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Portfolio Risk Management using Capital Asset Pricing Model

Navneet Bihani[1], Somya Khandelwal[2]
[1,2]Indian Institute of Technology, Delhi, INDIA

ABSTRACT

Intricacies involved with a particular industry are revealed by risk and return analysis only. It is very important to decide the amount of risk one can take so as to remain comfortable with their investment. Closely visiting these ideas throws light on a clear understanding and facilitates in decision making about any investment. One seeks to achieve correct balance between risk and return to arrive at maximum optimization while going for any investment. A fact that remains is that risk and return always go together in investments. Everything and anything an investor does is tied directly or indirectly to return and risk. Their objective is to maximize expected returns from the investments, with the existing constraints. Return being the motivating force, inspires investors in the form of rewards for undertaking the investment. The importance of returns in any investment decision can be linked to many factors: enables investors to compare alternative investments in terms of what they have to offer, helps in measuring of historical returns to assess how well they have done and facilitates in measuring of the historical returns for estimation of future returns.

Keywords-- Capital Asset Pricing Model (CAPM), Expected Return, Risk, Beta for stock, Investment, Portfolio

I. INTRODUCTION

Stock market is a volatile place for any investor to invest their money. Volatility is a measure of dispersion around the mean or average return of a security but it is this volatility that also generates the market returns for investors. The dispersion of returns and thus risks associated with investment are greater when the standard deviation is higher. One can say that the greater the chance of lower-than expected return, the riskier the investment.

Market performance and volatility have a strong relationship. When stock markets fall volatility increases and hence risk increase and returns decrease. Risk as we say here is represented by the dispersion of returns around mean. The drop in compound returns comes from a greater dispersion of returns around the mean. The rate of return is expressed as a percentage, which represents the cumulative effect that a series of gains or losses have on an original amount of capital over a period of time.

In this paper we have discussed Capital Asset Pricing Model involved to keep a balance between risk & trade and to achieve the maximum expected return. This theory and the example thereof provides in depth understanding and implications of volatility in Indian stock market.

II. THEORY

Here we discuss the components of theory that would be used in the analysis done later in this paper.

Risk Analysis is an important skill that helps in distinguishing between expected return from realized return in an investment. An investor expects a return in future from his investment, but that is uncertain. Whereas, the realized return is what an investor actually obtains from his investment at the end of the investment period. The investor usually makes a decision to invest based on the expected return from the investment. However, the actual return realized from the investment may not correspond to the expected return. This possible variation of the actual return from the expected return is termed as risk. If actual realizations corresponded to expectations exactly, there would have been no risk associated. Risk arises where there is a possibility of variation between expectations and realizations with regard to an investment.

Elements of Risk: We have discussed two types of risks involved in an investment process, namely, systematic risk and unsystematic risk.

The first i.e. systematic risk comprises factors that are external to a company and affect a large number of stakeholders simultaneously. These are mostly uncontrollable in nature. The second i.e. unsystematic risk includes those factors which are internal to a company and affect only them in particular. These are also controllable to a great extent.

The total variability in returns of a security is due to the total risk of that security. Hence,

Total risk = Systematic risk + Unsystematic risk

I). Systematic Risk: Due to dynamic nature of society the changes occur in the economic, political and social systems constantly. These changes have an influence on the performance of companies and thereby on their stock prices but in varying degrees. For example, economic and political instability adversely affects all industries and companies. When an economy moves into recession, corporate profits will shift downwards and stock prices of most companies may decline. Thus, the impact of economic, political and social changes is system- wide and that portion of total variability in security returns caused by such system-wide factors is referred to as systematic risk.

II). Unsystematic Risk: Sometimes the return from a security of any company may vary because of certain factors particular to this company. Variability in returns of the security on account of these factors, it is known as unsystematic risk. This is in addition to the systematic risk affecting companies.

Expected Returns: The expected return of the investment is the probability weighted average of all the possible returns. If the possible returns are denoted by Xi and the related probabilities are *p(Xi)* the expected return may be represented as X and can be calculated as:

$Mean(X) = \mu = \sum x_i P(X_i)$

Risk: Measure of risk is the variance or standard deviation of the probability distribution of possible returns.

$\sum[(X_i - \mu^2)p(X_i)]$

Beta: The ratio of covariance between the asset return and market return and the variance of market return.

$\beta_{im} = Cov(R_i, R_m)/\sigma^2(R_m)$

III. OUR APPROACH

In this study we would be analyzing the data series for January 2008 to December 2013. Only those stocks have been considered which were continuously traded for the above given period of interest. Since time series price is non stationary we won't be using the closing prices directly. We would be taking first order logarithmic difference to convert the data set into stationary data set.

$R_t = \ln(P_t/P_{t-1})$

In this equation ۪ Pt is the price of stock at time 't', ۪Pt-1 is the price of the same stock at time 't-1'. In the same way logarithmic returns of NSE index was calculated. These index returns are used as a proxy for the market return. Proxy for risk free rate of return is the average implicit yield at cut off price of 91 days Government of India Treasury bills.

Center for Monitoring Indian Economy database Prowess is the source of data collection.

It is tested in two stages of regression.

- The first stage is time series regression

$R_{it} = \alpha_i + ß_i R_{mt} + \varepsilon_{it}$

In which beta of each security is calculated by regressing the return of security/portfolio on the return of the market. In this ۪ R_{it} and ۪ R_{mt} are the return of stock/portfolio 'i' and the market return respectively at 't' point of time. α and ß are intercept and slope coefficient of the regression equation. ε is the error term of the regression equation.

Beta (β) of each security/portfolio is calculated and this is used in the second stage of CAPM.

- The second stage is a cross sectional regression.

In this the excess return of stock/portfolio is regressed on beta of stock/portfolio. The slope coefficient in this regression is the market risk premium of stock/portfolio.

$[E(R_{it}) - R_{ft}] = \beta_{im}[E(R_{mt}) - R_{ft}]$

In this equation $E(R_{it})$ and $E(R_{mt})$ are the average return of stock/portfolio and market respectively. ۪R_{ft} is the risk free rate of return at time period 't'. β_{im} is the systematic risk of security/portfolio with respect to market.

This beta (βim) as defined in the theory. We test the CAPM by applying the rolling regression technique. This rolling regression technique is used to test the robustness of the model. Further to remove the errors, which may be due to unsystematic risk factor of the stocks we have created portfolios. After creating the portfolio the two stage regression is applied on these portfolios. As mentioned earlier, the second stage of regression an intercept term is included and for a model fit it is assumed that intercept term should be zero or insignificant in the regression model. To test whether a model performs better in the presence of an intercept term or not, the second stage regression is done by applying both the methodology that is including an intercept term and excluding the intercept term.

IV. RESULTS & DISCUSSION

Calculation: The calculation of beta for each portfolio. Beta calculated in the first stage of regression has been used as the independent factor in the second stage, which is a cross sectional regression. The slope of cross sectional regression is the market risk premium for the securities/portfolios.

Results for rolling regressions on ten portfolios with an intercept:

Sub Periods		Market Risk Premium	Adjusted R Squared	F Statistic	Intercept
Jan08 Dec10	–	-0.505	0.909	90.762	0.386
Apr08	-	-0.387	0.733	25.74	0.381

Mar11					
Jul08 Jun11	–	-0.407	0.64	17.014	0.454
Oct08 Sept11	–	-0.43	0.707	22.735	0.472
Jan09 Dec11	-	-0.337	0.602	14.609	0.452
Apr09 Mar12	-	-0.191	0.273	4.379	0.418
Jul09 Jun12	-	-0.364	0.605	14.803	0.401
Oct09 Sept12	-	-0.405	0.839	47.908	0.365
Jan10 Dec12	-	-0.373	0.855	54.023	0.314
Apr10 Mar13	-	-0.433	0.875	63.877	0.29
Jul10 Jun13	-	-0.452	0.838	47.648	0.269
Oct10 Sept13	-	-0.516	0.795	35.844	0.251
Jan11 Dec13	-	-0.416	0.713	23.398	0.199

Results for rolling regressions on ten portfolios without an intercept. To test CAPM is valid assuming, first the intercept term should be zero or it should not be significant in the model and second the market risk premium term should be significant and positive

Sub Periods		Market Risk Premium	Adjusted R Squared	F Statistic
Jan08 Dec10	–	-0.082	0.301	5.297
Apr08 Mar11	-	0.04	0.008	1.078
Jul08 Jun11	–	0.103	0.286	5.001
Oct08 Sept11	–	0.092	0.24	4.161
Jan09 Dec11	-	0.152	0.523	11.979
Apr09 Mar12	-	0.248	0.785	37.593
Jul09 Jun12	–	0.041	0.009	1.096
Oct09 Sept12	-	-0.036	0.008	1.085
Jan10 Dec12	-	-0.054	0.184	3.253
Apr10 Mar13	-	-0.141	0.679	22.146
Jul10 Jun13	-	-0.181	0.782	36.918
Oct10 Sept13	-	-0.259	0.866	65.67
Jan11 Dec13	-	-0.21	0.832	50.561

As it can be inferred the model fits for most of the sub periods, which can be inferred from the F statistics which are significant in those cases. The constrained model is better in explaining the CAPM as compared to the unconstrained one. The adjusted R squared term is rules in favor of the above conclusion as seen from the higher value in table 2. From the above analysis it is evident that the failure of CAPM in the Indian market is due to inappropriate model while testing the CAPM, thus causing failure of CAPM in our case

V. CONCLUSIONS

This study finds out that CAPM can be estimated by removing the intercept term from the second stage of the model, thus performing better in comparison to the constrained model. Removing the intercept term gives a new model which explains the risk return relationship in the Indian equity market for more than 50% times. Also the high value of adjusted R squared in case of the constrained model concludes that the systematic risk is the only factor which helps in explaining the return generating process of risky assets.

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