AN EX-POST ANALYSIS OF THE VIABILITY OF THE CAPITAL ASSET PRICING MODEL IN PREDICTING NIFTY 50 STOCK RETURNS (2020-2024)

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Abstract
This study provides a comprehensive analysis of the historical performance of Nifty 50 companies from January 1, 2020, to December 31, 2024. The objective is to systematically collect and organize essential financial data, including historical Nifty 50 stock prices for this period. The analysis aims to compare expected and actual returns and evaluate the viability of the Capital Asset Pricing Model (CAPM) as a suitable model for calculating the expected rate of return for all constituent companies of the Nifty 50.

The study utilizes secondary data collected from the National Stock Exchange (NSE) website, employing a comparative analysis method to gain deeper insights into the effectiveness of the CAPM. This information is intended to assist financial professionals and investors.

The findings indicate that while the CAPM remains a valuable theoretical framework for understanding the fundamental principle of the risk-return trade-off, its practical application in explaining ex-post returns in dynamic emerging markets like India—particularly during the extremely volatile period from 2020 to 2024—requires a more nuanced approach.
Key Words: Capital Asset Pricing Model (CAPM), Nifty 50, Expected Rate of Return, Actual Rate of Return, Financial Model.

Introduction

The Nifty 50 index represents the Indian market and has seen significant growth and volatility over the past few decades. For investors, estimating market trends and return on investment (ROI) is crucial for decision-making and portfolio management. The Capital Asset Pricing Model (CAPM), developed by Sharpe, Lintner, and Mossin, is the most recognized method for estimating expected returns based on systematic risk. The period from 2020 to 2024 was tumultuous for the global economy, including India, with disruptions from COVID-19, technological advancements, and geopolitical tensions creating uncertainty and challenging the application of CAPM. This research investigates the historical performance of Nifty 50 companies during this time to assess CAPM's viability in estimating expected returns based on actual performance. By analysing historical data, this study aims to clarify Nifty 50's performance and whether CAPM effectively captures the risk-return relationship. The insights will help investors refine their strategies and inform academics about the limitations of theoretical financial models in real-world applications.

Statement of Problem

The Indian financial market experienced a volatile and unprecedented period from 2020 to 2024, marked by significant changes driven by various factors, including COVID-19 and political tensions in different regions. While the Capital Asset Pricing Model (CAPM) serves as a fundamental tool for calculating the expected rate of return based on systematic risk, its relevance and effectiveness in such a dynamic market environment necessitate a thorough re-evaluation. Therefore, this study aims to address the gap in comprehensive, updated assessments regarding the CAPM's applicability in calculating and explaining the actual historical rates of return for individual Nifty 50 companies during this highly eventful period.

Scope of the study

This research focuses specifically on analysing the performance of Nifty 50 companies and the applicability of the Capital Asset Pricing Model (CAPM) during the historical period from

January 2020 to December 2024. The study is limited to the Indian equity market, examining companies listed on the National Stock Exchange (NSE) that make up the Nifty 50 index. The primary theoretical framework used in this research is the Capital Asset Pricing Model (CAPM).

Objectives of the Study

1. To systematically collect and organize historical financial data for all constituent companies of the Nifty 50 index from January 1, 2020, to December 31, 2024.
2. To find the viability of the Capital Asset Pricing Model (CAPM) to calculate the expected rate of return for each Nifty 50 company.
3. To analyse and compare the calculated expected rates of return across different Nifty 50 companies.

Research Methodology

This research employs a quantitative approach along with a comparative analysis to meet the study's objectives. The methodology consists of several distinct phases: data collection, data processing, calculation of returns and Capital Asset Pricing Model (CAPM) variables, and, finally, comparative analysis. Data were systematically collected, including historical financial data for all companies that make up the Nifty 50 index. Secondary data were obtained from the official website of the National Stock Exchange (NSE) for the period from January 1, 2020, to December 31, 2024.The NSE official website for the period ranging from January 1, 2020, to December 31, 2024.

Steps Used in Calculating Expected and Average Rate of Return

The data for our study was carefully collected and processed through various stages to determine the historical returns of Nifty 50 companies and their expected rates of return using the Capital Asset Pricing Model (CAPM).

1. Data Gathering: Weekly adjusted closing prices for each company within the Nifty 50 index were systematically collected for the entire study period, which began in the first week of January 2020 and extended through the last week of December 2024.

2. Annual Return Calculation: The collected weekly data for each individual share within a specific year was averaged to calculate the annual return. This calculation was applied to all constituent companies of the Nifty 50 across the different years.

3. Average Annual Return Percentage Calculation: For each Nifty 50 company, the annual return was computed for each year in the 2020-2024 period. This utilized the following formula:

Annual Return = [(year-end return - previous year end return) / Previous year end return] ×100.
This method effectively captures the capital appreciation component of annual returns.

4. Expected Rate of Return (CAPM) Calculation: The expected rate of return for each Nifty 50 company was calculated using the Capital Asset Pricing Model (CAPM) formula:

$$ER_i = R_f + \beta_i (ER_m - R_f)$$

Where,

ER_i=*Expected Return of Investment*

R_f=*Risk - Free Rate;* The values are derived approximated by the yield on government securities for the period 2020 – 2024.

β_i=*Beta of the Investment: The values are derived from di*viding particular share price for particular year by Market Return of Nifty 50 for a particular year.

($ER_m - R_f$)=market risk premium: The value is calculated by subtracting Risk Free Rate from Market Return.

Statistical Tool Analysis

1)ANOVA SINGLE FACTOR TEST BETWEEN THE PERIODS 2020 – 2024 EXPECTED RATE OF RETURN OF NIFTY 50 STOCKS

H_0: There is no significant difference between 2020 – 2024 expected rate of return of nifty 50 stocks.

H_1: There is a significant difference between 2020 – 2024 expected rate of return of nifty 50 stocks.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2020	50	-243.31	-4.8662	453.736
2021	50	2587.1	51.742	3097.84
2022	49	-46.265	-0.9442	235.033
2023	49	741.359	15.1298	110.956
2024	50	1722.06	34.4412	657.93

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	114218	4	28554.6	31.1332	6.20E-21	2.40879
Within Groups	222873	243	917.174			
Total	337092	247				

Interpretation

The average values for each year were quite different, from a low of -4.87 (2020) to a high of 51.74 (2021). The "F-statistic" (31.13) was much higher than the "F critical value" (2.41). The "P-value" was extremely small (0.00000000000000000062). This means the differences in the average values between the years are **not due to random luck**. There's a real, significant difference in the data from year to year. Therefore, we reject null hypothesis.

2)ANOVA SINGLE FACTOR TEST BETWEEN THE PERIODS 2020 – 2024 ACTUAL RATE OF RETURN OF NIFTY 50 STOCKS

H_0: There is no significant difference between 2020 – 2024 actual rate of return of nifty 50 stocks.

H_1: There is a significant difference between 2020 – 2024 actual rate of return of nifty 50 stocks.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2020	50	-915.67	-18.313	1385.97
2021	50	3074.36	61.4872	5414.71
2022	50	602.545	12.0509	502.671
2023	50	630.34	12.6068	274.962
2024	50	2159.1	43.1821	1646.76

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	191005	4	47751.3	25.8813	6.64E-18	2.40849
Within Groups	452029	245	1845.02			
Total	643034	249				

Interpretation

This ANOVA table shows a **significant difference** in average values between the years 2020 and 2024. The F-statistic (25.88) is much higher than the critical value (2.41), and the P-value (6.64E-18) is extremely low, meaning these year-to-year differences are **not due to random chance**. Which means There is a significant difference between 2020 – 2024 actual rate of return of nifty 50 stocks. Therefore, we reject null hypothesis.

3.ANOVA SINGLE FACTOR TEST BETWEEN THE EXPECTED RATE OF RETURN OF THE NIFTY 50 COMPANIES STOCK FROM THE PERIOD 2020 – 2024.

H_0: There is no significant difference between the expected rate of return of the nifty 50 companies' stock from the period 2020 – 2024.

H_1: There is a significant difference between the expected rate of return of the nifty 50 companies' stock from the period 2020 – 2024.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
INFOSYS	5	105.935	21.187	664.0009
ULTRACEMENT	5	124.96	24.992	424.74
SBILIFE	5	68.3	13.66	121.8027
BHARTI AIRTEL	5	107.52	21.504	436.9963
MAHINDRA	5	112.811	22.5622	857.0191
JIOFIN	3	35.1	11.7	410.67
RELIANCE	5	45.913	9.1826	158.9061
NTPC	5	48.468	9.6936	1576.392
EICHER MOTOR	5	29.17	5.834	1018.904
TCS	5	87.5	17.5	235.2769
BAJAJFINSV	5	41.91	8.382	2044.4
HDFC LIFE	5	82.75	16.55	25.51415
HDFC BANK	5	43.3545	8.6709	332.9094
ONGC	5	77.06	15.412	819.5168
TECHMAHINDRA	5	102.29	20.458	580.1437
ICICI BANK	5	88.67	17.734	494.5694
TITAN	5	82.86	16.572	635.3019
HINDALCO	5	139.36	27.872	2044.051
SBIN	5	-33.51	-6.702	1411.153
BAJAJ FINANCE	5	90.9939	18.1988	704.2286
POWERGRID	5	64.14	12.828	849.1688
CIPLA	5	99.27	19.854	247.437

HINDUSTAN UNILIVER	5	56.2076	11.2415	19.36777
ADANI ENTERPRISE	5	340.93	68.186	25329.84
SHRIRAM FINANCE	5	152.31	30.462	632.1886
ITC	5	23.08	4.616	676.3434
ADANIPORTS	5	109.81	21.962	2364.73
TATACONSUMER	5	73.68	14.736	1027.216
L&T	5	116.03	23.206	422.4533
JSWSTEEL	5	115.702	23.1405	3150.773
KOTAKBANK	5	52.09	10.418	77.23472
WIPRO	5	107.19	21.438	1878.94
DRREDDY	5	44.3	8.86	591.5699
SUNPHARMA	5	101.75	20.35	512.7791
TATAMOTOR	5	192.57	38.514	3479.593
HERO MOTORS	5	100.45	20.09	333.4078
COAL INDIA	5	59.252	11.8504	936.2907
HCLTECH	5	92.5	18.5	655.9512
INDUSUNDBANK	5	55.36	11.072	541.3428
MARUTI	5	44.38	8.876	113.4475
ASIAN PAINTS	5	78.482	15.6964	354.1301
AXIS BANK	5	72.99	14.598	342.4722
NESTLEY	5	-1.45	-0.29	611.4222
BAJAJ AUTO	5	139.69	27.938	680.3689
BEL	5	118.79	23.758	2974.749
ETERNAL	5	170.34	34.068	2249.104
GRASIM	5	135.679	27.1358	1549.819
TRENT	5	222.1	44.42	3249.765
TATA STEEL	5	180.86	36.172	3263.566
APOLLOHOSPITALS	5	161.05	32.21	1516.687

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	
Between Groups	35398.3	49	722.415	0.474118	0.99868	
Within Groups	301693	198	1523.7			
Total	337092	247				

The ANOVA table provides the key statistical findings:

- The "Between Groups" Sum of Squares (SS) is 35398.33, representing the variation between the company averages.
- The "Within Groups" SS is 301693.3, representing the variation within each company's data.
- The calculated F-statistic is 0.474118, which is derived from the ratio of the "Between Groups" Mean Square (MS = 722.4148) to the "Within Groups" Mean Square (MS = 1523.703).

- The corresponding P-value is an extremely high 0.998675. This exceptionally high P-value (far greater than common significance levels like 0.05) indicates that there is **no statistically significant difference** between the means of these Nifty 50 companies' stocks.

Therefore, we accept null hypothesis.

4)ANOVA SINGLE FACTOR TEST BETWEEN THE ACTUAL RATE OF RETURN OF THE NIFTY 50 COMPANIES STOCK FROM THE PERIOD 2020 – 2024.

H_0: There is no significant difference between the actual rate of return of the nifty 50 companies' stock from the period 2020 – 2024.

H_1: There is a significant difference between the actual rate of return of the nifty 50 companies' stock from the period 2020 – 2024.

Anova: Single Factor
SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
INFOSYS	5	108.09	21.6179	1164.4
ULTRACEMENT	5	118.98	23.7961	925.082
SBILIFE	5	80.175	16.035	74.3428
BHARTI AIRTEL	5	165.915	33.183	416.327
MAHINDRA	5	179.571	35.9143	1031.02
JIOFIN	5	44.2282	8.84564	391.226
RELIANCE	5	21.1207	4.22414	595.697
NTPC	5	78.5143	15.7029	3846.22
EICHER MOTOR	5	6.17276	1.23455	2716.13
TCS	5	78.5627	15.7125	422.972
BAJAJFINSV	5	-20.234	-4.0469	4469.87
HDFC LIFE	5	36.5825	7.31649	256.807
HDFC BANK	5	-1.3629	-0.2726	796.1
ONGC	5	102.29	20.458	1604.22
TECHMAHINDRA	5	90.1634	18.0327	1133.38
ICICI BANK	5	121.903	24.3807	518.872
TITAN	5	134.789	26.9579	571.092
HINDALCO	5	173.758	34.7515	3312.21
SBIN	5	-23.52	-4.7039	2946.89
BAJAJ FINANCE	5	94.5714	18.9143	1137.46
POWERGRID	5	89.0355	17.8071	1797.56
CIPLA	5	124.3	24.8599	246.695

HINDUSTAN UNILIVER	5	33.7739	6.75478	63.1354
ADANI ENTERPRISE	5	626.436	125.287	34705.9
SHRIRAM FINANCE	5	163.943	32.7887	1461.69
ITC	5	43.5441	8.70881	1625.18
ADANIPORTS	5	118.253	23.6507	5038.19
TATACONSUMER	5	57.5818	11.5164	2263.96
L&T	5	151.454	30.2908	486.303
JSWSTEEL	5	113.899	22.7797	6199.92
KOTAKBANK	5	22.0955	4.41911	156.562
WIPRO	5	58.5748	11.715	4045.52
DRREDDY	5	-18.245	-3.6491	1589.31
SUNPHARMA	5	160.435	32.0871	340.621
TATAMOTOR	5	271.692	54.3385	5253.59
HERO MOTORS	5	83.4998	16.7	999.54
COAL INDIA	5	111.086	22.2171	1780.76
HCLTECH	5	76.4282	15.2856	1442.3
INDUSUNDBANK	5	25.0247	5.00494	1310.2
MARUTI	5	62.2213	12.4443	130.355
ASIAN PAINTS	5	78.1372	15.6275	596.244
AXIS BANK	5	62.825	12.565	712.437
NESTLE	5	-43.23	-8.646	1917.92
BAJAJ AUTO	5	155.927	31.1853	1748.94
BEL	5	229.431	45.8861	5045.46
ETERNAL	5	134.967	26.9933	6832.79
GRASIM	5	161.122	32.2244	2570.69
TRENT	5	379.16	75.8321	5167.6
TATA STEEL	5	214.655	42.931	5552.62
APOLLOHOSPITALS	5	212.381	42.4761	2143.45

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	116811	49	2383.9	0.90604	0.65047	1.41805
Within Groups	526223	200	2631.11			
Total	643034	249				

Interpretation

The **ANOVA** table reveals the following:

- The "Between Groups" Sum of Squares (SS) is 116822.8, representing the variability between the means of the different companies.
- The "Within Groups" SS is 526111.2, representing the variability within the observations of each individual company.
- With 49 degrees of freedom (df) between groups and 200 df within groups, the Mean Square (MS) for "Between Groups" is 2383.902, and for "Within Groups" it is 2631.114.

The calculated F-statistic is 0.906043.

The critical F-value is 1.418051.

Most importantly, the P-value is 0.650472.

Since the calculated F-statistic (0.906043) is **less than** the F critical value (1.418051), and the P-value (0.650472) is **very high** (much greater than typical significance levels like 0.05), we conclude that there is **no statistically significant difference** between the average values of these Nifty 50 companies' stocks.

5) CORRELATION BETWEEN THE EXPECTED RATE OF RETURN OF NIFTY 50 STOCKS IN THE PERIOD 2020 – 2024.

	2020	*2021*	*2022*	*2023*	*2024*
2020	1				
2021	0.16318	1			
2022	-0.1541	-0.4747	1		
2023	-0.057	-0.2781	-0.1997	1	
2024	0.05794	-0.0728	-0.1185	0.45454	1

Interpretation

This correlation matrix for Nifty 50 expected stock returns illustrates the linear relationship between anticipated returns across different years, with diagonal entries of 1 showing perfect self-correlation. The off-diagonal values reveal varying degrees of co-movement: for instance, a weak positive correlation of 0.163177 between 2020 and 2021 suggests a slight tendency for expected returns to move together, while a moderate negative correlation of -0.47468 for 2021 and 2022 indicates that higher expected returns in one year were associated with lower expected returns in the next. Notably, the 0.454541 correlation between 2023 and 2024 signifies a stronger positive relationship, implying that expected returns for Nifty 50 stocks tended to move in the same direction during those two years, providing insights into the historical interdependence of anticipated market performance.

6) CORRELATION BETWEEN THE ACTUAL RATE OF RETURN OF NIFTY 50 STOCKS IN THE PERIOD 2020 – 2024.

	2020	*2021*	*2022*	*2023*	*2024*
2020	1				
2021	0.15666	1			
2022	0.12703	0.47504	1		
2023	-0.0709	-0.2768	0.21467	1	
2024	0.08458	-0.0679	0.11723	0.44325	1

Interpretation

This correlation matrix displays the relationships between actual returns for each year from 2020 to 2024. As expected, the diagonal elements are all 1, indicating a perfect correlation of each year's returns with itself. The off-diagonal values show varying degrees of positive and negative correlation between the actual returns of different years. For instance, the actual returns of 2020 and 2021 exhibit a weak positive correlation of 0.156661, while 2021 and 2022

show a moderate positive correlation of 0.47504. In contrast, 2021 and 2023 have a negative correlation of -0.27679, suggesting that actual returns tended to move in opposite directions. Notably, 2023 and 2024 share a moderately strong positive correlation of 0.443251, indicating a tendency for their actual returns to move in the same direction.

7) t-TEST BETWEEN THE EXPECTED RATE OF RETURN BETWEEN THE YEAR 2020 AND 2024.

t-Test: Two-Sample Assuming Unequal Variances

	2020	*2024*
Mean	-4.8662	34.4412
Variance	453.736	657.93
Observations	50	50
Hypothesized Mean Difference	0	
df	95	
t Stat	-8.3363	
P(T<=t) one-tail	2.93E-13	
t Critical one-tail	1.66105	
P(T<=t) two-tail	5.86E-13	
t Critical two-tail	1.98525	

Interpretation

This t-test, comparing the expected rates of return for Nifty 50 stocks between 2020 and 2024, reveals a stark difference in their means: -4.87 for 2020 versus 34.44 for 2024. With a large absolute t-statistic of -8.33628 and an extremely small two-tailed p-value (5.86×10−13), which is far below any typical significance level, we decisively reject the null hypothesis. This overwhelmingly indicates a highly statistically significant difference, confirming that the expected returns for Nifty 50 stocks in 2024 were substantially and significantly higher than those in 2020.

8) t-TEST BETWEEN THE ACTUAL RATE OF RETURN BETWEEN THE YEAR 2020 AND 2024

t-Test: Two-Sample Assuming Unequal Variances

	2020	*2024*
Mean	-18.3134	43.1821
Variance	1385.97	1646.76
Observations	50	50
Hypothesized Mean Difference	0	
df	97	
t Stat	-7.89608	
P(T<=t) one-tail	2.23E-12	
t Critical one-tail	1.660715	
P(T<=t) two-tail	4.46E-12	
t Critical two-tail	1.984723	

Interpretation

This t-test, comparing the actual rates of return for Nifty 50 stocks between 2020 and 2024, reveals a substantial difference in their average values: -18.3134 for 2020 versus 43.18209 for 2024. With a large absolute t-statistic of -7.89608 and an extremely small two-tailed **p-value**

of 4.46×10−12 (0.00000000000446), which is significantly lower than any common alpha level, we overwhelmingly reject the null hypothesis. This strongly indicates a highly statistically significant difference between the actual returns of the two years, concluding that Nifty 50's actual returns in 2024 were considerably higher than in 2020.

Findings

- The Nifty 50 constituent companies demonstrated a positive annualized return from 2020 to 2024, despite an initial decline due to COVID-19 in early 2020.
- There are notable differences in expected and actual rates of return among Nifty 50 stocks during this period. Applying the Capital Asset Pricing Model (CAPM) indicated varying expected returns, suggesting that the market anticipated different compensation levels for the systematic risk of each company.
- While the overall Nifty 50 index showed a positive return, individual companies experienced a wide range of performances. The high P-value of 0.998675 indicates no statistically significant difference between the average returns of these stocks.
- The calculated F-statistic of 0.906043 is less than the F critical value of 1.418051, and the P-value of 0.650472 confirms no significant difference in average returns.
- Furthermore, the correlation of 0.454541 between 2023 and 2024 reflects a strong positive relationship, indicating expected returns moved similarly during those years. A moderately strong correlation of 0.443251 also suggests actual returns followed the same trend. Overall, the study found a significant difference, highlighting that the expected and actual returns for Nifty 50 stocks in 2024 were notably higher than those in 2020.

Suggestions

- The observed discrepancies between actual returns and those predicted by the Capital Asset Pricing Model (CAPM) indicate that investors should use a multi-factor approach rather than relying solely on systematic risk (beta).
- CAPM's limitations in explaining returns during the volatile 2020-2024 period highlight the need for more advanced asset pricing models. The rapid market sentiment shifts likely allowed behavioural biases to affect stock prices. Consequently, investors should avoid using a single financial model to assess trends.
- The significant gap between actual returns and CAPM expectations (alpha) may indicate market inefficiencies, warranting further analysis of alpha distribution and its correlation with major economic announcements or global events.

Conclusion

This research paper meticulously examined the financial performance of NIFTY 50 constituent companies' stocks during the high volatile period ranging from 2020 – 2024. The main objective of this research is to assess the viability of the CAPM financial model in determining the Expected Rate of Return by comparing it with actual return. Though, the empirical adoption of the CAPM revealed a mixed viability. The inherent volatility of the specified period further challenged the stability of beta estimates and the fundamental assumptions underlying the Capital Asset Pricing Model (CAPM). This research study concludes that, even though, the CAPM remains a valuable and remarkable theoretical framework for understanding the basic principle of risk-return trade-off, its practical application for smoothly explaining the *ex-post* returns in a dynamic emerging market in countries like India, particularly during an extremely volatile period like 2020-2024, needs for a more nuanced approach. Investors and financial professionals should, therefore, consider adopting a wide range of analytical tools and factors beyond just systematic risk to navigate the complexities and capitalize on the diverse opportunities presented by the Indian equity market.

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