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Applicability of Capital Asset Pricing Model in the Indian Stock Market

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Abstract: **Capital Asset Pricing Model (CAPM) was a revolution in financial theory. CAPM postulates an equilibrium linear association between expected return and risk of an asset. This study investigates a risk-return relationship within the CAPM framework in Indian Stock Exchange. From the CAPM empirical analysis, it is observed that intercept term is significantly different from zero and insignificant but there exists a positive relationship between beta and share return. This research paper tries to explain the foundations of investment decision-making and factors which affect the investment decisions. Beginning with portfolio theory and the tradeoff between risk and return, it shows how the definition of investors risk depends crucially upon diversification. It explains modern asset pricing models currently used to determine the expected rate of return on investments. Using CAPM model in the Indian Stock Market, I have evaluated 12 stocks for various analysis such as STANDARD DEVIATION, RATE OF RETURN and CORRELATION of the stocks with the index i.e. NIFTY etc. The results of the study prove the CAPM hypothesis and offer evidence favour the CAPM in Indian Stock Market. However, there exists linearity in the securities market line. The unique risk and the interaction are insignificant during the period. Finally it presents evidence about what information can be used for strategic investment advantage.**

Keywords: Investment Decision, Rate of Return, Beta, Market Risk, Expected Return

1. INTRODUCTION

Capital Asset Pricing Model

CAPM (Capital Asset Pricing Model) is one of the most popular models in the finance industry. It is required to determine a theoretically estimated required rate of return of an asset. The model takes into account the asset's sensitivity to non-diversifiable risk (also known as systematic or market risk), often represented by quantity beta in the financial industry as well as expected rate of return of the market and expected return of a theoretically risk free asset.

This modelwas introduced by Treynor, Sharpe, Lintner and mossin independently building on the earlier work of Markowitz on diversification and modern portfolio theory. The model has contributed a lot to the development in the field of finance by providing the estimations of return of different assets based on statistical data and certain indicators. For individual securities, we make use of the security market line (SML) and its relation to expected return and systematic risk (beta) to show how the market must price individual securities in relation to their security risk class.

The SML enables us to calculate the reward-to-risk ratio for any security in relation to that of the overall market. Therefore, when the expected rate of return for any security is deflated by its beta coefficient, the reward-to-risk ratio for any individual security in the market is equal to the market reward- to-risk ratio,

Thus, the market reward-to-risk ratio is effectively the market risk premium and by rearranging the above equation and solving for E (Ri), we obtain the **Capital Asset Pricing Model (CAPM).**

2. RESEARCH METHODOLOGY

The paper aims to study **"Applicability of Capital Asset Pricing Model in the Indian Stock Market**"

This paper also:

- Explain the theory behind the CAPM
- Calculation of Beta by own by using past 5 years of data of stock prices and market prices
- Calculation of Expected return using CAPM model so as to predict the anticipated return of an asset.
- Compare CAPMs expected return and the actual return to recommend user to buy, sell or wait it for some more time regarding the stock i.e. checking for overvalued and undervalued securities and hence capitalizing the opportunities if any
- Explain how to use the CAPM to establish benchmarks for measuring the performance of 21 stocks sample.

Data Collection

- The data collected for the research paper is secondary data from National Stock Exchange of India Ltd. for the historical data of all the21 stocks and other information such as Interest rates is collected from various other websites of Economic Times and Yale Education.

Research Methodology

- For the application of the Capital Asset Pricing Model in the Indian Stock Market, 21 Stocks have been taken into consideration.
- The stocks are selected on the basis of Market Capitalization. The one which are leaders are selected out of their respective industry.

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Statistical Tool Applied:

There will be a great usage of statistical tools such as:

- Standard Deviation
- Coefficient of Correlation
- Mean

Sample Size

- 21 stocks from the Indian Stock Market have been picked up randomly. (AMBUJA, BHARTI AIRTEL, BHEL, GAIL, SAIL, TATAMOTORS, UNITECH, WIPRO, STER, HDFC,ICICI, IDFC, RELIANCE, ITC,NTPC,RELIANCE,RELIANCE CAPITAL,ONGC)

RESEARCH HYPOTHESIS

Hypothesis1- Differentiation

Hypothesis Testing- To show whether expected return from market is different from actual return.

H0- The intercept (Alpha) in CAPM is significantly different from zero.

H1- The intercept (Alpha) in CAPM is not significantly different from zero.

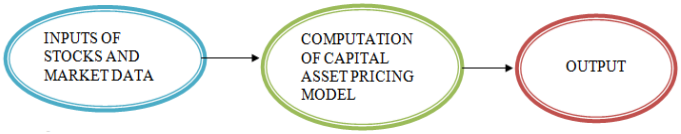
Hypothesis2-Relation

Hypothesis Testing- To show whether there is any significant positive relationship between returns on stocks and their betas.

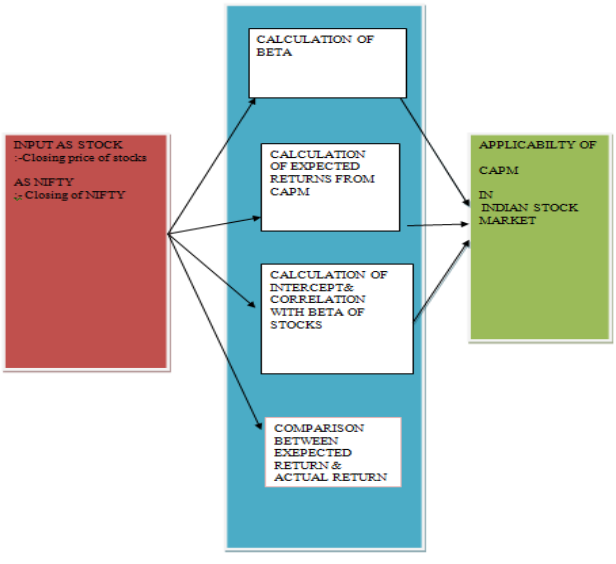
H0- There is no significant positive relationship between return on portfolios and their betas.

H1- There is a significant positive relationship between returns on portfolios and their betas.

RESEARCH PAPER DESIGN



MODEL OF Research Paper



3. DATA ANALYSIS AND INTERPRETATION

Data has been collected from secondary sources. For collecting secondary data various banks, journals & internet has been used. The data has been represented with the help of pie charts & bar diagrams & the interpretation of the data has been done accordingly

1) Historical prices of stocks of past 5 years (monthly) so as to calculate Beta(Risk factor) of a stock in relation to the market.
2) Data about the total debt of company and its current market value.
3.) Expected market return of NIFTY index which was calculated using
Average annualized gains of the market for past 5years.
4.) Risk free rate which was obtained by Reserve Bank of India's website and taking the Monthly rates of historical risk free rates.

4. TESTING OF HYPOTHESIS

Testing of Hypothesis 1 (Correlation)

Karl Pearson's Coefficient of Correlation: For the purpose of testing the first Hypothesis, Karl Pearson's Coefficient of Correlation between returns on stocks and their beta's is calculated. Correlation is the degree of association between 2 variables & it is represented in term of a coefficient known as Correlation Coefficient.

The range of correlation coefficient is between +1 and -1. If the correlation coefficient is negative, then the variables are inversely proportional & it is maximum when it is -1, if the coefficient is 0, there is no association b/w the variables. If the coefficient is positive then the variables are associated directly & it is maximum when it is +1.

Hypothesis for Correlation

H0- There is no significant positive relationship between returns on stocks and their betas.

H1- There is a positive relationship between returns on stocks and their betas

Company	Returns	Beta	Company	Returns	Beta
1.Ambuja	0.423	0.69	12.NTPC	1.856825	0.58
2.Bharti Airtel	1.249086	0.93	13.Ranbaxy	0.612229	0.86
3.Bhel	2.7837	0.92	14.ONGC	1.130957	0.86
4.Gail	1.863	0.68	15. Reliance Cap.	2.7837	1.66
5.Hdfc	11.3377	1.18	16.Reliance	0.926529	1.13
6.Hindalco	1.7009	1.32	17.SAIL	3.356195	1.33
7.Icici	2.437	1.47	18.Ster	-0.05475	1.38
8.Idfc	2.9533	1.36	19.Tata motors	2.200184	1.25
9.Itc	0.1045	0.63	20.Unitech	151.0019	1.7
10.L&T	2.6657	1.66	21.Wipro	0.926529	0.79
11.JP Associates	2.547	1.27			

Number of Cases Used: 21

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Mean (SD) BETA = 1.1262(.3553)
Mean (SD) RETURN = 9.2767(32.5555)

Pearson's Correlation analysis results

Pearson's r (Correlation Coefficient) = 0.3876

Analysis:-

Karl Pearson's correlation coefficient = **0.3876** so from above calculation we can see that the correlation coefficient between the variables Returns of stocks & their Portfolios are positive but the intensity of correlation is low, so the null hypothesis (Ho) gets disapproved & the alternate hypothesis (H1) is accepted. We can thus say there is a positive correlation between returns of stocks and their beta's. But, there is no significant linear relationship between BETA and RETURN.

Hypothesis for Mean

The CAPM considers that the intercept is zero for every asset

HYPOTHESIS 2

H0- The intercept (Alpha) in CAPM is not significantly different from zero.

H1- The intercept (Alpha) in CAPM is significantly different from zero.

COMPANY	INTERCEPT	COMPANY	INTERCEPT
1.Ambuja	1.92974	12.NTPC	0.701297
2.Bharti Airtel	1.530701	13.Ranbaxy	1.862224
3.Bhel	0.824143	14.ONGC	1.387245
4.Gail	0.824143	15.Reliance Capital	0.824143
5.Hdfc	1.698899	16.Reliance	1.653779
6.Hindalco	1.797169	17.SAIL	0.559605
7.Icici	0.865888	18.Ster	1.675526
8.Idfc	1.870799	19.Tata motors	1.060846
9.Itc	2.022606	20.Unitech	2.298002
10.L&T	1.111567	21.Wipro	1.653779
11.JP Associates	1.531849		

Mean of Inetrcept-1.4135 Analysis

The mean of the intercept is 1.4135 which is much above than zero. So we would reject the null hypothesis and accept the alternate hypothesis. The intercept shows the difference between the actual return and the expected returns. The intercept is not zero because its not possible to have expected and actual results same(incidentally it can be),because actual returns are being affected by many factors like economic, industry, fundamental etc. out of which many cannot be presumed.

Company	Beta	Intercept	Company	Beta	Intercept
1.Ambuja	0.69	1.92974	12.NTPC	0.58	0.701297
2.Bharti Airtel	0.93	1.530701	13.Ranbaxy	0.86	1.862224
3.Bhel	0.92	0.824143	14.ONGC	0.86	1.387245
4.Gail	0.68	0.824143	15.Reliance capital	1.66	0.824143
5.Hdfc	1.18	1.698899	16.Reliance	1.13	1.653779
6.Hindalco	1.32	1.797169	17.SAIL	1.33	0.559605
7.Icici	1.47	0.865888	18.Ster	1.38	1.675526
8.Idfc	1.36	1.870799	19.Tata motors	1.25	1.060846
9.Itc	0.63	2.022606	20.Unitech	1.7	2.298002
10.L&T	1.66	1.111567	21.Wipro	0.79	1.653779
11.JP Associates	1.27	1.531849			

Variables used: BETA and INTERCEPT
Number of cases used: 21
Mean (SD) BETA = 1.1262(.3553)
Mean (SD) INTERCEPT = 1.4129(.5038)
Pearson's Correlation analysis results

Pearson's r (Correlation Coefficient) = -0.0158

ANALYSIS:-

The high value of the estimated correlation coefficient between the intercept and the slope indicates that the model used explains excess returns. Since, here correlation coefficient is negative we can say model does not explains the excess returns. An evaluation was made of the linear relationship between BETA and INTERCEPT using Pearson's correlation. An analysis using Pearson's correlation coefficient indicates no statistically significant linear relationship between BETA and INTERCEPT.

Standard Deviation signifies the risk that the security encompasses.

COMPANY	Std. Deviation	INTERCEPT	Std. Deviation
1.Ambuja	16.49332	12.NTPC	8.682875
2.Bharti Airtel	11.3500245	13.Ranbaxy	18.54053
3.Bhel	12.87451	14.ONGC	12.00704
4.Gail	11.90811	15.Reliance capital	12.84295
5.Hdfc	91.15728	16.Reliance	12.87451
6.Hindalco	28.76891	17.SAIL	16.04376
7.Icici	15.26614	18.Ster	13.73746
8.Idfc	17.04353	19.Tata motors	15.7389
9.Itc	14.69671	20.Unitech	38.16571
10.L&T	17.96165	21.Wipro	12.84295
11.JP Associates	23.24784		

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Company	Security	Market	Investor's Preference	Company	Security	Market	Investor's Preference
1.Ambuja	3.2723	2.03132	Buy	12.NTPC	0.9611	2.03132	Sell
2.Bharti Airtel	2.308772	2.03132	Buy	13.Ranbaxy	2.58622	2.03132	Buy
3.Bhel	2.3484	2.03132	Buy	14.ONGC	2.58622	2.03132	Buy
4.Gail	3.299	2.03132	Buy	15.Reliance capital	3.49785	2.03132	Buy
5.Hdfc	1.3178	2.03132	Sell	16.Reliance	2.86	2.03132	buy
6.Hindalco	0.7629	2.03132	Sell	17.SAIL	0.723333	2.03132	sell
7.Icici	0.1684	2.03132	Sell	18.Ster	6.1107	1.3844	Buy
8.Idfc	-0.046	1.907	Sell	19.Tata motors	1.0404	2.03132	sell
9.Itc	0.6044	2.03132	Sell	20.Unitech	-.7431	2.03132	Sell
10.L&T	3.49785	2.03132	Buy	21.Wipro	2.86	2.03132	buy
11.JP Associates	-0.584	2.03132	Sell				

The higher the Standard Deviation, the more risky is the security.

Analysis

In the table given above, the security with the highest **Standard Deviation** is **HDFC**followed by **Unitech** and the security with the lowest **Standard Deviation** is **BHARTI AIRTEL** followed **GAIL.**

Correlation measures the correlation between the stock and index.

COMPANY	CORRELATION	COMPANY	CORRELATION
1.Ambuja	0.373752	12.NTPC	0.700174
2.Bharti Airtel	0.517667	13.Ranbaxy	0.576494
3.Bhel	0.628538	14.ONGC	0.769805
4.Gail	0.774437	15.Reliance capital	0.593953
5.Hdfc	0.210866	16.Reliance	0.632307
6.Hindalco	0.445854	17.SAIL	0.792021
7.Icici	0.821783	18.Ster	-0.09641
8.Idfc	0.772597	19.Tata motors	0.781544
9.Itc	0.137952	20.Unitech	0.490352
10.L&T	0.736346	21.Wipro	0.593953
11.JP Associates	0.495239		

Analysis

Positive correlation of the stock with the index means that the stock moves or behaves in the same direction as that of the index. Here all the stocks are positively correlated with the index except STER. The degree of correlation varies as some stocks may be highly correlated and some may have low degree of correlation.

Negative correlation of the stock with the index means that the stock moves in the opposite direction as that of the index. In the sample of 21 stocks only a STER behaved that way.

Rate of Return of the Security

Analysis

Expected Rate of Return of various securities is calculated by using the formula:

$$R_s = R_f + ß\ (R_m - R_f)$$

Expected rate of return of the market is calculated by taking the average of all the years return.

If the expected return of the security is greater than the market return then the investor would prefer to buy the stock and vice-versa.

Limitations of the Research Paper

1.) It is developed initially for just 21 stocks of S&P index which is a short number. An investor may want to invest in stock other than these 21 stocks.

2.) The research is analyzed on the basis of 5 years past data only.

3.) It doesn't take into account 52 week range of stock, and various other indicators which may be important for stock evaluation.

4.) It is does not kept difference among the boom and the recession period which leads to major changes

5.) It doesn't allow a researcher to select multiple stocks and get accumulated returns on that stock.

6.) Researcher had to select each stock manually and then figure out the return on the stock.

5. CONCLUSION

The results obtained support to the linear structure of the **CAPM** equation being a good explanation of security returns. The high value of the estimated correlation coefficient between the intercept and the slope indicates that the model used, explains excess returns.However, the fact that the intercept has a value around zero weakens the above explanation.

The **CAPM**'s prediction for the intercept is that it should be equal to zero and the slope should equal to the excess return on the market portfolio. The findings of the study contradict the above hypothesis and indicate evidence against the **CAPM.**

It is possible to build an IT system which could help user to take better investment decisions by providing the details about overvalued and undervalued stocks. This kind of system would be of special interest to a layman user who knows nothing about finance. This would be helpful in terms of saving time, effort and money to pull out the data manually and analyzing the data.

As Black (1972) points out that these results can be explained in two ways. First, measurement and model specification

errors arise due to the use of a proxy instead of the actual market portfolio. This error biases the regression estimated slope towards zero and its estimated intercept away from zero. Second, if no risk free asset exists, the CAPM does not predict an intercept of zero.

The tests may provide evidence against the CAPM but that does not necessarily constitute evidence in support of alternative model

6. FUTURE WORK SCOPE

This research paper has lot of scope for future work and could be a good foundation to start with. Additional functionalities could be included which would take into account various indicators like MB ratio, Book value of share, comparison with WACC,P/E Ratio. 52 week range and other metrics which would help in valuation of stock. Moreover, the flexibility to select multiple stocks over flexible time range could be a good choice for the user.

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