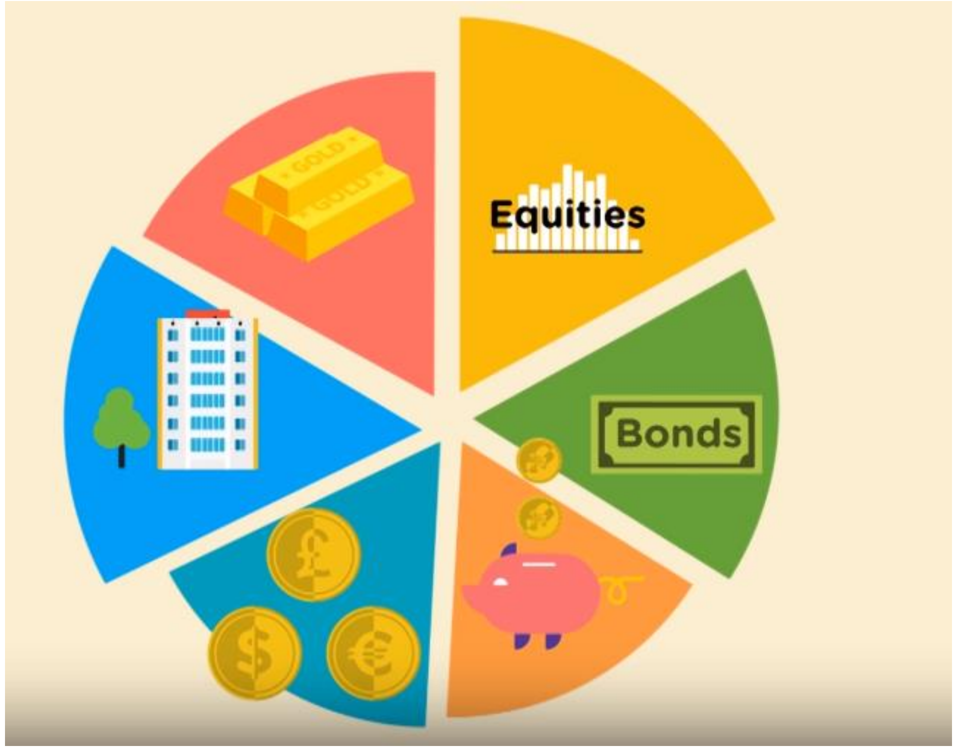
# INTERNATIONAL FINANCE




# PORTFOLIO THEORIES TO MANAGE INTERNATIONAL DIVERSIFICATION

# ❑PORTFOLIO THEORY

- **Portfolio Theory – An Overview**
  - Types of risks
  - Portfolio theory - What it is?
  - A brief background
  - Efficient Frontier
- **Expected Return and Risk (Variance) of an international portfolio. – This captures diversifiable risk**
  - Expected Returns on an international Portfolio
  - Expected risk on an international Portfolio

❑PORTFOLIO THEORY

- **Capital Asset Pricing Model**
  - The overview and standard CAPM
  - Measuring Beta
  - International Capital Asset Pricing Model.

❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- **Portfolio Theory – An Overview**

- Before going further let us look at two types of risks

**Systematic Risk** and **Non-systematic Risk.**

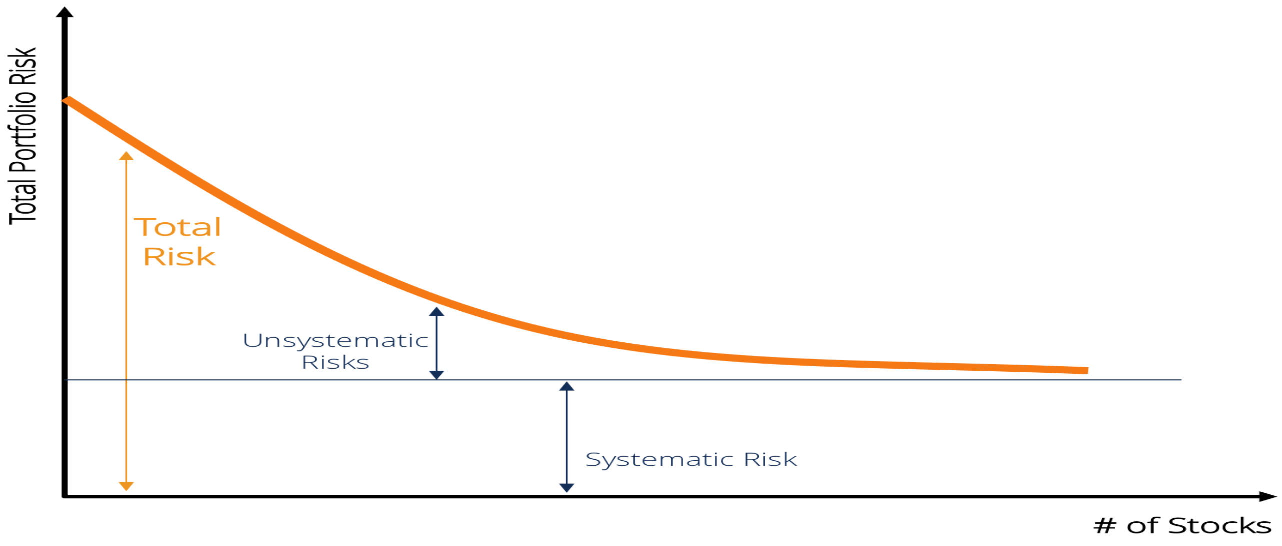
- **Systematic Risk (Undiversifiable risk):** When you invest in a market, you face systematic risk. This risk is tied to market conditions like interest rates, inflation, and politics, among others. You can't escape systematic risk.

- **Non-systematic Risk (Diversifiable risk):** Non-systematic risk is limited to a particular asset class or security. Investors can avoid non-systematic risk through portfolio diversification. A diversified portfolio reduces exposure or reliance on any one underlying security or asset class.

❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- **Portfolio Theory – An Overview**
- Before going further let us look at two types of risks

**Systematic Risk** and **Non-systematic Risk.**




Total Risk = Systematic Risk + Unsystematic Risk

# PORTFOLIO THEORY

## Portfolio Theory – An Overview

## What it is?

- **Portfolio Theory** is concerned with **guidelines for building up portfolio** of stocks and shares, or a portfolio of investment projects.
- **A portfolio** describes the **collection of various different investments** that make up on investor's total investments. It is **a combination** of two or more security or assets. A portfolio might refer to either **investments in stocks and shares of an investor**, or **investment in capital projects.**

## ❑PORTFOLIO THEORY

- ➢ **Portfolio Theory – An Overview**
- ➢ **A brief background**

- Basic portfolio theory was **originated by Harry Markowitz** (Nobel Prizewinner) in the early 1950's.
- His theory precisely is based on the principle that – **"Don't put all your eggs in one basket"**.

# ❑PORTFOLIO THEORY

## ➢ Portfolio Theory – An Overview

## ➢ A brief background

- While investors before then knew intuitively that it was smart to diversify.
- Markowitz was among the first to attempt to quantify risk and demonstrate quantitatively why and how portfolio diversification works to reduce risk for investors.

## ❑PORTFOLIO THEORY

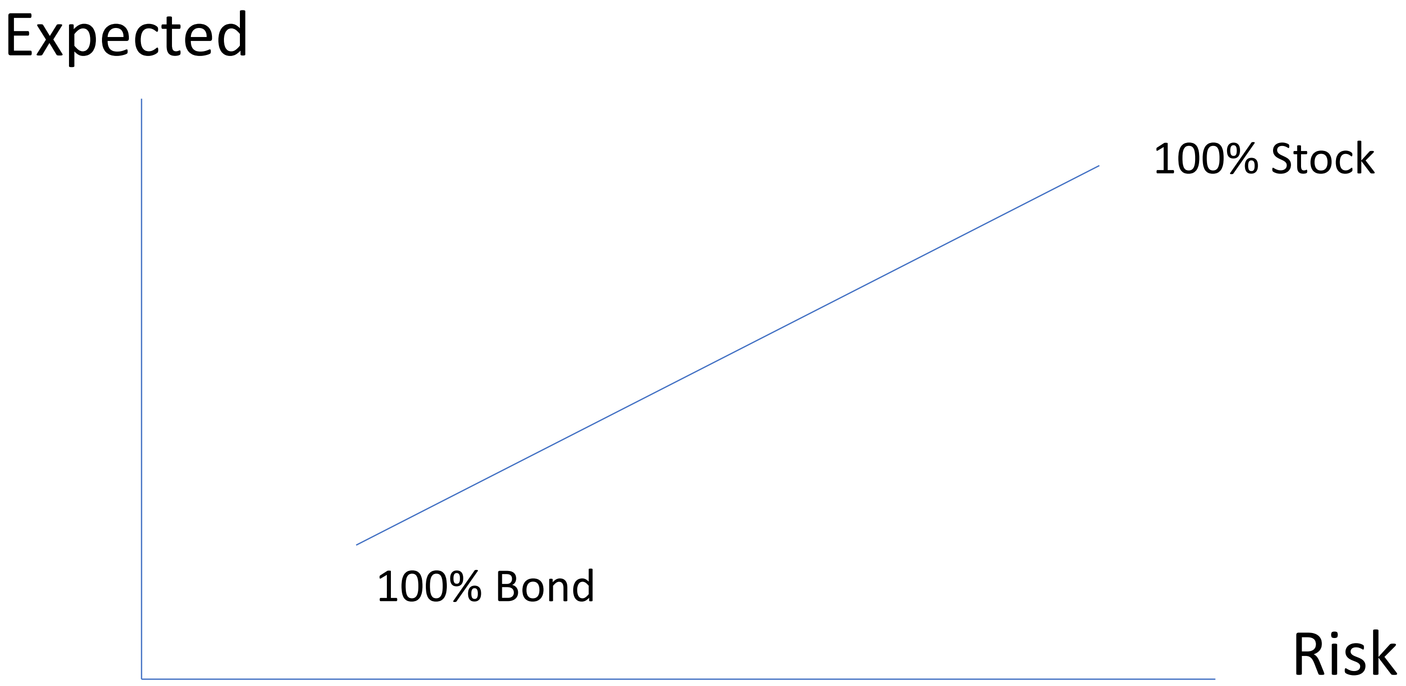
- **Portfolio Theory – An Overview**
- **A brief background**

- Harry Markowitz was also the first to establish the concept of an "efficient portfolio".

- An efficient portfolio is one which has the smallest attainable portfolio risk for a given level of expected return (or the largest expected return for a given level of risk).

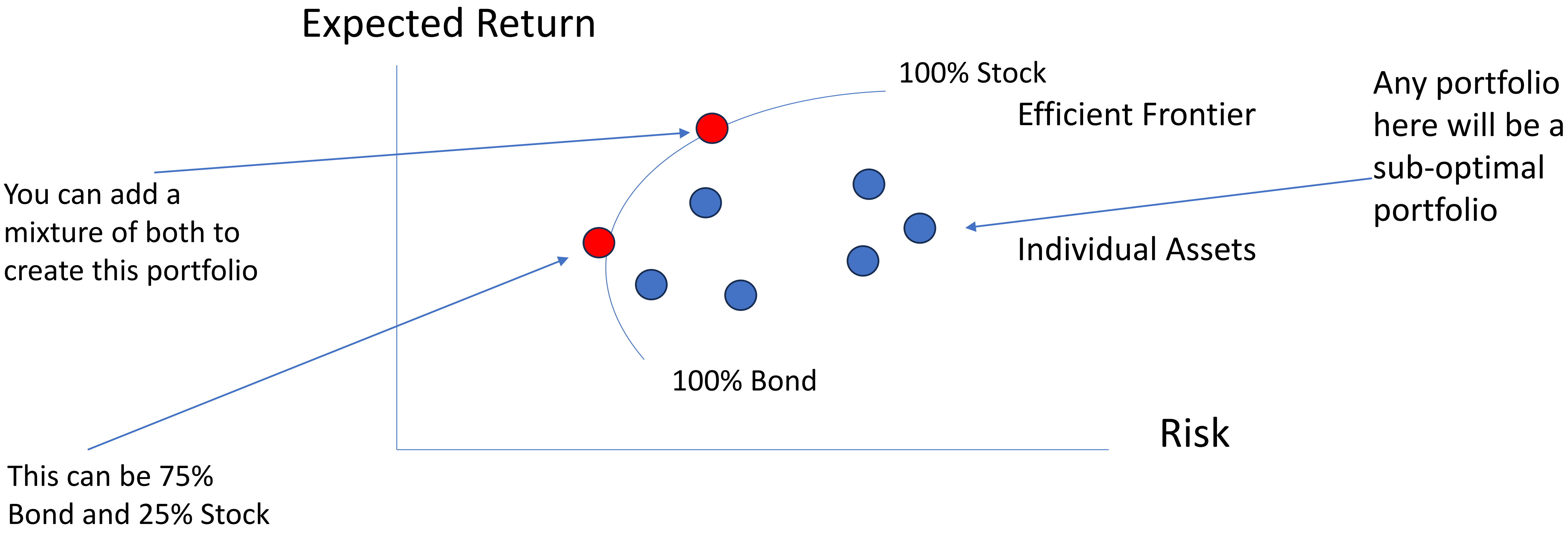
## ❑PORTFOLIO THEORY

- **Portfolio Theory – An Overview**
- **Efficient Portfolio**



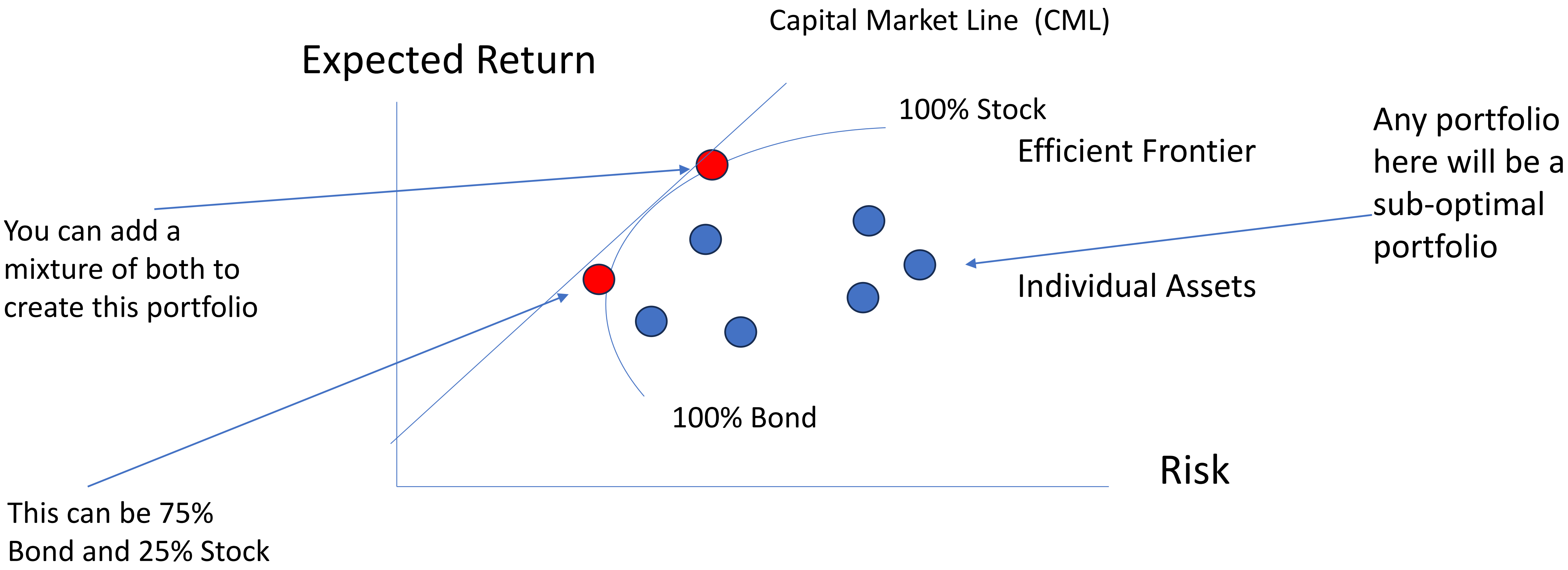
## ❑PORTFOLIO THEORY

- ➢ **Portfolio Theory – An Overview**
- ➢ **Efficient Portfolio**



## ❑PORTFOLIO THEORY

- ➢ **Portfolio Theory – An Overview**
- ➢ **Efficient Portfolio**



## ❑PORTFOLIO THEORY

- **Portfolio Theory – An Overview**
- **Efficient Portfolio**

- Thus, efficient portfolio has the smallest attainable portfolio risk for a given level of expected return (or the largest expected return for a given level of risk) and provides the importance of diversification.

- Diversification can also be done internationally which we will look at now

# ❑PORTFOLIO THEORY

➢ **Portfolio Theory – An Overview**

➢ **International Diversification**

- **International Diversification** is concerned with building up **portfolio of international investment projects.**

- International diversification simply refers to **holding investments of securities or assets in more than one country** with a view of **minimising risks** for targeted return level or **maximizing return** for a given level of risk.

## ❑PORTFOLIO THEORY

- ➢**Portfolio Theory – An Overview**
- ➢**International Diversification**
- ➢**Advantages of international diversification**

### ➢Risk Reduction:

- International diversification can be considered a **strategy for risk reduction** because **correlation coefficient** across markets (countries) **are reasonably low**.

- It is naturally accepted that the **economic, political, institutional and even psychological factors affecting securities'** (assets') returns tend to **vary** a great deal across countries which in turn results in relatively low correlation among international assets.

- Most importantly **the broader the diversification the more stable the returns and the more diffuse the risks** are expected to be.

## ❑PORTFOLIO THEORY

- **Portfolio Theory – An Overview**
- **International Diversification**
- **Advantages of international diversification**
- **Diversifies Currency Exposure**:

• When investors buy stocks for an international portfolio, they are also **effectively buying the currencies in which the stocks are quoted.**

• For example, if an investor purchases a stock listed on the London Stock Exchange, the value of that stock may rise and fall with the British pound. If the U.S. dollar falls, the investor's international portfolio helps to neutralize currency fluctuations.

## ❑PORTFOLIO THEORY

### ➢Portfolio Theory – An Overview

### ➢International Diversification

### ➢Barriers to International Diversification

The benefits to international diversification are not automatic and free. The benefits are normally affected (reduced) by some barriers. The barriers include:

- Exchange risk.
- Lack of liquidity.
- Legal and economic impediments - currency controls.
- Specific tax regulations.
- Relatively less-developed capital markets abroad.
- Lack of readily accessible and comparable information on potential foreign security acquisitions.

## ❑PORTFOLIO THEORY

### ➢Portfolio Theory – An Overview

### ➢International Diversification

- Just like diversification domestically, the efficiency and effectiveness of international diversification as risk reduction strategy is influenced and depends on three main factors. These factors are:

1) **The Expected return** in each individual country.
2) **The Variance (risk)** of returns in each individual country.
3) **The Intercountry correlations** – (-1.0 to 1.0) low correlations among markets are better in realizing benefits in international diversification. Diversification including countries with different economic, legal and political setting can be good. (More on correlation in the next slides).

## ❑PORTFOLIO THEORY

### ➢ Portfolio Theory – An Overview

### ➢ International Diversification - More on correlation

- The relationship between markets can be classified as one of three main types:
- **Positive Correlation:** This mean **both markets are very similar**, if one market does well (or badly) it is likely that the other will perform likewise. Take an example of stocks here - if you invest in one company making umbrellas and another which sells rain coats you would expect good whether to mean that both companies suffer.
- **Negative Correlation:** This means **both markets differ**. If one does well the other can do badly, and vice-versa. Take an example of stocks here - if you hold shares in one company making umbrellas and another which sells ice-cream, the weather will affect the companies differently.
- **No Correlation:** This means both **markets are independent of each other**. Take an example of stocks here - If you hold shares in a mining company and a company selling milk products, it is likely that there would be no relationship between the returns from each.

## ❑PORTFOLIO THEORY

### ➢Expected Return and Risk of an international portfolio

### ➢Expected Returns of an international portfolio.

- Recall that expected return of a portfolio is calculated by multiplying the weight of each asset by its expected return.

- So therefore, expected returns of an international portfolio is simply the weighted average of the expected returns of individual markets. Weights here are the weights invested in different parts of the world, and expected returns are returns from investments invested in different parts of the world.

## ❑PORTFOLIO THEORY

➢**Expected Return and Risk of an international portfolio**

➢**Expected Returns of an international portfolio.**

➢The general formula for expected return of a portfolio

$$E(r)_p = w_1\, E(r)_1 + w_2\, E(r)_2 + \ldots + w_i\, E(r)_i$$

$$E(r)_p = \sum_{i=1}^{n} \mathrm{w}\, E(r)_i$$

Where

$E(r)_p$ Expected return of international portfolio

$w_i$ $Weight\ of\ investment\ in\ individual\ country\ i$

$E(r)_i$ $Expected\ return\ of\ investments\ in\ individual\ country\ i$

➢

## ❑PORTFOLIO THEORY

➢ **Expected Return and Risk of an international portfolio**

➢ **Expected Returns of an international portfolio.**

**Example1 :** Calculate the expected return of an international portfolio with investments in three countries.

| Stock | Expected return | Weight of Investment |
|---|---|---|
| Tanzania | 3% | 25% |
| Uganda | 1% | 50% |
| Kenya | 9% | 25% |

$$E(r)_p = w_1\,E(r)_1 + w_2\,E(r)_2 + w_3\,E(r)_3$$

$$E(r)_p = (0.25 \times 3) + (0.50 \times 1) + (0.25 \times 9)$$

$$E(r)_p = 3.5\%$$

## ❑PORTFOLIO THEORY

- **Expected Return and Risk of an international portfolio**
- **Expected Returns of an international portfolio.**

**Example 2:** Calculate the expected return of an international portfolio with investments in three countries with equal weight.

| State of the Economy | Probability | Expected Returns | | |
|---|---|---|---|---|
| | | Tanzania | Uganda | Kenya |
| Boom | 0.5 | 10% | 15% | 20% |
| Bust | 0.5 | 8% | 4% | 0% |

❑PORTFOLIO THEORY

➢ **Expected Return and Risk of an international portfolio**

➢ **Expected Returns of an international portfolio.**

**Example 2: Solution**

**Step 1: Multiply the return in each stock by its probability to find the expected return of individual market**

**Tanzania =** $(0.5 \times 10\%) + (0.5 \times 8\%) = 9\%$

**Uganda =** $(0.5 \times 15\%) + (0.5 \times 4\%) = 9.5\%$

**Kenya =** $(0.5 \times 20\%) + (0.5 \times 0\%) = 10\%$

❑PORTFOLIO THEORY

➢ **Expected Return and Risk of an international portfolio**

➢ **Expected Returns of an international portfolio.**

## Example 2: Solution

## Now you know the expected return of markets

| State of the Economy | Probability | Expected Returns | | |
|---|---|---|---|---|
| | | Tanzania | Uganda | Kenya |
| **Expected Returns of Markets** | | **9%** | **9.5%** | **10%** |

## Step 2: Now find expected return of portfolio – Use the formula here

$$E(r)_p = w_1\,E(r)_1 + w_2\,E(r)_2 + w_3\,E(r)_3$$

$$E(r)_p = (0.333 \times 9\%) + (0.333 \times 9.5) + (0.333 \times 10)$$

$$E(r)_p = 9.5\%$$

❑PORTFOLIO THEORY

➢ **Expected Return and Risk of an international portfolio**

➢ **Expected Returns of an international portfolio.**

**Example 3:** Calculate the expected return of an international portfolio where 40% is invested in Tanzania and the rest in Kenya

| Year | Tanzania | Kenya |
|---|---|---|
| | Expected Returns | |
| 1 | 10% | 15% |
| 2 | 8% | 4% |

❑ PORTFOLIO THEORY

## ➢ Expected Return and Risk of an international portfolio

## ➢ Expected Returns of an international portfolio.

**Solution Example 3:**

**Step 1: find the expected returns of individual markets.**

**Tanzania =** $(0.5 \times 10\%) + (0.5 \times 8\%) = 9\%$

**Kenya =** $(0.5 \times 15\%) + (0.5 \times 4\%) = 9.5\%$

| Year | Tanzania | Kenya |
|---|---|---|
| 1 | 10% | 15% |
| 2 | 8% | 4% |
| Expected Return | 9% | 9.5% |

**Step 2: find the expected returns of international portfolio.**

$$E(r)_p = w_1\, E(r)_1 + w_2\, E(r)_2 + w_3\, E(r)_3$$

$$E(r)_p = (0.4 \times 9\%) + (0.6 \times 9.5\%)$$

$$E(r)_p = 9.3\%$$


Almost
Done!

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

- The risk in a portfolio of investments, is that the **actual return** will **not be the same as the expected return**.

- A wise **investor** will **want to avoid too much risk**, and thus its important to know how to calculate the risk of a portfolio.

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

- The risk of a portfolio can be measured as the standard deviation ($\boldsymbol{\sigma_p}$) of expected returns of the portfolio.

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

- The risk of the portfolio of 2 markets can simply be obtained using the following:

$$\boldsymbol{\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2}$$

**Where**
$\boldsymbol{\sigma_p^2}$= Variance
$\boldsymbol{\rho_{1,2}}$ = Correlation between market 1 and 2
$\boldsymbol{\sigma_1}$ and $\boldsymbol{\sigma_2}$ = Standard Deviation of market 1 and 2
**w1** and **w2** = weight of investment in market 1 and 2

Also know that Standard Deviation, $\sigma_p = \sqrt{\sigma_p^2}$

Also know that Covariance, $Cov_{1,2} = \boldsymbol{\rho_{1,2}\sigma_1\sigma_2}$

- The risk of the portfolio of 3 markets can be obtained as follows:

$$\boldsymbol{\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + w_3^2\sigma_3^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2 + {}}$$
$$\boldsymbol{+ 2w_2w_3\rho_{2,3}\sigma_2\sigma_3 + 2w_1w_3\rho_{1,3}\sigma_1\sigma_3}$$

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

**Example 4:** What is the expected return and risk of a portfolio if you invest equally in the following markets

| | **Tanzania** | **Kenya** |
|---|---|---|
| Expected Return | 8% | 10% |
| Standard Deviation ($\sigma$) | 3 | 5 |
| Correlation with Tanzania ($\rho$) | 1.0 | 0.4 |

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

**Example 4:** Solution

**Expected Return**

$$E(r)_p = w_1\, E(r)_1 + w_2\, E(r)_2$$

$$E(r)_p = (0.5 \times 8\%) + (0.5 \times 10\%) = 9\%$$

**Variance**

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2$$

$$\sigma_p^2 = (0.5^2 \times 3^2) + (0.5^2 \times 5^2) + (2 \times 0.5 \times 0.5 \times 0.4 \times 3 \times 5)$$

$$\sigma_p^2 = 2.25 + 6.25 + 3$$

$$\sigma_p^2 = 11.5\%$$

- Sometimes you may not be given all the information as above and be given only few details.

- See the example that follows

**Example 4:** You have the following returns where the manager invests 60% in NMB and 40% in Sainsbury

| Year | NMB Plc (Tanzania) | Sainsbury Plc (UK) |
|---|---|---|
| 1 | 10% | 15% |
| 2 | 20% | 9% |

The correlation between securities is 0.6

1. Calculate the risk associated with individual capital market
2. Calculate risk and return of portfolio

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

- **Example 4:** Solution – in this example you have not been provided the standard deviation of individual market, so we can find that first
- **We calculate the risk of individual market – we know the following**

$$\textbf{Standard Deviation}(\boldsymbol{\sigma}) = \sqrt{\boldsymbol{Variance}}$$

$$\textbf{Variance}\left(\boldsymbol{\sigma^2}\right) = \frac{\sum(\boldsymbol{X_i} - \overline{\boldsymbol{X}})^2}{\boldsymbol{n-1}}$$

- Where,
- $\boldsymbol{X_i}$ is the return of the individual market
- $\overline{\boldsymbol{X}}$ is the average return of the individual market
- n is the number of observations

**Example 4:** Solution Risk of individual market

To calculate the variance of individual market, follow the steps

1) Find the average expected return of the market ($\bar{X}$).
2) Calculate return deviation (Expected return ($X_i$) – Average Expected Return($\bar{X}$)).
3) Square the return deviation $(X_i - \bar{X})^2$.
4) Find the sum of squared return $\sum(X_i - \bar{X})^2$
5) Now calculate the variance $\frac{\sum(X_i - \bar{X})^2}{n-1}$

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

**Example 4:** Solution Variance of individual market (NMB Plc -Tanzania)

| Year | (1) Returns (xi) | (2) Return Deviation ($xi - \bar{X}$) | (3) Square Return Deviation $(xi - \bar{X})^2$ |
|---|---|---|---|
| 1 | 10% | -5% | 25% |
| 2 | 20% | 5% | 25% |
| | Mean ($\bar{X}$) = 15% | | (4) $\sum(xi - \bar{X})^2 = 50\%$ |

**5) Variance** $\left(\sigma^2\right) = \frac{\sum(xi - \bar{X})^2}{n-1}$

**Variance** $\left(\sigma^2\right) = \frac{50}{2-1} = 50$

**Standard Deviation** $(\sigma) = \sqrt{50} = 7.0711$

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk of an international portfolio**

**Example 4:** Solution Variance of individual market Sainsbury Plc (UK)

| Year | (1)<br>Returns (xi) | (2)<br>Return Deviation $(xi - \bar{X})$ | (3)<br>Square Return Deviation $(xi - \bar{X})^2$ |
|---|---|---|---|
| 1 | 15% | 3% | 9% |
| 2 | 9% | -3% | 9% |
| | **Mean $(\bar{X})$ = 12%** | | **(4) $\sum(xi - \bar{X})^2 = 18\%$** |

**5) Variance $\left(\sigma^2\right)$ = $\frac{\sum(xi - \bar{X})^2}{n-1}$**

**Variance $\left(\sigma^2\right)$ = $\frac{18}{2-1}$ = 18**

**Standard Deviation $(\sigma) = \sqrt{18} = 4.243$**

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk**
- **Risk of International Portfolio**

**Example 4**: Solution - Now you know the risk (i.e., the variance and standard deviation) of individual market, you know correlation you can calculate risk of a portfolio.

$$\boldsymbol{\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2}$$

$$\boldsymbol{\sigma_p^2} = \mathbf{(0.6 \times 50) + (0.4 \times 18) + (2 \times 0.6 \times 0.4 \times 0.6 \times 7.0711 \times 4.243)}$$


$$\boldsymbol{\sigma_p^2} = \mathbf{(0.6 \times 50) + (0.4 \times 18) + (2 \times 0.6 \times 0.4 \times 0.6 \times 7.0711 \times 4.243)}$$


$$\boldsymbol{\sigma_p^2} = \mathbf{30 + 7.2 + 8.623}$$

$$\boldsymbol{\sigma_p^2} = \mathbf{45.823}$$

$$\sigma_p = \sqrt{\mathbf{45.823}} = \mathbf{6.7692}$$

**Example 5:** Consider the international portfolio below, what would be the portfolio's risk if 50% is invested in Tanzania and 50% in Uganda.

| State of the Economy | Probability | Returns | |
|---|---|---|---|
| | | Tanzania | Uganda |
| Boom | 0.2 | 70% | 15% |
| Bust | 0.8 | -20% | 20% |

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk**
- **Risk of Individual Market**

**Example 7:** Solution – Recall in example 5 we calculated variance of Tanzania

| Probability | (1) Returns ($x_i$) | (2) Return Deviation ($x_i - \bar{X}$) | (3) Square Return Deviation $(x_i - \bar{X})^2$ | (4) Square Return deviation × Probability $p(x_i - \bar{X})^2$ |
|---|---|---|---|---|
| 0.2 | 70% | 72% | 51.8% | 10.368% |
| 0.8 | -20% | -18% | 3.2% | 2.592% |
| | $\bar{X}$=-2% | | | (5) $\sum p(x_i - \bar{X})^2 = 12.96$ |

6) Variance $(\sigma^2) = \frac{\sum p(xi - \bar{X})^2}{n-1}$

Variance $(\sigma^2) = \frac{12.96}{2-1} = 12.96$

**Standard Deviation** $(\sigma) = \sqrt{12.96} = 3.6$

## ❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk**
- **Risk of Individual Market**

**Example 7:** Solution – Now let us calculate variance of Uganda

| Probability | (1) Returns (xi) | (2) Return Deviation $(xi - \bar{X})$ | (3) Square Return Deviation $(xi - \bar{X})^2$ | (4) Square Return deviation × Probability $p(xi - \bar{X})^2$ |
|---|---|---|---|---|
| 0.2 | 15% | -4% | 16% | 3.2% |
| 0.8 | 20% | 1% | 1% | 0.8% |
| | $\bar{X}$=-19% | | | (5) $\sum p(xi - \bar{X})^2 = 4$ |

**6) Variance** $(\sigma^2) = \frac{\sum p(xi - \bar{X})^2}{n-1}$

**Variance** $(\sigma^2) = \frac{4}{2-1} = 4$

**Standard Deviation** $(\sigma) = \sqrt{4} = 2$

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk**
- **Risk of Individual Market**

**Example 7:** Since correlation is not given, you may find the covariance of the portfolio as you know

Covariance, $Cov_{1,2} = \boldsymbol{\rho_{1,2}\sigma_1\sigma_2}$

Formula for covariance is

$$cov_{x,y} = \frac{\sum(xi - \overline{X})(yi - \overline{Y})}{N-1}$$

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk**
- **Risk of Individual Market**

**Example 7:** Covariance, $Cov_{1,2} = \boldsymbol{\rho_{1,2}\sigma_1\sigma_2}$

Formula for covariance is

| Probability | Returns (xi) | Return Deviation (xi -$\bar{X}$) | Returns (yi) | Return Deviation (yi -$\bar{Y}$) | $(xi - \overline{X})(yi - \overline{Y})$ | $P(xi - \overline{X})(yi - \overline{Y})$ |
|---|---|---|---|---|---|---|
| 0.2 | 70% | 72% | 15% | -4% | -288 | -57.6 |
| 0.8 | -20% | -18% | 20% | 1% | -18 | -14.4 |
| | $\bar{X}$=-2% | | $\bar{Y}$=-19% | | | $\sum p(xi - \overline{X})(yi - \overline{Y})$ = 72 |

$$cov_{x,y} = \frac{\sum p(xi - \overline{X})(yi - \overline{Y})}{N-1} = \frac{72}{2-1} = -72\%$$

Hence covariance is -7.2

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk**
- **Risk of Individual Market**

**Example 7:** Covariance, $Cov_{1,2} = \boldsymbol{\rho_{1,2}\sigma_1\sigma_2}$

$$cov_{x,y} = \frac{\sum p(xi - \overline{X})\,(yi - \overline{Y})}{N-1} = \frac{7.2}{2-1} = \text{-}7.2$$

Given covariance we can also find correlation

$Cov_{1,2} = \boldsymbol{\rho_{1,2}\sigma_1\sigma_2}$

-7.2 = $\boldsymbol{\rho_{1,2}}$ × **3.6** ×2

-7.2 = $\boldsymbol{\rho_{1,2}}$ × 7.2

$\boldsymbol{\rho_{1,2}}$ = -1.0

❑PORTFOLIO THEORY

- **Expected Return on a Portfolio and Portfolio Risk (Portfolio Variance)**
- **Portfolio Risk**
- **Risk of International Portfolio**

**Solution:** Example 7 - Now that you know the risk (i.e., the variance and standard deviation) of individual market, you know covariance you can calculate risk of a portfolio.

$$\boldsymbol{\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2}$$

$$\boldsymbol{\sigma_p^2 = (0.5 \times 12.96) + (0.5 \times 4) + (2 \times 0.5 \times 0.5 \times -7.2)}$$

$$\boldsymbol{\sigma_p^2 = 6.48 + 2 - 3.6}$$

$$\boldsymbol{\sigma_p^2 = 4.88}$$

$$\boldsymbol{\sigma_p = \sqrt{4.88} = 2.209}$$


90%
Almost
DONE

# 1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

## ❑ 1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

Lets say a person safely deposits in a bank account which pays 5% interest.

You have an investment idea. However, the investment idea is to risky. Will this person invest in risky company if it pays 5%?



# ❑ 1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

The person lets say has invested in stock market (which is medium risk) which gives a return of 8%


The Risky investment idea can pay you 8%.

Will this person invest in risky company if it pays 8%



## 1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

➢ **Systematic Risk** and **Non-systematic Risk.**

- Before going further let us again recall the two types of risk

**Systematic Risk** and **Non-systematic Risk.**

- **Systematic Risk (Undiversifiable risk):** When you invest in a market, you face systematic risk. This risk is tied to market conditions like interest rates, inflation, and politics, among others. You can't escape systematic risk.

- **Non-systematic Risk (Diversifiable risk):** Non-systematic risk is limited to a particular asset class or security. Investors can avoid non-systematic risk through portfolio diversification. A diversified portfolio reduces exposure or reliance on any one underlying security or asset class.

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- The question comes up – how much return should the risky investment pay.
- The capital asset pricing model (CAPM) helps to answer this.
- The CAPM was developed by William Sharpe in the 1960's and it has important implications for finance ever since.
- The model describes the relationship between **risk and expected (required) return**. Precisely, It calculates the expected rate of return for an asset or investment given the level of risk.

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- There are several different versions of CAPM, of which international CAPM (which we will look at) is just one.

### Standard CAPM

- The following equation is used to calculate the expected return of an asset/stock given its risk in the standard CAPM:

$$\boldsymbol{R_i = R_f + \beta_i \times (R_m - R_f)}$$

Where,

- $\boldsymbol{R_i}$ is the expected return on asset *i*
- $\boldsymbol{R_f}\ is\ the\ risk\ free\ rate$
- $\boldsymbol{\beta_i}\ is\ the\ beta\ of\ asset\ i$
- $\boldsymbol{R_m}\ is\ expected\ return\ of\ the\ market$

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- CAPM rests on the central idea that investors need to be compensated in two ways: the time value of money and risk.
- In the formula above, the time value of money is represented by the risk-free **($R_f$)** rate; this compensates investors for tying up their money in any investment over time (in contrast with keeping it in a more accessible, liquid form). The risk-free rate is generally the yield on government bonds
- The other half of the CAPM formula represents risk, calculating the amount of compensation an investor needs for assuming (i.e., taking) more risk.

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

$\boldsymbol{R_i = R_f + \beta_i \times (R_m - R_f)}$ shows he relationship between **systematic risk** for an investment and the expected return on it.

- **Risk-free rate ($R_f$):** The risk-free rate is usually the return rate on government bonds.
- **Beta ($\beta_i$):** The beta is a measure of how much risk the investment will add to our portfolio, a measure of its returns' volatility. It shows the fluctuations of the price changes relative to the overall market.
- **Market Risk Premium ($R_m$ – $R_f$):** The market risk premium represents the expected return from the market, above the risk-free rate. The more volatile a market or an investment class is, the higher the market risk premium will be.
- **Expected return ($R_i$):** When we add all the components of the equation, we get the desired yield of the investment.

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

➢ **Systematic Risk and Non-systematic Risk.**

➢ **Beta (β)**

- Beta is a measure of systematic risk, i.e., risk that affects the entire market.
- Beta measures how an individual asset moves compared to how the market moves.
- Market by definition gets the Beta = 1,
- If the stock has beta equal to 1 it means The stock shares the same volatility as the overall market. Any change in the market indices will produce an equivalent change in the stock prices.

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

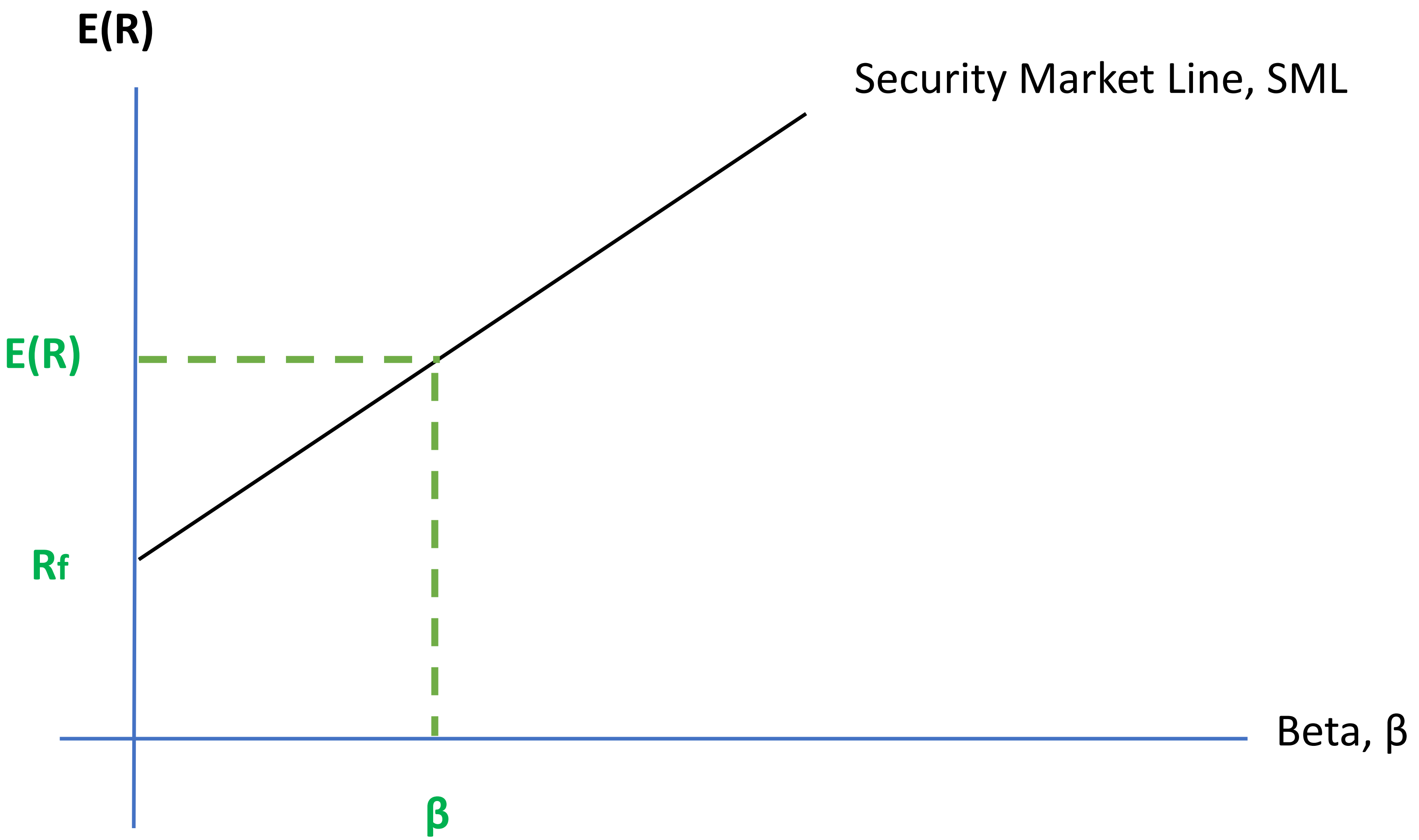
➢**Systematic Risk and Non-systematic Risk.**

➢**Beta (β)**

- If Beta of stock is higher than 1, it shows the stock moves more aggressively than the market (i.e., it is more volatile). It gives you more upside potential when markets are in bullish territory, but it also carries higher risk of losing money in market downturn (i.e., when the market is in bear market).
- Beta smaller than 1 means stock is more defensive than the market (i.e., less volatile). This means you will lose less money in market downturn but also less upside potential, i.e., gains, when market goes up.
- Beta can also be negative, however with very limited assets, such as gold and precious metals

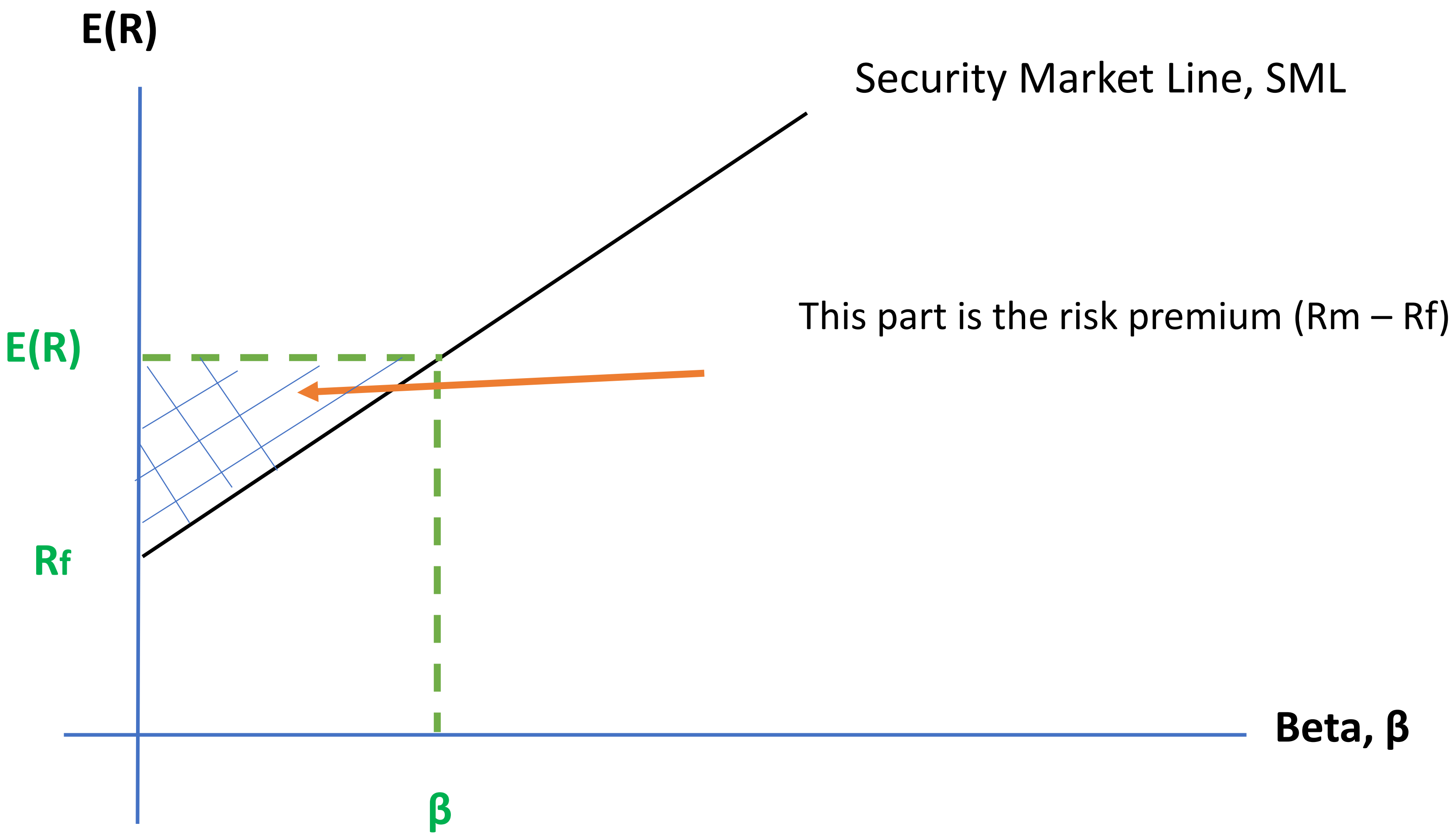
## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- The CAPM can also be represented graphically,



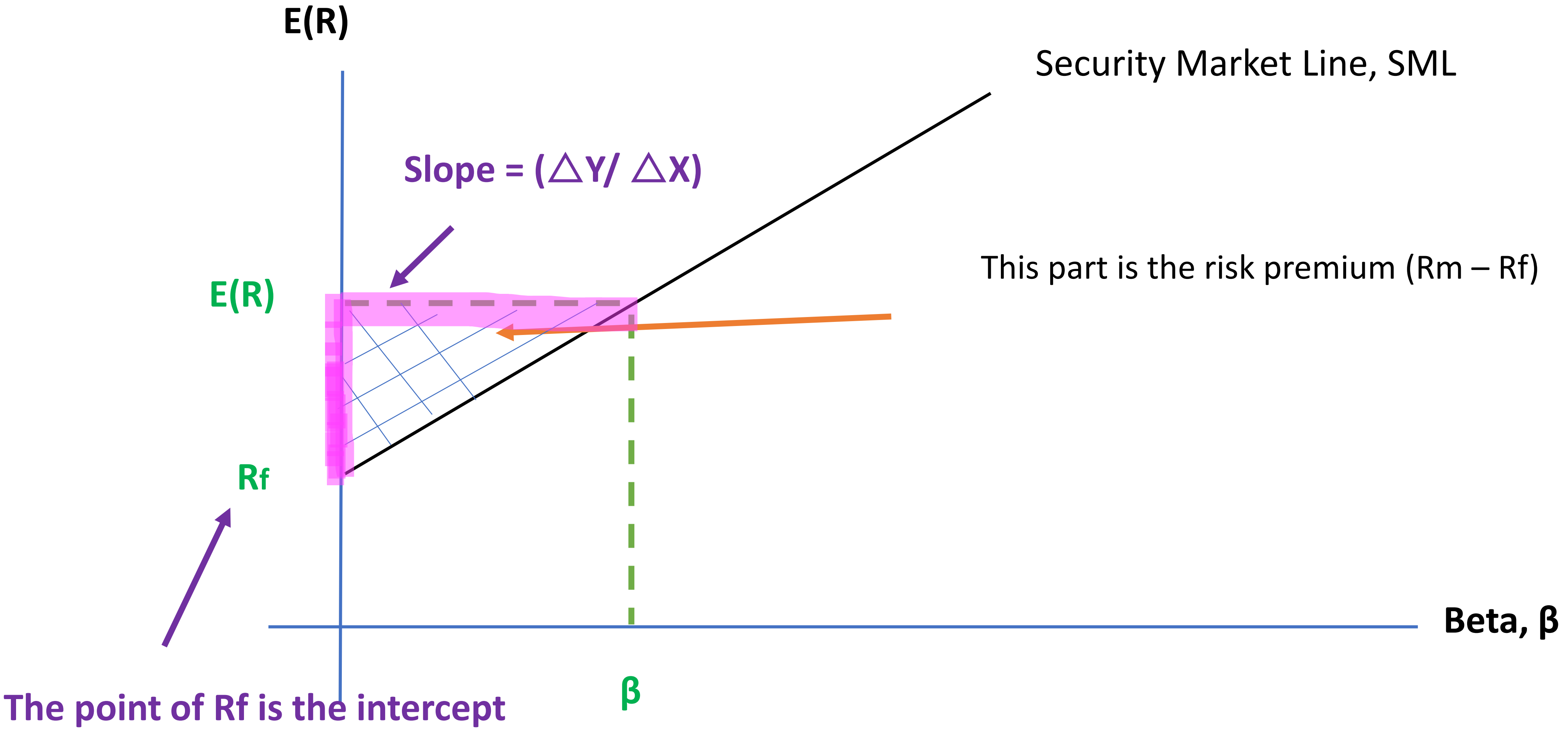
## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- The CAPM can also be represented graphically,



# ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- The CAPM can also be represented graphically (some important points)



## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

The following are the assumptions of the CAPM model:

- All investors are **risk-averse** by nature.
- **Investors** have the **same time** to evaluate information.
- There is **unlimited capital to borrow at the risk-free rate** of return.
- **Investments can be divided** into unlimited **pieces and sizes**.
- There are **no taxes, inflation, or transaction costs.**
- **Risk and return** are **linearly related.**

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

➢**Systematic Risk and Non-systematic Risk.**

➢**Beta (β)**

- **Beta of the portfolio is calculated as follows**
- $\beta_p = w_1\ \beta_1 + w_2\ \beta_2$
- **Example:** Given the following information calculate the beta of an equally weighted portfolio

| Country | Beta |
|---|---|
| TANZANIA | 0.497 |
| CANADA | 0.723 |

$\beta_p$ = (0.5 × 0.497) + (0.5 × 0.723)

$\beta_p$ = 0.61

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

➢**Systematic Risk and Non-systematic Risk.**

➢**Beta (β)**

- Sometimes you may not be given betas, Let us see how to calculate Beta

**Using Covariance/Variance Method**

Method 1: **Beta** $(\boldsymbol{\beta_i}) = \dfrac{\boldsymbol{Covariance\ (R_i,R_m)}}{\boldsymbol{Variance\ (R_m)}} = \dfrac{\rho_{i,m}\sigma_i\sigma_m}{\sigma_m\sigma_m}$

Method 2: **Beta** $(\boldsymbol{\beta_i}) = \dfrac{\boldsymbol{\sum((R_i - \overline{R_i})\ (R_m - \overline{R_m})}}{\boldsymbol{n-1}}$

Method 3: using Correlation - we know Covariance, $Cov_{i,m} = \rho_{i,m}\sigma_i\sigma_m$ and $Var\ (R_m) = \sigma_m\sigma_m$

- Beta $(\beta_i) = \dfrac{\rho_{i,m}\sigma_i\sigma_m}{\sigma_m\sigma_m}$, You cancel out $\sigma_m$ and you remain with

**Beta** $(\boldsymbol{\beta_i}) = \dfrac{\boldsymbol{\rho_{i,m}\sigma_i}}{\boldsymbol{\sigma_m}}$

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- **Systematic Risk and Non-systematic Risk.**
- **Beta (β)**

- **Example:** Use the following data Calculate the foreign market beta (i.e., Beta Canada) relative to the Tanzania market

| Country | Correlation with Tanzania Market | Standard Deviation of Returns |
|---|---|---|
| TANZANIA | 1.00 | 18.2 |
| CANADA | 0.60 | 21.9 |

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)

- **Systematic Risk and Non-systematic Risk.**
- **Beta (β)**

Solution

Given

| Country | Correlation with Tanzania Market | Standard Deviation of Returns |
|---|---|---|
| TANZANIA | 1.00 | 18.2 |
| CANADA | 0.60 | 21.9 |

We can use correlation method here

**Beta** $(\boldsymbol{\beta_i}) = \dfrac{\boldsymbol{\rho_{i,m}\sigma_i}}{\boldsymbol{\sigma_m}}$

**Beta** $(\boldsymbol{\beta_{Canada}}) = \dfrac{\boldsymbol{\rho_{Canada,Tanzania} \times \sigma_{Canada}}}{\boldsymbol{\sigma_{Tanzania}}} = \dfrac{\mathbf{0.60 \times 21.9}}{\mathbf{18.2}} = 0.723$

## 1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)
## International CAPM (ICAPM)

In the international CAPM (ICAPM), in addition to getting compensated for the time value of money and the premium for deciding to take on market risk, investors are also rewarded for direct and indirect exposure to foreign currency.

The ICAPM allows investors to account for the sensitivity to changes in foreign currency when investors hold an asset.

## ❑International CAPM (ICAPM)

The ICAPM formula is

$$\mathbf{E(Ri)} = \boldsymbol{R_f} + \boldsymbol{\beta_w}(\boldsymbol{RP_W}) + (\boldsymbol{C} \times \boldsymbol{CRP})$$

Where,

$\boldsymbol{R_f}$ is the risk-free rate.

$\boldsymbol{\beta_w}$ is the beta world.

$\boldsymbol{RP_W}$ is the risk premium world.

**C** is the currency exposure.

**CRP** is the currency risk premiums.

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)
## ❑International CAPM (ICAPM)

**CRP** is the currency risk premiums and it is calculated as follows

$CRP = E[(S_1 - S_o)/S_0] - (r_{DC} - r_{FC})$

Where

$\mathrm{E}[(\mathrm{S}_1 - \mathrm{S}_\mathrm{o})/\mathrm{S}_0]$ is the expected change in the currency

$\mathrm{r}_{\mathrm{DC}}$ is the risk-free rate home

$\mathrm{r}_{\mathrm{FC}}$ is the risk-free rate foreign

Example: One-year risk-free rate DC is 6% and FC is 3%. The expected exchange rate is 4%. What is the foreign risk premium?

$CRP = E[(S_1 - S_o)/S_0] - (r_{DC} - r_{FC})$

$CRP = 4\% - (6\% - 3\%) = 1\%$

## ❑1.2 CAPITAL AND ASSET PRICING MODEL (CAPM)
## ❑International CAPM (ICAPM)

Example: Assume you are a US investor who is considering investments in German market. The world risk premium is 6%. The currency risk premium on Euro is 1.5%. The interest-free rate on one year US bond is 4.25%. World market beta is 1 and currency exposure Euro is 1. Using the ICAPM calculate the expected return to invest in German market.

Solution

$$\mathbf{E(Ri)} = \boldsymbol{R_f + \beta_w(RP_W) + (C \times CRP)}$$

$$\mathbf{E(Ri)} = \mathbf{4.25 + 1(6) + (1 \times 1.5)}$$

$$\mathbf{E(Ri)} = \mathbf{11.75}$$

- **PORTFOLIO THEORY**
- **Recap**

- **Portfolio Theory – An Overview**
  - What it is?
  - A brief background
  - Efficient Frontier
- **Expected Return and Risk (Variance) of an international portfolio. – This captures diversifiable risk**
  - Expected Returns on an international Portfolio
  - Expected risk on an international Portfolio

- **PORTFOLIO THEORY**
- **Recap**

# ➢ Capital Asset Pricing Model

- ➢ The overview and standard CAPM
- ➢ Measuring Beta
- ➢ International Capital Asset Pricing Model.


We Did It!


THANK YOU
FOR YOUR
ATTENTION


THE
END