Stock Exchange and Portfolio Management-II (FIN)

Portfolio Management - Meaning and Important Concepts

It is essential for individuals to invest wisely for the rainy days and to make their future secure.

What is a Portfolio?

A portfolio refers to a collection of investment tools such as stocks, shares, mutual funds, bonds, cash and so on depending on the investor's income, budget and convenient time frame.

Following are the two types of Portfolio:

1. Market Portfolio
2. Zero Investment Portfolio

What is Portfolio Management?

The art of selecting the right investment policy for the individuals in terms of minimum risk and maximum return is called as portfolio management.

Portfolio management refers to managing an individual's investments in the form of bonds, shares, cash, mutual funds etc so that he earns the maximum profits within the stipulated time frame.

Portfolio management refers to managing money of an individual under the expert guidance of portfolio managers.

In a layman's language, the art of managing an individual's investment is called as portfolio management.

Need for Portfolio Management

Portfolio management presents the **best investment plan** to the individuals as per their income, budget, age and ability to undertake risks.

Portfolio management **minimizes the risks** involved in investing and also increases the chance of making profits.

Portfolio managers understand the client's financial needs and suggest the best and unique investment policy for them with minimum risks involved.

Portfolio management enables the portfolio managers to **provide customized investment solutions** to clients as per their needs and requirements.

Types of Portfolio Management

Portfolio Management is further of the following types:

- **Active Portfolio Management:** As the name suggests, in an active portfolio management service, the portfolio managers are actively involved in buying and selling of securities to ensure maximum profits to individuals.
- **Passive Portfolio Management:** In a passive portfolio management, the portfolio manager deals with a fixed portfolio designed to match the current market scenario.
- **Discretionary Portfolio management services:** In Discretionary portfolio management services, an individual authorizes a portfolio manager to take care of his financial needs on his behalf. The individual issues money to the portfolio manager who in turn takes care of all his investment needs, paper work, documentation, filing and so on. In discretionary portfolio management, the portfolio manager has full rights to take decisions on his client's behalf.
- **Non-Discretionary Portfolio management services:** In non discretionary portfolio management services, the portfolio manager can merely advise the client what is good and bad for him but the client reserves full right to take his own decisions.

Who is a Portfolio Manager?

An individual who understands the client's financial needs and designs a suitable investment plan as per his income and risk taking abilities is called a portfolio manager. A portfolio manager is one who invests on behalf of the client.

A portfolio manager counsels the clients and advises him the best possible investment plan which would guarantee maximum returns to the individual.

In an investment setting, an investor sets his required rate of return as the base return he requires from an investment. However, given the usual uncertainty in the market, it is difficult to meet that required rate of return exactly. As such, an investor would set his return above his required rate of return to diminish the risk that his required rate of return will not be met. The excess return above the investor's required rate of return is known as the risk premium.
The fundamental sources of risk that contribute to the need of the risk premium, such as:

1. Business risk
2. Financial risk
3. Liquidity risk
4. Exchange rate risk
5. Political risk.

These risks comprise systematic risk, and cannot be avoided through diversification since they affect the entire market.

1. ***Business Risk:*** Business risk is the risk that a business' cash flow will not meet its needs due to uncertainty in the company's business lines.
2. ***Financial Risk:*** Financial risk is the risk to equity holders as a company increases its debt load. As debt load increases, interest expense also increases, leading to less income to be paid out to investors.
3. ***Liquidity Risk:*** Liquidity risk is the uncertainty around the ability to sell an investment. The more liquid an investment is the easier it is to sell.

4. ***Exchange-Rate Risk*:** Exchange-rate risk is the risk a company faces when it has businesses in other countries. When a company is in the business of producing or buying products in a country other than its own, a company can face exchange-rate risk when in the process when it needs to exchange currency to transact business as a part of its normal business routine.

5. ***Political Risk:*** Political risk is the risk of changes in the political environment of a country in which company transacts its businesses. This risk could be caused by changes in laws relating to a specific business or even more serious as a country revolution that would cause disruption in a company's operations.

T he portfolio management process is the process an investor takes to aid him in meeting his investment goals.

The procedure is as follows:

1. ***Create a Policy Statement*** -A policy statement is the statement that contains the investor's goals and constraints as it relates to his investments.

2. ***Develop an Investment Strategy* -** This entails creating a strategy that combines the investor's goals and objectives with current financial market and economic conditions.

3. ***Implement the Plan Created*** -This entails putting the investment strategy to work, investing in a portfolio thatmeets the client's goals and constraint requirements.

4. ***Monitor and Update the Plan*** -Both markets and investors' needs change as time changes. As such, it is important to monitor for these changes as they occur and to update the plan toadjust for the changes that have occurred.

Policy Statement

A policy statement is the statement that contains the investor's goals and constraints as it relates to his investments. This could be considered to be the most important of all the steps in the portfolio management process. The statement requires the investor to consider his true financial needs, both in the short run and the long run. It helps to guide the investment portfolio manager in meeting the investor's needs. When there is market uncertainty or the investor's needs change, the policy statement will help to guide the investor in making the necessary adjustments the portfolio in a disciplined manner.

Expressing Investment Objectives in Terms of Risk and Return

Return objectives are important to determine. They help to focus an investor on meeting his financial goals and objectives. However, risk must be considered as well. An investor may require a high rate of return. A high rate of return is typically accompanied by a higher risk. Despite the need for a high return, an investor may be uncomfortable with the risk that is attached to that higher return portfolio. As such, it is important to consider not only return, but the risk of the investor in a policy statement.

Factors Affecting Risk Tolerance

An investor's risk tolerance can be affected by many factors:

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- ***Age***- an investor may have lower risk tolerance as they get older and financial constraints are more prevalent.
- ***Family situation*** - an investor may have higher income needs if they are supporting a child in college or an elderly relative.
- ***Wealth and income*** - an investor may have a greater ability to invest in a portfolio if he or she has existing wealth or high income.
- ***Psychological*** - an investor may simply have a lower tolerance for risk based on his personality.

Risk Aversion

Risk aversion is an investor's general desire to avoid participation in "risky" behavior or, in this case, risky investments. Investors typically wish to maximize their return with the least amount of risk possible. When faced with two investment opportunities with similar returns, good investor will always choose the investment with the least risk as there is no benefit to choosing a higher level of risk unless there is also an increased level of return.

Insurance is a great example of investors' risk aversion. Given the potential for a car accident, an investor would rather pay for insurance and minimize the risk of a huge outlay in the event of an accident.

Markowitz Portfolio Theory

Harry Markowitz developed the portfolio model. This model includes not only expected return, but also includes the level of risk for a particular return. Markowitz assumed the following about an individual's investment behavior:

Given the same level of expected return, an investor will choose the investment with the lowest amount of risk.

Investors measure risk in terms of an investment's variance or standard deviation.

For each investment, the investor can quantify the investment's expected return and the probability of those returns over a specified time horizon.

Investors seek to maximize their utility.

Investors make decision based on an investment's risk and return, therefore, an investor's utility curve is based on risk and return.

The Efficient Frontier

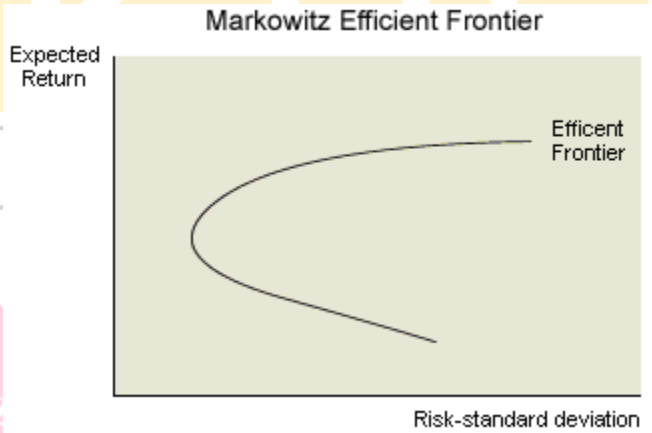
Markowitz' work on an individual's investment behavior is important not only when looking at individual investment, but also in the context of a portfolio. The

risk of a portfolio takes into account each investment's risk and return as well as the investment's correlation with the other investments in the portfolio.

Risk of a portfolio is affected by the risk of each investment in the portfolio relative to its return, as well as each investment\'s correlation with the other investments in the portfolio.

A portfolio is considered efficient if it gives the investor a higher expected return with the same or lower level of risk as compared to another investment.
The efficient frontier is simply a plot of those efficient portfolios, as illustrated below.

Figure 17.2: Efficient Frontier



While an efficient frontier illustrates each of the efficient portfolios relative to risk and return levels, each of the efficient portfolios may not be appropriate for every investor. Recall that when creating an investment policy, return and risk were the key objectives.

An investor's risk profile is illustrated with indifference curves. The optimal portfolio, then, is the point on the efficient frontier that is tangential to the investor's highest indifference curve. See our article: A Guide to Portfolio Construction, for some essential steps when taking a systematic approach to constructing a portfolio.

Individual Investment The expected return for an individual investment is simply the sum of the probabilities of the possible expected returns for the investment.

Formula 17.3

Expected Return $E(R) = p_1R_1 + p_2R_2 + ...+ p_nR_n$

Where: p_n = the probability the return actually will occur in state n

R_n = the expected return for state n

Example:

For Newco's stock, assume the following potential returns.

Figure 3.3: Expected returns for Newco's stock price in the various states

Scenario	Probability	Expected Return
Worst Case	10%	10%
Base Case	80%	14%
Best Case	10%	18%

Given the above assumptions, determine the expected return for Newco's stock.

Answer:

E(R) = (0.10)(10%) + (0.80)(14%) + (0.10)(18%)

E(R) = 14.0%

The expected return for Newco's stock is 14%.

Portfolio

To determine the expected return on a portfolio, the weighted average expected return of the assets that comprise the portfolio is taken.

Formula 17.4

E(R) of a portfolio = $w_1R_1 + w_2R_q + ...+ w_nR_n$

Example:

Assume an investment manager has created a portfolio with the Stock A and Stock B. Stock A has an expected return of 20% and a weight of 30% in the portfolio. Stock B has an expected return of 15% and a weight of 70%. What is the expected return of the portfolio?

Answer:

E(R) = (0.30)(20%) + (0.70)(15%)

= 6% + 10.5% = 16.5%

The expected return of the portfolio is 16.5%

Computing Variance and Standard Deviation for an Individual

To measure the risk of an investment, both the variance and standard deviation for that investment can be calculated.

Formula 17.5

Variance = $\sigma^2 = \sum P_n (R_n - E(R))^2$

Where: P_n = probability of occurrence

R_n = return in n occurrence

E(R) = expected return

Formula 17.6

Standard Deviation = $\sigma = \sqrt{\sigma^2}$

Example: Variance and Standard Deviation of an Investment

Given the following data for Newco's stock, calculate the stock's variance and standard deviation. The expected return based on the data is 14%.

Figure: Expected return for Newco in various states

Scenario	Probability	Return	Expected Return
Worst Case	10%	10%	0.01
Base Case	80%	14%	0.112
Best Case	10%	18%	0.018

Answer:

$\sigma^2 = (0.10)(0.10 - 0.14)^2 + (0.80)(0.14 - 0.14)^2 + (0.10)(0.18 - 0.14)^2$

$= 0.00032$

The variance for Newco's stock is 0.0003.

Given that the standard deviation of Newco's stock is simply the square root of the variance, the standard deviation is 0.0179 or 1.79%.

Covariance

The covariance is the measure of how two assets relate (move) together. If the covariance of the two assets is positive, the assets move in the same direction. For example, if two assets have a covariance of 0.50, then the assets move in the same direction.

If however the two assets have a negative covariance, the assets move in opposite directions. If the covariance of the two assets is zero, they have no relationship.

Formula 17.7

$$\text{Covariance}_{a,b} = \sum \frac{(R_a - Avg\ R_a)(R_b - Avg\ R_b)}{n\ periods}$$

Example: Calculate the covariance between two assets

Assume the mean return on Asset A is 10% and the mean return on Asset B is 15%. Given the following returns over the past 5 periods, calculate the covariance for Asset A as it relates to Asset B.

Returns

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N	R_a	R_b
1	10%	18%
2	15%	25%
3	5%	2%
4	13%	8%
5	8%	17%

Answer:

N	*R_a*	*R_b*	*R_a- Avg R_a*	*R_b-Avg R_b*	*R_a- Avg R_a R_b-Avg R_b*
1	*10*	*18*	*0*	*3*	*0*
2	*15*	*25*	*5*	*10*	*50*
3	*5*	*2*	*-5*	*-13*	*65*
4	*13*	*8*	*3*	*-7*	*-21*
5	*8*	*17*	*-2*	*2*	*-4*
Sum					*90.00*

The covariance would equal 18 (90/5).

Correlation

The correlation coefficient is the relative measure of the relationship between two assets. It is between +1 and -1, with a +1 indicating that the two assets move completely together and a -1 indicating that the two assets move in opposite directions from each other.

Formula 17.8

$$\text{Correlation Coefficient} = \frac{\text{Covariance}_{a,b}}{\sigma_a \sigma_b}$$

Example: Calculate the correlation of Asset A with Asset B.

Given our covariance of 18 in the example above, what is the correlation coefficient for Asset A relative to Asset B if Asset A has a standard deviation of 4 and Asset B has a standard deviation of 8.

Answer:

Correlation coefficient = 18/(4)(8) = 0.563

Components of the Portfolio Standard Deviation Formula

Remember that when calculating the expected return of a portfolio, it is simply the sum of the weighted returns of each asset in the portfolio. Unfortunately, determining the standard deviation of a portfolio, it is not that simple. Not only are the weights of the assets in the portfolio and the standard deviation for each asset in the portfolio needed, the correlation of the assets in the portfolio is also required to determine the portfolio standard deviation.

The equation for the standard deviation for a two asset portfolio is long, but should be memorized for the exam.

Formula 17.9

$$\sigma_{portfolio} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2Cov_{1,2}}$$

The capital market theory builds upon the Markowitz portfolio model. The main assumptions of the capital market theory are as follows:

1. ***All Investors are Efficient Investors* -** Investors follow Markowitz idea of the efficient frontier and choose to invest in portfolios along the frontier.
2. ***Investors Borrow/Lend Money at the Risk-Free Rate*** - This rate remains static for any amount of money.
3. ***The Time Horizon is equal for All Investors*** - When choosing investments, investors have equal time horizons for the choseninvestments.
4. ***All Assets are Infinitely Divisible*** - This indicates that fractional shares can be purchased and the stocks can be infinitely divisible.
5. ***No Taxes and Transaction Costs*** -assume that investors' results are not affected by taxes and transaction costs.
6. ***All Investors Have the Same Probability for Outcomes*** -When determining the expected return, assume that all investors have the same probability for outcomes.
7. ***No Inflation Exists* -** Returns are not affected by the inflation rate in a capital market as none exists in capital market theory.
8. ***There is No Mispricing Within the Capital Markets*** - Assume the markets are efficient and that no mispricings within the markets exist.

What happens when a risk-free asset is added to a portfolio of risky assets?
To begin, the risk-free asset has a standard deviation/variance equal to zero for its given level of return, hence the "risk-free" label.

- ***Expected Return - When the Risk-Free Asset is Added***
  Given its lower level of return and its lower level of risk, adding the risk-free asset to a portfolio acts to reduce the overall return of the portfolio.

  Example: Risk-Free Asset and Expected Return
  Assume an investor's portfolio consists entirely of risky assets with an expected return of 16% and a standard deviation of 0.10. The investor would like to reduce the level of risk in the portfolio and decides to transfer 10% of his existing portfolio into the risk-free rate with an expected return of 4%. What is the expected return of the new portfolio and how was the portfolio's expected return affected given the addition of the risk-free asset?

  Answer:
  The expected return of the new portfolio is: (0.9)(16%) + (0.1)(4%) = 14.4%

  With the addition of the risk-free asset, the expected value of the investor's portfolio was decreased to 14.4% from 16%.

- ***Standard Deviation - When the Risk-Free Asset is Added***
  As we have seen, the addition of the risk-free asset to the portfolio of risky assets reduces an investor's expected return. Given there is no risk with a risk-free asset, the standard deviation of a portfolio is altered when a risk-free asset is added.

Example: Risk-free Asset and Standard Deviation

Assume an investor's portfolio consists entirely of risky assets with an expected return of 16% and a standard deviation of 0.10. The investor would like to reduce the level of risk in the portfolio and decides to transfer 10% of his existing portfolio into the risk-free rate with an expected return of 4%. What is the standard deviation of the new portfolio and how was the portfolio's standard deviation affected given the addition of the risk-free asset?

Answer:

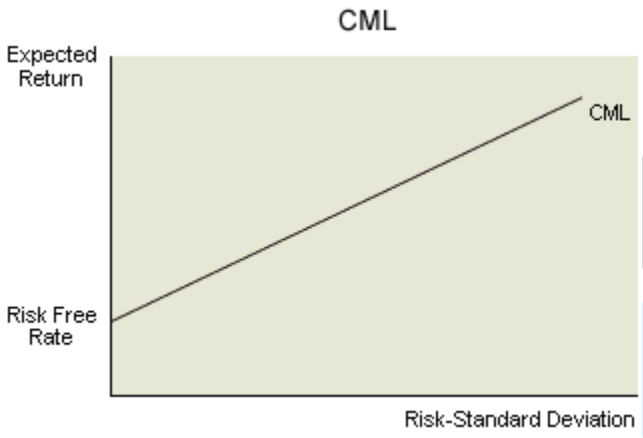
The standard deviation equation for a portfolio of two assets is rather long, however, given the standard deviation of the risk-free asset is zero, the equation is simplified quite nicely. The standard deviation of the two-asset portfolio with a risky asset is the weight of the risky assets in the portfolio multiplied by the standard deviation of the portfolio.

Standard deviation of the portfolio is: (0.9)(0.1) = 0.09

Similar to the affect the risk-free asset had on the expected return, the risk-free asset also has the affect of reducing standard deviation, risk, in the portfolio.

As seen previously, adjusting for the risk of an asset using the risk-free rate, an investor can easily alter his risk profile. Keeping that in mind, in the context of the **capital market line (CML**), the market portfolio consists of the combination of all risky assets and the risk-free asset, using market value of the assets to determine the weights. The CML line is derived by the CAPM, solving for expected return at various levels of risk.

Markowitz' idea of the efficient frontier, however, did not take into account the risk-free asset. The CML does and, as such, the frontier is extended to the risk-free rate as illustrated below:



Systematic and Unsystematic Risk

Total risk to a stock not only is a function of the risk inherent within the stock itself, but is also a function of the risk in the overall market. Systematic risk is the risk associated with the market. When analyzing the risk of an investment, the systematic risk is the risk that cannot be diversified away.

Unsystematic riskis the risk inherent to a stock. This risk is the aspect of total risk that can be diversified away when building a portfolio.

Formula 17.10

Total risk = Systematic risk + Unsystematic risk

When building a portfolio, a key concept is to gain the greatest return with the least amount of risk. However, it is important to note, that additional return is not guaranteed for an increased level of risk. With risk, reward can come, but losses can be magnified as well.

The capital asset pricing model (CAPM) is a model that calculates expected return based on expected rate of return on the market, the risk-free rate and the beta coefficient of the stock.

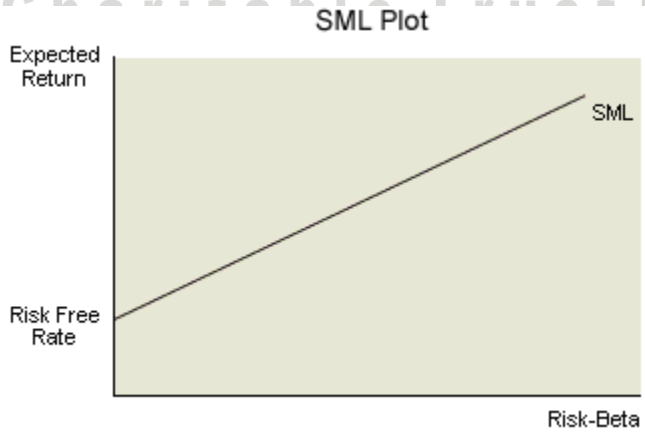
Example: CAPM model
Determine the expected return on Newco's stock using the capital asset pricing model. Newco's beta is 1.2. Assume the expected return on the market is 12% and the risk-free rate is 4%.

Answer:
E(R) = 4% + 1.2(12% - 4%) = 13.6%.

Using the capital asset pricing model, the expected return on Newco's stock is 13.6%.

The Security Market Line (SML)
Similar to the CML, the SML is derived from the CAPM, solving for expected return. However, the level of risk used is the Beta, the slope of the SML.

The SML is illustrated below:



Beta

Beta is the measure of a stock's sensitivity of returns to changes in the market. It is a measure of systematic risk.

Formula 17.12

Beta = B = Covariance of stock to the market

Variance of the market

Example: Beta

Assume the covariance between Newco's stock and the market is 0.001 and the variance of the market is 0.0008. What is the beta of Newco's stock?

A**nswer:**

B_{Newco} = 0.001/0.0008 = 1.25

Newco's beta is 1.25.

Determing Whether a Security is Under-, Over- or Properly Valued

As discussed, the SML line can be derived using CAPM, solving for the expected return using beta as the measure of risk. Given that interpretation and a beta value for a specific security, we can then determine the expected return of the security with the CAPM. Then, using the expected return for a security derived from the CAPM, an investor can determine whether a security is undervalued, overvalued or properly valued.

Example:Calculate the expected return on a security and evaluate whether the security is undervalued, overvalued or properly valued.

An investor anticipates Newco's security will reach $30 by the end of one year. Newco's beta is 1.3. Assume the return on the market is expected to be 16% and the risk-free rate is 4%. Calculate the expected return of Newco's stock in one year and determine whether the stock is undervalued, overvalued or properly valued with a current value of $25.

Answer:

$E(R)_{Newco} = 4\% + 1.3(16\% - 4\%) = 20\%$

Given the expected return of Newco's stock using CAPM is 20% and the investor anticipates a 20% return, the security would be properly valued.

- If the expected return using the CAPM is higher than the investor's required return, the security is undervalued and the investor should buy it.
- If the expected return using the CAPM is lower than the investor's required return, the security is overvalued and should be sold.

The Characteristic Line

The characteristic line is line that occurs when an individual asset or portfolio is regressed to the market. The beta is the slope coefficient for the characteristic line and is thus the measure of systematic risk for the asset or portfolio. Recall, a beta is the measure of a stock's sensitivity of returns to changes in the market. It is a measure of systematic risk.

Steps involved in Portfolio management process

Portfolio management involves complex process which the following steps to be followed carefully.

1. **Identification of objectives and constraints.**
2. **Selection of the asset mix.**
3. **Formulation of portfolio strategy**
4. **Security analysis**
5. **Portfolio execution**
6. **Portfolio revision**
7. **Portfolio evaluation.**

Now each of these steps can be discussed in detail.

1. Identification of objectives and constraints

The primary step in the portfolio management process is to identify the limitations and objectives. The portfolio management should focus on the objectives and constraints of an investor in first place. The objective of an Investor may be income with minimum amount of risk, capital appreciation or for future provisions. The relative importance of these objectives should be clearly defined.

2. Selection of the asset mix

The next major step in portfolio management process is identifying different assets that can be included in portfolio in order to spread risk and minimize loss.

In this step, the relationship between securities has to be clearly specified. Portfolio may contain the mix of Preference shares, equity shares, bonds etc. The percentage of the mix depends upon the risk tolerance and investment limit of the investor.

3. Formulation of portfolio strategy

After certain asset mix is chosen, the next step in the portfolio management process is formulation of an appropriate portfolio strategy. There are two choices for the formulation of portfolio strategy, namely

i. an active portfolio strategy; and

ii. a passive portfolio strategy.

An active portfolio strategy attempts to earn a superior risk adjusted return by adopting to market timing, switching from one sector to another sector according to market condition, security selection or an combination of all of these.

A passive portfolio strategy on the other hand has a pre-determined level of exposure to risk. The portfolio is broadly diversified and maintained strictly.

4. Security analysis

In this step, an investor actively involves himself in selecting securities.

Security analysis requires the sources of information on the basis of which analysis is made. Securities for the portfolio are analyzed taking into account of their price, possible return, risks associated with it etc. As the return on investment is linked to the risk associated with the security, security analysis helps to understand the nature and extent of risk of a particular security in the market.

Security analysis involves both micro analysis and macro analysis. For example, analyzing one script is micro analysis. On the other hand, macro analysis is the analysis of market of securities. Fundamental analysis and technical analysis helps to identify the securities that can be included in portfolio of an investor.

5. Portfolio execution

When selection of securities for investment is complete the execution of portfolio plan takes the next stage in a portfolio management process. Portfolio execution is related to buying and selling of specified securities in given amounts. As portfolio execution has a bearing on investment results, it is considered one of the important step in portfolio management.

6. Portfolio revision

Portfolio revision is one of the most important step in portfolio management. A portfolio manager has to constantly monitor and review scripts according to the market condition. Revision of portfolio includes adding or removing scripts, shifting from one stock to another or from stocks to bonds and vice versa.

7. Performance evaluation

Evaluating the performance of portfolio is another important step in portfolio management. Portfolio manager has to assess the performance of portfolio over a selected period of time. Performance evaluation includes assessing the relative merits and demerits of portfolio, risk and return criteria, adherence of the portfolio management to publicly stated investment objectives or some combination of these factors.

The quantitative measurement of actual return realized and the risk borne by the portfolio over the period of investment is called for while evaluating risk and return criteria. They are compared against the objective norms to assess the relative performance of the portfolio.

Performance evaluation gives a useful feedback to improve the quality of the portfolio management process on a continuing basis.

PORTFOLIO PERFORMANCE EVALUATION

Abstract

The portfolio performance evaluation involves the determination of how a managed portfolio has performed relative to some comparison benchmark. Performance evaluation methods generally fall into two categories, namely conventional and risk-adjusted methods. The most widely used conventional methods include benchmark comparison and style comparison. The risk-adjusted methods adjust returns in order to take account of differences in risk levels between the managed portfolio and the benchmark portfolio. The major methods are the Sharpe ratio, Treynor ratio, Jensen's alpha, Modigliani and Modigliani, and Treynor Squared. The risk-adjusted methods are preferred to the conventional methods.

Keywords: performance; evaluation; standard deviation; systematic risk; conventional methods; benchmark comparison; style comparison; risk-adjusted measures; Sharpe measure; Treynor measure; Jensen measure; alpha; Modigliani-Mod-igliani measure; Treynor squared

Introduction

The portfolio performance evaluation primarily refers to the determination of how a particular investment portfolio has performed relative to some comparison benchmark. The evaluation can indicate the extent to which the portfolio has outperformed or under-performed, or whether it has performed at par with the benchmark.

The evaluation of portfolio performance is important for several reasons. First, the investor, whose funds have been invested in the portfolio, needs to know the relative performance of the portfolio. The performance review must generate and provide information that will help the investor to assess any need for rebalancing of his investments. Second, the management of the portfolio needs this information to evaluate the performance of the manager of the portfolio and to determine the manager's compensation, if that is tied to the portfolio performance. The performance evaluation methods generally fall into two categories, namely conventional and risk-adjusted methods.

Conventional Methods

Benchmark Comparison

The most straightforward conventional method involves comparison of the performance of an investment portfolio against a broader market index. The most widely used market index in the United States is the S&P 500 index, which measures the price movements of 500 U.S. stocks compiled by the Standard & Poor's Corporation. If the return on the portfolio exceeds that of the benchmark index, measured during identical time periods, then the portfolio is said to have beaten the benchmark index. While this type of comparison with a passive index is very common in the investment world, it creates a particular problem. The level of risk of the investment portfolio may not be the same as that of the benchmark index portfolio. Higher risk should lead to commensurately higher returns in the long term. This means if the investment portfolio has performed better than the benchmark portfolio, it may be due to the investment portfolio being more risky than the benchmark portfolio. Therefore, a simple comparison of the return on an investment portfolio with that of a benchmark portfolio may not produce valid results.

Style Comparison

A second conventional method of performance evaluation called "style-comparison" involves comparison of return of a portfolio with that having a similar investment style. While there are many investment styles, one commonly used approach classifies investment styles as value versus growth. The "value style" portfolios invest in companies that are considered undervalued on the basis of yardsticks such as price-to-earnings and price-to-topic value multiples. The "growth style" portfolios invest in companies whose revenue and earnings are expected to grow faster than those of the average company.

In order to evaluate the performance of a value-oriented portfolio, one would compare the return on such a portfolio with that of a benchmark portfolio that has value-style. Similarly, a growth-style portfolio is compared with a growth-style benchmark index.

This method also suffers from the fact that while the style of the two portfolios that are compared may look similar, the risks of the two portfolios may be different. Also, the benchmarks chosen may not be truly comparable in terms of the style since there can be many important ways in which two similar style-oriented funds vary.

Reilly and Norton (2003) provide an excellent disposition of the use of benchmark portfolios and portfolios style and the issues associated with their selection. Sharpe (1992), and Christopherson (1995) have developed methods for determining this style.

Risk-adjusted Methods

The risk-adjusted methods make adjustments to returns in order to take account of the differences in risk levels between the managed portfolio and the benchmark portfolio. While there are many such methods, the most notables are the Sharpe ratio (S), Treynor ratio (T), Jensen's alpha (a), Modigliani and Modigliani (M2), and Treynor Squared (T2). These measures, along with their applications, are discussed below.

Sharpe Ratio

The Sharpe ratio (Sharpe, 1966) computes the risk premium of the investment portfolio per unit of total risk of the portfolio. The risk premium, also known as excess return, is the return of the portfolio less the risk-free rate of interest as measured by the yield of a Treasury security. The total risk is the standard deviation of returns of the portfolio. The numerator captures the reward for investing in a risky portfolio of assets in excess of the risk-free rate of interest while the denominator is the variability of returns of the portfolio. In this sense, the Sharpe measure is also called the "reward-to-variability" ratio. Equation (34.1) gives the Sharpe ratio:

$$S = \frac{r_p - r_f}{\sigma_p} \qquad (34.1)$$

where S is the Sharpe ratio, rp the return of the portfolio, rf the risk-free rate, and sp the standard deviation of returns of the portfolio.

The Sharpe ratio for an investment portfolio can be compared with the same for a benchmark portfolio such as the overall market portfolio. Suppose that a managed portfolio earned a return of 20 percent over a certain time period with a standard deviation of 32 percent. Also assume that during the same period the Treasury bill rate was 4 percent, and the overall stock market earned a return of 13 percent with a standard deviation of 20 percent. The managed portfolio's risk premium is (20 percent — 4 percent) = 16 percent, while its Sharpe ratio, S, is equal to 16 percent/32 percent = 0.50. The market portfolio's excess return is (13 percent — 4 percent) = 9 percent, while its S equals 9 percent/20 percent = 0.45. Accordingly, for each unit of standard deviation, the managed portfolio earned a risk premium of 0.50 percent, which is greater than that of the market portfolio of 0.45 percent, suggesting that the managed portfolio outperformed the market after adjusting for total risk.

Treynor Ratio

The Treynor ratio (Treynor, 1965) computes the risk premium per unit of systematic risk. The risk premium is defined as in the Sharpe measure. The difference in this method is in that it uses the systematic risk of the portfolio as the risk parameter. The systematic risk is that part of the total risk of an asset which cannot be eliminated through diversification. It is measured by the parameter known as 'beta' that represents the slope of the regression of the returns of the managed portfolio on the returns to the market portfolio. The Treynor ratio is given by the following equation:

$$T = \frac{r_p - r_f}{\beta_p} \qquad (34.2)$$

where T is the Treynor ratio, rp the return of the portfolio, rf the risk-free rate, and bp the beta of the portfolio.

Suppose that the beta of the managed portfolio in the previous example is 1.5. By definition, the beta of the market portfolio is equal to 1.0. This means the managed portfolio has one-and-half times more systematic risk than the market portfolio.

We would expect the managed portfolio to earn more than the market because of its higher risk. In fact, in the above example, the portfolio earned an excess return of 16 percent whereas the market earned only 9 percent.

These two numbers alone do not tell anything about the relative performance of the portfolio since the portfolio and the market have different levels of market risk. In this instance, the Treynor ratio for the managed portfolio equals (20 percent — 4 percent)/1.5 = 10.67, while that for the market equals (13 percent — 4 percent)/1.00 = 9.00. Thus, after adjusting for systematic risk, the managed portfolio earned an excess return of 10.67 percent for each unit of beta while the market portfolio earned an excess return of 9.00 percent for each unit of beta. Thus, the managed portfolio outperformed the market portfolio after adjusting for systematic risk.

Jensen's Alpha

Jensen's alpha (Jensen, 1968) is based on the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965), and Mossin (1966). The alpha represents the amount by which the average return of the portfolio deviates from the expected return given by the CAPM. The CAPM specifies the expected return in terms of the risk-free rate, systematic risk, and the market risk premium. The alpha can be greater than, less than, or equal to zero. An alpha greater than zero suggests that the portfolio earned a rate of return in excess of the expected return of the portfolio. Jensen's alpha is given by.

$$\alpha = r_p - [r_f + \beta_p(r_m - r_f)] \qquad (34.3)$$

where a is the Jensen's alpha, rp the return of the portfolio, rm the return of the market portfolio, rf the risk-free rate, and bp the beta of the portfolio.

Using the same set of numbers from the previous example, the alpha of the managed portfolio and the market portfolio can be computed as follows. The expected return of the managed portfolio is 4 percent + 1.5 (13 percent — 4 percent) = 17.5 percent. Therefore, the alpha of the managed portfolio is equal to the actual return less the expected return, which is 20 percent — 17.5 percent = 2.5 percent.

Since we are measuring the expected return as a function of the beta and the market risk premium, the alpha for the market is always zero. Thus, the managed portfolio has earned a 2.5 percent return above that must be earned given its market risk. In short, the portfolio has a positive alpha, suggesting superior performance.

When the portfolio is well diversified all three methods - Sharpe, Treynor, and Jensen – will give the same ranking of performance. In the example, the managed portfolio outperformed the market on the basis of all three ratios. When the portfolio is not well diversified or when it represents the total wealth of the investor, the appropriate measure of risk is the standard deviation of returns of the portfolio, and hence the Sharpe ratio is the most suitable. When the portfolio is well diversified, however, a part of the total risk has been diversified away and the systematic risk is the most appropriate risk metric. Both Treynor ratio and Jensen's alpha can be used to assess the performance of well-diversified portfolios of securities.

These two ratios are also appropriate when the portfolio represents a sub-portfolio or only a part of the client's portfolio. Chen (1981, 1986) examined the statistical distribution of Sharpe, Treynor, and Jensen measures and show that the empirical relationship between these measures and their risk proxies is dependent on the sample size, the investment horizon and market conditions. Cumby and Glen (1990), Grinblatt and Titman (1994), Kallaberg et al. (2000), and Sharpe (1998) have provided evidence of the application of performance evaluation techniques.

Modigliani and Modigliani Measure

The Sharpe ratio is not easy to interpret. In the example, the Sharpe ratio for the managed portfolio is 0.50, while that for the market is 0.45. We concluded that the managed portfolio outperformed the market. The difficulty, however, is that the differential performance of 0.05 is not an excess return.

Modigliani and Modigliani (1997) measure, which is referred to as M2, provides a risk-adjusted measure of performance that has an economically meaningful interpretation. The M2 is given by

$$M^2 = r_{p^*} - r_m \tag{34.4}$$

where M2 is the Modigliani-Modigliani measure, rp* the return on the adjusted portfolio, rm the return on the market portfolio.

The adjusted portfolio is the managed portfolio adjusted in such a way that it has the same total risk as the market portfolio. The adjusted portfolio is constructed as a combination of the managed portfolio and risk-free asset, where weights are specified as in Equations (34.5) and (34.6).

$$w_{r_p} = \frac{\sigma_m}{\sigma_p} \tag{34.5}$$

$$w_{r_f} = 1 - w_{r_p} \tag{34.6}$$

where wrp represents the weight given to the managed portfolio, which is equal to the standard deviation of the market portfolio (sm) divided by the standard deviation of the managed portfolio (sp). wrf is the weight on the risk-free asset and is equal to one minus the weight on the managed portfolio. The risk of the adjusted portfolio (sp*) is the weight on the managed portfolio times the standard deviation of the managed portfolio as given in Equation (34.7). By construction, this will be equal to the risk of the market portfolio.

$$\sigma_{p^*} = w_{r_p} \times \sigma_p = \frac{\sigma_m}{\sigma_p} \times \sigma_p = \sigma_m \tag{34.7}$$

The return of the adjusted portfolio (rp*) is computed as the weighted average of the returns of the managed portfolio and the risk-free rate, where the weights are as in Equations (34.5) and (34.6) above:

$$r_{p^*} = w_{r_f} \times r_f + w_{r_p} \times r_p \qquad (34.8)$$

The return on the adjusted portfolio can be readily compared with the return on the market portfolio since both have the same degree of risk. The differential return, M2, indicates the excess return of the managed portfolio in comparison to the benchmark portfolio after adjusting for differences in the total risk. Thus, M2 is more meaningful than the Sharpe ratio.

In the example, the standard deviation of the managed portfolio is 32 percent and the standard deviation of the market portfolio is 20 percent. Hence, the wrp = 20/32 = 0.625, and wrf = 1 — 0.625 = 0.375. The adjusted portfolio would be 62.5 percent invested in the managed portfolio and 37.5 percent invested in Treasury bills. Now the risk of the adjusted portfolio, sp* = 0.625 x 32 percent = 20 percent, is the same as the risk of the market portfolio. The return on the adjusted portfolio would be rp* = 0.375 x 4 percent + 0.625 x 20 percent = 14 percent. The M2 = 14 percent — 13 percent = 1 percent. Thus, on a risk-adjusted basis, the managed portfolio has performed better than the benchmark by 1 percent.

Treynor Squared

Another performance measure, called T2 analogous to M2, can be constructed. This is a deviant of the Treynor measure, and the rationale is the same as that of M2. T2 is defined as

$$T^2 = r_{p^*} - r_m \qquad (34.9)$$

where T2 is the Treynor-squared measure, rp* the return on the adjusted portfolio, and rm the return on the market portfolio.

The adjusted portfolio is the managed portfolio adjusted such that it has the same degree of systematic or market risk as the market portfolio. Since the market risk or beta of the market portfolio is equal to one, the adjusted portfolio is constructed as a combination of the managed portfolio and risk-free asset such that the adjusted portfolio has a beta equal to one. The weights are specified as in equations below.

$$w_{r_p} = \frac{\beta_m}{\beta_p} \tag{34.10}$$

$$w_{r_f} = 1 - w_{r_p} \tag{34.11}$$

where wrp represents the weight given to the managed portfolio, which is equal to the beta of the market portfolio (bm) divided by the beta of the managed portfolio (bp). wrf is the weight on the risk-free asset and is equal to one minus the weight on the managed portfolio. The beta of the adjusted portfolio (bp) is the weight on the managed portfolio times the beta of the managed portfolio, and this will be equal to the risk ofthe market portfolio as shown in the following equation:

$$\beta_{p^*} = w_{r_p} \times \beta_p = \frac{\beta_m}{\beta_p} \times \beta_p = \beta_m \tag{34.12}$$

The return of the adjusted portfolio (rp*) is computed as the weighted average of the returns of the managed portfolio and the risk-free rate, where the weights are as determined above in equations (34.10) and (34.11):

$$r_{p^*} = w_{r_f} \times r_f + w_{r_p} \times r_p \tag{34.13}$$

The return on the adjusted portfolio can be readily compared with the return on the market portfolio since both have the same level of market risk. The differential return, T2, indicates the excess return of the managed portfolio in comparison to the benchmark portfolio after adjusting for differences in the market risk.

In the example, the beta of the managed portfolio is 1.5. Hence, wrp = 1.0/1.5 = 0.67 and wrf = 1 — 0.67 = 0.33. The adjusted portfolio would be 67 percent invested in the managed portfolio and 33 percent invested in Treasury bills. The beta of the adjusted portfolio, sp* = 0.67 x 1.5 = 1.00, which is equal to the beta of the market portfolio. The return on the adjusted portfolio would be rp* = 0.33 x 4 percent + 0.67 x20 percent = 14.72percent. T2 = 14.72 percent — 13.00 percent = 1.72 percent.

Thus, after adjusting for market risk, the managed portfolio has performed better than the benchmark by 1.72 percent. T2 is a better measure of relative performance when the market risk of a managed portfolio is the relevant risk metric.

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