International Management Studies

2024.10.15

Lecture 6

Contents

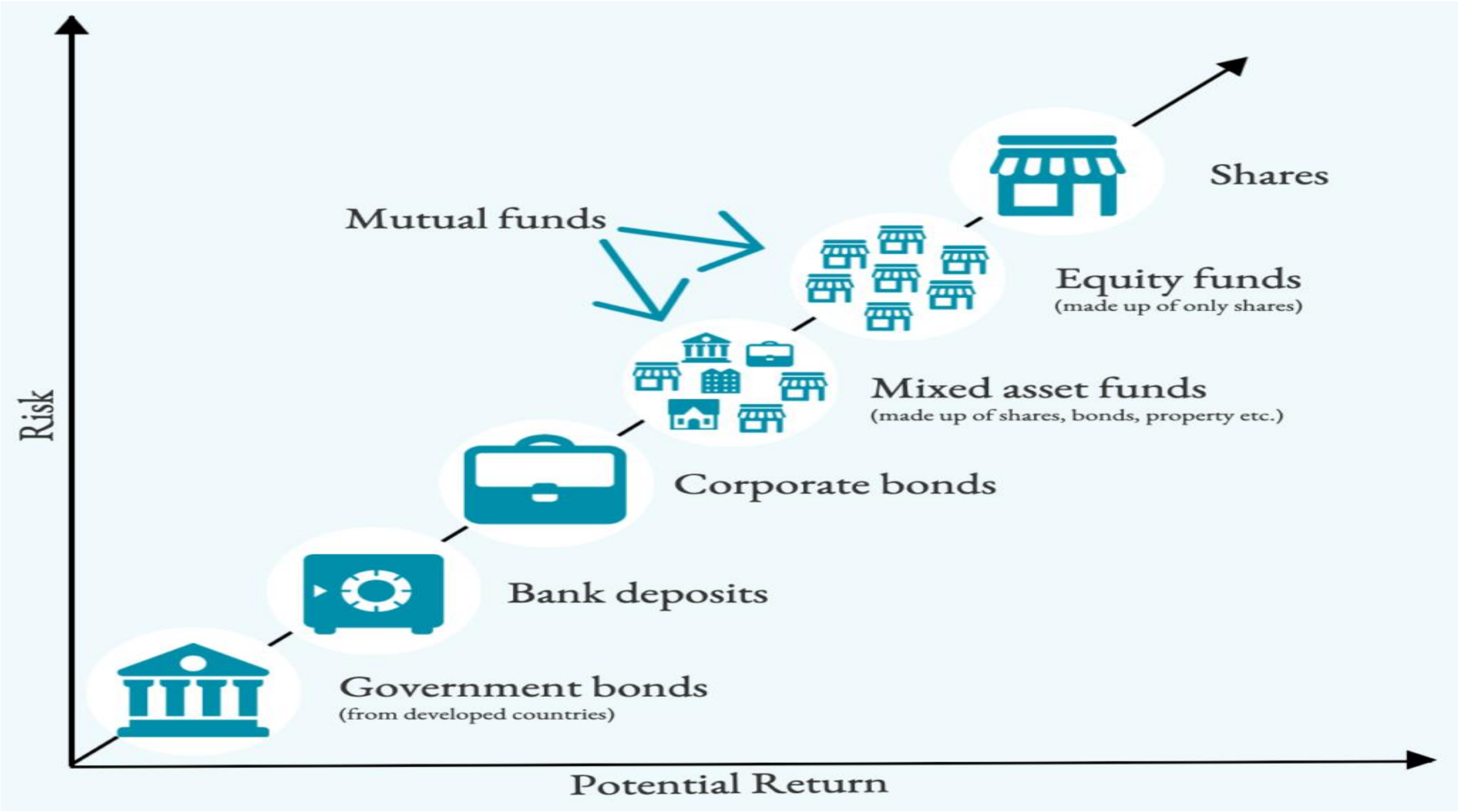
I. Portfolio Theory

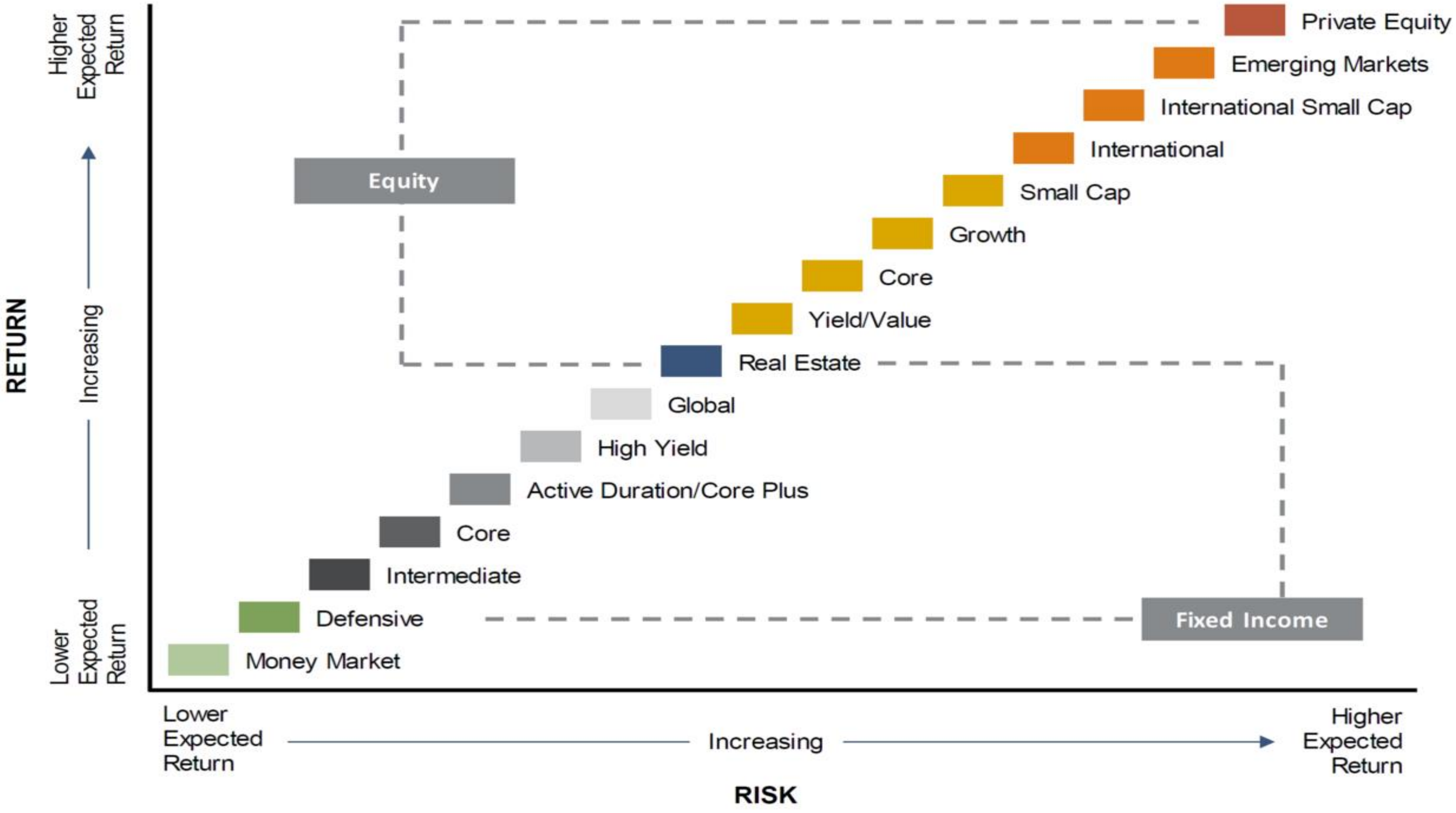
II. Valuation

1. Absolute Valuation Approach
2. Relative Valuation Approach

STUDENT LEARNING OBJECTIVES

- What is investment risk?
- What is Modern Portfolio Theory (MPT)
- What does MPT tell us about managing risk and diversificatio n?
- What is the Capital Asset Pricing Model?
- How does CAPM describe the efficient frontier?


Risk
Shares
Mutual funds
Equity funds
(made up of only shares)
Mixed asset funds
(made up of shares, bonds, property etc.)
Corporate bonds
Bank deposits
Government bonds
(from developed countries)
Potential Return



Source: Callan

INVESTMENT RISK

- The probability of losing some or all of your investment
- Risk is a function of the dispersion of possible future outcomes
  - Expected Value: probability of a particular outcome times the magnitude
  - Risk is measured as the <u>standard deviation of expected outcomes</u>

MODERN PORTFOLIO THEORY (H. MAR KOWITZ)

- The expected return of a portfolio is a weighted average of t he expected returns of each of the securities in the portfolio

$$E(R_p) = \Sigma X_i R_i$$

- The weights (X_i) are equal to the percentage of the portfolio's value which is invested in each security and R_i is the [expecte d] return for each asset i in the portfolio.

What Is the Modern Portfolio Theory (MPT)?

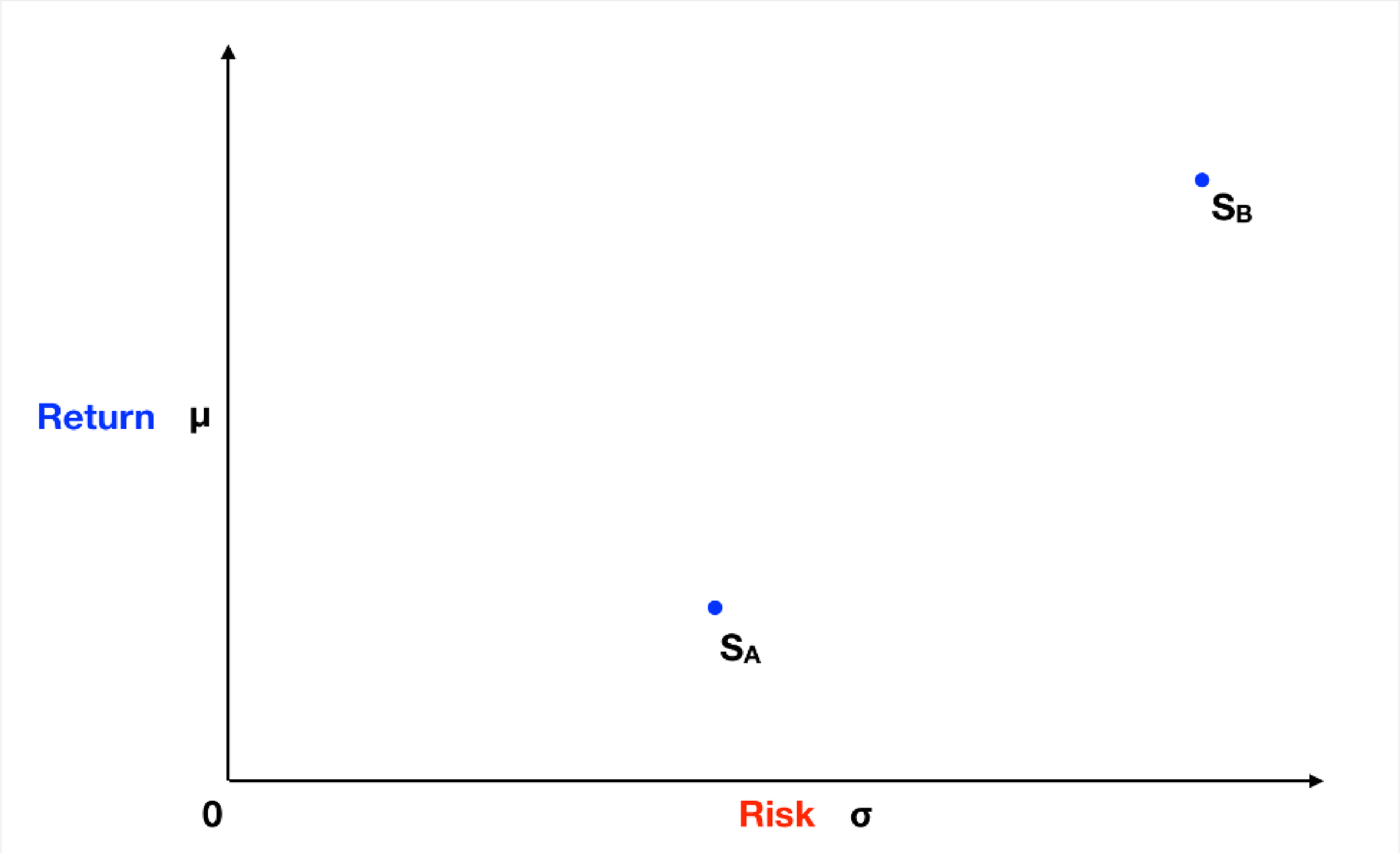
The modern portfolio theory (MPT) is a practical method for selecting investments in order to maximize their overall returns within an acceptable level of risk. This mathematical framework is used to build a portfolio of investments that maximize the amount of expected return for the collective given level of risk.

American economist Harry Markowitz pioneered this theory in his paper "Portfolio Selection," which was published in the Journal of Finance in 1952.[1] He was later awarded a Nobel Prize for his work on modern portfolio theory.[2]

A key component of the MPT theory is diversification. Most investments are either high risk and high return or low risk and low return. Markowitz argued that investors could achieve their best results by choosing an optimal mix of the two based on an assessment of their individual tolerance to risk.

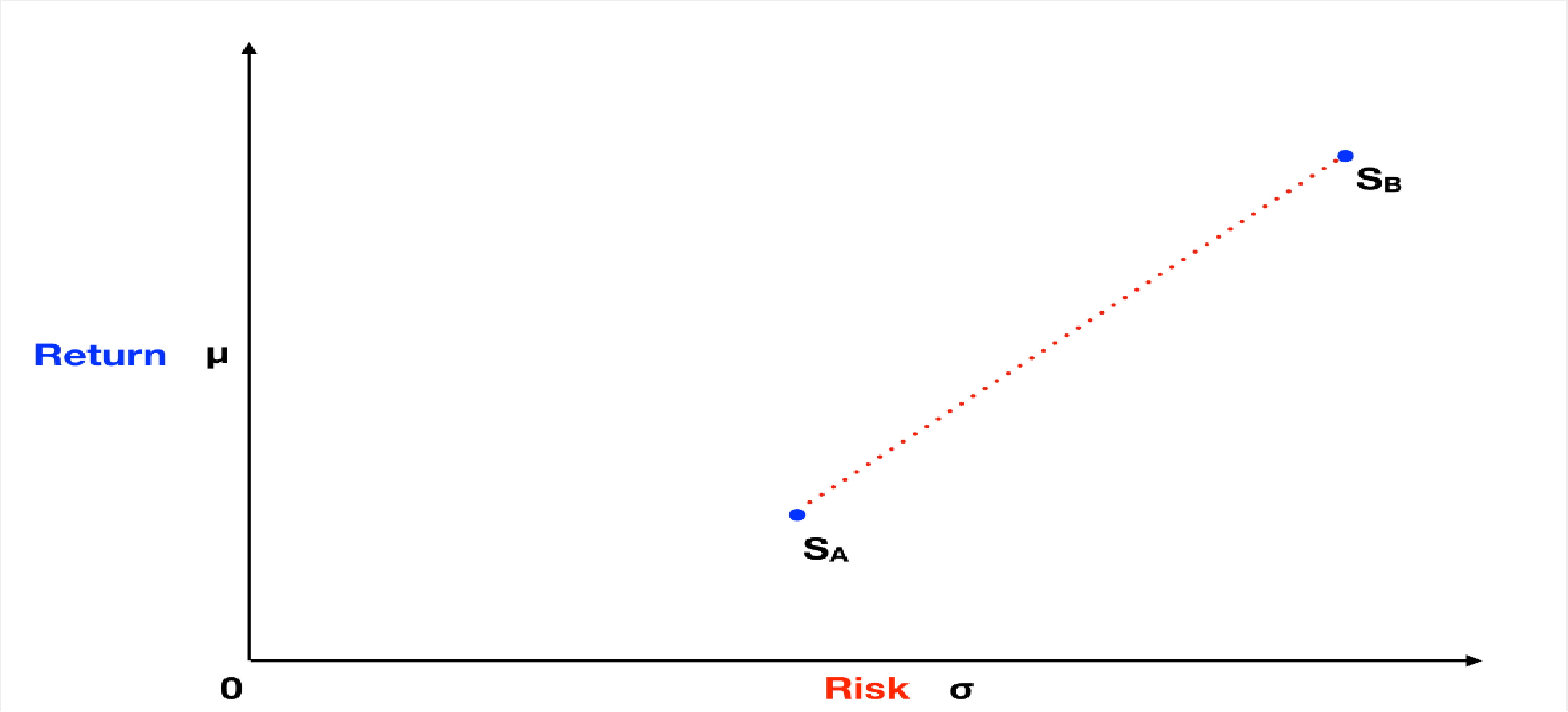
Comparing Assets

Let's start by defining two assets, stock A and stock B, in terms of their expected return and risk, where risk is determined by the stock's volatility in the market. We can then plot and compare these two stocks on the following graph, where the Y axis represents the expected return and the X axis the risk of the stocks.

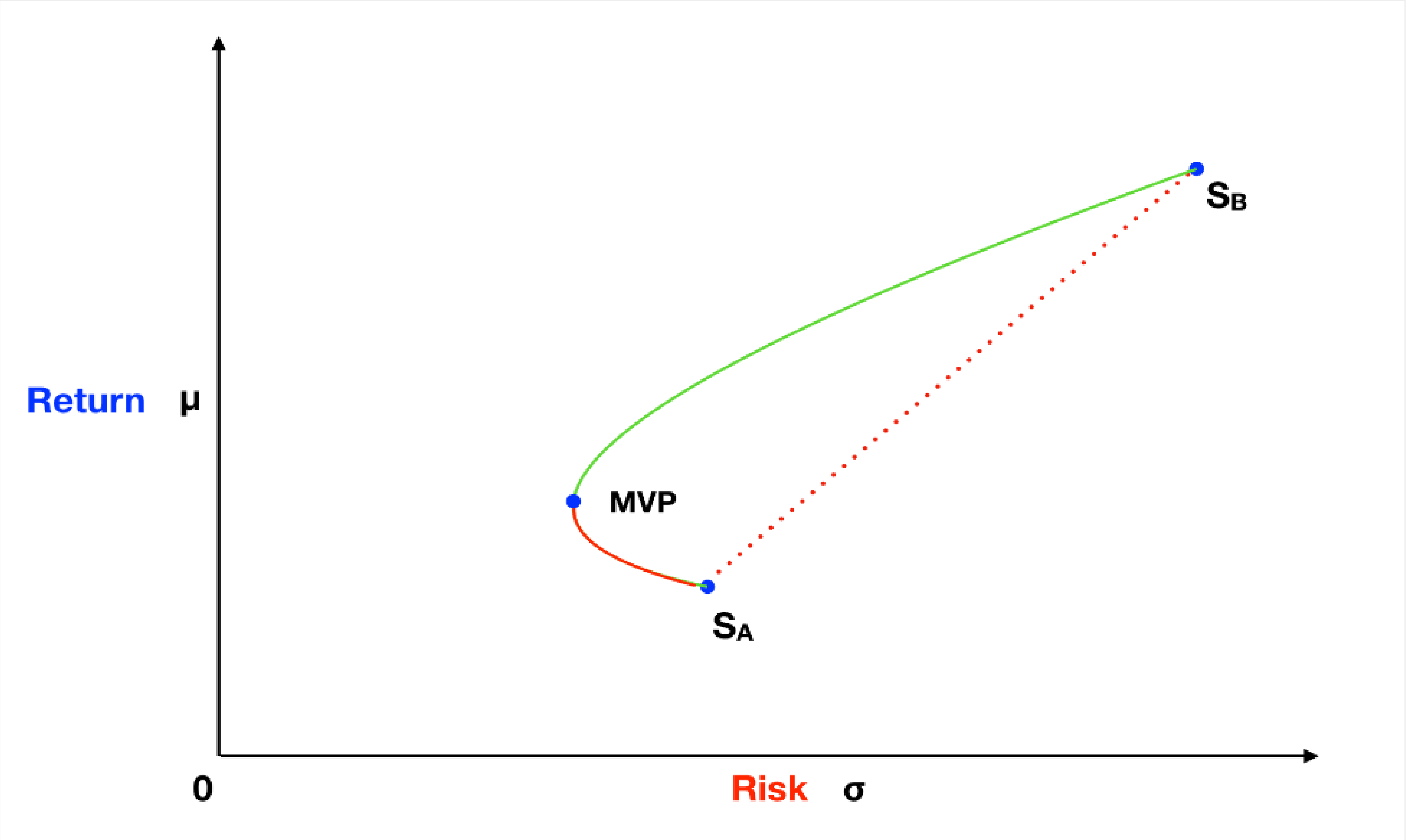


Basic Intuition

We can easily see that stock B has a higher expected return and higher risk than stock A. But can you predict where in this graph is a portfolio with a 50% weight split between these two stocks? Our natural inclination says that such portfolio is half way on a straight line between stock A and stock B. And that a portfolio with 75% weight on stock A and 25% weight on stock B, is one fourth of the way going up that line. The red dotted line on the graph below represents all the possible portfolios between stock A and stock B, as predicted by our basic intuition.



In this case, our intuition is wrong! The line of all possible portfolios of stock A and stock B is not straight, it is curved in the direction of the Y axis, having a hyperbola shape. This is pretty amazing, because it means that we can create portfolios with stock A and stock B, which have less risk than either of these stocks! On the next graph, the blue dot with the label MVP, shows one of these possible portfolios, specifically called the *Minimum Variance Portfolio*.



Correlation Magic

So where is the magic? How is that possible? To solve this puzzle, we need to understand how the portfolio expected return and risk are calculated. I am going to use the two-asset portfolio formula provide on the Wikipedia page for Modern Portfolio Theory. These formulas are easy to deduct with the use of algebra and basic finance knowledge, but I'll spare you the math, so we can focus on the results.

The portfolio expected return calculation is quite simple. It's just a weighted average of the individual stock returns, as illustrated by the following formula:

$$E(R_p) = \omega_A * E(R_A) + \omega_B * E(R_B) = \omega_A * E(R_A) + (1 - \omega_A) * E(R_B)$$

Portfolio Expected Return Formula

Where E(R) is the expected return and ω is the weight allocated to each stock.

This formula is consistent with our initial intuition, that the plot of portfolios created with stock A and stock B would be on a straight line between these two stocks. Now, let's analyze the formula for portfolio variance, which is the square of standard deviation, our chosen measure of risk.

$$\sigma_p^2 = \omega_A^2 * \sigma_A^2 + \omega_B^2 * \sigma_B^2 + 2 * \omega_A * \omega_B * \sigma_A * \sigma_B * \rho_{AB}$$

Portfolio Variance Formula

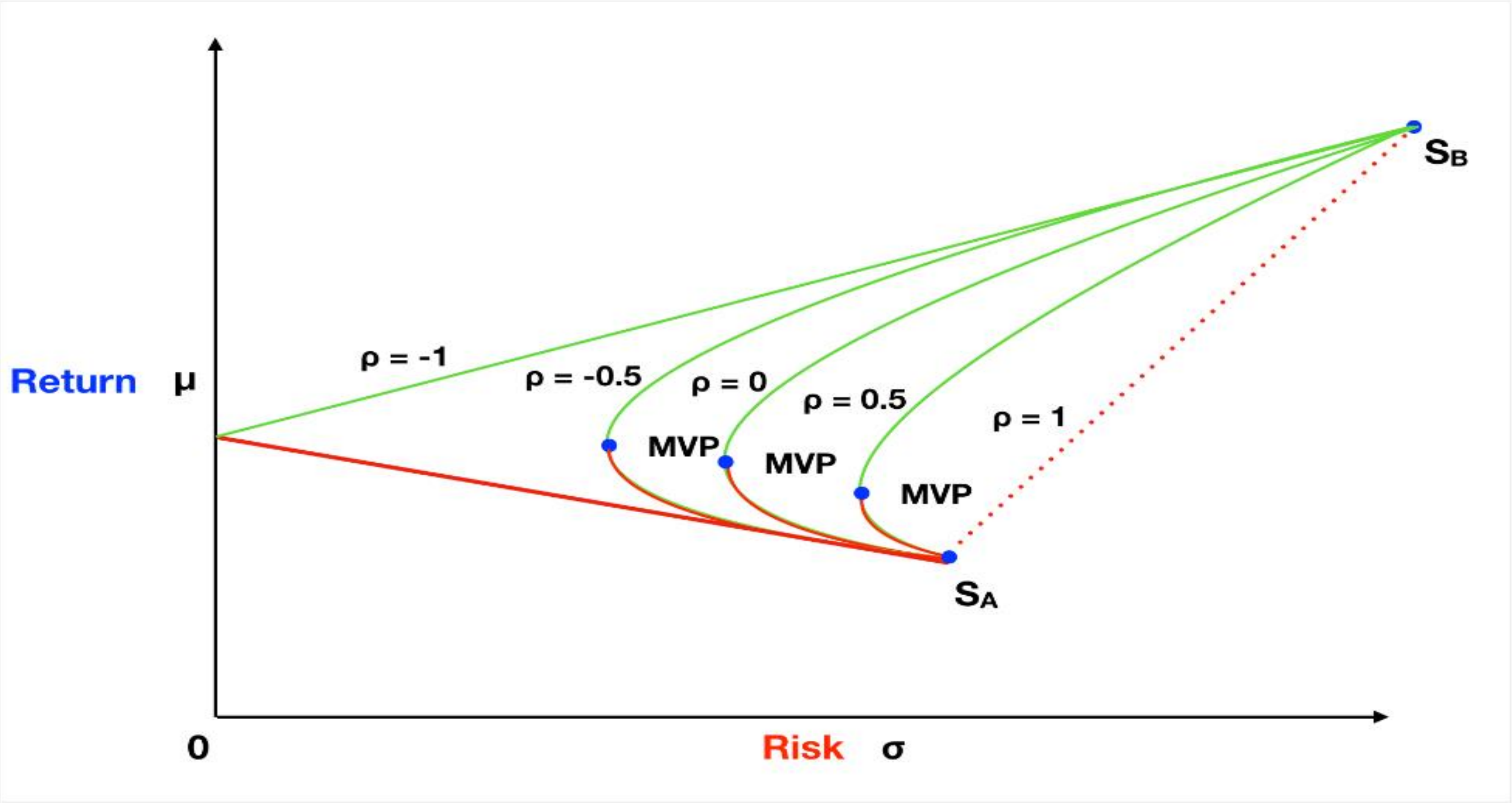
Where σ is the standard deviation of each stock and ρ is the correlation between stocks.

This is where our intuition is failing us. The portfolio variance formula has an additional, and unexpected, component: the correlation between the stocks. Correlation is a number varying between -1 and 1 and describes how the stock returns are related. If the two stocks had a perfect positive correlation, ρ would be equal 1, and the formula would look like this:

$$\sigma_p{}^2 = \omega_A{}^2 * \sigma_A{}^2 + \omega_B{}^2 * \sigma_B{}^2 + 2 * \omega_A * \omega_B * \sigma_A * \sigma_B * \rho_{AB} = (\omega_A * \sigma_A + \omega_B * \sigma_B)^2$$

Portfolio Variance Formula → A and B Correlation = 1

This would be coherent with our initial intuition, that all portfolios formed with stock A and stock B would be on the straight line between A and B. But in the market, stocks rarely have perfect positive correlation. Stock A could go up by 1% and stock B go up by 2% in one month, and then on the following month, stock A goes up by 0.5% and stock B goes down by 0.7%. So ρ will probably be a number lower than 1, therefore, reducing the overall portfolio variance. The graph below shows hypothetical hyperbola curves, each using a different correlation, of portfolios created by combining stock A and B. You can easily see that the lower the correlation of these two stocks, the bigger the reduction in portfolio variance, hence, the lower the portfolio risk.



Risk and Return Graph For Two Assets → Varying Correlations

Next: Portfolio Management

MODERN PORTFOLIO THEORY

C. The riskiness of a portfolio is more complex; it is the square root of the sum of the weighted (X^2i) times the variances (s^2) of each se curity and the correlation (r - rho) between each pair of securities i n a 2-Asset Portfolio.

$$\sigma_p = (X^2_i \sigma^2_i + X^2_j \sigma^2_j + 2 X_i X_j \rho_{i,j} \sigma_i \sigma_j)^{1/2}$$

- The correlation coefficient ($\rho_{i,j}$) can be positive (+1), zero, or negative (-1)
- If the average correlation of securities in the portfolio is positive – the riski ness of the portfolio will be larger.
- If the average correlation of securities in the portfolio is negative – the risk iness of the portfolio is smaller: the third term will be negative

MODERN PORTFOLIO THEORY

- The following conclusions can be drawn:
  - When the holding period returns of two securities move in the same direction, by the same amount at the same time, the pair is perfectly positively correlated: rho = 1
  - When the holding period returns of two securities are totally unrelat ed to each other, the pair is uncorrelated; rho = 0
  - The risk of a portfolio is the weighted average of the risk of each se curity in the portfolio, and the correlations between each pair of sec urities in the portfolio
  - Some textbooks use the covariance terms in the third term of Eq. 17 -4: $\sigma_{i,j} = \rho_{i,j}\,\sigma_i\,\sigma_j\,\rho$ = rho (r)

Risk Reduction: Benefits of Diversification

- Portfolio diversification
  - Diversification can increase the risk/return tradeoff if the average correlatio n coefficient between individual securities in the portfolio is less than 1.0
  - The benefits of diversification increase as the correlation coefficient gets s maller
- Diversification across securities
  - As the number of securities in a portfolio increases the portfolio risk decre ases and approaches the risk of the total market
  - Market risk is inherent from business cycles, inflation, interest rates, and ec onomic factors
  - Firm-specific risk is tied to the company's labor contracts, new product dev elopment and other company related factors

Risk Reduction: Benefits of Diversification

C. Forms of Diversification

- Mathematical: Increasing the number of stocks reduces the portfolio risk
- Diversification across time
- Dollar cost averaging
- Naive Diversification
  - Naive diversification occurs when investors select stocks at random, and purchase and equal dollar amount of each security
  - When N becomes large enough, naive diversification averages out the firm-specific (unsystematic) risk of the stocks in the portfolio, so that only the market (or systematic) risk remains

Capital Asset Pricing Model (CAPM)

- Equation that defines the risk/return relationship
  - The CAPM assumes two assets: the risk-free asset and the risky mark et portfolio
  - The two asset CAPM world results in a linear efficient frontier: Capita l Market Line (CML)
  - The risk aversion characteristic of the investor will determine how m uch is invested in the risk-free asset and how much is invested in th e risky market portfolio
  - The standard deviation of the risk-free asset is zero.
  - Based on the idea that investors accept a higher risk only for a high er return

II. Valuation (Firm and Stock)

1. Absolute Valuation

Fundamental Approach
(Top-down Approach vs Bottom-up Approach)

2. Relative Valuation

1. Top-down Approach

1) Global Macro Analysis

2) Industry Analysis

3) Company Analysis