Portfolio Management

Study Sessions 18 & 19

Weight on Exam	6%
SchweserNotes™ Reference	Book 5, Pages 77–197

STUDY SESSION 18: PORTFOLIO MANAGEMENT (1)

PORTFOLIO MANAGEMENT: AN OVERVIEW

Cross-Reference to CFA Institute Assigned Reading #51

The Portfolio Perspective

The **portfolio perspective** refers to evaluating individual investments by their contribution to the risk and return of an investor's overall portfolio. The alternative is to examine the risk and return of each security in isolation. An investor who holds all his wealth in a single stock because he believes it to be the best stock available is not taking the portfolio perspective—his portfolio is very risky compared to a diversified portfolio.

Modern portfolio theory concludes that the extra risk from holding only a single security is not rewarded with higher expected investment returns. Conversely, diversification allows an investor to reduce portfolio risk without necessarily reducing the portfolio's expected return.

The **diversification ratio** is calculated as the ratio of the risk of an equal-weighted portfolio of *n* securities (standard deviation of returns) to the risk of a single security selected at random from the portfolio. If the average standard deviation of returns of the *n* stocks is 25%, and the standard deviation of returns of an equal-weighted portfolio of the *n* stocks is 18%, the diversification ratio is 18 / 25 = 0.72. Note that a *lower* diversification ratio indicates a *greater* risk-reduction benefit from diversification.

- Portfolio diversification works best when financial markets are operating normally.
- Diversification provides less reduction of risk during market turmoil.
- During periods of financial crisis, correlations tend to increase, which reduces the benefits of diversification.

Steps in the Portfolio Management Process

Planning begins with an analysis of the investor's risk tolerance, return objectives, time horizon, tax exposure, liquidity needs, income needs, and any unique circumstances or investor preferences.

This analysis results in an **investment policy statement (IPS)** that:

- Details the investor's investment objectives and constraints.
- Specifies an objective benchmark (such as an index return).
- Should be updated at least every few years and anytime the investor's objectives or constraints change significantly.

The **execution** step requires an analysis of the risk and return characteristics of various asset classes to determine the asset allocation. In *top-down* analysis, a portfolio manager examines current macroeconomic conditions to identify the asset classes that are most attractive. In *bottom-up* analysis, portfolio managers seek to identify individual securities that are undervalued.

Feedback is the final step. Over time, investor circumstances will change, risk and return characteristics of asset classes will change, and the actual weights of the assets in the portfolio will change with asset prices. The portfolio manager must monitor changes, **rebalance** the portfolio periodically, and evaluate performance relative to the benchmark portfolio identified in the IPS.

Investment Management Clients

Individual investors save and invest for a variety of reasons, including purchasing a house or educating their children. In many countries, special accounts allow citizens to invest for retirement and to defer any taxes on investment income and gains until the funds are withdrawn. Defined contribution pension plans are popular vehicles for these investments.

Many types of **institutions** have large investment portfolios. **Defined benefit pension plans** are funded by company contributions and have an obligation to provide specific benefits to retirees, such as a lifetime income based on employee earnings.

An **endowment** is a fund that is dedicated to providing financial support on an ongoing basis for a specific purpose. A **foundation** is a fund established for charitable purposes to support specific types of activities or to fund research related to a particular disease.

The investment objective of a **bank** is to earn more on the bank's loans and investments than the bank pays for deposits of various types. Banks seek to keep risk low and need adequate liquidity to meet investor withdrawals as they occur.

Insurance companies invest customer premiums with the objective of funding customer claims as they occur.

Investment companies manage the pooled funds of many investors. **Mutual funds** manage these pooled funds in particular styles (e.g., index investing, growth investing, bond investing) and restrict their investments to particular subcategories of investments (e.g., large-firm stocks, energy stocks, speculative bonds) or particular regions (emerging market stocks, international bonds, Asian-firm stocks).

Sovereign wealth funds refer to pools of assets owned by a government.

Figure 51.1 provides a summary of the risk tolerance, investment horizon, liquidity needs, and income objectives for these different types of investors.

Figure 51.1: Characteristics of Different Types of Investors

Investor	Risk Tolerance	Investment Horizon	Liquidity Needs	Income Needs
Individuals	Depends on individual	Depends on individual	Depends on individual	Depends on individual
DB pensions	High	Long	Low	Depends on age
Banks	Low	Short	High	Pay interest
Endowments	High	Long	Low	Spending level
Insurance	Low	Long—life Short—P&C	High	Low
Mutual funds	Depends on fund	Depends on fund	High	Depends on fund

The Asset Management Industry

The asset management industry comprises firms that manage investments for clients. They are referred to as **buy-side firms**, in contrast with **sell-side firms** such as broker/dealers and investment banks.

Full-service asset managers are those that offer a variety of investment styles and asset classes.

Specialist asset managers may focus on a particular investment style or a particular asset class.

A **multi-boutique firm** is a holding company that includes a number of different specialist asset managers.

A key distinction is between firms that use active or passive management. **Active management** attempts to outperform a chosen benchmark through manager skill, for example by using fundamental or technical analysis. **Passive management** attempts to replicate the performance of a chosen benchmark index. This may include traditional broad market index tracking or a **smart beta** approach that focuses on exposure to a particular market risk factor.

Asset management firms may also be classified as traditional or alternative asset managers. Traditional asset managers focus on equities and fixed income securities. Alternative asset managers focus on asset classes such as private equity, hedge funds, real estate, or commodities.

Robo-advisors are a technology that offers investors portfolio allocation advice and recommendations based on their investment requirements and constraints, using a computer algorithm.

PORTFOLIO RISK AND RETURN: PART I

Cross-Reference to CFA Institute Assigned Reading #52

Risk and Return of Major Asset Classes

Based on U.S. data over the period 1926–2017, Figure 52.1 indicates that small capitalization stocks have had the greatest average returns and greatest risk over the period. T-bills had the lowest average returns and the lowest standard deviation of returns.

Figure 52.1: Risk and Return of Major Asset Classes in the United States (1926–2017)[1]

Assets Class	Average Annual Return (Geometric Mean)	Standard Deviation (Annualized Monthly)
Small-cap stocks	12.1%	31.7%
Large-cap stocks	10.2%	19.8%
Long-term corporate bonds	6.1%	8.3%
Long-term government bonds	5.5%	9.9%
Treasury bills	3.4%	3.1%
Inflation	2.9%	4.0%

Results for other markets around the world are similar: asset classes with the greatest average returns also have the highest standard deviations of returns.

Variance and Standard Deviation

Variance of the rate of return for a risky asset calculated from expectational data (a probability model) is the probability-weighted sum of the squared differences between the returns in each state and the unconditional expected return.

$$\text{variance} = \sigma^2 = \sum_{i=1}^{n}\left\{[R_i - E(R)]^2 \times P_i\right\}$$
$$\text{standard deviation} = \sigma = \sqrt{\sigma^2}$$

Covariance and Correlation

Covariance measures the extent to which two variables move together over time. The covariance of returns is an absolute measure of movement and is measured in return units squared.

Using *historical data*, we take the product of the two securities' deviations from their expected returns for each period, sum them, and divide by the number of (paired) observations minus one.

$$\text{cov}_{1,2} = \frac{\sum_{t=1}^{n}\left\{[R_{t,1} - \overline{R}_1]\,[R_{t,2} - \overline{R}_2]\right\}}{n-1}$$

1 2018 Ibbotson SBBI Yearbook

Covariance can be standardized by dividing by the product of the standard deviations of the two securities. This standardized measure of co-movement is called their *correlation coefficient* or *correlation* and is computed as:

$$\text{correlation of assets 1 and 2} = \rho_{1,2} = \frac{\text{cov}_{1,2}}{\sigma_1 \sigma_2} \text{ so that,}$$

$$\text{cov}_{1,2} = \rho_{1,2}\sigma_1\sigma_2$$

Risk Aversion

A **risk-averse** investor is simply one that dislikes risk (i.e., prefers less risk to more risk). Given two investments that have equal expected returns, a risk-averse investor will choose the one with less risk (standard deviation, σ).

A **risk-seeking** (risk-loving) investor actually prefers more risk to less and, given equal expected returns, will choose the more risky investment. A **risk-neutral** investor has no preference regarding risk and would be indifferent between two such investments.

A risk-averse investor may select a very risky portfolio despite being risk averse; a risk-averse investor may hold very risky assets if he feels that the extra return he expects to earn is adequate compensation for the additional risk.

Risk and Return for a Portfolio of Risky Assets

When risky assets are combined into a portfolio, the expected portfolio return is a weighted average of the assets' expected returns, where the weights are the percentages of the total portfolio value invested in each asset.

The standard deviation of returns for a portfolio of risky assets depends on the standard deviations of each asset's return (σ), the proportion of the portfolio in each asset (w), and, crucially, on the covariance (or correlation) of returns between each asset pair in the portfolio.

Portfolio standard deviation for a two-asset portfolio:

$$\sigma_p = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{12}}$$

which is equivalent to:

$$\sigma_p = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\text{Cov}_{12}}$$

If two risky asset returns are perfectly positively correlated, $\rho_{12} = +1$, then the square root of portfolio variance (the portfolio standard deviation of returns) is equal to:

$$\sigma_{portfolio} = \sqrt{Var_{portfolio}} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2(1)}$$
$$= w_1\sigma_1 + w_2\sigma_2$$

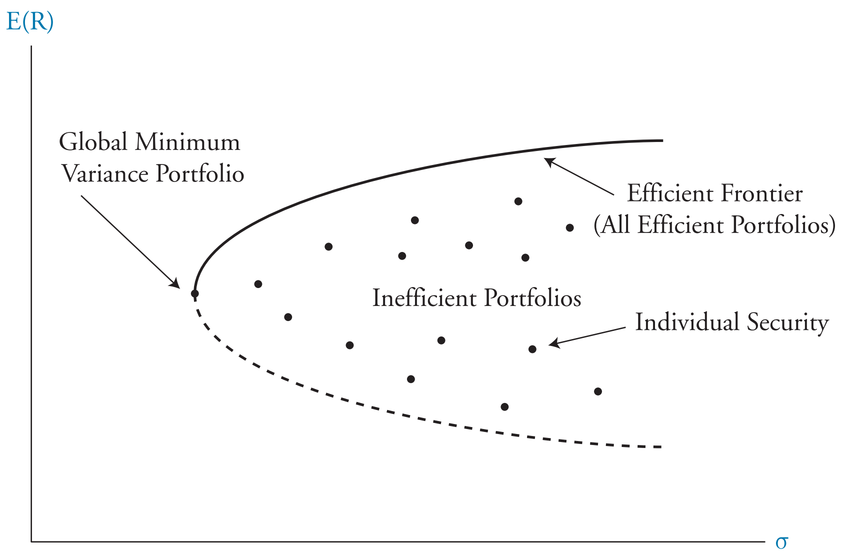
In this unique case, with $\rho_{12} = +1$, the portfolio standard deviation is simply the weighted average of the standard deviations of the individual asset returns.

Other things equal, the greatest portfolio risk results when the correlation between asset returns is +1. For any value of correlation less than +1, portfolio variance is reduced. Note that for a correlation of zero, the entire third term in the portfolio variance equation is zero. For negative values of correlation ρ_{12}, the third term becomes negative and further reduces portfolio variance and standard deviation.

Efficient Frontier

The Markowitz efficient frontier represents the set of possible portfolios that have the greatest expected return for each level of risk (standard deviation of returns).

Figure 52.2: Minimum Variance and Efficient Frontiers



An Investor's Optimal Portfolio

An investor's **expected utility function** depends on his degree of risk aversion. An **indifference curve** plots combinations of risk (standard deviation) and expected return among which an investor is indifferent, as they all have equal expected utility.

Indifference curves slope upward for risk-averse investors because they will only take on more risk if they are compensated with greater expected return. An investor who is relatively more risk averse requires a relatively greater increase in expected return to compensate for taking on greater risk. In other words, a more risk-averse investor will have steeper indifference curves.

In our previous illustration of efficient portfolios available in the market, we included only risky assets. When we add a risk-free asset to the universe of available assets, the efficient frontier is a straight line. Using the formulas:

$$E(R_{portfolio}) = W_A E(R_A) + W_B E(R_B)$$

$$\sigma_{portfolio} = \sqrt{W_A^2 \sigma_A^2 + W_B^2 \sigma_B^2 + 2 W_A W_B \rho_{AB} \sigma_A \sigma_B}$$

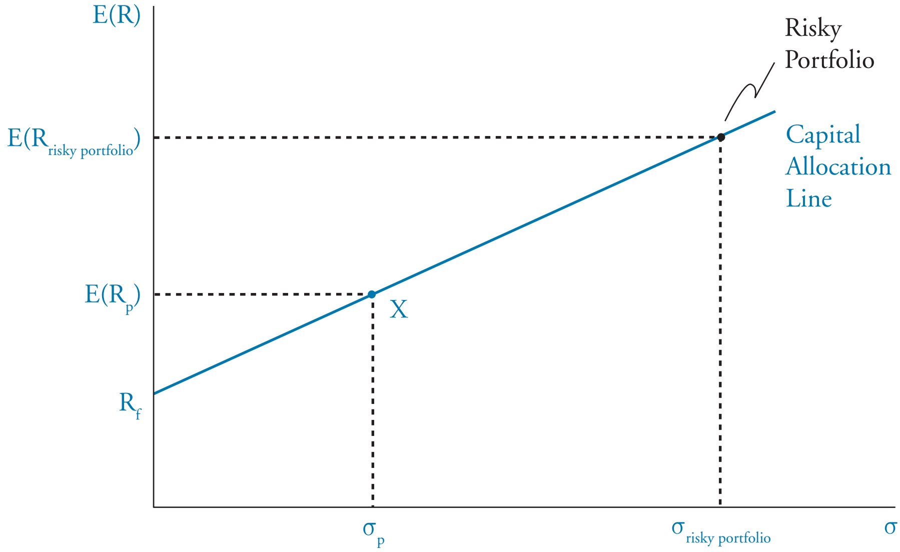
allow Asset B to be the risk-free asset and Asset A to be a risky portfolio of assets.

Because a risk-free asset has zero standard deviation and zero correlation of returns with those of the risky portfolio, this results in the reduced equation:

$$\sigma_{portfolio} = \sqrt{W_A^2 \sigma_A^2} = W_A \sigma_A$$

If we put X% of our portfolio into the risky asset portfolio, the resulting portfolio will have standard deviation of returns equal to X% of the standard deviation of the risky asset portfolio. The relationship between portfolio risk and return for various portfolio allocations is linear, as illustrated in Figure 52.3.

Figure 52.3: Capital Allocation Line and Risky Asset Weights

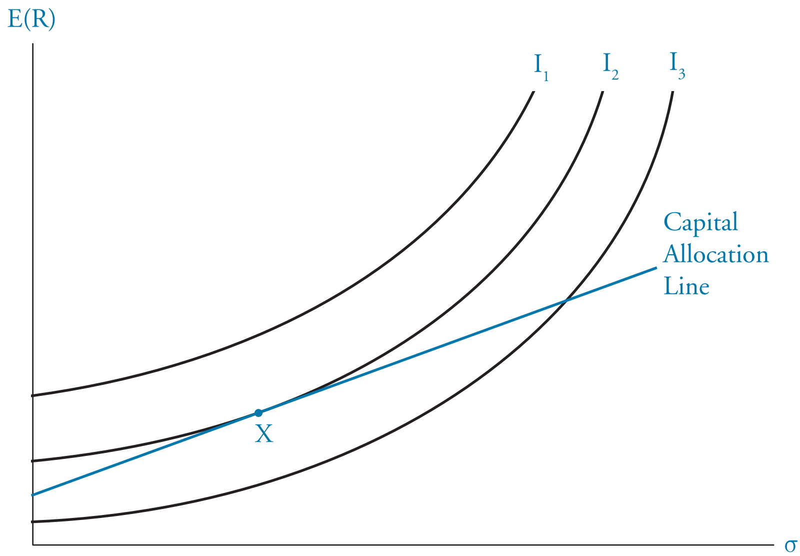


Combining a risky portfolio with a risk-free asset is the process that supports the **two-fund separation theorem**, which states that all investors' optimum portfolios will be made up of some combination of an optimal portfolio of risky assets and the risk-free asset. The line representing these possible combinations of risk-free assets and the optimal risky asset portfolio is referred to as the **capital allocation line**.

Point X on the capital allocation line in Figure 52.3 represents a portfolio that is 40% invested in the risky asset portfolio and 60% invested in the risk-free asset. Its expected return will be $0.40[E(R_{\text{risky asset portfolio}})] + 0.60(R_f)$ and its standard deviation will be $0.40(\sigma_{\text{risky asset portfolio}})$.

We can combine the capital allocation line with indifference curves to illustrate the logic of selecting an optimal portfolio (i.e., one that maximizes the investor's expected utility). In Figure 52.4, we can see that an investor with preferences represented by indifference curves I_1, I_2, and I_3 can reach the level of expected utility on I_2 by selecting portfolio X. This is the optimal portfolio for this investor, as any portfolio that lies on I_2 is preferred to all portfolios that lie on I_3 (and in fact to any portfolios that lie between I_2 and I_3). Portfolios on I_1 are preferred to those on I_2, but none of the portfolios that lie on I_1 are available in the market.

Figure 52.4: Risk-Averse Investor's Indifference Curves



The final result of our analysis here is not surprising; investors who are less risk averse will select portfolios with more risk. As illustrated in Figure 52.5, the flatter indifference curve for Investor B (I_B) results in an optimal (tangency) portfolio that lies to the right of the one that results from a steeper indifference curve, such as that for Investor A (I_A). An investor who is less risk averse should optimally choose a portfolio with more invested in the risky asset portfolio and less invested in the risk-free asset.

Figure 52.5: Portfolio Choices Based on Investor's Indifference Curves