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A STUDY ON THE RELIABILITY OF THE CAPITAL ASSET PRICING MODEL WITH RESPECT TO THE BANKING SECTOR

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Abstract: The Capital Asset Pricing Model (CAPM) is a model that is used by investors to calculate the expected return on their portfolio. The model uses the risk-free rate of return, market risk premium and market beta in order to give the investors an idea about the return that the investor can get if he/she invests in a particular security or portfolio. This research aims to check the validity of the CAPM model in calculating expected return by comparing the calculated return with the actual return.

In order to do this, the author has used 5 years of data from 1st April 2013 to 31st March 2018. The author has assumed the portfolio to comprise of all the companies of the Bank Nifty Index. The market beta has been calculated using the Nifty 50 index as the market and the Bank Nifty as the portfolio.

Using the CAPM formula, the author calculates the expected return for the above-mentioned period and compares it with the actual return. The author finds a deviation of 1.7539%, where the actual return is higher than the calculated return. In order to confirm this, the author used ANOVA test between the actual and calculated deviation, which also confirmed the deviation.

The author also carried out tests to check the effect of GARCH Model on the calculated return as well as expected return. Neither of the variables was affected by the GARCH Model, confirming that there was not much volatility in either of the variables. However, a basic standard deviation test carried out on both variables showed that the volatility in the calculated returns was higher than that of the actual returns.

Index Terms - CAPM, Bank Nifty, Expected Return, Beta, Calculation of Expected Return, Deviation, GARCH Model

I. INTRODUCTION

The Capital Asset Pricing Model has various applications, one of which is to calculate the expected return on a security or portfolio. This model was developed in the early 1960s by William Sharpe (1964), Jack Treynor (1962), John Lintner (1965) and Jan Mossin (1966). It is based on the principle that the expected return is based on the risk environment in the market and the premium that an investor expected as compensation for the amount of risk he/she undertakes.

CAPM Formula:

Expected Return = Risk free rate + Beta (Return on Market - Risk free return)

The Risk Free rate of return is the rate of return that the investor will get in a no-risk environment. While this is not practically possible, Government bonds or Treasury bills are generally considered to be risk-free.

The Beta or the Market Beta is a measure of risk. It is calculated keeping in mind the security or portfolio in relation to the market. Thus, Beta gives the risk of a portfolio or security with respect to the market. For the purpose of this research, the Bank Nifty is assumed to be the portfolio and the Nifty 50 index is assumed to be the market.

Formula for Beta Calculation:

Beta = Covariance (R_E, R_M) / Variance (R_M)

The Return on Market is the extra premium that an investor requires in order to get compensation for the risk that he/she is undertaking in order to invest in the security/portfolio. In this research, this has been calculated using the average monthly return of Nifty 50. (CAPM) (Kenton, 2019)

II. LITERATURE REVIEW

Validity of Capital Asset Pricing Model & Stability of Systematic Risk (Beta): An Empirical Study on Indian Stock Market – Krishnendu Maji (Maji, 2010)

CAPM is a model used by most academics and investors for the return on risk. The underlying concept of CAPM is that investors are rewarded for only that undiversifiable portion of risk. This non-diversifiable risk is called beta, which is correlated with expected returns. The research aims to test the validity of this hypothesis on the Indian capital market and the stability of this non-diversifiable risk (i.e.,

systemic risk, or beta). For the research, the study used data from 10 stocks & 10 sector indices listed on the BSE for a period of four years (January 2005 to December 2008). This research concludes that there is a deviation in the returns as calculated by the CAPM formula and the actual returns. The paper also provides evidence against the stability of systematic risk.

CAPM with reference to selected companies of BSE Sensex - Chauhan, Dr. Apurva; Bhatt, Dr. Babaraju K (Chauhan & Bhatt, 2016)
This paper identifies that the CAPM model splits risk down into systemic risk and unsystematic risk. The relationship between beta assets, risk-free rate, and equity risk premium is focused on that. The purpose of this analysis is to analyze the applicability of CAPM on the Indian Security market, with respect to selected BSE Sensex companies. There are 5 companies selected from the BSE Sensex for the purpose of this research. These are: SBI, Tata Steel, Sunpharma, ICICI bank and Maruti Suzuki ltd, are selected on the basis of their market turnover and information on their regular closing price. The information was taken for the period 2011 to 2015. The stock valuation was analyzed by comparing CAPM returns with actual financial asset returns. The result indicates there's a gap in stock market observed between CAPM and Real return. The findings challenges the fundamental assumption that higher beta results in higher returns. The study also states that there is no statistically significant influence of CAPM on market returns that reaffirms CAPM's non-applicability for the duration of the study on selected companies.

Does the Capital Assets Pricing Model (CAPM) Predicts Stock Market Returns in Ghana? Evidence from Selected Stocks on the Ghana Stock Exchange - Prince Acheampong (Acheampong, 2013)
The research analyzed the ability of CAPM in identifying the risk-return relationship of certain selected stocks Ghanaian stock market from Jan 2006 through Dec 2010. The paper tested CAPM with constant beta, using linear regression. They concluded that there was a deviation in the actual return and expected return as calculated by CAPM. The author of this paper feels that the reason for this deviation is factors apart from systematic risk that beta calculates. The paper also proves that all of the stocks that they have selected have either been overvalued or undervalued. For example, stocks of CAL, GCB, and SCB were undervalued on average for the period being checked. Nonetheless, SG-SSB stock was overvalued on average for the period under review.

Test of Capital Asset Pricing Model in Turkey - Gursoy C, Rejepova G (C & G, 2007)
This paper aims to check how valid CAPM is. It uses weekly risk premiums (rj-rf) from1995-2004. These are used against the beta coefficients. It uses 20 portfolios, each of which contains 10 inventories. The standards used for company assets and risk free rates were ISE 100 index and the US T-Bill average. These were adjusted for the disparity in Turkish and US inflation rates. Fama and MacBeth (1973), and Pettengil et al. Al. (1995) Approaches were selected as two alternative methods for the analysis. Conclusions using the Fama&MacBeth methodology revealed no relationship in the beta coefficients and the selected portfolios ' ex-post risk premiums. The author also identified strong beta-risk premium relationships during the research.

III. RESEARCH METHODOLOGY

3.1 Research Objectives

This paper aims to achieve the following objectives:

- To calculate the expected return of the portfolio, where the portfolio is assumed to consist of the companies in the Nifty Bank index
- To compare the calculated return with the actual return.
- To check the amount of deviation, if any
- To study and compare the volatility of the calculated return and actual return

3.2 Statement of Problem

Each investment comes with a certain level of risk attached to it. An investor is compensated for the risk he/she undertakes by the additional income or rate of return received from the investment. To become a reasonable investment, higher the risk, higher the return the stock must pay back. Therefore, the idea of risk and return can be understood to go hand in hand. Investing in the stock market is more risky as compared to other forms of investments. It is therefore very important that the person investing thinks about risk-return trade off.
The CAPM model uses the market risk, risk free rate as well as the market return in order to calculate the expected return. As can be seen, all of these parameters are highly dependant on the market that is highly volatile. It is a combination of all these parameters that given the expected return is highly trusted and used by many investors. This fact alone makes it very important to check if the model is valid and if not, to what extent is it valid and what changes can be made in order to get the most accurate value for expected return.

3.3 Scope of Problem

CAPM has strong applications in investment management, with its perception in the equity pricing of financial markets and calculation of expected returns. Its use in this area has progressed far beyond the limits of this introductory exposition to a level of sophistication. CAPM has also a major use in corporate finance. The expected return of the stock is the opportunity cost to owners of the equity funds that the company employs. As a risk factor, beta is evidently correlated with past returns. Due to the close relationship between complete and systemic risk, the empirical differentiation of their effects is difficult. The relationship is also sloping positively — that is, there is a positive trade-off between the two (high risk equals high yield, low risk equals low yield). (Mullens)
The model not only provides the investor regarding information about the expected return. It also gives the investor an idea about the risk in investment and the risk-return trade-off. CAPM is a highly useful tool used by many investors in order to make accurate and profitable judgment calls.

3.4 Variables

The variables used in the study are - Risk Free rate of return, Market Beta, Market risk premium and Market return.

3.5 Hypotheses

[1] Hypothesis for existence of difference:

H0: There is no significant difference between the calculated return and actual return.
H1: There is significant difference between the calculated return and actual return.

[2] Hypothesis to check whether there is an effect of GARCH model on the Actual Return of the portfolio.

H0: There is no effect of the GARCH Model on the Actual Return
H1: There is an effect of the GARCH Model on the Actual Return

[3] Hypothesis to check whether there is an effect of GARCH model on the Calculated Return of the portfolio.

H0: There is no effect of the GARCH Model on the Calculated Return
H1: There is an effect of the GARCH Model on the Calculated Return

[4] Hypothesis to check whether there is an effect of GARCH model on the Deviation of the portfolio.

H0: There is no effect of the GARCH Model on the Deviation
H1: There is an effect of the GARCH Model on the Deviation

3.6 Method of Data Collection

This research used mainly secondary sources for the collection of data:

- Risk Free rate of Return: This value was found in government websites
- Market Return: This was calculated using the Nifty 50 index values. For the purpose of this research, an average of the monthly returns of each year has been used as the market return.
- Beta: The beta values were calculated using the Nifty 50 returns as well as the Bank Nifty Returns.

3.7 Sampling Type and Sampling Size

- Risk Free rate of Return: This value was found in government websites
- Market Return: This was calculated using the Nifty 50 index values. For the purpose of this research, an average of the monthly returns of each year has been used as the market return.
- Beta: The beta values were calculated using the Nifty 50 returns as well as the Bank Nifty Returns.

3.8 Statistical Tools

The statistical tools used in this research are – Stationary test (Augmented Dickey-Fuller –ADF), Descriptive Statistics, ANOVA test, GARCH Model.

3.9 Limitations of the Study

The CAPM formula has market return as one of the key aspects in calculating returns. Different investors use different methods to calculate market return. Some investors use historical data, like this paper has done. Some decide the market return based on the amount of risk that they are taking on and some others even look at GDP estimations in order to calculate market return. Thus, the expected return as calculated from the CAPM formula varies as and when different investors calculate it.

Another drawback of this research is that the market here is only taken as the Nifty 50 index. While this index is a good representation of the overall market, there are other indices or a combination of indices that might have given slightly different results.

IV. RESULTS AND DISCUSSION

Hypothesis for existence of difference:

H0: There is no significant difference between the calculated return and actual return.
H1: There is significant difference between the calculated return and actual return.

[1] Using ANOVA Test

Test for Equality of Means Between Series
Date: 02/14/20 Time: 05:39
Sample: 1 61
Included observations: 61

Method	df	Value	Probability
t-test	116	-6.399645	0.0000
Satterthwaite-Welch t-test*	84.25808	-6.335910	0.0000
Anova F-test	(1, 116)	40.95545	0.0000
Welch F-test*	(1, 84.2581)	40.14376	0.0000

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	0.009139	0.009139
Within	116	0.025884	0.000223
Total	117	0.035022	0.000299

Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
CALCULATED_RETURN	58	-0.007313	0.018904	0.002482
ACTUAL_RETURN	60	0.010290	0.009667	0.001248
All	118	0.001637	0.017301	0.001593

As can be seen, the p value is lesser than 0.05. Thus, the null hypothesis (H0) is rejected and the alternate hypothesis (H1) is accepted. Thus, there is deviation between the calculated return and actual return.

[2] Using Descriptive Statistics (Standard Deviation)

	CALCULATED_RETURN	ACTUAL_RETURN
Mean	-0.007313	0.010226
Median	-0.001241	0.012149
Maximum	0.030825	0.022506
Minimum	-0.055562	-0.006606
Std. Dev.	0.018904	0.009829
Skewness	-0.759099	-0.632472
Kurtosis	2.899323	2.373590
Jarque-Bera	5.594732	4.815138
Probability	0.060970	0.090034
Sum	-0.424180	0.593082
Sum Sq. Dev.	0.020370	0.005506
Observations	58	58

These are the combined descriptive statistics for Calculated Return (Col 1) and Actual Return (Col 2). Looking at the standard deviation of both, it is evident that the standard deviation of Calculated Return is 0.018904 and that of the Actual Return is 0.009829. Thus, the standard deviation of the Calculated Return is much higher than that of the Actual return, which means that the Calculated return is much more volatile than the actual return. This further proves that there is a difference between the Calculated Return and the Actual Return.

[3] By calculation and comparison of Calculated Return with Actual Return:

In this research, expected return using the CAPM formula has been calculated. Then, the difference between the two was calculated. After taking an average of the deviations of the calculated time period, the author noticed that there was a difference of 1.7539% where the Actual Return was higher than the Calculated return.
Thus, this also proves that the null hypothesis (H0) is to be rejected and the alternate hypothesis (H1) is to be accepted. Thus, there is a difference between the calculated return and the actual return.

Hypothesis to check whether there is an effect of GARCH model on the Actual Return of the portfolio

H0: There is no effect of the GARCH Model on the Actual Return
H1: There is an effect of the GARCH Model on the Actual Return

Dependent Variable: ACTUAL_RETURN
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/14/20 Time: 05:50
Sample (adjusted): 1 60
Included observations: 60 after adjustments
Convergence achieved after 24 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	1.80E-05	0.000214	0.084087	0.9330
RESID(-1)^2	0.943676	10.77659	0.087567	0.9302
GARCH(-1)	-0.032404	11.70163	-0.002769	0.9978
R-squared	-1.152171	Mean dependent var		0.010290
Adjusted R-squared	-1.116301	S.D. dependent var		0.009667
S.E. of regression	0.014063	Akaike info criterion		-5.855348
Sum squared resid	0.011866	Schwarz criterion		-5.750631
Log likelihood	178.6604	Hannan-Quinn criter.		-5.814388
Durbin-Watson stat	0.121432			

The p value is 0.9, which is greater than 0.05. Thus, the null hypothesis (H0) is accepted and the alternate hypothesis (H1) is rejected. Thus, there is no effect of the GARCH Model on the Actual Return. This means that there is not much volatility in the actual returns.

Hypothesis to check whether there is an effect of GARCH model on the Calculated Return of the portfolio:

H0: There is no effect of the GARCH Model on the Calculated Return
H1: There is an effect of the GARCH Model on the Calculated Return

Dependent Variable: CALCULATED_RETURN
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/14/20 Time: 05:52
Sample (adjusted): 3 60
Included observations: 58 after adjustments
Convergence achieved after 21 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	4.54E-05	3.45E-05	1.317506	0.1877
RESID(-1)^2	0.269254	0.162074	1.661298	0.0967
GARCH(-1)	0.620961	0.164755	3.768996	0.0002
R-squared	-0.152294	Mean dependent var		-0.007313
Adjusted R-squared	-0.132427	S.D. dependent var		0.018904
S.E. of regression	0.020117	Akaike info criterion		-5.049508
Sum squared resid	0.023472	Schwarz criterion		-4.942933
Log likelihood	149.4357	Hannan-Quinn criter.		-5.007995
Durbin-Watson stat	1.078626			

The p value is 0.1877, which is greater than 0.05. Thus, the null hypothesis (H0) is accepted and the alternate hypothesis (H1) is rejected. Thus, there is no effect of the GARCH Model on the Actual Return. This means that there is not much volatility in the calculated returns.

Hypothesis to check whether there is an effect of GARCH model on the Deviation of the portfolio:
H0: There is no effect of the GARCH Model on the Deviation
H1: There is an effect of the GARCH Model on the Deviation

Dependent Variable: DEVIATION
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/14/20 Time: 05:52
Sample (adjusted): 3 61
Included observations: 59 after adjustments
Convergence achieved after 19 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	3.80E-05	4.86E-05	0.781617	0.4344
RESID(-1)^2	0.095056	0.108404	0.876873	0.3806
GARCH(-1)	0.804097	0.209955	3.829848	0.0001

R-squared	-0.881213	Mean dependent var	0.017539
Adjusted R-squared	-0.849328	S.D. dependent var	0.018844
S.E. of regression	0.025626	Akaike info criterion	-4.654278
Sum squared resid	0.038745	Schwarz criterion	-4.548641
Log likelihood	140.3012	Hannan-Quinn criter.	-4.613041
Durbin-Watson stat	0.721278		

The p value is 0.4344, which is greater than 0.05. Thus, the null hypothesis (H0) is accepted and the alternate hypothesis (H1) is rejected. Thus, there is no effect of the GARCH Model on the Actual Return. This means that there is not much volatility in the Deviations.

V. SUMMARY OF FINDINGS

The main aim of this research was to check the validity of the CAPM formula. For this, this paper used the Nifty Bank Index as the portfolio and assumed the Nifty 50 Index as the market. The CAPM formula has the following variables:

- Risk free Rate of Return: sourced from the internet
- Market rate of Return: used average of monthly actual returns of the index. Thus, a yearly actual return was found and taken as the Market rate of Return.
- Market Beta: calculated using the actual changes in the Nifty Bank and Nifty 50 indices.

Using the above-mentioned data, this paper calculated the expected return for each month. This paper then compared this return to the actual return and found out the deviation. The deviation noticed was 1.7539%.

The author also carried out ANOVA test between the two and the results were that there is a deviation of the calculated results from the actual returns. The standard deviation test that was carried out between the two also shows that there is a higher volatility in the Calculated returns as compared to the actual returns. Thus, all the tests regarding this objective coincide.
The paper also checked the volatility of the Actual Return, Calculated Return as well as the Deviation using GARCH Model. None of these variables were affected by the GARCH Model. This means that there is not much volatility in these variables. The lack of volatility in Actual Return and Calculated return is due to the lack of volatility in the market since even the calculated return, as discussed earlier, is highly dependant on the market. The lack of volatility in Deviation however is interesting and a plus point for the CAPM model. However, as has been calculated earlier, there is a deviation of 1.7539%. Thus, even if there is not much volatility, there is some amount of deviation.

VI. RECOMMENDATIONS

- Based on the results of this research, this paper can conclude that since there was a deviation of **1.7539%** between the actual return and the calculated return, where the actual return is higher than the calculated return, the CAPM formula with the variables calculated in the method that this paper did show lower expected return than what the return actually is.
- Thus, investors can simply add **1.7539%** to the expected return that they get after calculating the expected return using the CAPM formula.
- While this will not work every time, if the investor does this on a monthly basis for 5 years, keeping all other things common, the average of those deviations should be zero or a negligible value.
- While CAPM is used mainly for calculation of Expected Returns and matched with Actual Returns, the author suggests that the investor adjust the market risk premium in order to get expected returns as close to the returns that they desire. After this, the

investor can calculate the Expected Return using the return on market as calculated in this paper. This will enable the investor to compare the Desired Return with the Expected Return. Thus, the investor will be able to take decision most suited to his/her needs.

- The author also recommends that the investors repeat this calculation periodically in order to get an accurate percentage relevant to that period.

VII. CONCLUSION

This paper concludes that there is a deviation between the Actual Returns and the Returns as calculated by the Capital Asset Pricing Model. This deviation is **1.7539%** where the actual return is higher than the calculated return. The paper also concludes that there is not much volatility in the Actual Return, Calculated Return or the Deviation. The paper thus recommends that the investor add **1.7539%** to their Expected Return.

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