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The Capital Asset Pricing Model: A New Look on Risk -Reward Relationship, Beta Estimation, Further Evidence on the Validity and Scientifically Based Applications.

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Abstract:-All over the world, the vigorous development of the securities industry has introduced a large number of theories related to securities investment analysis. In this connection, the theoretical basis of securities analysis mainly includes Markowitz (1952) Asset Portfolio Theory, Sharpe (1964) Capital Asset Pricing Model (CAPM) and Ross (1976) Arbitrage Pricing Model (APT). Among these models, CAPM is a classic model in people's hearts and minds. The model is widely used in the various stock markets and financial investment markets, especially for riskier investments. It is used to determine the required rate of return of an asset, to make decisions about adding assets to a well-diversified portfolio. The model is represented by the beta coefficient which measures the sensitivity of the financial instrument in relation to the systematic risk. But, CAPM's critics point out that, it makes unrealistic assumptions and beta does not acknowledge that price swings in either direction don't hold equal risk. Bedside this, using a particular period for risk assessment ignores that risk and returns do not distribute evenly over time. Thus, many experts, researchers, academicians and investors have doubt regarding current validity of the model. In this context, the study is felt necessary to bring a new look on the theory. The study reviewed the theory, framework and evidence of the Capital Asset Pricing Model (CAPM). The applications of this model have been analyzed from different perspectives. In this context, the measurement and use of beta coefficients for stock predictions were also discussed. It has also exposed a rational assessment between Security Market Line (SML) and Capital Market Line (CML). Beside this, the study showed that, the Security Market Line (SML) may be instigated from Capital Market Line (CML) and vice- versa. Furthermore, the Arbitrage Pricing Theory (APT) has also been described as an additional evidence of CAPM. Overall, the study critically analysed the beta estimation and a new look on risk -reward relationship for assets, particularly stocks.

Keywords: *Instigated, Price Swings, Rational Assessment.*

1. Introduction

The Capital Asset Pricing Model (CAPM) is based on the earlier work of Harry Markowitz on diversification and Modern Portfolio Theory. Harry Markowitz laid down the foundation of Modern Portfolio Management in 1952 and the CAPM was developed 12 years later in

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articles by William Sharpe, John Linter. Actually, the model was introduced by Jack Treynor (1962), William F. Sharpe (1964), John Lintner (1965) and Jan Mossin (1966) independently. The issue that Markowitz (1952) proposed portfolio theory considered was how investors balance the average income and uncertainty and look for an optimal portfolio of assets. The CAPM discusses the theory of equilibrium prices in a single period, frictionless and fully competitive uncertain financial and securities markets, essentially pricing the uncertainty of assets (Zhou, Taoyuan and Liu, Huarong, 2018)

The principal prediction of the model is that the expected return on any two assets is linearly related to the covariance of the return on these assets with the return on the market portfolio (Matteo, 2016). Actually, the theory says that the only reason an investor should earn more, on average, by investing in one stock rather than another is that one stock is riskier. Beside this, the model provides an equilibrium relationship between risk and return, which helps in identifying the underpriced and overpriced assets. This equilibrium relationship is also known as the security market line (SML). The line explains the relationship between the return of asset and beta of asset (Chong, 2013). Moreover, CAPM model plays a very important role in establishing the investment portfolio, that's why, the model is widely used in the various stock markets of the different countries. The model also plays an important role in the real financial investment market and occupies an important position in modern investment science (Bodie, 2009).

2. Objectives

The CAPM is an idealized representation of how financial markets price securities and thereby determine expected returns on capital investments. Actually, the model provides a methodology for quantifying risk and translating that risk into estimates of expected return on equity. Thus, the model allows investors to optimise their portfolios by selecting a mix of assets that collectively align with their risk tolerance and return objectives. In this context, the objectives of the study are as follows:

I. Reviewed the theory, framework and evidence of the Capital Asset Pricing Model (CAPM).

II. Exposed a rational assessment between Security Market Line (SML) and Capital Market Line (CML). In this connection, the study showed that, the Security Market Line (SML) may be instigated from Capital Market Line (CML) and vice- versa.

III. Analysized the applications of CAPM from different perspectives. In this context, the measurement and use of beta coefficients for stock predictions were also discussed.

IV. Described the Arbitrage Pricing Theory (APT) as an additional evidence of CAPM.

V. The study critically analysed the beta estimation and a new look on risk -reward relationship for assets, particularly stocks.

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3. Methods

3.1. Review of Literature

The CAPM model determines the fairest price for an investment, based on the risk, potential return and other factors. That's why; it is still extensively used in various applications, such as estimating the cost of equity capital for firms, the expected return of an asset and evaluating the performance of managed portfolios. But, there are lots of criticism regarding assumptions, validity and uses of the model. In this connection, the different literatures relating to the present study are as follows:

Markowitz (1952) in his journal paper of Portfolio Selection had introduced the modern portfolio theory. The main motive of this model is to analyse and manage the investment portfolio through proper use of mathematical mean and variance. He mentioned that rational investor will not only pay attention to its earnings, but ignore its risks. In this regard, he showed that, each type of securities or combination of assets has different returns and risks.

Sharpe (1964) and Lintner (1965) introduced the Capital Asset Pricing Models (CAPM). The main conclusion of this theory is that when all investors use Markowitz's portfolio theory to make investment decisions, there is a linear relationship between the expected return rate of the assets and the system risk. He discussed the way of matching potential gain from an investment with the potential risk.

The empirical tests conducted by Friend and Blume (1970), Black, Jensen and Scholes (1972) to show the support to CAPM and concluded that return of risky assets are a linear function of the beta factor. They studied the price movements of the stocks on the New York Stock Exchange between 1931 and 1965. They found that Beta, compared with the equity risk premium, shows the amount of compensation equity investors need for taking on additional risk.

Fama and MacBeth (1973) used the cross-sectional data from 1935 to 1968 to test CAPM Model. They found that the average yield and beta coefficient of the stock have an exact linear relationship. It is also found that the positive correlation between the average rate of return and the beta coefficient is established, the intercept is almost equal to the risk-free rate of return, and the non-systematic risk is not compensated.

Roll (1977) pointed out that true market mix cannot be observed and the test uses an approximate market portfolio, the CAPM model cannot be truly tested. This is a significant idea because a truly diversified portfolio is one of the key variables of the CAPM, which is a widely used tool among market analysts. In this context, due to Roll (1977) criticism, people began to look for and test whether there are other variables other than market factors that can explain the risks faced by individual securities.

Gupta and Sehgal (1993), Obaidullah (1994), Madhusoodan (1997) and Sehgal (1997) denied the applicability of CAPM in Indian stock market. They claimed that, the single factor beta

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cannot explain the return generating process of assets. They also mentioned that, it is based on some irrelevant assumptions and the reasons why they are criticised.

Yalwar (1988) also supported the CAPM and stated that the model is applicable for calculation of expected return from an asset. His study was based on Bombay stock markets of India and he pointed out that it is very much useful in the stock market.

Fama, French (1992 and 2004), mentioned that the model is its powerfully simple logic and intuitively pleasing predictions about how to measure risk and about the relation between expected return and risk. Unfortunately, because of its simplicity, the empirical record of the model is poor enough to invalidate the way it is used in applications.

Dhankar and Kumar (2007) explained that the model takes into account the asset's sensitivity to non-diversifiable risk (also known as systematic risk), often represented by the quantity beta (β) in the financial industry, as well as the expected return of the market and the expected return of a theoretical risk-free asset.

Bajpai and Sharma (2014) focused on empirical testing the model in the Indian equity market. In this study, a comparison between the developed model and the traditional model has been made. The results showed that CAPM is very much significant in the Indian equity market and the model developed in this study, performs better than the traditional model.

Chaudhary (2016) mentioned that the studies on asset pricing in initial years supported the CAPM (Fama-Macbeth, 1973). However, there were many studies conducted later such as by Stattman (1980), Banz (1981), Basu (1983) and Bhandari (1988) that found some anomalies such size effect, leverage, value effect etc. which were not explained by CAPM. He conducted the test of CAPM in India with the help of data relating to the CNX S&P 500 index and its constituents. The results suggest that CAPM does not have much explanatory power and we should search for the alternative models for the asset pricing in India.

The existing literature provides the mixed kind of evidences in support of CAPM. It is also found that maximum studies regarding CAPM Model were conducted in developed countries and relatively less no of studies were found in developing countries. In India too, there are very few studies, which have addressed the same issue. Beside this, in the late twentieth century, the CAPM started losing its popularity as various other theories/ model of asset pricing came into existence, which contradicted the model and claimed that the single factor, beta, cannot explain the return generating process of assets. There are various other factors which influence risk return relationships and those factors should also be taken into account. This kind of ambiguity prevail the literature of CAPM model has given the motivation to the author to study on Risk -Reward Relationship, Beta Estimation, Further Evidence on the Validity and Scientifically Based Applications.

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3.2. Research Methodology

In the course of analyzing the Capital Asset Pricing Model in a new look on risk -reward relationship, beta estimation, validity and applications, a number of text and references books, Government Publications and other published & unpublished documents relating to the study have been considered. The study is based upon secondary data. In this study, the following methods/tactics/equations have been used:

a) CAPM: An Important Step toward the Theory

The rate of return and risk of the new portfolio are as follows:

Rate of Return, $r_p = w_f r_f + w_m r_m$ ……………………………………………………(1)

Risk of the New Portfolio, $\sigma_p = \left(w_f^2\, \sigma_f^2 + w_m^2 \sigma_m^2 + 2 w_f \sigma_f w_m \sigma_m \rho_{f.m}\right)\frac{1}{2}$ …………..(2)

r_f *and* r_m refers to the rate of return of risk-free asset and market portfolio respectively. w_f and w_m refers to the weights of risk-free asset and market portfolio respectively, σ_f and σ_m refers to the risk of risk-free asset and market portfolio.

(b) CAPM: Risk-Reward Relationship and Security Market Line (SML)

To fulfil the objectives, the equation of Capital Asset Pricing Model (CAPM) has been used in this study. The basic equation is:

$E\,(R_i) = R_f + \beta_i\,[E\,(R_M) - R_f]$ ……………………………………………………….…..(3)

Where $E\,(R_i)$ is expected return on asset i, R_f is the risk-free rate of return, $E\,(R_M)$ is expected return on market proxy and β_i is a measure of risk specific to asset i.

From basic equation of CAPM, various forms of equations have also been derived. Moreover, the Security Market Line (SML) is well described from these equations.

(c) Derivation of CML from SML:

For efficient a portfolio, the relationship between risk and return is depicted by the straight line called the Capital Market Line (CML). The CML has shown by using the following equation:

$$E(R_j) = R_f + \lambda\sigma_j \quad \text{…………………………………………………….. (4)}$$

Where $E(R_j)$, the expected return on portfolio j, R_f is the risk free rate, λ is the slope of the market line and σ_j is the standard deviation of portfolio j. The value of lambda is:

$$\lambda = \frac{E(R_M) - R_f}{\sigma_M} \quad \text{……………………………………………………… … (5)}$$

Where λ , the slope of the CML may be regarded as the “Price of risk” in the market.

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By using equation of $E(R_i)$ and λ, Capital Market Line (CML) has been derived from Security Market Line (SML). Similar way, Security Market Line (SML) has also been derived from Capital Market Line (CML).

(d) Estimation of Portfolio Beta: Three Different Methods.

(i) Beta Estimation: Covariance and variance of market return:

The standardized measure of systematic risk, popularly called as beta (β_i). This beta (β_i) is the ratio of covariance between the asset return and market return and the variance of market return.The beta can be calculated as:

$$\beta_i = \frac{\sigma_{iM}}{\sigma_M^2} \quad \ldots\ldots(6)$$

Where, market portfolio is σ_{iM} & the market risk is σ_M

ii) Beta Estimation: Correlation Method

The model calculates the expected return of an asset based on its beta and expected market returns. The beta can also be calculated on the basis of correlation between market risk and stock & variance of market risk. In this context, the equation of beta is as follows:

Beta coefficient, $\beta_i = \frac{Cov\,(R_A, R_M)}{\sigma_M^2}$ ……(7)

Here, $Cov\,(R_A, R_M) = \frac{\sum(R_A - \overline{R_A})(R_M - \overline{R_M})}{n-1}$, and, $\sigma_M^2 = \frac{\sum(R_M - \overline{R_M})^2}{n-1}$

Where, R_A is return on stock & R_M is Return on market portfolio.

(iii) Beta Estimation: Regression Method

The following regression model is used for calculation of Beta-

$$y_t = \alpha + \beta x_t \quad \ldots\ldots (8)$$

- α coefficient calculation method. The constant term of the linear regression model obtained by the statistical software is the α coefficient.

- β coefficient calculation method. Similarly, the slope of the regression equation obtained using statistical software is the β coefficient.
  The specific formula can be expressed as follows:

$$\beta = \frac{n\sum_{t=1}^{n} x_t y_t - \sum_{t=1}^{n} x_t \sum_{t=1}^{n} y_t}{n\sum_{t=1}^{n} x_t^2 - \left(\sum_{t=1}^{n} x_t\right)^2} \quad \ldots\ldots(9)$$

This method is to use the definition method. Select the historical yield of a single stock for a period of time $\{y_t\}$ and historical yield of the market index for the same period of time $\{x_t\}$.

(e) Estimation of Portfolio Beta: Thirty Indian companies

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Beta is important because it measures the risk of an investment that cannot be reduced by diversification. The significance of Beta has been analysed as per its different values. On the basis of Beta Coefficient, a comparative analysis was made among thirty Indian companies. The formula used for that:

Beta = Co-variance (SENSEX, Stock)/ Variance (SENSEX) ……..........… (10)

(f) Evidence of CAPM:

For understanding the evidence of the model, Security Characteristic Lines (SCLs) and the Security Market Line (SML) have been derived. For that purpose, the following two equations are need to be analysed:

For Security Characteristic Lines (SCLs), the equation is:

$$R_{it} - R_{ft} = a_i + b_i(R_{Mt} - R_{ft}) + e_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

Where, a_i is a constant and b_i is also constant for a particular situations.

For estimating the Security Market Line (SML), the equation is:

$$\overline{R_i} = \gamma_0 + \gamma_1 b_i + e_i \quad i = 1\ldots n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(12)$$

Where, γ_0, the intercept, should not be significantly different from the risk –free rate, $\overline{R_f}$
γ_1, the slope coefficient, should not be significantly different from $\overline{R_M - R_f}$

For Security Characteristic Lines (SCLs), the return on security i is regressed on the return on the market portfolio, whereas for the Security Market Line (SML), the excess return on security i is regressed on the excess return on market portfolio and this equation is used more commonly.

As an additional evidence of CAPM, the equilibrium relationship of Arbitrage Pricing Theory (APT) has also been analysed:

$$E(R_i) = \lambda_0 + b_{i1}\lambda_1 + b_{i2}\lambda_2 + \cdots b_{ij}\lambda_j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(13)$$

Where $E(R_i)$, the expected return on asset is i, λ_0 is the expected return on an asset with zero systematic risk, b_{ij} is the sensitivity of asset i's return to the common risk factor j and λ_j is the risk premium related to the jth risk factor.

g) CAPM: Scientifically Based Applications

The different application analysed by different equations and graphical representation. The various applications like expected Return for a portfolio offers, CAPM in investment appraisal and Asset pricing have been analysed in this study.

On the basis of the above points, the Capital Asset Pricing Model (CAPM) have been analysed in different way and presented in a different equation form, tabular and graphical form as and where necessary.

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4. Results

4.1. A New Look on Risk -Reward Relationship and SML Graph:

Capital Asset Pricing Model: An Important Step toward the Theory

In portfolio management theory (Markowitz, 1952), it is assumed that all the assets in a constructed portfolio are risky assets. However, it is also possible to introduce a risk-free asset into the asset portfolio, so the asset portfolio contains a risk-free asset and a set of risk assets. Risk-free assets, there are basically only one type in the economy, such as government bonds. Risky assets in a group of risky assets are in fact just risky assets that are restricted to the stock market, such as stocks. The change of stock price reflects the risk of the issuer and the society in which the issuer is located. Therefore, the combination of all assets in the stock market to a certain extent represents a collection of all risky assets in society. Such a risky asset portfolio is called a market portfolio (Zhou, Taoyuan and Liu, Huarong, 2018)

Use f and m to represent a risk-free asset and market respectively. The rate of return and risk of the new portfolio are as follows.

$$r_p = w_f r_f + w_m r_m \quad \ldots\ldots(14)$$

$$\sigma_p = \left(w_f^2\,\sigma_f^2 + w_m^2\sigma_m^2 + 2w_f\sigma_f w_m\sigma_m\rho_{f.m}\right)\frac{1}{2} \quad \ldots\ldots (15)$$

r_f *and* r_m refers to the rate of return of risk-free asset and market portfolio respectively. w_f and w_m refers to the weights of risk-free asset and market portfolio respectively, σ_f and σ_m refers to the risk of risk-free asset and market portfolio. Since the risk-free rate has no risk, namely, $\sigma_f = 0$. Therefore, $\rho_{f.m} = 0$ as well. Obviously, the risk-free formula for a portfolio is not complicated by the introduction of risk-free assets.

The risk of a portfolio is equal to the weights of risk assets in the portfolio multiplied by their standard deviation.

$$\sigma_p = w_m\sigma_m \quad \ldots\ldots (16)$$

This is an important step toward a Capital Asset Pricing Model. Based on the expected return on the portfolio and the risk, a straight line that is tangential to the portfolio curve can be drawn on the chart. This line is called the Capital Market Line (CML).

CAPM: Risk -Reward Relationship and Security Market Line (SML)

As per the CAPM, it is to be mentioned that only reason an investor should earn more, on average, by investing in one stock rather than another is that one stock is riskier. In this context, the CAPM is a method of calculating the return required on an investment, based on an assessment of its risk.

In equation form, the model can be expressed as follows:

$$E(R_i) = R_f + \beta_i [E(R_M) - R_f] = R_f + \sigma_{iM} / \sigma_M [(E(R_M) - R_f)/ \sigma_M] \ldots\ldots(17)$$

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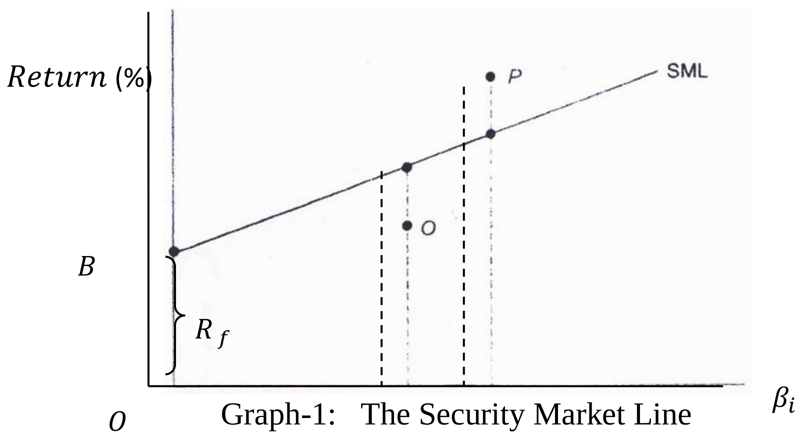
Where E (R_i) is expected return on asset i, R_f is the risk-free rate of return, E (R_M) is expected return on market proxy and β_i is a measure of risk specific to asset i. Here, σ_M is the variance of return on market portfolio, and σ_{iM} is the covariance of retunes between security i and market portfolio.

There is a linear relationship between their expected return and their covariance with the market portfolio. The relationship between expected return on asset i and expected return on market portfolio is also called the Security Market Line (SML). For SML, the equation can be expressed as like as follows:

$$E(R_i) = R_f + \left(\frac{E(R_M)-R_f}{\sigma_M^2}\right)\sigma_{iM} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(18)}$$

In words, Expected return on security i =Risk-free return + (Price per unit of risk) Risk
Here, the price per unit of risk is: $\frac{E(R_M)-R_f}{\sigma_M^2}$ & the measure of risk is: σ_{iM}

The SML reflects the expected return-beta relationship. Actually, the security market line is a financial concept where the capital asset pricing model is shown in the form of a graph along with beta, which is the systematic risk. The graph can be used to compare two similar investment securities that have approximately the same return to determine which of the two securities carries the least amount of inherent risk relative to the expected return. It can also compare securities with equal risk to determine if one offers a higher expected return. The slope of the SML indicates the market risk premium. The SML has shown in Graph-1.



Graph-1: The Security Market Line

In the Graph-1, Assets which are fairly priced plot exactly on the SML. Underpriced securities (such as P) plot above the SML, whereas overpriced securities (such as O) plot below the SML. The difference between the actual expected on a security and its fair return as per the SML is called the security's alpha (α).

SML Graph: The Characteristics at a Glance

A standard graph shows beta values across its X-axis and expected return across its Y-axis. The risk-free rate, or beta of zero, is located at the y-intercept. The purpose of the graph is to

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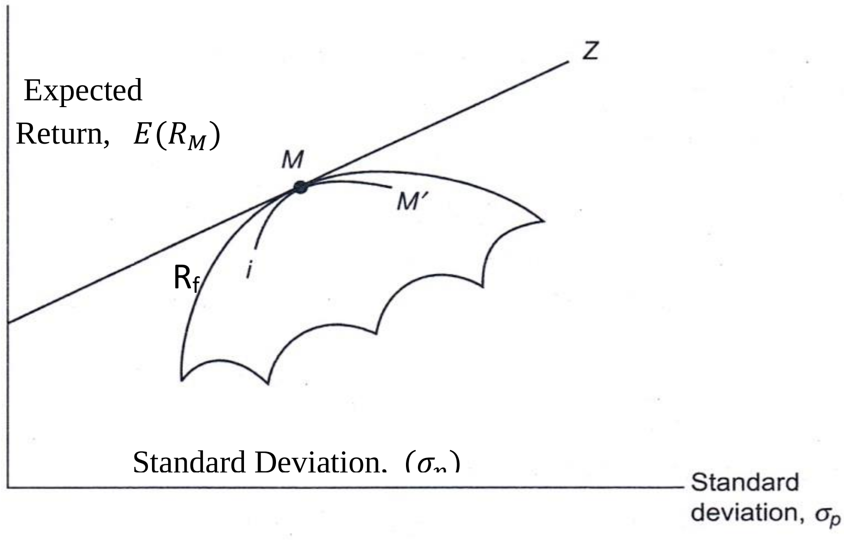
identify the action, or slope, of the market risk premium. In this connection, the characteristics of the Security Market Line (SML) are as below (Srivastav and Vaidya, 2021)

- SML graph is a good representation of investment opportunity cost, which provides a combination of the risk-free asset and the market portfolio.
- Zero-beta security or zero-beta portfolio has an expected return on the portfolio, which is equal to the risk-free rate.
- The slope of the Security Market Line is determined by market risk premium, which is: $(E(R_M) – R_f)$. Higher the market risk premium steeper the slope and vice-versa
- All the assets which are correctly priced are represented on SML.
- The assets above the SML are undervalued as they give the higher expected return for a given amount of risk.
- The assets which are below the SML are overvalued as they have lower expected returns for the same amount of risk.

Derivation of the Security Market Line (SML)

Graph-2 has considered for understanding the derivation of SML Graph. The graph shows the typical relationship between a single security (point i) and the market portfolio (M).The curve iMM' indicates all possible Rp, σ_p values obtainable by various feasible combinations of i and M. The curve iM M' is tangential to the capital market line R_f MZ at M.



Graph-2: Relationship between a Security and the Market portfolio

Let,

S_M is the slope of iMM’ at point M',

E (R_i) is the expected return on security i,

$E(R_M)$ is the expected return on market portfolio,

σ_M is the standard deviation of the Return on market portfolio,

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σ_{iM} is the covariance of return between security i and market portfolio.

The slope of iMM' is the derivative of E (R_p) with respect to σ_p, Hence slope iMM' is d E(R_p)/d σ_p. Now, applying the chain Rule of differentiation,

$$write, \quad dE(R_p)/d\sigma_p = \frac{dE(R_p)/dw_i}{d\sigma_p/dw_i} \text{...} (19)$$

Now, $E(R_p) = w_i E(R_i) + (1 - w_i)E(R_M)$

So, $\quad dE(R_p)/dw_i = E(R_i) - E(R_M) \text{...} (20)$

Further, $\sigma_p = [w_i^2\sigma_i^2 + (1 - w_i)^2{\sigma_M}^2 + 2w_i(1 - w_i)\sigma_{iM}]1/2$

$$\text{Hence,} \quad \frac{d\sigma_p}{dw_i} = \frac{w_i(\sigma_i^2 + \sigma_M^2 - -2\sigma_{iM}) + \sigma_{iM} - \sigma_M^2}{\sigma_p} \text{...............................} (21)$$

substituting the results(20)and (21)in equation (19), we get

$$\frac{dE(R_p)}{d\sigma_p} = \frac{(E(R_i) - E(R_M))\sigma_p}{w_i(\sigma_i^2 + \sigma_M^2 - 2\sigma_{iM}) + \sigma_{iM} - \sigma_M^2}$$

Evaluting $\frac{dE(R_p)}{d\sigma_p}$ at point M where $\mathrm{w_i} = 0$, we get

$$\left[\frac{Ed(R_p)}{d\sigma_p}\right] = \frac{(E(R_i) - E(R_M)\sigma_M}{\sigma_{iM} - \sigma_M^2}$$

The slope of iM M' at point M is equal to:

$$S_M = \frac{[E(R_i) - E(R_M)]\sigma_M}{\sigma_{iM} - \sigma_M^2} \dots\dots\dots\dots\dots\dots\dots\dots\dots.\dots\dots (22)$$

Again, the slope of the CML graph is,

$$\lambda = \frac{E(R_M) - R_f}{\sigma_M} \text{...} (23)$$

Since the slope of iMM' at M is equal to the slope of the Capital Market Line, the above two equation (22 and 23), it can be written,

$$\text{Then:} \quad \frac{[E(R_i) - E(R_M)]\sigma_M}{\sigma_{iM} - \sigma_M^2} = \frac{E(R_M) - R_f}{\sigma_M}$$

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Simplifying and rearranging,

$E(R_i) = R_f + \sigma_{iM} / \sigma_M [(E(R_M) - R_f)/ \sigma_M]$

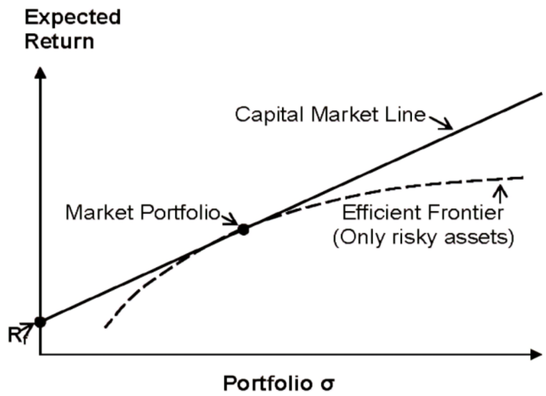
Again, $\beta_i = \frac{\sigma_{iM}}{\sigma_M^2}$

Hence, $E(R_i) = R_f + \beta_i [E(R_M) - R_f]$ ……………………………………… (24)

This is the Security Market Line (SML).

Capital Market Line (CML) Graph: An Overview

The Capital Market Line is a graphical representation of all the portfolios that optimally combine risk and return. Actually, it is a graphical representation that shows a portfolio's expected and required return based on a chosen level of risk. The portfolios that are on the CML optimize the required risk and return relationship that maximizes the performance of the portfolio. The CML Graph is as follows (Graph-3):



Grpah3: Capital Market Line (source: cml graph - Search (bing.com)

It is also noteworthy that under CAPM, all investors will choose a position on the capital market line, in equilibrium, by borrowing or lending at the risk-free rate, since this maximizes return for a given level of risk. The capital market line (CML) represents portfolios that optimally combine risk and return.

SML and CML: A Comparative Analysis

The similarities between CML and SML are: (1) The Capital Market line and Security Market line are both based on the trade-off between risk and return. (2) Both the lines intersect the vertical axis or the y-axis at the risk-free rate point. However, the difference between SML Graph and CML graph are as follows:

Table 1: Difference between SML Graph and CML Graph

Sl. No.	Point of Difference	Security Market Line	Capital Market Line
1	Meaning	SML is used to show the risk and return for individual securities	CML indicates the risk and returns for a portfolio of securities

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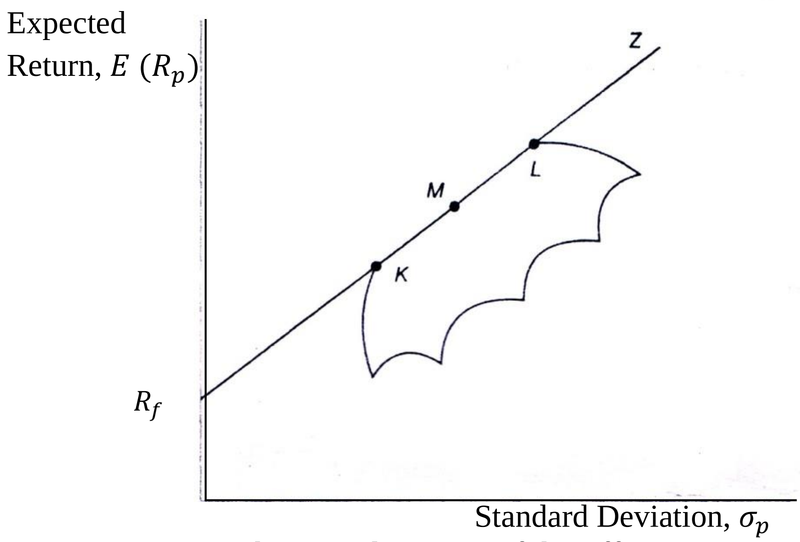
2	Risk factor metric	Beta of a security	Standard Deviation of the portfolio
3	Risk considered	Systematic Risk	Total Risk (systematic plus unsystematic)
4	Representation	Depicts all market portfolios, efficient or non-efficient	Only depicts efficient portfolios
5	Portfolios	Defines functioning portfolios.	Defines both functioning and non-functioning portfolios.
6	Agenda	To describe only market portfolios and risk-free investments.	To describe overall security factors.
7	Functioning	More efficient	Less efficient

Source: Designed by author, from Security Market Line and Capital Market Line (2021), https://tavaga.com/tavagapedia/security-market-line/

Derivation of CML from SML:

The CML shows the rates of return for a specific portfolio and the SML represents the market's risk and return at a given time, and shows the expected returns of individual assets (Capital Market Line, 2021). Actually, CML graph shows a simple linear relationship between the expected return and standard deviation (as far as efficient portfolios). Typically, the expected return and standard deviation for individual securities will be below the CML, reflecting the inefficiency of undiversified holdings. Portfolios which have returns that are perfectly positively correctively correlated with the market portfolio are referred to as efficient portfolios. In this context, adjustment of the Efficient Frontier has shown in Graph-4



Graph- 4: Adjustment of the Efficient Frontier

For an efficient portfolio, the relationship between risk and return is depicted by the straight line R_f MZ. The equation for this line, called the Capital Market Line (CML), is:

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$$E(R_j) = R_f + \lambda\sigma_j \text{......} \quad (25)$$

Where $E(R_j)$, the Expected Return on portfolio j, R_f is the risk free rate, λ is the slope of the market line and σ_j is the standard deviation of portfolio j.

Given that the market portfolio has an expected return of $E(R_M)$ and standard deviation of σ_M, the slope of the CML can be obtained as follows:

$$\lambda = \frac{E(R_M)-R_f}{\sigma_M} \text{......} \quad (26)$$

Where λ , the slope of the CML may be regarded as the “Price of risk” in the market.

If CAPM is valid, all securities will lie in a straight line called the Security Market Line (SML) in the E(R), β_i frontier.

As per the Security Market Line,

$$E(R_i) = R_f + \left(\frac{E(R_M)-R_f}{\sigma_M^2}\right) \sigma_{iM} \text{......} \quad (27)$$

Since $\sigma_{iM} = \rho_{im}\sigma_i\sigma_M$, $Eq(7)$ can be re-written as:

$$E(R_i) = R_f + \left(\frac{E(R_M)-R_f}{\sigma_M}\right) \rho_{iM}\sigma_i \text{......} \quad (28)$$

If the returns on i and M are perfectly correlated (this is true for efficient portfolios), ρ_{iM} is 1 and Eq. (28) becomes:

$$E(R_i) = R_f + \left(\frac{E(R_M)-R_f}{\sigma_M}\right) \sigma_i \text{......} (29)$$

Equation (29) is the equation of CML line. Hence, CML line has derived from SML and CML is a special case of the SML.

4.2 Interpretation, Applications and Estimation of Portfolio Beta

Portfolio Beta: Interpretation

The beta (β) of an investment security (i.e. a stock) is a measurement of its volatility of returns relative to the entire market. The greater the proportion of fixed costs in the cost structures of the business, the higher the beta. A company with a higher beta has greater risk and also greater expected returns. In this regard, beta coefficient can be interpreted as follows:

Table2: Interpretation of Beta Co-efficient (β_i)

Sl No	Value	Remarks / Explanations
1	β =1	Exactly as volatile as the market
2	β >1	More volatile than the market

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3	β <1>0	Less volatile than the market
4	β =0	Uncorrelated to the market
5	β <0	Negatively correlated to the market

Source: CAPM Beta, Available At Http://Www.Wallstreetmojo.Com/Capm-Beta-Definition-Formula-Calculate-Beta-In-Excel/#Capmformula

Portfolio Beta: Applications

The application of β coefficient may be described as follows:

I. The calculated β value indicates the extent to which the return of a security or changes with changes in market returns, thus illustrating its degree of risk. The greater the value of β, the greater the system risk of a single security.

II. When the value of β is greater than 0, the return of securities or portfolios changes in the same direction as the market. When the value of β is less than 0, the return of securities or portfolios changes in the opposite direction as the market. The β coefficient is widely used in securities analysis and investment decisions. The application of β coefficients is mainly reflected in the following aspects.

III. Actually, it is used to divide the type of securities. According to the size of the β value, the securities can be of the following types. if β is less than 1, when the market income rises,

Estimation of Portfolio Beta: Regression Model and Definition Method

The beta coefficient may be determined by the linear regression of the change in the individual stocks, that is, the rate of return, on the change in the market index. Here, $\{y_t\}$ is the series of returns of individual stocks and $\{x_t\}$ is the series of returns of the market index. Consider the following regression model.

$$y_t = \alpha + \beta x_t \quad (30)$$

- α coefficient calculation method. The constant term of the linear regression model obtained by the statistical software is the α coefficient.

- β coefficient calculation method. Similarly, the slope of the regression equation obtained using statistical software is the β coefficient. The specific formula can be expressed as follows (Gujarati and Porter, 2003)

$$\beta = \frac{n\sum_{t=1}^{n} x_t y_t - \sum_{t=1}^{n} x_t \sum_{t=1}^{n} y_t}{n\sum_{t=1}^{n} x_t^2 - (\sum_{t=1}^{n} x_t)^2} \quad (31)$$

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The another method is to use the definition method. Select the historical yield of a single stock for a period of time $\{ y_t\}$ and historical yield of the market index for the same period of time $\{x_t\}$. Now, the following points are required to consider:

- Average rate of historical yield of individual stocks: $\bar{y} = \frac{1}{n}\sum_{t=1}^{n} y_t$................(32)
- Average rate of historical yield of market index: $\bar{x} = \frac{1}{n}\sum_{t=1}^{n} x_t$...................(33)
- Sample standard deviation of stocks' historical yield: $\sigma_y = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n}(y_t - \bar{y})^2}$..(34)
- Sample standard deviation of market index yield: $\sigma_x = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n}(x_t - \bar{x})^2}$........(35)
- The correlation coefficient between stock returns and market index returns: ρ= $\frac{\sum_{t=1}^{n}((y_t-\bar{y})(x_t-\bar{x}))}{\sqrt{\sum_{t=1}^{n}(y_t-\bar{y})^2}\ x\ \sqrt{\sum_{t=1}^{n}(x_t-\bar{x})^2}}$ .... (36)

Now, putting the value of ρ the beta formula may be written in the following form:

$$\beta = \rho \times \frac{\sigma_i}{\sigma_m} = \frac{\sum_{t=1}^{n}((x_t-\bar{x})(y_t-\bar{x}))}{\sum_{t=1}^{n}(x_t-\bar{x})^2} \qquad (37)$$

Formally, the equations (31) and (32) are different, but β coefficients calculated by the two different methods are exactly the same.

Estimation of Portfolio Beta: Correlation Method

The standardized measure of systematic risk, popularly called as beta (β_i). This beta (β_i) is the ratio of covariance between the asset return and market return and the variance of market return.The beta can be calculated as:

$$\beta_i = \frac{\sigma_{\ iM}}{\sigma_M^2} \text{...(38)}$$

Where, market portfolio is σ_{iM} & the market risk is σ_M

The model calculates the expected return of an asset based on its beta and expected market returns. The beta can also be calculated on the basis of correlation between market risk and stock & variance of market risk. In this context, the equation of beta is as follows:

Beta coefficient, $\beta_i = \frac{Cov\ (R_A, R_M)}{\sigma_M^2}$ ....(39)

Here, $Cov\ (R_A, R_M) = \frac{\sum(R_A-\overline{R_A})(R_M-\overline{R_M})}{n-1}$, ...(40)

and, $\sigma_M^2 = \frac{\sum(R_M-\overline{R_M})^2}{n-1}$ ....(41)

Where, R_A is return on stock & R_M Return on market portfolio.

Calculation Portfolio Beta in Stock market

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Beta is important because it measures the risk of an investment that cannot be reduced by diversification. The significance of Beta has described as per its different values. On the basis of Beta Coefficient, a comparative analysis has made among thirty Indian companies. The formula used for that:

Beta = Co-variance (SENSEX, Stock)/ Variance (SENSEX) ……………….(42)

Portfolio Beta: An Analysis for Indian Companies.

For analysing the Beta factor, thirty Indian Companies have been selected randomly from Stock Exchanges. These all companies are listed in Bombay Stock Exchanges. The Beta Co-efficient is calculated by using covariance between SENSEX & Stock and Variance of SENSEX. In this regard, the beta formula is: Beta Co-efficient = Co-variance (SENSEX, Stock)/ Variance (SENSEX). In this connection, Indian Stocks Trading with High Beta values (as on 18th July, 2021) is as follows:

Table 3- : Indian Stocks Trading with High Beta value (as on 18th July, 2021)

High Beta Stock-Short Term		High Beta Stock-Medium Term		High Beta Stock-Long Term	
Name	Beta Value	Name	Beta Value	Name	Beta Value
Farmax India	13.3431	Talwalkars Better Value Fitness	3.54073	Diamond Power Infrastructure	3.71239
Austral Coke & Projects Ltd.	9.64373	Signet Industries	3.42273	Supreme Infrastructure India	3.64842
Cords Cable Industries	6.21308	Orchid Pharma Ltd.	3.08055	Splendid Metal Products Ltd.	3.61277
Panache Digilife Ltd.	6.21162	Gangotri Textiles	2.83771	Vishnu Chemicals	3.57835
Srs Ltd	6.01492	Karuturi Global	2.62009	Bkm Industries Ltd.	3.47703

Source: Design by Author from Top Stock Research (2021), available at https://www.topstockresearch.com/BetaStocks/HighBetaStocks.html

From the table-3, it is found that short term stock beta value is very high, medium term and long term stock beta value is relatively low. Thus, short term stock is very risky, but sometimes, it may provide more return. In this context, Indian Stocks Trading with Low Beta values (as on 18th July, 2021) is as follows:

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Table 4: Indian Stocks Trading with Low Beta value (as on 18th July, 2021)

Low Beta Stock-Short Term		Low Beta Stock-Medium Term		Low Beta Stock-Long Term	
Name	Beta Value	Name	Beta Value	Name	Beta Value
Kuantum Papers Ltd.	9.14572	DSP Blackrock Liquid ETF	1.08292	Liquid Bees	3.4783
LIC NOMURA MF - LIC	0.00160487	Liquid Bees	1.69158	MRO-TEK Realty Ltd.	0.00572608
Sovereign Gold Bond 2.50% 2027 S	0.00432215	DB (International) Stock Brokers	0.00340407	Motilal Oswal MOSt Shares NASDAQ	0.0274662
Bata India Ltd.	0.00465833	Sovereign Gold Bonds 2.75% Sep 2	0.00743279	Advance Metering Technology	0.0293956
Blue Blends (India) Ltd.	0.00748793	Reliance Power Ltd.	0.0074351	Visagar Polytex	0.0653499

Source: Design by Author from Top Stock Research (2021), available at https://www.topstockresearch.com/BetaStocks/LowBetaStocks.html

Generally, the large companies with more predictable financial statements and profitability have lower beta values. Most betas normally fall between 0.1 and 2.0 though negative and higher numbers are possible. From the table-4, it is found that low beta-short term stock is not risky. Beside this, it is also found that, short term stock, medium term stock and long term stock, beta value is relatively low and also there are not a significance difference except Kuantum Papers Ltd and Liquid Bees.

4.3 Further Evidence on the Validity of CAPM

CAPM: Empirical Evidence

It is difficult to predict from beta how individual stocks might react to particular movements, but investors can probably safely deduce that a portfolio of high-beta stocks will move more than the market in either direction, or a portfolio of low-beta stocks will move less than the market (McClure, 2017). According to the CAPM, the expected return on a security is:

$$E(R_i) = R_f + \beta_i [E(R_M) - R_f] \quad \ldots\ldots(43)$$

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The CAPM Model estimates the two important points; Estimate the security characteristic lines (SCLs) and Estimate the security market line (SML)

For estimating the Security Characteristic Lines, (SCLs) , the betas for each security in the sample have estimated. There are two ways in which security beta is estimated.

$$R_{it} = a_i + b_i R_{Mt} + e_{it} \quad \ldots\ldots (44)$$

$$R_{it} - R_{ft} = a_i + b_i(R_{Mt} - R_{ft}) + e_{it} \quad \ldots\ldots (45)$$

In equation (44), the return on security i is regressed on the return on the market portfolio, whereas in Equation (45), the excess return on security i is regressed on the excess return on market portfolio and this equation is used more commonly. In this case, the beta for each security is simply the slope of its security characteristic line.

For estimating the Security Market Line (SML), beta values are required.

$$\bar{R}_i = \gamma_0 + \gamma_1 b_i + e_i \quad i=1\ldots n \ldots\ldots (46)$$

Comparing Equations (44), (45) and (46), the inference that if the CAPM holds:

I. The relationship should be linear. This means that terms like b_i^2, if substituted for b_i, should not yield better explanatory power.

II. γ_0, the intercept, should not be significantly different from the risk –free rate, $\overline{R_f}$

III. γ_1, the slope coefficient, should not be significantly different from $\overline{R_M - R_f}$.

IV. No other factors, such as company size or total variance, should affect $\bar{R_i}$

V. The model should explain a significant portion of variation in returns among securities.

VI. If above points are hold good, the CAPM model is applicable. Thus, there is an evidence on the validity of CAPM (Prasanna, 2012)

CAPM: General Conclusions from Empirical Studies

It is to be mentioned that, numerous empirical studies have been conducted to test the CAPM. Richard Roll has argued persuasively that since the 'true' market portfolio (which in principle must include all assets – financial, real, as well as human – and not just equity stocks), cannot be measured, the CAPM cannot be tested (Prasanna, 2012). The following general conclusions that emerge from different studies:

I. In general γ_0 is greater than the risk-free rate. This means that the actual relationship between risk (as measured by beta) and return is flatter than the CAPM.

II. In addition to beta, some other factors, such as standard deviation of returns and company size, too have a bearing on return.

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III. Beta does not explain a very high percentage of the variance in return among securities.

Stability of Beta Coefficients

Many researchers have studied the question of beta stability intensively. They have attempted to find out the validity of the model by calculating the beta and realized rate of return. They had calculated betas for individual securities and portfolios of securities for a range of time spans. In general, the studies have produced the following results.

I. A significant positive relationship between the expected return and systematic risk. The slope of the relationship is usually less than that predicted by the CAPM.

II. The risk and return relationship appears to be linear. Empirical studies give no evidence of significant curvature in the risk/return relationship.

III. The CAPM theory implies that unsystematic risk is not relevant, but unsystematic and systematic risks are positively related to security returns. Higher returns are needed to compensate both the risks. Most of the observed relationship reflects statistical problems rather than the true nature of the capital market.

IV. The ambiguity of the market portfolio leaves the CAPM untestable (Richard Roll, 1977). The practice of using indices as proxies is loaded with problems.

V. If the CAPM is completely valid, it should apply to all financial assets including bonds. When bonds are introduced into the analysis, they do not fall on the security market line.

Researchers' first conclusion is that the betas of individual stocks are unstable, that suggests that past betas for individual securities are not good estimators of their future risk. Their second conclusion is that betas of portfolios are reasonably stable. Thus, there is a question mark regarding beta stability.

Current Validity of CAPM

The CAPM is greatly appealing at an intellectual level, as it is logical and rational. Although its basic assumptions raise some doubts in the minds of the investors, investment analysts have been creative in adapting CAPM for their use.

- ❖ By focusing on the market risk, it makes the investors think about the riskiness of assets in general. It provides the basic concepts and these are of fundamental value.

- ❖ Beside this, It is useful for the selection of securities and portfolios. Securities with higher returns are considered to be undervalued and attractive buys. Overvalued securities, whose returns are lower than the normal return, are suitable for sale.

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- In the CAPM, it is assumed that investors consider only the market risk. Given the estimate of the risk free rate, the beta of the firm and the required market rate of return, one can find out the expected return for a firm's security. This expected return can be used as an estimate of the cost of retained earnings.

Arbitrage Pricing Theory (APT): The Nature of Equilibrium in Asset Pricing

APT explains the nature of equilibrium in asset pricing in a less complicated manner with fewer assumptions than CAPM. According to Stephen Ross, the returns of the securities are influenced by a number of macroeconomic factors. These are growth rates of industrial production, rate of inflation, spread between long-term and short-term interest rates and spread between low-grade and high-grade bonds. The arbitrage theory is represented by the equation:

$$R_i = \lambda_0 + \lambda_1 bi_1 + \lambda_2 b_{i_2 + \cdots + \lambda_j bi_j} \qquad (47)$$

R_i= average expected return

λ_1 = sensitivity of return to bi_1

$bi1$= beta co-efficient relevant to the particular factor

In a single factor model of APT, the linear relationship between the return R_1 and sensitivity b_1 can be given in the following form.

$R_i = \lambda_0 + \lambda_i b_i$

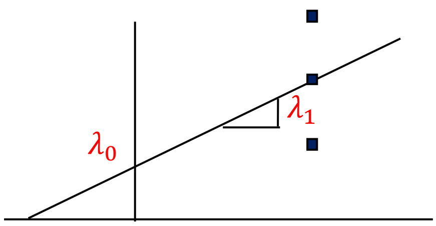
R_i= return from stock A

λ_0 = risk-free rate of return

b_1= sensitivity related to the factor

λ_1 = Slope of the arbitrage pricing line

The above model is known as a single factor model since only one factor is considered. Here, only industrial production is considered. The APT one factor model is shown in Graph-5



Graph 5: APT Model.

Risk is measured along the horizontal axis and return on the vertical axis. The arbitrage pricing line intersects the Y axis on λ_0 which represents the risk free rate of interest i.e., the interest offered for the treasury bills. Here, the investments involve zero risk and it is appealing to investors who are highly risk averse. Moreover, λ_1 stands for the slope of the arbitrage pricing line. It indicates the market price of risk and measures the risk return trade

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off in the securities market. β_1 is the sensitivity coefficient or factor beta that shows the sensitivity of the asset or stock corresponding risk factor.

Arbitrage Pricing Theory (APT): A further Evidence of CAPM

Arbitrage pricing theory is an asset pricing model based on the idea that an asset's returns can be predicted using the relationship between that asset and many common risk factors. The APT does not require the assumptions which under gird the CAPM.

The equilibrium relationship according to the APT is as follows:

$$E(R_i) = \lambda_0 + b_{i1}\lambda_1 + b_{i2}\lambda_2 + \cdots\ b_{ij}\lambda_j \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (48)$$

Where $E(R_i)$, the expected return on asset is i, λ_0 is the expected return on an asset with zero systematic risk, b_{ij} is the sensitivity of asset i's return to the common risk factor j and λ_j is the risk premium related to the j^{th} risk factor.

The APT was a revolutionary model because it allows the user to adapt the model to the security being analyzed. And as with other pricing models, it helps the user decide whether a security is undervalued or overvalued and so he or she can profit from this information. APT is also very useful for building portfolios because it allows managers to test whether their portfolios are exposed to certain factors.

4.4. CAPM: Scientifically Based Applications

The model generates a theoretically-derived relationship between required return and systematic risk which has been subject to frequent empirical research and testing. Beside this, it is generally seen as a much better method of calculating the cost of equity than the dividend growth model (DGM).It is clearly superior to the WACC in providing discount rates for use in investment appraisal. In this regard, the different applications of this model are:

CAPM: Calculation of Risk

Beta values are now calculated and published regularly for all stock exchange-listed companies. The problem here is that uncertainty arises in the value of the expected return because the value of beta is not constant, but changes over time. The yield on short-term Government debt, which is used as a substitute for the risk-free rate of return, is not fixed but changes on a daily basis according to economic circumstances. As a result, Beta value also changes. But, from the Beta value, the risk of a particular share can be determined.

CAPM: Determination of Expected Return

It is a useful tool in determining if an asset being considered for a portfolio offers a reasonable expected return for risk. Individual securities are plotted on the SML graph. If the security's expected return versus risk is plotted above the SML, it is undervalued since the investor can expect a greater return for the inherent risk. And a security plotted below the SML is overvalued since the investor would be accepting less return for the amount of risk assumed.

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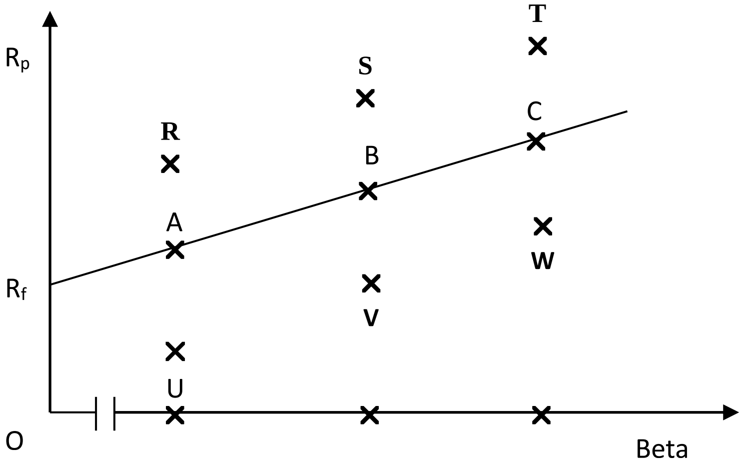
Investment Appraisal using CAPM

Once the expected/required rate of return is calculated using CAPM, one can compare this required rate of return to the asset's estimated rate of return over a specific investment horizon to determine whether it would be an appropriate investment. To make this comparison, you need an independent estimate of the return outlook for the security based on either fundamental or technical analysis techniques, including P/E, EPS etc.

SML Graph: Evaluation of Securities

It is to be mentioned that stocks with risk factor are expected to yield more return and verse. But, the investor would be interested in knowing whether the security is offering return more or less Proportional to its risk. The Evaluation of Securities with SML has shown at Graph -6:



Graph 6: Evaluation of Securities with SML

From the graph, it is found that, the stocks above the SML yield higher returns for the same level of risk. They are underpriced compared to their beta value. With the simple rate of return formula, we can prove that there are undervalued.

$$R_i = \frac{P_i - P_o + Div}{P_o} \quad \text{.......(49)}$$

P_i is the present price, P_o- the purchase price and Div- Dividend. When the purchase price is low i. e. when the denominator value is low the expected could be high. Applying the same principle the stocks U, V and W can be classified as overvalued securities and expected to lower returns then sticks of comparable risk and the securities A, B and C are on the line and therefore, it may be considered to be appropriately valued. Thus, by using Capital Asset Pricing Model, the values of the securities may be evaluated (Pandian, 2006).

SML Graph: Asset Pricing

The SML graph is very much helpful to identify the asset pricing. The security market line can also be used to determine whether an asset is overpriced or under-priced, given its level of systematic risk, compared to the market. If the asset offers a return that is higher than the market's for a given level of systematic risk, it will be plotted above the security market line.

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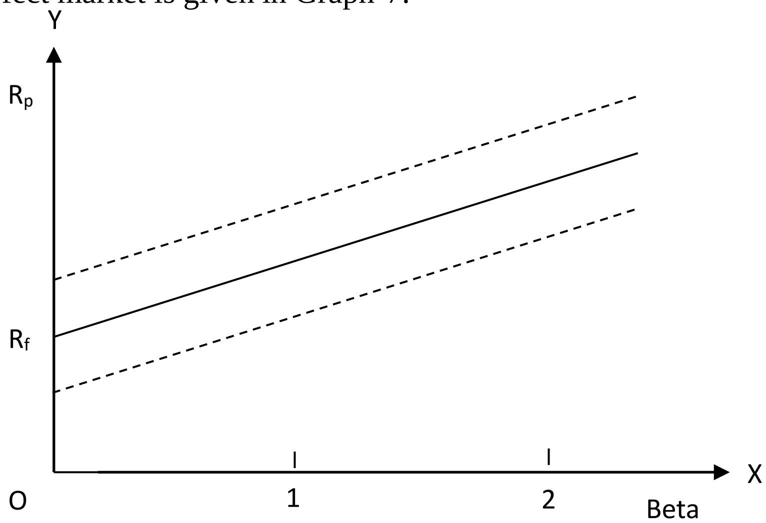
However, if the asset offers a return that is lower than the market's for a given level of systematic risk, it will be plotted below the security market line. If an asset is plotted above the security market line, it is under-priced. If an asset is plotted below, it is overpriced. Thus, with the security market line, if an asset is providing too large of a return, it means that it is under-priced (SML, 2021).

CAPM: Market imperfection and SML

In a market with perfect information, all securities should lie on SML. Market imperfections would lead to a band of SML rather than a single line. Market imperfections affect the width of the SML to a band. If imperfections are more, the width also would be larger (Pandian, 2006). SML in imperfect market is given in Graph-7.



Graph-7: Market imperfection and SML

SML Graph: Economic Analysis

After running different securities through the CAPM equation, a line can be drawn on the SML graph to show theoretical risk-adjusted price equilibrium. It is rare that any market is in equilibrium, so there may be cases where a security experiences excess demand and its price increases belong where CAPM indicates the security should be. This reduces expected return. Any gap between the actual return and the expected return is known as alpha. When alpha is negative, excess supply raises expected return. When alpha is positive, investors realize above normal returns. The opposite is true with negative alphas. According to most SML analysis, consistently high alphas are the result of superior stock-picking and portfolio management. Additionally, a beta higher than 1 suggests the security's return is greater than the market as a whole (Security Market Line, 2021).It is also noteworthy that, several different exogenous variables can impact the slope of the security market line. For example, the real interest rate in the economy might change; inflation may pick up or slow down; or a recession can occur and investors become generally more risk-averse.

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5. Discussion

The model explains the relationship between the return of any asset and the risk component involved with that return. The importance of CAPM model lies in the fact that, on the one hand it offers the possibility of comparison of different variants of placement in the financial markets and, on the other hand, justifies the estimate on the scientific basis of the expected future value of profits generated by a financial instrument. In the study, the model has been expressed in different forms. The various findings of these studies are also mixed. The Security Market Line (SML) and Capital Market Line (CML) both are important for understanding the risk of the shares. The significant point is that the CML can be derived from SML and vice-versa. The beta value has been estimated, analysed and interpreted in different ways. The model has also been defined in different way regarding its validity. In this regard, Arbitrage Pricing Theory is an additional evidence of CAPM. The model has different applications for a portfolio offer like calculation of risk, determination of expected return, investment appraisal, evaluation of securities, asset pricing and so on. Now-a-days, investment analysts have been more creative in adapting CAPM for their uses. In this connect ion, the model is greatly appealing at an intellectual, logical and rational level and it focuses on the market risk, makes the investors to think about the riskiness of the assets in general. Thus, CAPM is a simple and intuitively appealing risk-return model. Despite it failing numerous empirical tests and the existence of more modern approaches to asset pricing and portfolio selection, the CAPM still remains popular due to its simplicity and utility in a variety of situations.

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