UNIT 12 CAPITAL ASSET PRICING MODEL*

Structure

12.0 OBJECTIVES

After studying this Unit, you should be able to:

- Explain the concept of a market line;
- Differentiate between systematic and non-systematic risk;
- Discuss the Capital Asset Pricing Model (CAPM); and
- Highlight the limitations of the CAPM.

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12.1 INTRODUCTION

To find an optimal portfolio among many risky portfolios for the investor using the capital asset pricing model (CAPM), it is necessary to know the computation of risk and return of a portfolio and the role of correlation in diversifying portfolio risk. This has already been covered in Unit 10. In this unit, we will understand the concept of the capital market line, which is a special case of the capital allocation line. To understand the CAPM model, it is very important to know the difference between systematic and non-systematic risk and also answer why there is compensation for taking a systematic risk but no compensation for taking a non-systematic risk. Finally, the CAPM, which is a simple model used for estimating asset returns using systematic risk only, will be discussed in detail.

We will start our discussion with the capital market line and capital allocation line. The unit will introduce leveraged portfolios and the pricing of risk in terms of systematic risk and non-systematic risk because we will decompose total risk into systematic and non-systematic risk. Then, the capital asset pricing model will be introduced to estimate the required return of the equity or portfolio and the relation between CAPM and the security market line. Further, we will discuss the assumptions behind the CAPM, its applications and limitations.

12.2 PASSIVE AND ACTIVE MANAGEMENT INVESTMENT

A market which fully reflects all the publicly available information in its prices is termed an **informationally efficient market.** In such markets, price is an unbiased estimate of all future discounted cash flows i.e. investors cannot expect to earn a return that is greater than the required rate of return for that asset. Thus, investors cannot outperform the market through active asset management strategies and investment in the calculation of an investor's estimates of cash flows and rate of return is not significant too.

The best strategy in an informationally efficient market is to make decisions based on the prices set by the market. It is the most simple and convenient approach to investing in the market portfolio as we know that market prices are unbiased. The portfolios based on this assumption are referred to as passive portfolios. They are also called index funds as they are based on market indices. Such portfolios develop and track market indexes and replicate their performance based on market prices and market capitalizations. Examples are the S&P 500 Index, the Nikkei 300, etc. These portfolios are low costs because no technical analysis is expended which requires special skills, knowledge and expertise in valuing securities. Passive investors are involved in fundamental analysis for valuing investment portfolios.

In contrast to passive investors, active investors have more confidence in their ability to estimate cash flows, growth rates, and discount rates. Thus, they may

not rely on market valuations. Based on these estimates, they value assets and determine whether an asset is undervalued, fairly valued or overvalued. Undervalued security carries positive weight in the portfolio as it has a chance of offering above-normal returns. In an actively managed portfolio, such assets are overweighted as compared to the market weight in the benchmark index. In case short selling is permitted for the security, the weight of the security may be zero or negative i.e., some assets will be under-weighed compared with the market weight in the benchmark index. **Short selling** is defined as a transaction in which:

a) Securities are borrowed from the lender.

b) Borrowed securities are sold to a seller in such a way that they can be repurchased at a lower price at a future date, and

c) Then these securities are returned to the lender.

Short selling is an active investment strategy and the portfolios obtained are referred to as active portfolios. Open-ended mutual funds and hedge funds use active investment management techniques to value investments and add value to the investment of the investor.

12.3 THE CAPITAL MARKET LINE (CML)

In unit 10, we discussed how a capital allocation line (CAL) was constructed with different combinations of a risk-free asset and a risky portfolio with different weights for the two assets. In this section, we discuss a special case of CAL in which a risk-free asset is combined with the market portfolio to create an optimal risky portfolio for the investor. This specific type of CAL is known as the capital market line. We know that the risk-free asset (*Rf*) is a debt security which is free from all kinds of risks such as default risk, inflation risk, liquidity risk, interest rate risk, etc. For example, Treasury bills issued by the government are usually used as a proxy to measure the risk-free return, *Rf*.

Now we will turn our attention to the second important part of CML the market portfolio. For example, the S&P 500 may be considered a proxy of the market portfolio to measure the expected return on the risky portfolio which is expressed as the expected market return, $E(Rm)$. The capital market line is drawn by measuring the standard deviation (σp), or total risk, on the x-axis and the expected market portfolio return, $E(Rp)$, is on the y-axis.

Markowitz's efficient frontier has a very important role in choosing a market portfolio for an investor. The point of tangency of the line from the risk-free asset and the Markowitz efficient frontier determines the market portfolio. Graphically, all points on the interior of the Markowitz efficient frontier are inefficient whereas the points above the CML are not achievable for an investor given the resources. Portfolios under CML are considered inefficient because they provide the same level of return with a higher level of risk or a lower level of return with

the same amount of risk. Based on the market prices and market capitalizations, the point at which the CML is tangent to the Markowitz efficient frontier is the optimal combination of risky assets. This optimal combination of risky assets is the optimal risky portfolio i.e. the market portfolio.

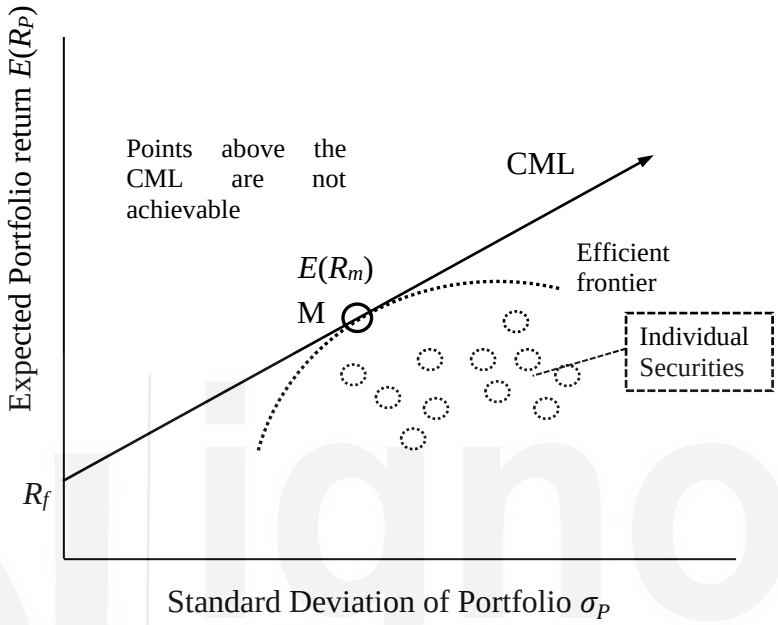

Figure 1: Capital Market Line

The intercept of the CML on the *y*-axis is the risk-free return (*Rf*) and the slope is positive based on the risk and returns relationship which is considered positive. Higher risk gives higher returns. The expected market return through which CML passes is represented by *E*(*Rm*). Under the capital market theory, we know that an investor will not be able to achieve any point above the CML as it is not achievable and any point below the CML because the points on the CML are dominated by the points below the CML. They are considered inferior to any point on the CML.

The risk and return of the portfolio on the CML can be estimated by using the return and risk formulas for a two-asset portfolio:

$$R_p = w_A r_A + w_B r_B$$

Where $r_A \; and \; r_B$ are the return of Asset A and Asset B respectively and have the weight of $w_A \; and \; w_B$ of Asset A and Asset B respectively in the portfolio. The standard deviation of the two asset portfolios is written as:

$$\sigma_p = \sqrt{w_A^2 \sigma_A^2 + w_B^2 \sigma_B^2 + 2 w_A w_B \rho_{AB} \sigma_A \sigma_B}$$

Correlation between the two returns (ρ_{AB}) and the standard deviations of the two assets namely, $\sigma_A \; and \; \sigma_B$.In case an asset is a risk-free asset and the other asset is risky, the portfolio of these two assets with a portfolio expected return, *Rp*, risk-free return, rf, and risky asset return, $E(r_i)$, can be constructed as follows:

$R_p = w_A r_f + w_B E(r_i)$**Equation (1)**

The sum of the weight of a risk-free asset and the weight of the risky asset is 1. So,w_B = 1-w_A.

$\sigma^2{}_p = w_A^2\sigma_f^2 + w_B^2\sigma_i^2 + 2w_A w_B \rho_{if}\sigma_f\sigma_i$**Equation (2)**

Because the risk-free asset has no risk, that is, σf = 0, the first and third terms in the formula for variance are zero.

By taking the square root of both sides,

the standard deviation for a portfolio of a risk-free asset and risky asset is given by:

σ_p=$w_B\sigma_i$**Equation (3)**

$$R_p = R_f + \sigma_p \frac{\{E(R_i) - R_f\}}{\sigma_i}$$

The observations from the above formula are:

- The CML has a positive slope because as the market's risk of the risky portfolio increases, the market return will also increase. Certainly, the market return is larger than the risk-free return.

As the amount of the total investment in the market assets increases, both standard deviation (risk) and expected return will also increase.

12.4 LEVERAGED PORTFOLIOS

With different levels of investment varying between 0 per cent and 100 per cent in the market asset and the remaining in the risk-free assets such as T-bills. The line connecting risk-free asset (*Rf)*and market portfolio (*M)* showing such portfolios with their respective levels of investment is constructed in figure 2. At *Rf*, an investor is lending all his or her wealth into risk-free securities earning a risk-free rate on his investment. So, at this point till point M, no risk is involved by investing all of his or her wealth into risk-free securities. The combinations of the risk-free asset and the market portfolio, which may be achieved by the points between Rf and M, are termed "lending" portfolios. At Point *M*, the investor is holding the market portfolio by not lending any money at the risk-free rate. Assuming that the lending rate (*Rf)* and borrowing rate (*Rb)* are different and the borrowing rate is higher than the lending rate i.e. *Rf*<*Rb.* Thus, an investor can invest (lend) at *Rf*, a rate that is lower than the rate at which he can borrow at *Rb*.

With different lending and borrowing rates, the slope of CML will be different and hence the line will no longer be a single straight line. To the left of M, the line will have a larger slope than to the left of M because the points between *Rf* and Muse lending rate and the points to the right of M use borrowing rate, Symbolically, the slopes of both sides are:

$$\frac{[E(Rm) - Rf]}{\sigma m} < \frac{[E(Rm) - Rb]}{\sigma m}$$

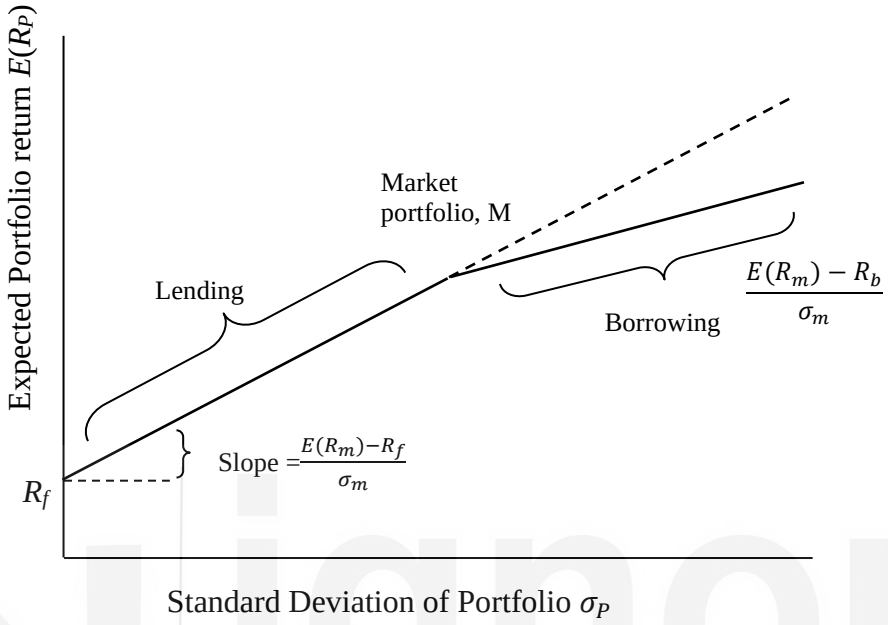

Figure 2: Leveraged Portfolios on CML

The equations for the two lines are given below.

To the left of M, when the weight of the risk-free asset is zero or positive:

$$w_A \geq 0: E(R_P) = R_f + (\frac{E(R_M)-R_f}{\sigma_M})\sigma_P$$

When negative or zero investment occurs in the risk-free assets i.e., to the right of M, the weight of the market portfolio is positive or higher:

$$w_A < 0: E(R_P) = R_b + (\frac{E(R_M)-R_b}{\sigma_M})\sigma_P$$

The difference between the two equations is in the borrowing and lending interest rates used. A risk-averse investor will invest in a leveraged portfolio which allows increasing the quantum of risk by borrowing or investing more than 100 per cent in the passive portfolio. Thus, all the passive portfolios will lie on the kinked CML where leveraged portfolios can be chosen. Although, the investment in the risk-free asset may be

- positive (lending),
- zero (no lending or borrowing),
- or negative (borrowing)

In all the above situations, passive portfolios can be chosen from the kinked CML.

Check Your Progress 1

Note: i) Use the space given below for your answers.

ii) Check your progress with those answers given at the end of the unit.

1) Explain Capital Market Line.

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2) "The points on the CML are the same irrespective of the amount invested by the investor." Comment.

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3) What do you understand by leveraged portfolio?

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12.5 TYPES OF RISK

Risk is a very important component in constructing a portfolio. While we have seen that it is very important to include correlation and standard deviation to measure the overall risk of a portfolio. However, the risk of the assets that are less than perfect correlation can be diversified and reduces the risk of a portfolio of those assets. As a result, the risk of an individual asset held may be greater than the risk of that asset in a portfolio. Broadly, we have discussed risk in a portfolio till now. Now we will discuss the types of risk which varies from one situation to another and which kind of risk is diversified or not. The total risk of the portfolio can be decomposed into systematic and non-systematic risks.

12.5.1 Non-systematic Risk

Non-systematic risk is one of the components of total risk which is specific to a particular industry and affects those assets related to that industry or class only. Since this type of risk is local or limited to a particular asset or industry, they need not affect assets outside of that asset class. So, they are also called company-specific, industry-specific, diversifiable, or idiosyncratic risks. For Example, an airline crash will affect the securities or assets in the airline industry only. The failure of a drug trial will have an impact on the securities of the pharmaceutical industry. Therefore, the events in a particular industry will directly affect their respective class of companies and possibly industries. These activities will not affect securities that are unrelated to these industries.

To avoid non-systematic risk, Investors can purchase securities from different industries in such a way that the events in one industry do not affect the events in the other. The investors through diversification can form a portfolio of assets that are not highly correlated with one another and reduce portfolio risk. It is important to note that the investor is not compensated by higher returns by increasing non-systematic risk because such risk can be diversified in the asset portfolio.

12.5.2 Systematic Risk

The other component of total risk which cannot be diversified or avoided is known as systematic risk or non-diversifiable or market risk. These risks affect the entire market or economy and the whole market suffers. For example, COVID-19 has affected the entire world and nearly all the assets and industries have been affected by the spread of the virus. Another example is when the economy of a country slows down, the financial market or securities in all industries are affected by the slowdown. These risks cannot be diversified irrespective of the intensity of the impact. They have to be borne by the investor and higher systematic risk is compensated by higher returns. These risks are inherent in the overall market and hence cannot be diversified.

Changes in the interest rates, rate of inflation, movement in the economic cycles, political uncertainty, and widespread natural disasters affect the entire market, and there is no way to avoid their effects. However, their effects on the systematic risk can be magnified by using leverage or diminished by including poorly correlated securities in the portfolio, that were not included in the portfolio before. The sum of systematic risk (measured by variance) and non-systematic risk(measured by variance) equals the total risk(measured by variance) of the portfolio is given as:

Total risk = Systematic risk + Non-systematic risk

Let us consider a security with both systematic and non-systematic risk. Assume that each kind of risk is priced in terms of return earned from the security for taking both systematic risk and non-systematic risk. We know that non-systematic risk can be diversified away and a large amount of investment must be made in buying assets that offer a large amount of non-systematic risk. After owing those assets with non-systematic risk, the non-systematic risk can be reduced or eliminated through diversification. Thus, non-systematic risk has been eliminated from your portfolio. The diversified portfolio now has systematic risk only for which the returns will compensate the investor. Therefore, according to theory, in an efficient market, no additional reward is earned for taking on non-systematic or diversifiable risk.

We know that the investors who have non-systematic risk in their portfolio must diversify it away by investing in different industries, countries, and different asset classes. Such diversification helps in offsetting low returns in one asset class by

reaping higher returns in another asset class, thereby reducing the overall risk of the portfolio. Since future returns are uncertain, it is not possible to ensure that the investor will get positive returns only. On the other hand, the systematic risk must be compensated to the investors because that risk cannot be diversified away. Thus, an investor must refuse to accept an investment which does not commensurate with the amount of systematic risk they are taking by giving enough returns. In other words, the systematic or non-diversifiable risk is priced by the returns and investors are compensated for holding portfolios based only on the portfolio's systematic risk. There are no returns for accepting non- systematic or diversifiable risk. Therefore, a risk-averse investor must hold only well-diversified portfolios.

Before we move our attention to the **capital asset pricing model** (CAPM) which is one of the return-generating models, let us focus on the single-index model. Single-index model is a model which involves a single factor. **Beta** measures the sensitivity of an asset's return to the overall market as a whole. It is calculated as the covariance of the return on an asset *i* and the return on the market divided by the variance of the market return;

$$\beta_i = \frac{Cov(R_i, R_m)}{\sigma_m^2}$$

Asset Beta is the product of the correlation between the asset and the market, standard deviation and the standard deviation of the asset divided by the variance of return from the market.

$$\beta_i = \frac{\rho_{i,m}\sigma_i\sigma_m}{\sigma_m^2} = \frac{\rho_{i,m}\sigma_i}{\sigma_m}$$

In other words, Beta is also defined as the product of the correlation between an asset and the market and the standard deviation of the asset divided by the standard deviations of return from the market.

$$\beta_i = \frac{\rho_{i,m}\sigma_i}{\sigma_m}$$

The above expressions show that the beta captures an asset's systematic risk which cannot be eliminated by diversification. The historical returns of the asset and market are used to calculate the variances and correlations required for the calculation of beta. The sign of beta shows the direction in which the asset returns and market returns are moving. When the return of an asset follows the trend of the general market, it is termed a positive beta. Whereas an opposite trend of the asset to that of the market is termed as negative beta. In other words, if the movement of the return of an asset and the market happens in the same direction the market indicates a positive beta. On the other hand, a negative beta indicates that the movement of the return of an asset and the market happens in the opposite direction of the market. In the case of a risk-free asset, there is no systematic risk. Hence, the value of beta is zero. The covariance between the risk-free asset and the other asset is also zero which means that the asset's return does not correlate with the trends in the market.

Check Your Progress 2

Note: i) Use the space given below for your answers.

ii) Check your progress with those answers given at the end of the unit.

1) Explain the concept of expected returns and the Beta of a portfolio.

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2) Differentiate between systematic and non-systematic risk.

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3) Suppose the risk-free rate is 8 per cent, the expected return on the market portfolio is 15 per cent, and its standard deviation is 23 per cent. A company, TeaRoom, has a standard deviation of 75 per cent and a correlation of -1 with the market. Calculate TeaRoom's beta and expected return.

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12.6 CAPITAL ASSET PRICING MODEL (CAPM)

In this section, we will introduce the calculation of the estimated returns of the asset with the help of the risk-free rate of the asset, market rate of return and the given values of the asset betas. The CAPM is usually written with the risk-free rate as:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

The above expression shows that the main factor in the determination of the expected return for security is its beta. The second part of the expression is positive which means that there exists a positive relationship between the beta of an asset and the expected return of the asset. In other words, the higher the beta of an asset, the higher will be its expected return. The model provides a linear relationship between the expected return–beta that determines the expected return of an asset, given its beta. The beta also explains how well the asset correlates with the market. If β_i>1 i.e., assets with a beta greater than 1 will have a higher expected return than that of the market return, whereas if β_i< 1 i.e., assets with a beta of less than 1 expected return of the asset will be less than the market return.

Sometimes, assets with low beta are valuable for a portfolio when they reduce the overall risk of the portfolio even though the return of the asset is less than the risk-free return. Such asset's beta may be negative which means that the required

return will be less than the risk-free rate. For example, assets such as insurance give a positive return to the investor when the wealth of the insured is reduced because of a sudden loss. However, the insurance premium is paid irrespective of the occurrence of the loss of the property to the investor. Thus, insurance has a negative beta and a negative expected return, but the overall risk of the portfolio is reduced by including insurance.

The capital asset pricing model is one of the most simple and powerful methods in portfolio theory. The CAPM was introduced by William Sharpe, John Lintner, Jack Treynor, and Jan Mossin. The model builds its framework on Harry Markowitz's work on diversification and modern portfolio theory. Two assets with the same beta will have the same expected return irrespective of the type of those assets. Given the relationship between risk and return, all assets are defined only by their beta risk.

Illustration 1:

Suppose the risk-free rate is 5 per cent, the expected return on the market portfolio is 25 per cent, and its standard deviation is 50 per cent. A Chinese company, Alibaba, has a standard deviation of 85 per cent but is uncorrelated with the market. Calculate Alibaba's beta and expected return.

$$\beta_i = \frac{\rho_{i,m}\sigma_i\sigma_m}{\sigma_m^2} = \frac{0*0.5*0.85}{(0.5)^2} = 0$$

$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right]$$

= 0.05 + 0[0.25 – 0.05] = 0.05 or 5%

Illustration 2:

Suppose the risk-free rate is 6 per cent, the expected return on the market portfolio is 25 per cent, and its standard deviation is 33 per cent. A Canadian company, Faces Canada, has a standard deviation of 45 per cent and a correlation of 0.35 with the market. Calculate Faces Canada's beta and expected return.

$$\beta_i = \frac{\rho_{i,m}\sigma_i\sigma_m}{\sigma_m^2} = \frac{0.35*0.33*0.45}{(0.33)^2} = \frac{0.1575}{0.33} = 0.4773$$

$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right]$$

= 0.06 + 0.4773 [0.25-0.06] = 0.06 + 0.0907 = 0.1507 or 15.07 %

12.6.1 Assumptions of the CAPM

Every model is developed in the realm of its assumptions and ignores the complexities of the real world. The simplifying assumptions help to understand the complexities of the model simply. These assumptions also help to gain important insights into the process of pricing the assets without complicating the analysis. To gain further insights, the assumptions can be relaxed and more robust results can be derived. The assumptions of the CAPM are as follows:

1) **Risk-averse, utility-maximizing, rational investors**

   The model assumes investors to be risk-averse. However, the degree of risk aversion may differ from one individual to another. We know that risk-averse individuals need compensation for the risk they take. Systematic risk takes care of the additional risk that risk-averse investor takes and compensates them with higher returns. In addition to the risk aversion assumption, the investor is a utility maximizer too as he always wants higher returns and would not compromise on lower returns in his portfolio. As we know more is always better, and a rational investor would always want more and more wealth. Hence, he/she is never satisfied. By investors being rational, the model assumes that they can correctly evaluate and analyze the available information to make at correct decisions. The calculations by rational investors may bring them to different estimates of expected risk and expected returns but they will remain rational individuals. Even in economics, every economic theory assumes consumers to be risk averse and utility maximizers. This gives us a realistic view of the world which is generally accepted as well.

2) **Frictionless markets**

   Frictionless markets allow smooth functioning of the market and analysis of the operational characteristics of such markets is abstract. In the absence of transaction costs and taxes, the trading volume or the prices in the market do not affect the risk-return relationship of the securities. In other words, it is assumed that frictionless markets do not have any costs or restrictions on short selling too. It also assumes that the rate at which borrowing and lending take place in the market is the same and at the risk-free rate.

3) **Investors plan for the same single holding period**

   The model assumes that the investors make decisions for one period only and hence it is a single-period model. Working with a multi-period model is very difficult and inconvenient. A drawback of the single period model is that it does not allow investors to learn from past mistakes and bad decisions are bound to persist. It may be possible that sub-optimal decisions are to be made in single periods to achieve maximising outcomes in multi-period settings. But it has been observed that the single holding period does not largely affect the application of the CAPM to the multi-period horizon.

4) **Investors have homogeneous expectations or beliefs**

All the investors are assumed to analyze assets using the same probability distributions and the same inputs for future cash flows. Furthermore, they are also assumed to be rational investors who arrive at the same valuations. As a consequence of similar valuations of all assets, they will choose or produce the same optimal risky portfolio or the market portfolio.

5) **All investments are infinitely divisible**

An individual is assumed to invest as little or as much as he or she wishes in an asset. This allows the model to rely on continuous functions and discrete jump functions can be avoided or excluded from the framework. The assumption does not have any direct consequences on implications from the model. It only makes the understanding of the model convenient for investors.

6) **Investors are price takers**

There is a large number of investors and no investor is large enough to influence prices in the market. The security prices are assumed to be unaffected by the number of trades investors typically trade-in. Even though, the prices of the small stocks may be affected by the investors but not large enough to affect the primary estimates of the CAPM. Thus, investors are price takers.

12.6.2 The security MarketLine & CAPM

The model can be applied to the pricing of various securities in different settings. In this section, we will focus our attention on the application of CAPM in the context of the **security market line** (SML). The SML is a graphical representation of the capital asset pricing model with beta on the *x*-axis and the expected return of the security on the *y*-axis. Similar to the capital market line, the SML intersects the *y*-axis at the risk-free rate of return, and the slope of the SML is defined by the market risk premium, *Rm – Rf*. In contrast to CML, SML applies to individual securities rather than portfolios on the efficient frontier. Recall that the efficient frontier reflects optimal combinations of expected return and total risk for the investors. In other words, the security market line works for all securities, whether efficient or not. In the case of efficient portfolios, the total risk and systematic risk are equal because there is no scope for diversification of risk any further.

Figure 3 shows a graphical representation of the security market line in the CAPM framework. The beta of the market is 1.0 on the *x*-axis and the expected rate of return (*Rm)* earned by the market is mentioned on the*y*-axis. The points on this line help to calculate the expected return of an asset based on systematic risk only. The figure shows that at point M, the systematic risk of the market and the security are the same which means that the expected returns from the security

will be the same as the expected returns from the market. The positive and linear relationship between beta and expected return shows that an increase in the Beta will increase the expected return from the security, given the risk-free rate in the market.

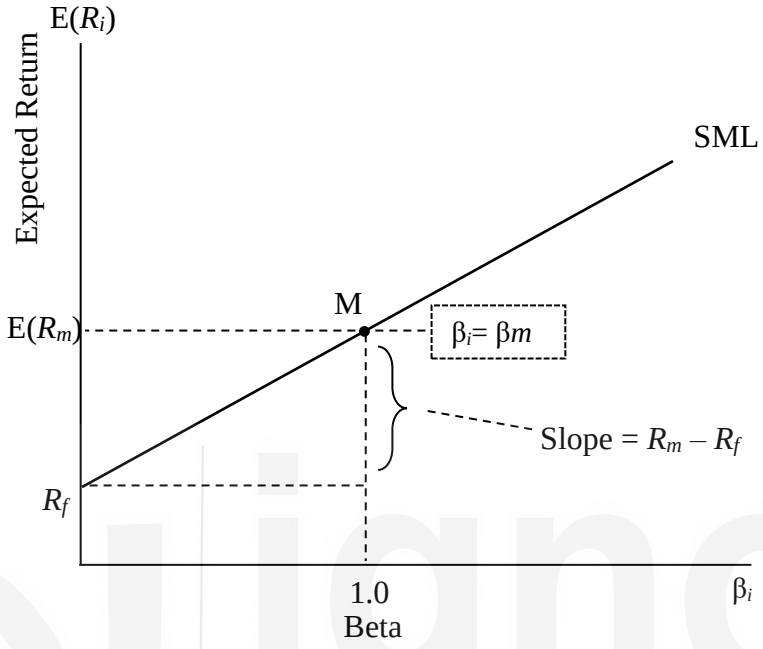

Figure 3: The Security Market Line

12.6.3 Applications of the CAPM

The predictive power of the CAPM regarding risk and the relationship between risk and return makes it very powerful and appealing. There is a large number of practical applications of the CAPM that may not be true from a theoretical perspective. In this section, we will discuss the common applications of the model. We will see that the CAPM and the SML took together will indicate the direction of the market returns at the given level of risk under different situations. However, the results may indicate that the actual return may be quite different from the expected return which helps to evaluate whether a security is overvalued, undervalued or fairly valued. Other major applications of the CAPM include computation of the estimates of the expected return for capital budgeting, the performance appraisal of the portfolio manager can also be done by comparing the actual return of a portfolio and the CAPM return estimated by the portfolio manager, and the output from the model also helps in the selection of the security based on the analysis of alternate return estimates and the CAPM returns.

For instance, we have calculated the expected return of the asset using CAPM under the assumption of the given systematic risk of the asset. To value assets such as stocks, bonds, real estate, and other financial assets, the estimate of the expected rate of return derived from the CAPM is an important benchmark for making an investment decision for that asset. Similarly, to determine the economic feasibility of projects in the capital budgeting decision-making process,

the estimated required rate of return from the CAPM helps in choosing the right project for the company. Analytical tools of capital budgeting such as the net present value of a project, investments and net revenues also require estimates of cash flows which are discounted at the required rate of return. Depending on the risk of the project, the required rate of return is estimated using the CAPM. It is not surprising that the CAPM is used to estimate the expected return of the assets in many scenarios. Such an example includes the computation of the cost of capital for the companies regulated by regulatory commissions and setting fair insurance premiums.

12.6.4 Limitations of the CAPM

Besides the usefulness of the CAPM, it is subject to theoretical and practical limitations. Theoretical limitations refer to the problems which restrict the estimated values of the model because of the inherent framework of the model, whereas practical limitations of the model are faced by managers during the implementation of the model.

12.6.4.1 Theoretical Limitations of the CAPM

In a single-factor model, only systematic risk or beta risk is used for the pricing of the securities in the CAPM. Thus, no other features of the investment are considered in estimating the returns of the asset. This makes the model very restrictive and inflexible. In addition, the model is more prescriptive in nature and popular because it is easy to understand and apply. The model does not make predictions in the multi-period horizon and has no further implications regarding the investment objectives of future periods. As a consequence, it has led to myopic and suboptimal investment decisions.

12.6.4.2 Practical Limitations of the CAPM

Apart from the theoretical limitations, the practical implementation of the CAPM raises some serious concerns which are listed below:

- **True Market portfolio:**

According to the CAPM theory, the true market portfolio is defined as the sum of investible and non-investible assets of all kinds such as all asset classes, financial and nonfinancial instruments, human capital and assets in closed economies. Thus, it is difficult to test the estimates of the CAPM for some assets of the true market portfolio which are not observable.

- **Market portfolio Proxies:**

In the absence of true estimates, different assumptions are made by the market participants which produce proxies to estimate the expected return of the assets. These proxies change depending on the assumptions made by the analysts, the country of the investor, etc. And in turn, generate different return estimates for the same asset. This is not permitted in the CAPM framework.

- **Estimation of systematic risk**:

Sufficient historical data is needed to estimate beta risk under CAPM. In some cases, it is possible that the historical status of the company, may not be an accurate and reliable representation of the recent or future state of the company. The CAPM can be considered *an ex-ante* model. However, the estimates obtained from the model are obtained using *ex-post* data. Thus, different periods used for the estimation of results will produce different estimates of beta.

- **Poor predictor of returns:**

The empirical support for the reliability of the estimates of the CAPM is weak when the estimate of asset returns is closely associated with realized returns. In other words, empirical results or historical data do not support the hypothesis that asset returns are determined only by systematic risk. The low predictive power of the CAPM model is a serious limitation because investors make investments based on their prediction of future returns.

- **Homogeneity in investor expectations:**

There is a single security market line under the CAPM because it assumes that investor expectations are homogeneous and as a consequence, the model generates a single optimal risky portfolio for the market and investors. By relaxing this assumption, there will be many optimal risky portfolios and a large number of security market lines. Thus, investors will use the same information as rational decision makers and make choices between different optimal risky portfolios.

Check Your Progress 2

Note: i) Use the space given below for your answers.

ii) Check your progress with those answers given at the end of the unit.

1) Explain the assumptions of the CAPM model.

……

……

2) In what way does the CAPM model build upon Markowitz's theory of portfolio selection?

……

……

3) What are the practical and theoretical limitations of the model in the portfolio theory.

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12.7 LET US SUM UP

In this unit, we have discussed the concepts, assumptions and limitations of the capital asset pricing model in detail which is very important in the estimation of the asset returns based on the systematic beta. The unit also discussed other related topics such as the capital market line and security market line. The understanding of passive asset management strategy is very important for an investor as market conditions define the use of investment strategies. The investors usually lend and borrow at different rates to form a leverage market portfolio and obtain a higher expected return. Next, we discussed the importance of each type of risk namely, systematic and non-systematic risk and which one can be avoided or not. The introduction to beta explains the estimation of the sensitivity of the asset to market conditions. The model entails a relationship between beta and expected return through its equation.

12.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) See section 12.3 and answer.
2) See section 12.3 and answer.
3) See section 12.4 and answer.

Check Your Progress 2

1) See section 12.5 and answer.
2) See sub-section 12.5.2 and answer.
3) See section 12.5 and answer.

Check Your Progress 3

1) See sub-section 12.6.1 and answer.
2) See sub-section 12.6.2 and answer.
3) See sub-section 12.6.4 and answer.

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