} = Return on the market portfolio at time *t*
- β_i = Beta coefficient of asset *i* (measure of systematic risk)
- u_t = Random error term at time *t*

2. Literature Review

The Capital Asset Pricing Model (CAPM) serves as the cornerstone of asset pricing theories and remains a widely utilized framework for estimating the required rate of return by investors. Numerous empirical investigations have been carried out globally to validate the model, yielding mixed outcomes.

Fama and MacBeth (1973) conducted a study on the New York Stock Exchange to examine the relationship between average returns and risk. Their findings supported CAPM, revealing a positive risk-return trade-off and a linear relationship, while suggesting that unsystematic risk does not significantly impact portfolio average returns.

In the Hungarian market, Andor (1999) tested CAPM using monthly data from 17 firms listed on the Budapest Stock Exchange over the period from July 1991 to June 1999. The regression analysis demonstrated a relationship between firm betas and average returns, leading to the conclusion that CAPM satisfactorily explains returns in Hungary.

Rahman, Baten, and Ashraf-Ul-Ala (2006) applied the Fama-French (1992) approach to the Bangladeshi stock market for the years 1999–2003. By examining five factors—market return, beta, book-to-market value, firm size (based on market capitalization and sales)—the study confirmed the relevance of CAPM and found significant relationships with stock returns.

Chan, Hamao, and Lakonishok (1991) evaluated Japanese stocks from 1971 to 1988 using variables such as earnings yield, firm size, book-to-market ratio, and cash flow yield. Their findings highlighted a notable influence of book-to-market ratio and cash flow yield on expected returns, emphasizing the role of factors beyond beta.

Basu (1977), in his research on the relationship between price-earnings (P/E) ratios and stock performance, challenged the Efficient Market Hypothesis and CAPM, arguing that P/E ratios contain predictive information not fully reflected in market prices, suggesting omitted risk factors in CAPM.

Roll (1977) argued that empirical testing of CAPM is fundamentally flawed due to the unobservable nature of the true market portfolio, which would need to encompass not only financial assets but also real and human capital.

Banz (1980) explored the link between returns and firm size on the NYSE and found that smaller firms consistently achieved higher risk-adjusted returns than larger ones. This "size effect" persisted for decades and raised concerns about the completeness of CAPM.

Bhandari (1988) provided evidence from NYSE data showing a positive relationship between expected returns and firms' debt-to-equity ratios, even after controlling for beta and firm size. This indicated that CAPM's beta alone could not fully explain return variations.

Fama and French (2004) critically reviewed CAPM, asserting that the model fails to capture the influence of size, value metrics, and momentum on average returns. Although the beta-return relationship exists, it is flatter than what CAPM predicts, prompting the development of more comprehensive models like the Inter temporal CAPM (ICAPM).

In the Indian context, Ansari (2000) empirically assessed CAPM and concluded that while the model faces limitations, it should not be completely disregarded. Instead, users should be aware of its constraints.

Choudhary and Choudhary (2010) tested CAPM on 278 companies listed in the BSE 500 Index from January 1996 to December 2009. While the study validated the model's linear structure and the assumption of excess returns, it found no significant relationship between beta and expected returns, indicating limited support for CAPM's core premise.

Basu and Deepak (2010) analyzed data from 50 stocks across 10 portfolios traded on the NSE from 2003 to 2008. Their results suggested that CAPM failed to adequately describe asset pricing in the Indian context during the sample period.

Shrivastav (2018) examined the stock performance of 15 NSE-listed firms between 2006 and 2017 using cross-sectional and portfolio analysis methods. Both analyses contradicted the CAPM's hypothesis that higher beta equates to higher returns, and also rejected the model's zero-intercept assumption, concluding CAPM's ineffectiveness in the Indian capital market.

Bajpai and Sharma (2016) conducted a decade-long study using daily data from January 2006 to December 2015, employing a rolling regression technique with a moving three-year window. Their constrained model, which assumed a zero intercept, performed better than the traditional CAPM, reinforcing the model's relevance in the Indian equity market.

Despite its widespread adoption, CAPM began to lose prominence in the late 20th century due to growing criticism and the emergence of alternative asset pricing models. These newer models argue that multiple factors—beyond beta—play a significant role in determining asset returns. This debate has sparked continued interest in re-evaluating CAPM, especially in emerging markets where limited empirical work has been done.

Given the scarcity of studies focused on the Indian stock market and the conflicting results among them, there is a clear need to reassess CAPM's validity across different time periods. The present research is an empirical investigation into the applicability of CAPM in the Indian context, specifically analyzing firms listed on the Bombay Stock Exchange (BSE) Sensex index.

3. Objective of the Study

The objective of this study is to examine the validity of the Capital Asset Pricing Model (CAPM) within the context of the Indian stock market, specifically the Bombay Stock Exchange (BSE).

4. Dataset and Methodological Approach

Data: The study considers the period of 2 years from 1^{st} April 2023 to 31^{st} March 2025.

Individual Securities: The study has been carried out based on BSE Sensex companies that were part of the index from 1^{st} April 2023 to 31^{st} March 2025.

Market Proxy: The BSE Sensex index has been taken as the market proxy. The BSE Sensex index comprises of 30 stocks. Daily returns of the BSE Sensex is been considered as market return.

Risk-free return proxy: 91 days Treasury bill rates have been taken as a risk-free return proxy (6.93%, 6.55% & 5.90%) 6.46%

Source of the data: BSE Website, 91 days T bill interest rate from tradingeconomics.com

Return Calculation

Daily Return = (Present Close – Previous Close) / Previous Close

Beta = Covariance (Ri, Rm) / Variance (Rm)

Portfolio returns were regressed on portfolio beta, beta squared, and residual variances to test the statistical significance of the regression coefficients using t-test.

The beta coefficients for the selected stocks were estimated by performing a regression analysis of the daily stock returns against the corresponding daily market returns. The following regression equation was employed to compute the beta values:

$R_{it}=\alpha_i+\beta_i R_{mt}+\varepsilon_t$

Where:

- R_{it} represents the return on stock *i* at time *t*,
- R_{mt} denotes the market return at time *t*,
- α_i is the intercept term,
- β_i is the beta coefficient, and
- ε_t is the error term.

Based on the computed beta values, the selected stocks were ranked in descending order. Six distinct portfolios were then constructed. The first portfolio comprised the top five stocks with the highest beta values, the second included the next three, and this process continued until all stocks were grouped, with the final portfolio containing those with the lowest beta values. This classification aimed to reduce the influence of unsystematic risk on the analysis (refer to Table 1).

Once the portfolios were established, weekly data were used to compute the portfolio returns, portfolio betas, and residual variances. Portfolio returns were determined by calculating the average return of all constituent stocks within a portfolio, assuming equal weighting for each stock. The beta coefficient and residual variance for each portfolio were derived by regressing the respective portfolio returns on the market returns. Additionally, the excess return or risk premium for each portfolio was obtained by deducting the risk-free rate from the portfolio's average return.

TABLE 1: FORMATION OF PORTFOLIO BASED ON BETA VALUES

Rank	Company Name	BETA	Portfolio Return
1	NTPC Ltd.	1.5107	
2	State Bank of India (SBI)	1.3055	
3	Larsen &Toubro Ltd. (L&T)	1.2758	I
5	Mahindra & Mahindra Ltd.	1.2581	
5	IndusInd Bank Ltd.	1.1861	
6	Reliance Industries Ltd.	1.1765	
7	Power Grid Corporation of India Ltd.	1.1595	
8	Wipro Ltd.	1.1195	II
9	Tata Motors Ltd.	1.1168	
10	UltraTech Cement Ltd.	1.0768	
11	Bajaj Finance Ltd.	1.0628	
12	Axis Bank Ltd.	1.0369	
13	HDFC Bank Ltd.	1.0332	III
15	Bajaj Finserv Ltd.	1.0162	
15	Tech Mahindra Ltd.	1.0126	
16	ICICI Bank Ltd.	0.9671	
17	Kotak Mahindra Bank Ltd.	0.9500	
18	Infosys Ltd.	0.9556	IV
19	Bharti Airtel Ltd.	0.8205	
20	Maruti Suzuki India Ltd.	0.8055	
21	HCL Technologies Ltd.	0.7820	
22	Tata Consultancy Services Ltd. (TCS)	0.7613	
23	Titan Company Ltd.	0.7357	V
25	ITC Ltd.	0.7265	
25	Bajaj Auto Ltd.	0.6723	
26	Asian Paints Ltd.	0.5973	
27	Sun Pharmaceutical Industries Ltd.	0.5168	
28	Dr. Reddy's Laboratories Ltd.	0.5551	VI
29	Hindustan Unilever Ltd. (HUL)	0.3869	
30	Nestlé India Ltd.	0.0002	

The following regression model was used.

$R = \alpha_1\beta_{it} + \alpha_2\beta_{it}^2 + \alpha_3 RV_{it} + \varepsilon_t$

R = Risk premium (difference between R_{it} and R_{ft} (R_{it} is the return on portfolio i at time t and R_{ft} is the return on the risk-free asset at time t)

β_{it} is the beta of the portfolio – Representing the systematic risk

B_{it}^2 is the beta of the portfolio – non-linearity of return

Rv_{it} is the residual variance of portfolio – Representing unsystematic risk

E_t is the stochastic error term at time t

$\alpha_1 > 0$ (there should be positive returns for risk taken and must be statistically significant

$\alpha_2 = 0$ (a linear security market line)

$\alpha_3 = 0$ (unsystematic risk can be diversified and should not affect the returns)

Analysis of Beta

Table 2: Regression Results of Estimating the Equation: $R = \alpha_1\beta_{it} + \alpha_2\beta_{it}^2 + \alpha_3 RV_{it} + \varepsilon_t$
Estimated Standardized Coefficients and p-values at 5% level of significance

Portfolio	Constant	β	β	RV	R2	DW	F-Stat (Probability)
I	-8.253 (0.000)	-0.050 (0.825)	0.038 (0.831)	0.662 (0.000)	38.9%	1.97	0.001
II	-6.053 (0.000)	-0.136 (0.665)	0.133 (0.619)	0.517 (0.000)	38.5%	1.96	0.020
III	-6.215 (0.000)	0.133 (0.954)	-0.082 (0.966)	0.580 (0.000)	48.2%	1.96	0.000
IV	-6.256 (0.000)	0.055 (0.884)	-0.031 (0.955)	0.533 (0.000)	38.65%	1.97	0.146
V	-6.387 (0.000)	0.015 (0.924)	0.025 (0.950)	0.939 (0.000)	19.5%	1.96	0.030
VI	-6.895 (0.000)	-0.022 (0.924)	0.055 (0.907)	0.790 (0.000)	55.2%	1.96	0.000

The results reveal that the intercept term is significantly different from zero across all six portfolios, which contradicts the core assumption of the Capital Asset Pricing Model (CAPM) that presumes a zero intercept. While the beta coefficient is positive in four out of the six portfolios, it remains statistically insignificant in every case, challenging CAPM's theoretical premise that portfolio returns are driven by systematic risk. Furthermore, the beta-squared terms are insignificant in all instances, implying the linearity of the Security Market Line (SML) and thereby supporting the model in that aspect. However, the residual variance coefficients are statistically significant in all six cases, indicating that unsystematic risk influences portfolio returns—an outcome inconsistent with CAPM, which assumes that only systematic risk is priced. Although the R-squared values are generally low, the F-statistics suggest that the models are statistically significant overall. Additionally, the Durbin-Watson statistics, being close to 2 in all cases, indicate an absence of autocorrelation in the residuals.

Table 2: Regression Results of Estimating the Equation: $R = \alpha_1\beta_i + \alpha_2\beta_i^2 + \alpha_3 RV_i + \varepsilon$

Portfolio	β	B^2	RV
I	-0.241	0.156	0.360
II	-1.568	0.847	0.272
III	-2.657	2.542	0.565
IV	-1.534	1.346	0.218
V	0.303	0.243	0.585
VI	0.287	0.587	0.230

Results of the Model without Intercept:

Since the CAPM is treated as a model without an intercept—also known as a zero-intercept model—it is reasonable to evaluate it by excluding the intercept term. However, even under this condition, the findings do not support the hypotheses affirming the validity of CAPM, as the model is rejected in all six instances (refer to Table 3).

5. Conclusion

The findings of this research suggest that the Capital Asset Pricing Model (CAPM) does not hold in the context of the Indian stock market during the selected period. The results challenge the core assumptions and theoretical underpinnings of the CAPM. Even when the model is tested without an intercept term, the outcomes consistently contradict the theory.

However, the study is subject to certain limitations: (a) the theoretical assumptions underlying CAPM were not entirely satisfied, and (b) the analysis was based on a relatively small sample of 30 companies over a limited duration of two years. The low R-squared values indicate that beta alone cannot fully explain the variations in excess portfolio returns. This suggests the potential relevance of other variables such as market capitalization, net profit ratio, and book-to-market ratio, which might enhance the explanatory power of the model. These additional factors were not incorporated in the present study and warrant further investigation.

Overall, this study reinforces the growing skepticism around the applicability of CAPM in emerging and more volatile markets. The evidence, both from this study and from similar research in developing economies, points to the inadequacy of CAPM in capturing the complexities of such markets. Therefore, there is a compelling need to revise or replace the existing model with one that more accurately reflects the factors influencing asset price movements

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