CAPITAL ASSET PRICING MODEL (CAPM)

Introduction

The capital asset pricing model was developed in mid-1960s by three researchers William Sharpe, John Lintner and Jan Mossin independently. Consequently, the model is often referred to as Sharpe-Lintner-Mossin Capital Asset Pricing Model.

The capital market theory is a major extension of the portfolio theory of Markowitz. Portfolio theory is a description of how rational investors should built efficient portfolios. Capital market theory tells how assets should be priced in the capital markets if, indeed, everyone behaved in the way portfolio theory suggests. The capital asset pricing model (CAPM) is a relationship explaining how assets should be priced in the capital markets.

Assumptions underlying Capital asset pricing model (CAPM)

The specific assumptions underlying capital asset pricing model are:

1. Investors make decisions based solely upon risk-and-return assessments. These judgments take the form of expected values and standard deviation measures.

2. The purchase or sale of a security can be undertaken in infinitely divisible units.

3. Investors can short sell any amount of shares without limit.

4. Purchases and sales by a single investor cannot affect prices i.e. there is perfect competition where investors in total determine prices by their actions. Otherwise, monopoly power could influence prices (returns).

5.There are no transaction costs. Where there are transaction costs, returns would be sensitive to whether the investor owned a security before the decision period.

6.The purchase or sale of securities is done in the absence of personal income taxes i.e. we are indifferent to the form in which the return is received (dividends or capital gains).

7.The investor can borrow or lend any amount of funds desired at an identical riskless rate (example: the Treasury bill rate).

8. Investors share identical expectations with regard to the relevant decision period, the necessary decision inputs, their form and size. Thus investors are

The capital market line

All investors are assumed to have identical (homogeneous) expectations. Hence, all of them will face the same efficient frontier depicted in the above diagram. Every investor will seek to combine the same risky portfolio *B* with different levels of lending or borrowing according to his desired level of risk. Because all investors hold the same risky portfolio, then it will include all risky securities in the market. This portfolio of all risky securities is referred to as the market portfolio *M*. Each security will be held in the proportion which the market value of the security bears to the total market value of all risky securities in the market. All investors will hold combinations of only two assets, the market portfolio and a riskless security.

The capital market line

All these combinations will lie along the straight line representing the efficient frontier. This line formed by the action of all investors mixing the market portfolio with the risk free asset is known as the **capital market line (CML)**. All efficient portfolios of all investors will lie along this capital market line.

$E(Rp) = Rf + \sigma p ((Rm – Rf) / \sigma m)$

Where,

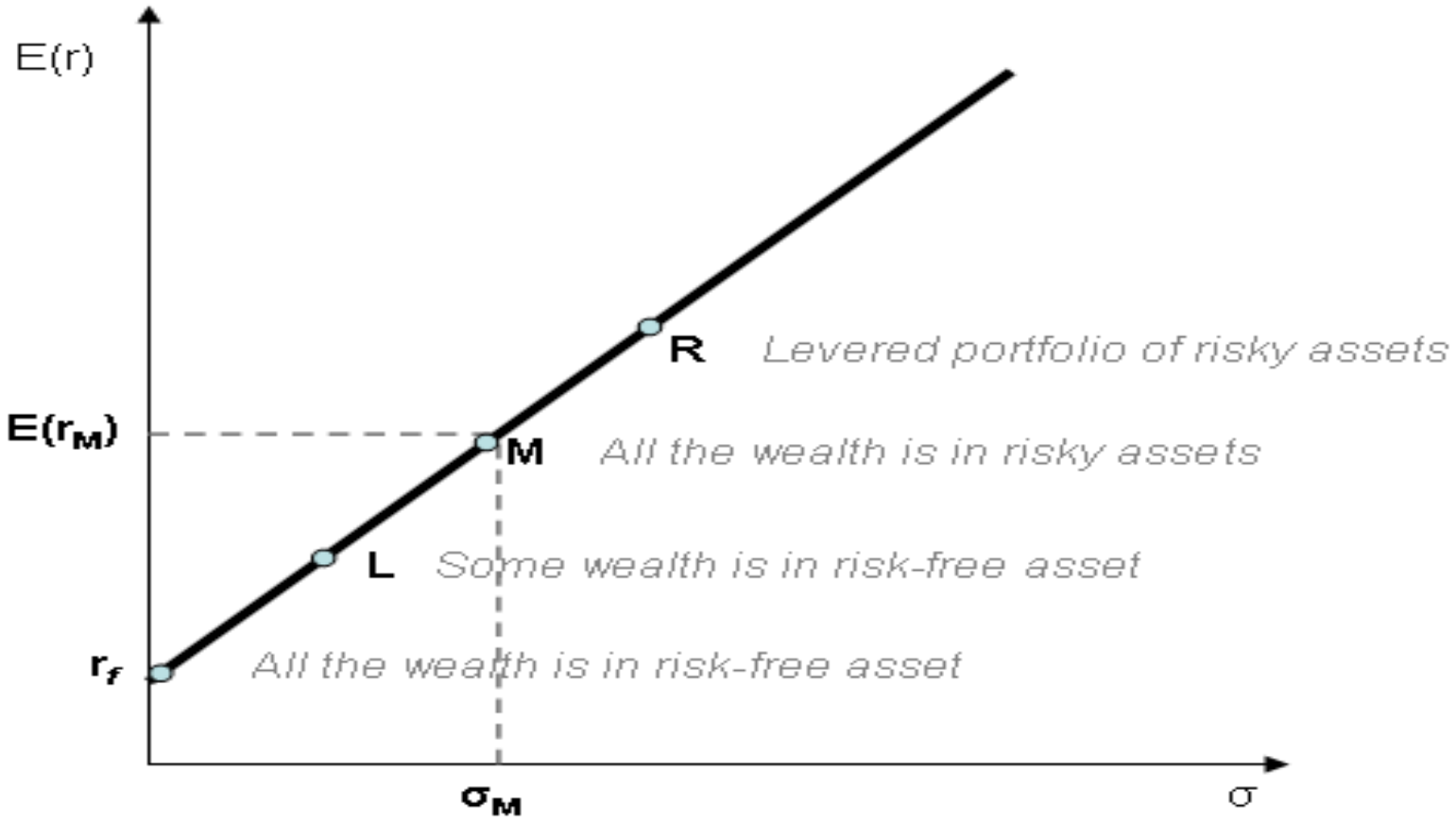
$E(R_p)$ = Expected return of a portfolio

R_f = Risk free rate of return

σ_p = Standard deviation of a portfolio

σ_m = Standard deviation of market

R_m = Market rate of return


E(r)
R
Levered portfolio of risky assets
E(r_M)
M
All the wealth is in risky assets
L
Some wealth is in risk-free asset
r_f
All the wealth is in risk-free asset
σ_M
σ

The capital market line

The CML provides a risk return relationship and a measure of risk for efficient portfolios. The appropriate measure of risk for an efficient portfolio is the standard deviation of return of the portfolio. There is a linear relationship between the risk as measured by the standard deviation and the expected return for these efficient portfolios.

The Security Market Line:

The CML shows the risk-return relationship for all efficient portfolios. They would all lie along the capital market line. All portfolios other than the efficient ones will lie below the capital market line. The CML does not describe the risk-return relationship of inefficient portfolios or of individual securities. The capital asset pricing model specifies the relationship between expected return and risk for all securities and all portfolios, whether efficient or inefficient. . The total risk of a security as measured by standard deviation is composed of two components: systematic risk and unsystematic risk or diversifiable risk. As investment is diversified and more and more securities are added to a portfolio, the unsystematic risk is reduced. For a very well diversified portfolio, unsystematic risk tends to become zero and the only relevant risk is systematic risk measured by beta (). Hence, it is argued that the correct measure of a security‘s risk is beta

The Security Market Line:

While evaluating the performance of a portfolio, the return earned on the portfolio has to be evaluated in the context of the risk associated with that portfolio. One approach would be to group portfolios into equivalent risk classes and then compare returns of portfolios within each risk category. An alternative approach would be to specifically adjust the return for the riskiness of the portfolio by developing risk adjusted return measures and use these for evaluating portfolios across differing risk levels.

The Security Market Line:

It follows that the expected return of a security or of a portfolio should be related to the risk of that security or portfolio as measured by . Beta is a measure of the security‘s sensitivity to changes in market return. Beta value greater than one indicates higher sensitivity to market changes, whereas beta value less than one indicates lower sensitivity to market changes. A value of one indicates that the security moves at the same rate and in the same direction as the market. Thus, the of the market may be taken as one.

The Security Market Line:

The relationship between expected return and of a security can be determined graphically. Let us consider an *XY* graph where expected returns are plotted on the *Y* axis and beta coefficients are plotted on the *X* axis. A risk free asset has an expected return equivalent to and beta coefficient of zero. The market portfolio *M* has a beta coefficient of one and expected return equivalent to. A straight line joining these two points is known as the **security market line (SML)**. This is illustrated in the following diagram.

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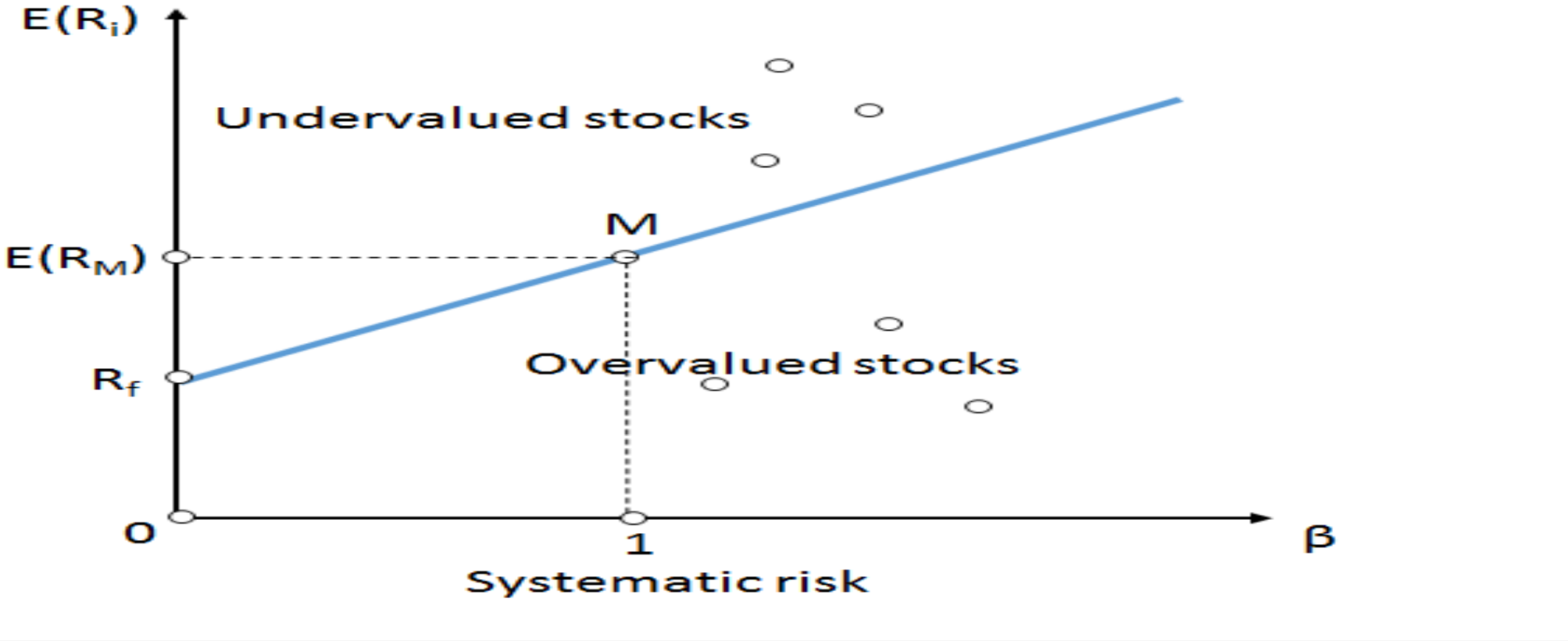

The Security Market Line:

The security market line provides the relationship between the expected return and beta of a security or portfolio. This relationship can be expressed in the form of the following equation

A part of the return on any security or portfolio is a reward for bearing risk and the rest is the reward for waiting, representing the time value of money. The risk free rate, Rf (which is earned by a security which has no risk) is the reward for waiting. The reward for bearing risk is the risk premium. The risk premium of a security is directly proportional to the risk as measured by . The risk premium of a security is calculated as the product of beta and the risk premium of the market which is the excess of expected market return over the risk free return

SML and CML: It is necessary to contrast SML and CML. Both postulate a linear (straight line) relationship between risk and return. In CML the risk is defined as total risk and is measured by standard deviation, while in SML the risk is defined as systematic risk and is measured by . Capital market line is valid only for efficient portfolios while security market line is valid for all portfolios and all individual securities as well. CML is the basis of the capital market theory while SML is the basis of the capital asset pricing model. .

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