



# CHAPTER 19

## PERFORMANCE EVALUATION

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## LEARNING OUTCOMES

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After completing this chapter, you should be able to do the following:

- a** Describe a performance evaluation process;
  - b** Describe measures of return, including holding-period returns and time-weighted rates of return;
  - c** Compare use of arithmetic and geometric mean rates of returns in performance evaluation;
  - d** Describe measures of risk, including standard deviation and downside deviation;
  - e** Describe reward-to-risk ratios, including the Sharpe and Treynor ratios;
  - f** Describe uses of benchmarks and explain the selection of a benchmark;
  - g** Explain measures of relative performance, including tracking error and the information ratio;
  - h** Explain the concept of alpha;
  - i** Explain uses of performance attribution.
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## INTRODUCTION

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# 1

Investors are interested in knowing how their investments have performed. For retail investors, the performance of their investments may determine whether they will enjoy a comfortable retirement, whether they will have enough money to send their children to university, or whether they can afford their dream holiday. Likewise, the pension plans, foundations, and other institutional investors want to monitor the performance of their investments to ensure that the assets will be sufficient to meet their needs. The performance of a fund and its fund manager is also important to an investment management firm; after all, if the output of the car industry is cars, then the output of the investment management industry is, arguably, investment returns. For an investment management company, measuring and understanding fund manager performance is vital to managing and improving the investment process.

But knowing the return achieved by an investment management company or fund manager is only part of the process of performance evaluation. Investment management is a competitive industry. Both investors and investment management companies will want to know how fund managers have performed relative to familiar and relevant financial market benchmarks (e.g., a stock index, such as the S&P 500 Index in the United States or the Hang Seng Index in Hong Kong SAR) and relative to their peers. In addition, interested parties will want to know how the fund manager achieved the performance—for example, whether the performance was the result of skill or luck or perhaps the result of excessive risk taking.

It is only through the robust evaluation of investment performance that investment management companies and their investors can make informed decisions about their investments. After reviewing a fund manager's performance, investors can decide whether they want to continue to invest with the manager or to move their funds to another manager. Similarly, the investment management company can decide whether the manager should be asked to manage additional funds, be supported with more resources in an effort to improve the company's performance, or be replaced.

The performance evaluation process includes four discrete but related components:

-  Measure absolute returns
-  Adjust returns for risk
-  Measure relative returns
-  Attribute performance

These four components are discussed in the following sections.

## 2

## MEASURE ABSOLUTE RETURNS

**Absolute returns** are the returns achieved over a certain time period. Absolute returns do not consider the risk of the investment or the returns achieved by similar investments.

## 2.1 Holding-Period Returns

The performance of a security, such as an equity (stock) or debt (bond) security, over a specific time period—called the holding period—is referred to as the **holding-period return**. The holding-period return measures the total gain or loss that an investor owning a security achieves over the specified period compared with the investment at the beginning of the period. The return over the holding period usually comes from two sources: changes in the price (capital gain or loss) and income (dividends or interest).

The holding-period return from owning an ordinary or common share of a company typically comes from a change in the price of the share between the beginning and the end of the period, as well as from the dividends received over the period. The change in the price of the shares over the period is the capital gain or loss portion of the return. The dividends received over the period are the income portion of the return. Similarly, the holding-period returns from owning bonds result from changes in price (capital gain or loss) and receipt of interest (income).

Example 1 illustrates how holding-period returns are calculated. As always, you are *not* responsible for calculations, but the presentation of formulae and calculations may enhance your understanding.

## EXAMPLE 1. HOLDING-PERIOD RETURNS

An investor buys one ordinary share in Company A on 1 January at a price of £100. On 31 December, Company A pays a dividend per share of £5, and an ordinary share of Company A is selling for £110 on that date.

In this case, the holding period is one year—from 1 January to 31 December. The return achieved by the investor from the increase (appreciation) in the share price over this period is calculated as follows:

$$\begin{aligned} &\text{Capital component of the holding-period return} \\ &= \frac{110 - 100}{100} = \frac{10}{100} = 0.10 = 10\% \end{aligned}$$

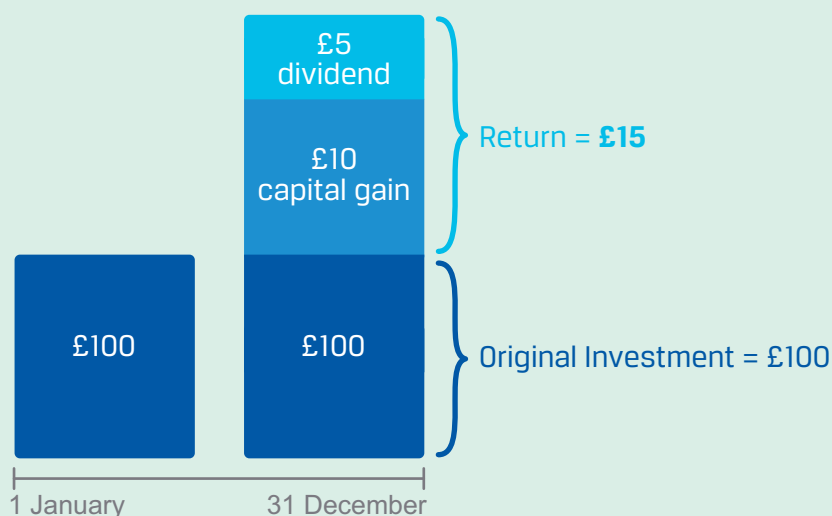
But the holding-period return should also include the dividend paid to the investor. The return achieved by the investor from the income received on the share is as follows:

$$\text{Income component of the holding-period return} = \frac{5}{100} = 0.05 = 5\%$$

The total holding-period return is the sum of the capital and income components (i.e., 15%). Mathematically, this sum can be shown as

$$\text{Total holding-period return} = \frac{(110 - 100) + 5}{100} = \frac{10 + 5}{100} = 0.15 = 15\%$$

### Holding Period Return



$$\begin{aligned} \text{Holding-period return} &= \text{Return} \div \text{Original investment} \\ &= (10 + 5) \div 100 \\ &= .15 \\ &= 15\% \end{aligned}$$

The return to an investment fund or portfolio over the course of a given period is typically made up of the capital gains or losses on all of the assets held over that period plus any income earned on those assets over the same period. This income may include dividend income from equity securities, interest income for portfolios of debt securities, and rental income for portfolios of commercial real estate.

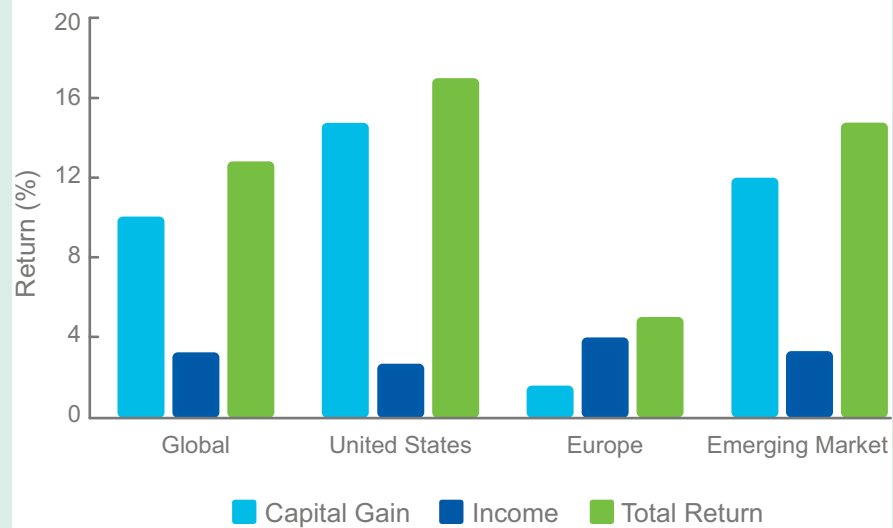
### HOLDING-PERIOD RETURNS FOR A VARIETY OF PORTFOLIOS

We can see how capital and income components combine to produce returns by looking at some representative investment portfolios. Exhibits 1A and 1B present the holding-period returns and the split between the capital gains and losses portion and the income portion for a range of investment portfolios in 2010.

Exhibit 1A shows the investment performance of four equity portfolios. The global equity portfolio includes equity securities from around the globe; the US and European equity portfolios include equity securities listed in the

United States and in Europe; the emerging market equity portfolio includes equity securities listed in emerging markets, such as Brazil, Russia, India, and China—widely known as the BRIC countries.

**Exhibit 1A Capital Gains, Income, and Total Return for Equity Portfolios, 2010**



*Source:* Based on data from the Centre for Asset Management Research, Cass Business School, London.

Exhibit 1B presents the investment performance of three bond portfolios and two commercial property portfolios. The European government bond portfolio includes bonds issued by eurozone governments, such as France, Germany, Greece, Italy, Ireland, and Spain; the European corporate bond portfolio includes bonds issued by companies headquartered in the eurozone; the high-yield bond portfolio includes bonds that are rated BB+ or below by Fitch and Standard & Poor's and Ba1 or below by Moody's, the credit rating agencies discussed in the Debt Securities chapter; the last two portfolios include US and UK commercial property, respectively.

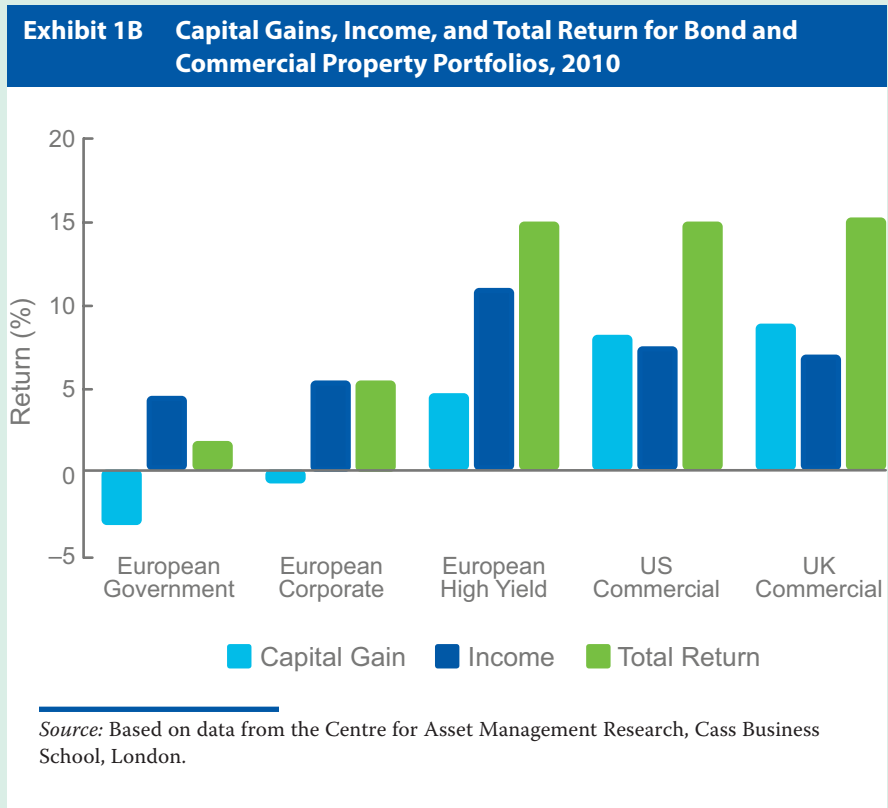


Exhibit 1A shows that the total holding-period return of all the equity portfolios except the European equity portfolio was more than 12% and that the capital gains portion was much larger than the income portion. The European equity portfolio's total holding-period return was approximately 4% and was made up almost entirely of income return.

Exhibit 1B indicates that the total holding-period returns of the European government bonds portfolio and the European corporate bonds portfolio were positive. Each of these portfolios experienced a capital loss, but it was more than offset by positive income returns. The high-yield bond portfolio and the two commercial property portfolios had positive total holding-period returns. Each experienced both a capital gain and a positive income return.

## 2.2 Cash Flows and Time-Weighted Rates of Return

In the holding-period return calculation in Example 1, the income (the dividend) was received at the end of the holding period. This time of receipt, plus the fact that no additional investments were made during the period, makes the calculation of the return relatively easy. In practice, however, calculating a fund's holding-period return is more complex. In particular,

- funds may consist of hundreds of individual investments that pay income at different times throughout the holding period.
- clients may make additional investments (cash inflows) in and withdrawals (cash outflows) from a fund throughout the holding period.

In other words, there is a constant flow of cash into and out of most investment funds and portfolios. Additional investments and withdrawals by clients will affect the calculation of the performance of the fund. Example 2 illustrates this point.

### EXAMPLE 2. EFFECT OF A DEPOSIT ON A FUND'S INVESTMENT PERFORMANCE

Suppose that an investment fund has a value of \$100 million on 1 January. By 31 December, the fund has grown in value to \$110 million. The increase in the value of this fund came from changes in the values of the securities held in the portfolio and from income received and reinvested during the year. The total holding-period return on the fund is 10%, calculated as follows:

$$\text{Fund return} = \left( \frac{\$110 \text{ million} - \$100 \text{ million}}{\$100 \text{ million}} \right) = 0.10 = 10\%$$

But suppose that one of the fund's clients deposited an additional \$5 million into the fund on 30 June. This deposit means that some of the change in the fund's value over the year was not from the performance of the securities or from the income on these securities, but attributable to the receipt of additional client money. In other words, a total holding-period return of 10% overstates the fund's investment performance.

Flows of money into and out of funds over time can be accounted for by dividing the measurement period into shorter holding periods. A new holding period starts each time a cash flow occurs—that is, each time money flows into or out of a fund. If there is only one cash flow during the holding period, the measurement period will be divided into two shorter holding periods. If there are two cash flows, there will be three holding periods, and so on. In practice, client cash inflows and outflows may occur on a daily basis, in which case an annual holding-period return is divided into daily holding-period returns.

Example 3 illustrates how the total holding-period return is calculated when a cash flow occurs during the holding period. There are two approaches used to combine returns. The first approach is to calculate the arithmetic mean by adding the two six-month returns. This approach, however, does not consider compounding; recall from the time

value of money discussion in the Quantitative Concepts chapter that compounding is the process by which interest is reinvested to generate its own interest. The second approach is to calculate the geometric mean, which does consider compounding and is usually the preferred approach.

### EXAMPLE 3. CALCULATION OF A FUND'S RETURN WHEN THERE IS A DEPOSIT

Suppose that the fund in Example 2 had received one client cash inflow of \$5 million at the close of business on 30 June. No other cash inflows or outflows occurred in the period; there was no additional cash from clients and there was no cash from income on holdings of the fund. The holding period of one year can be divided into two periods of six months. The holding-period return is calculated as follows:

- First, calculate the six-month holding-period return for the period from 1 January to 30 June, before the additional deposit.
- Next, calculate the six-month holding-period return for the period from 1 July to 31 December, including the cash inflow of \$5 million that increased the value of the fund on 30 June.
- Finally, calculate the annual holding-period return by combining the two six-month holding-period returns.

There is one final piece of information that is needed to calculate the return over each of these two six-month periods: the value of the fund on 30 June immediately before the inflow of \$5 million. Assume that the fund's value was as follows (the 30 June value does not include the \$5 million deposit):

Date	Fund's Value
1 January	\$100 million
30 June	\$98 million
31 December	\$110 million

The holding-period return over the first six months (1 January to 30 June) is as follows:

$$\text{Fund return} = \left( \frac{\$98 \text{ million} - \$100 \text{ million}}{\$100 \text{ million}} \right) = -0.020 = -2.0\%$$

On 30 June, the fund has fallen in value to \$98 million. But at this point, the fund experiences the positive cash inflow of \$5 million. This event means that at the start of the second holding period on 1 July, the fund has a value of \$103 million (\$98 million + \$5 million). On 31 December, the fund has a value of \$110 million. Thus, the holding-period return for the second six months (1 July to 31 December) is as follows:

$$\text{Fund return} = \left( \frac{\$110 \text{ million} - \$103 \text{ million}}{\$103 \text{ million}} \right) = 0.068 = 6.8\%$$

The clients of the fund may want to know the return achieved by the fund manager over the full calendar year rather than over each six-month period. Using our current example, the fund return was  $-2.0\%$  for the first six months and  $6.8\%$  for the last six months. The fund's arithmetic return for the year is  $4.8\%$  ( $= -2.0\% + 6.8\%$ ). Alternatively, the fund's compounded return for the year is calculated as follows:

$$\text{Fund return} = [(1 - 2.0\%) \times (1 + 6.8\%)] - 1 = 0.0466 = 4.66\%$$

The fund manager achieved an annual holding-period return of  $4.66\%$ , which is the return achieved by the fund manager on the funds under management between 1 January and 31 December.

Returns calculated in the manner described in Example 3 are known as time-weighted rates of returns. The **time-weighted rate of return** calculation divides the overall measurement period (e.g., one year) into sub-periods representing one month, week, or day of that year. The timing of each individual cash flow identifies the sub-periods to use for calculating holding-period returns. Each sub-period has its own separate rate of return. These sub-period returns are then used to calculate the return for the whole period. By calculating holding-period returns in this manner, client cash inflows and outflows do not distort the measurement and reporting of a fund's investment performance.

To compare the performance of one fund from one year with the next year or to compare the performance of one fund with another fund requires that returns be measured on a consistent basis over time and across fund managers. In 1999, a set of voluntary investment performance standards—the Global Investment Performance Standards (GIPS)—was proposed for this purpose. Investment management firms around the globe have adopted GIPS, and organisations in more than 30 countries sponsor and promote the Standards, which were created by and are administered by CFA Institute. GIPS requires the use of the time-weighted rates of return method because this measure is not distorted by cash inflows and outflows.

## 3

### ADJUST RETURNS FOR RISK

Investors want to get as much return as possible for as little risk as possible. So, if two investments have a holding-period return of  $10\%$  but the first investment has very little risk whereas the second one is very risky, the first investment is better than the second one on a risk-adjusted basis.

#### 3.1 Standard Deviation

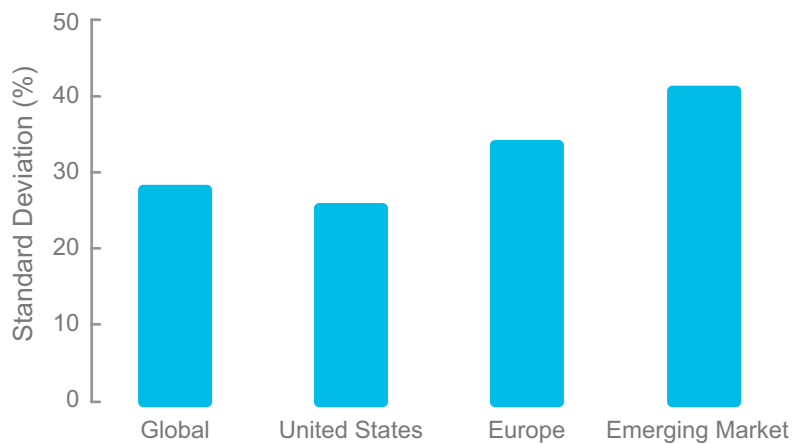
As discussed in the Risk Management chapter, risk can take different forms. The risk we refer to in the rest of this chapter is investment risk. Recall from the Quantitative Concepts chapter that investment risk is often measured using some measure of variability (or volatility) of returns, and a common measure of variability is the standard

deviation. The standard deviation of returns reflects the variability of returns around the mean (or average) return; the higher the standard deviation of returns, the higher the variability (or volatility) of returns and the higher the risk.

### STANDARD DEVIATION OF RETURNS FOR A VARIETY OF PORTFOLIOS

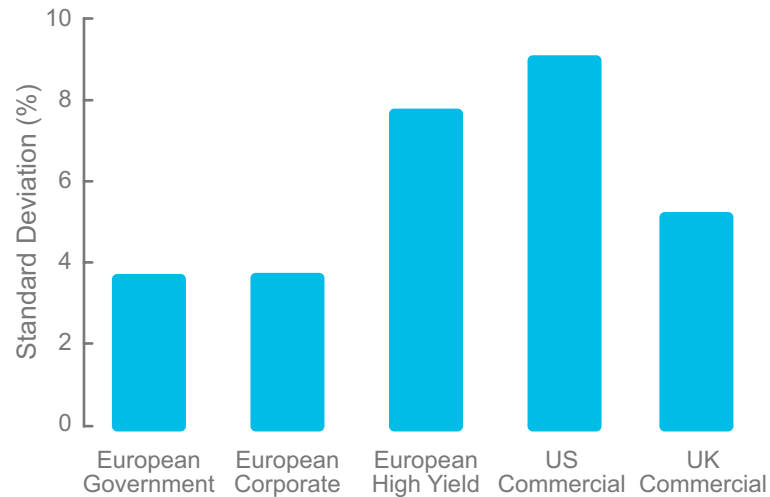
Exhibits 2A and 2B show the standard deviation of the annual returns for 2006–2010 on the four equity, three bond, and two commercial property portfolios introduced in Exhibits 1A and 1B.

#### Exhibit 2A Standard Deviation of Returns in Equity Portfolios



*Source:* Based on data from the Centre for Asset Management Research, Cass Business School, London.

**Exhibit 2B Standard Deviation of Returns in Bond and Commercial Property Portfolios**



*Source:* Based on data from the Centre for Asset Management Research, Cass Business School, London.

Exhibits 2A and 2B support the common perception that equities are riskier than bonds. As shown in Exhibit 2A, the standard deviation of annual returns for the equity portfolios exceeded 20%, reaching 41% for the emerging market equity portfolio. In contrast, Exhibit 2B indicates that the standard deviation of annual returns for the bond and commercial property portfolios are much less than for the equity portfolios: less than 5% for the European government and corporate bond portfolios and less than 10% for the high-yield bond and the two commercial property portfolios.

There are at least two reasons why investors care about historical variability (the standard deviation of past returns). First, past variability of returns might be indicative of how variable returns may be in the future. But it is important to be aware that volatility can change over time and that there is no guarantee that future returns will behave like past returns. Second, the variability of returns may affect an investor's objectives. Pension funds invest to generate the returns necessary to pay their beneficiaries, insurance companies invest to generate returns to meet the claims on their policies, and individuals invest because they usually have a future expenditure in mind. Investing in a portfolio or fund whose returns vary significantly over time could potentially disrupt investors' plans. If returns are very negative one year, then the investors' commitments, such as paying pensions, may be harder to meet. Retail investors may need to sell some of their investments because of unforeseen circumstances, such as a decline in dividend income.

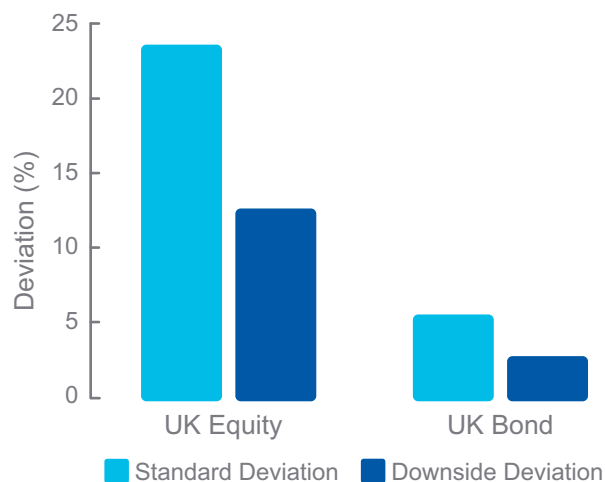
### 3.2 Downside Deviation

Standard deviation is a convenient measure of the variability (or volatility) of returns around the mean. Sometimes there is a positive deviation—that is, the return is greater than the mean—and sometimes there is a negative deviation—that is, the return is less than the mean. Which of these two types of deviation do you think investors would be more concerned about? Well, psychologists and economists have discovered that investors dislike losses more than they like equivalent gains. So, investors might be reasonably happy about achieving an investment return of +10%, but extremely unhappy about achieving a return of –10%. Because of this asymmetry in the way investors view the dispersion around the average, some investment professionals use a modified version of standard deviation known as downside deviation.

**Downside deviation** is calculated in almost exactly the same way as standard deviation, but instead of using all the deviations from the mean—positive and negative—downside deviation is calculated using only negative deviations. In other words, it is a measure of return variability that focuses only on outcomes that are less than the mean. Downside deviation may also be calculated by focussing on outcomes that are less than a specified return target; this target does not have to be the mean.

Exhibit 3 shows the standard and downside deviations of returns associated with investing in a diversified portfolio of UK equities and in a diversified portfolio of UK government bonds.

**Exhibit 3 Standard Deviation vs. Downside Deviation, 2001–2010**



*Source:* Based on data from the Centre for Asset Management Research, Cass Business School, London.

As we see, the downside deviations are lower than the standard deviations; this outcome is expected because downside deviations only consider the negative deviations. But both measures convey the same message: the risk of the bond portfolio is lower than that of the equity portfolio.

### 3.3 Reward-to-Risk Ratios

Investors prefer to achieve a high return rather than a low return on their investment portfolios. So all things being equal, they also prefer lower risk (less variability of returns) to higher risk (more variability of returns). In other words, investors are interested in maximising the return on their investments while simultaneously trying to minimise the risks. That is, they prefer investments that have a high return per unit of risk—investments with a high **reward-to-risk ratio**.

A reward-to-risk ratio is a metric that takes the following basic form:

$$\text{Reward-to-risk ratio} = \frac{\text{Measure of portfolio return}}{\text{Measure of portfolio risk}}$$

The higher the value of the reward-to-risk ratio, the better the risk-adjusted return—that is, the higher the return per unit of risk.

A commonly used reward-to-risk ratio is the **Sharpe ratio**, so-called because it was first suggested by Nobel Prize-winning economist William Sharpe.<sup>1</sup> The portfolio reward is measured as the portfolio's excess return, which is equal to the difference between the portfolio's holding-period return and the return on a "risk-free" investment. Risk-free investment is usually approximated by the return achieved from investing in short-term government bonds because in most countries government bonds are the investments that carry the lowest level of risk. The chosen measure of portfolio risk is the standard deviation of the portfolio returns, a measure of the portfolio's total risk. So the Sharpe ratio is calculated as follows:

$$\begin{aligned} \text{Sharpe ratio} \\ &= \frac{\text{Return on portfolio} - \text{Risk-free return}}{\text{Standard deviation of portfolio returns}} = \frac{\text{Excess return on portfolio}}{\text{Standard deviation of portfolio returns}} \end{aligned}$$

Another commonly used reward-to-risk ratio is the **Treynor ratio**, suggested by Jack Treynor.<sup>2</sup> The measure of portfolio reward is the same as that used in the Sharpe ratio but the measure of portfolio risk is different. The chosen measure of portfolio risk is beta of the portfolio, a measure of the portfolio's systematic risk (also called market or non-diversifiable risk). Systematic risk is discussed in the Investment Management chapter. The Treynor ratio is calculated as follows:

$$\begin{aligned} \text{Treynor ratio} \\ &= \frac{\text{Return on portfolio} - \text{Risk-free return}}{\text{Beta of portfolio returns}} = \frac{\text{Excess return on portfolio}}{\text{Beta of portfolio returns}} \end{aligned}$$

Example 4 illustrates the calculation of the Sharpe and Treynor ratios.

<sup>1</sup> William F. Sharpe, "Mutual Fund Performance," in Part 2: Supplement on Security Prices, *Journal of Business*, vol. 39, no. 1 (January 1966):119–138.

<sup>2</sup> Jack L. Treynor, "How to Rate Management of Investment Funds," *Harvard Business Review*, vol. 43, no. 1 (January–February 1965):63–75.

**EXAMPLE 4. CALCULATION OF SHARPE AND TREYNOR RATIOS**

Suppose that over a year, the holding-period return on an investment fund was 10% and the return achievable from investing in government bonds (“risk-free” investments) was 4%. Also assume that the standard deviation and beta of the investment fund’s returns over this period were 5% and 1.8, respectively.

The Sharpe ratio for this fund is

$$\text{Sharpe ratio} = \frac{10\% - 4\%}{5\%} = 1.2$$

The Treynor ratio for this fund is

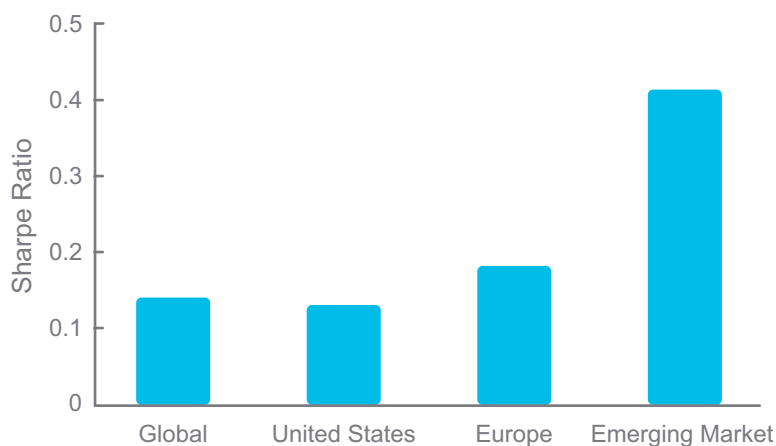
$$\text{Treynor ratio} = \frac{10\% - 4\%}{1.8} = 3.33$$

Each of these ratios can be compared with the same ratios for similar funds or portfolios to evaluate the fund’s or portfolio’s performance. As stated earlier, the higher the value of the reward-to-risk ratio, the better the risk-adjusted return—that is, the higher the return per unit of risk.

**SHARPE RATIO FOR A VARIETY OF PORTFOLIOS**

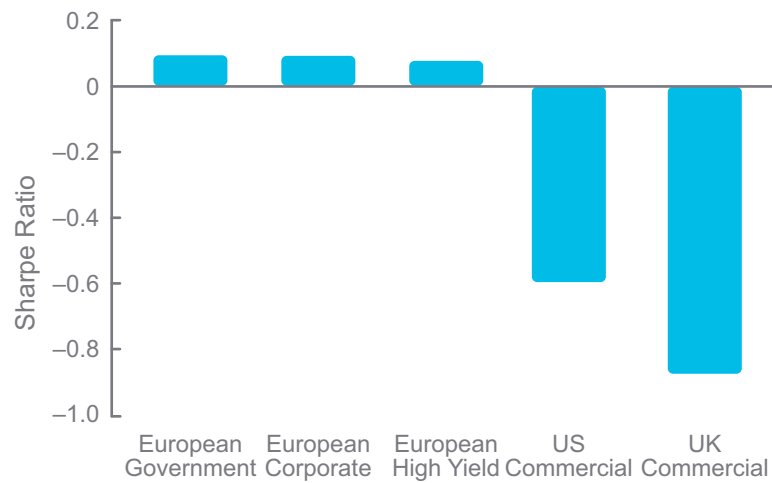
Exhibits 4A and 4B present the Sharpe ratios for the four equity, three bond, and two commodity property portfolios we examined in Exhibits 1A, 1B, 2A, and 2B.

**Exhibit 4A Sharpe Ratios for Equity Portfolios, 2006–2010**



*Source:* Based on data from the Centre for Asset Management Research, Cass Business School, London.

**Exhibit 4B Sharpe Ratios for Bond and Commercial Property Portfolios, 2006–2010**



*Source:* Based on data from the Centre for Asset Management Research, Cass Business School, London.

Exhibit 4A shows that the Sharpe ratios of all the equity portfolios were positive, ranging from 0.10 to 0.40. The emerging market equity portfolio had the highest Sharpe ratio. Put another way, this portfolio provided the highest amount of reward for the risk incurred. Exhibit 4B shows that the bond portfolios also had positive Sharpe ratios, although lower than the equity funds. But the commercial property portfolios had negative Sharpe ratios, indicating that these funds generated lower returns than the government bond portfolios during 2006–2010. That is, they provided a negative reward for the risk taken. But you should not conclude that commercial property portfolios are necessarily poor investments. The 2006–2009 period was not typical given that it was marked by a global financial crisis that saw a significant drop in property prices.

The Sharpe ratio, along with other reward-to-risk ratios, is an important metric for understanding the quality of the returns produced by a portfolio. A portfolio with high returns but with high risk might be said to have produced lower-quality returns than a portfolio with similarly high returns but with much lower risk. So, in a sense, reward-to-risk ratios, such as the Sharpe ratio, are one of the main quality control checks that investors need to apply to their investments. Such ratios are also helpful for comparing investments.

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## MEASURE RELATIVE RETURNS

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# 4

By measuring **relative returns**—that is, returns relative to a suitable benchmark—investors can determine whether they could have made more money in other investments. Measuring relative returns allows them to assess their opportunity cost and determine whether their investments are generating appropriate returns.

### 4.1 Benchmarks and the Calculation of Relative Returns

The calculation of a reward-to-risk ratio, such as the Sharpe ratio, allows investors to compare the performance of one investment fund with another. Many investors also want to compare the performance of their fund or portfolio with that of a financial market benchmark, such as a stock index. It is common practice in all industries, and indeed in many areas of life, to benchmark or compare performance. Olympic sprinters, for instance, may compare themselves against a time benchmark or against a close competitor. Beating the time benchmark or beating the competitor allows them to judge how they are performing.

Benchmarks can be used to assess the quality and/or quantity of a company's performance by comparing its performance with that of its peers and competitors; you have already seen an application of this use of comparison in the Financial Statements chapter with ratio analysis.

#### 4.1.1 Benchmarks

Fund managers may not only use a benchmark for assessment, but some, such as index fund managers, may also manage their portfolios to a **benchmark**.<sup>3</sup> This means that managers must regularly compare the composition and performance of their portfolios with the composition of a financial market index, such as the FTSE 100 Index or the S&P 500. For investors, knowing the financial market index that a fund manager uses as a benchmark will give them some idea of the return and risk that they can expect from investing in that fund.

Before engaging a fund manager, institutional investors will often specify the financial market benchmark that they intend to use to assess the performance of the fund manager. For example, a US equity fund manager may be asked, or mandated, to manage a portfolio of US equities for a client and told that they will be “benchmarked against” the S&P 500. A fund manager may simply be a passive index fund manager using S&P 500 as the reference index. Alternatively, a manager might be given a specific mandate reflecting specific risk requirements, return targets, or style or sector preferences, such as investing in biotech companies. In this case, simply holding the 500 US stocks that make up the S&P 500 in their appropriate proportions will not produce the performance demanded (and paid for) by clients. To beat this benchmark, the manager will have to be an active manager and to use analytical and trading skills and deliver high levels of client service to satisfy the mandate.

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<sup>3</sup> Index funds are described in the Investment Vehicles chapter.

To help clients meet their objectives, a benchmark should meet certain criteria:

- **Investability.** The benchmark should be composed of assets that can be bought and sold by the fund manager. For passive fund managers, it would be difficult to mimic the benchmark if it contained assets that they could not buy. For active fund managers, not being able to invest in some of the benchmark's components could limit their ability to outperform it.
- **Compatibility.** The benchmark should have an appropriate composition and level of risk for the investor. In other words, it should match the investor's objectives. For example, investors may not want to invest in assets that carry credit or default risk and so they may be willing to accept a relatively low return on their assets. In this case, a financial market index of government bonds might be compatible (based on historical performance) with investor preferences. A benchmark composed of emerging market equities would not be compatible.
- **Clarity.** The rules governing the construction of the benchmark should be clear. This clarity should extend to the weighting of individual benchmark constituents, to the method used to calculate benchmark returns, and to the process used to add and remove constituents to and from the benchmark over time.
- **Pre-specification.** The benchmark should be specified before an investment is made so that the manager is clear about the client's objectives and expectations and so the manager can construct a portfolio accordingly.

#### 4.1.2 Indices

A number of organisations produce financial market indices that allow investors to compare the holding-period return achieved by their fund manager with that generated by the wider market. For most equity exchanges around the world, there is at least one index that represents the majority of its stocks. In addition to these broad indices, stock indices that measure performance of industrial sectors are also available, both within a particular country and globally. These indices make it possible, for instance, for investors to compare the performance of a portfolio of global information technology (IT) stocks with the performance of a portfolio of Indian IT stocks, as long as the indices have been constructed using the same methodology.

A number of bond indices exist too. Many leading investment banks, such as Barclays Capital and Goldman Sachs, produce bond indices for different types of issuers located in developed or emerging countries. Independent index providers also provide a wide range of bond indices. In addition to aggregate bond indices that are designed to cover the market as a whole, many index providers offer bond indices classified by maturity, credit rating, currency, and industrial category. Many index providers, such as FTSE International, Standard & Poor's, and Morgan Stanley Capital International, produce indices for nearly every asset class, including cash, currencies, commercial property, hedge funds, private equity, and commodities, as well as for bonds and equities.

### 4.1.3 Relative Returns

The wide range of financial market indices available allows investors to set performance targets (passive or active) for their fund managers and enables them to compare the performance of their fund manager over time against an independent benchmark. In short, a benchmark index allows investors to evaluate relative returns.

Despite the widespread availability of independently constructed financial market indices covering nearly every conceivable sector and aspect of the world's financial markets, some investors prefer to compare their fund managers not with broad benchmarks constructed by index providers but instead with the fund manager's peers. For example, investors may compare the performance of one manager of European equities with that of other managers of European equities. Each manager is assigned a performance ranking within his or her particular sector of the financial markets. Managers who are in the top 10% of performers among their peers over a specific period are said to be top-decile performers. The performances of individual fund managers may be collected and then ranked by independent organisations, such as Morningstar, which then publishes the data, allowing investors to see the rankings of their particular fund managers relative to those of other managers that they could have chosen.

## 4.2 Tracking Error and Information Ratio

The **tracking error** of an investment fund reflects how the performance of the investment fund deviates from the performance of its benchmark. The tracking error is measured by taking the standard deviation of the differences between the returns on the fund and the returns on its benchmark. The bigger these differences, the larger the tracking error. A passive fund manager may be expected to have a very low tracking error because the manager is seeking to replicate a benchmark. But for an active fund manager, the tracking error will be higher.

Tracking error can also be used to formulate another widely used reward-to-risk ratio known as the **information ratio**. The “reward” part of the information ratio is the difference between the holding-period return on the portfolio and the return on an appropriate benchmark over the same period; the “risk” part of the information ratio is based on the tracking error of the fund—that is, its deviation from the performance of the benchmark. It is calculated as follows:

$$\text{Information ratio} = \frac{\text{Difference in average return between portfolio and benchmark}}{\text{Fund tracking error}}$$

Example 5 uses the annual holding-period returns on the UK equity portfolio as seen in Exhibit 3 to illustrate the calculations of the tracking error and the information ratio.

### EXAMPLE 5. TRACKING ERROR AND INFORMATION RATIO

The annual holding-period returns associated with investing in a diversified portfolio of UK equities and in the FTSE All-Share Index are shown in Exhibit 5. The last column shows the difference in the annual return achieved by the equity portfolio relative to its benchmark.

**Exhibit 5 Calculating Tracking Error**

Year	UK Equity Portfolio Total Return	FTSE All-Share Index Total Return	Difference
2001	5.00%	5.05%	-0.05%
2002	-15.00	-15.30	0.30
2003	-28.00	-28.56	0.56
2004	32.00	32.96	-0.96
2005	15.00	15.45	-0.45
2006	24.00	26.40	-2.40
2007	13.00	14.30	-1.30
2008	-3.00	-3.02	0.02
2009	-29.00	-29.15	0.15
2010	36.00	36.36	-0.36
Mean	5.00%	5.45%	
		Difference in Average Return	-0.45%
		Tracking Error	0.84%

*Source:* Based on data from the Centre for Asset Management Research, Cass Business School, London.

The average of the differences in returns is -0.45% per year; in other words, on average, the equity portfolio underperformed the benchmark by 0.45% each year over the 10-year period.

The standard deviation of these differences is 0.84%. The formula used to calculate standard deviation was presented in the Quantitative Concepts chapter, but you are *not* required to perform this calculation. This 0.84% represents the tracking error.

The information ratio is, therefore,

$$\text{Information ratio} = \frac{-0.45\%}{0.84\%} = -0.53$$

The information ratio is negative because the fund underperformed its benchmark over the period. If the information ratio had outperformed the benchmark, it would have been positive.

### 4.3 Skill vs. Luck

If a roomful of people each randomly buy 10 stocks and hold them for five years, some of those people may see the value of their investments rise. Does it follow that they are skilful investors? At the same time, other people in the room may see the value of their investments fall. Does that mean that they are poor investors? The answer to both questions is no. The stocks were chosen randomly, so the performance was

simply attributable to luck. But even when stocks are not chosen randomly, luck can play a big part in investment returns, so investors need a way to distinguish between skill and luck.

The calculation and analysis of reward-to-risk ratios allow an understanding of the price fund investors have to pay in terms of units of reward for each unit of risk—the total return—generated by the fund's manager. All things being equal, a manager who produces a consistently high reward-to-risk ratio could be said to be more skilful than one who consistently produces a lower ratio. Investors who invest in a fund that is managed on an active rather than on a passive basis are effectively paying for the manager's investment skill and expertise.

Fund manager skill is often referred to as **alpha**. Perhaps the best way to explain the concept of alpha is to consider the sources of a fund's return, which is composed of three elements:

- market return
- luck
- skill

#### 4.3.1 Market return

Managers of passive investment funds aim to produce returns for investors. These managers, however, are not looking to add value to the portfolios by picking securities that they believe will outperform other securities. Instead, they typically buy and hold in the appropriate proportions those securities that comprise their benchmark. Although this process requires some skill, it is not so much investment skill as efficient administration. When the passive benchmark rises, the value of the passive fund tracking it should also rise; conversely, when the benchmark falls, the value of the passive fund should also fall. Therefore, over time, the fund should produce a return similar to that of the chosen benchmark minus fees.

Given that most active fund managers benchmark their funds against financial market indices, such as the S&P 500, some of the return generated by an actively managed fund will come from market movements over which the active fund manager has no control. Arguably then, investors in actively managed funds should not pay higher active fees for fund returns that are generated by the market rather than by the investment acumen of their fund manager because they can access market returns more cheaply by investing in passively managed funds.

#### 4.3.2 Luck

Some of the return generated by an investment fund is the result of luck rather than judgement. The prices of financial assets held in portfolios are affected by events that cannot be foreseen by a fund manager.

Skilful fund managers may be unlucky on occasion and unskilled fund managers might enjoy some good luck. Because luck tends to even out over the long term, it is vital that investors are able to distinguish luck from skill. However, it is not always easy to do so.

### 4.3.3 Skill

A skilful fund manager is able to add value to a portfolio over and above changes to the portfolio's value that are driven by market movements and that could have been produced by a passive fund manager.

Because luck will tend to even out over time, a skilful manager is one who adds this value consistently over time, year after year. This outperformance over the returns from a relevant market benchmark is generally referred to as alpha.

### 4.3.4 Distinguishing Between Sources of Return

Performance evaluators try to distinguish between these three sources of fund manager return. To do so, factor models are used to determine the factors that make up returns and the importance of each factor. One such model is the capital asset pricing model (CAPM),<sup>4</sup> from which the term alpha comes. This model includes a measure of systematic risk: **beta**. **Systematic risk** (also called market or non-diversifiable risk) is the risk that affects all risky investments and cannot be diversified away. Factor models, such as the CAPM, separate a fund's performance into return from market performance (beta), from luck or randomness, or from the investment skills of the fund manager (alpha).

Most active managers benchmark their performance against an independently calculated financial market index. Just as standard deviation is a standardised measure of the deviation of a fund's return relative to its average return, tracking error is a standardised measure of the difference in the performance of the manager's fund relative to the benchmark. And just as the standard deviation of an investment fund's return can be used to produce the Sharpe ratio (a reward-to-risk ratio), the tracking error of an investment fund's return can be used to calculate another reward-to-risk ratio known as the information ratio. Both measures are widely used and referred to in the fund management industry. Finally, alpha is calculated by using factor models in an effort to identify the return from a fund manager's skill.

## 5

### ATTRIBUTE PERFORMANCE

Benchmarks form the basis of **performance measurement**, which is an important part of performance evaluation. By comparing the performance of a UK equity fund manager with the performance of an appropriate UK equity index, the fund manager's clients can get an idea of how well the fund manager is performing relative to the market in general, both in terms of average return and in terms of risk, by calculating the fund's tracking error or information ratio.

<sup>4</sup> William F. Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," *Journal of Finance*, vol. 19, no. 3 (September 1964):425–442.

Benchmarks can also be used to explore the reasons for the fund manager's performance. By using appropriate financial market indices, the fund manager's performance can be decomposed to reveal the sources of returns. Depending on the nature of the fund, the performance itself might come from the following sources:

- asset allocation
- sector selection
- stock selection
- currency exposure

Knowing how a fund manager's performance is derived is useful information both for the clients of the fund and for the investment management company. For example, if a fund manager is skilled at stock selection but less proficient at sector selection, another fund manager may be asked to give advice on the sector selection aspect of the portfolio, allowing the first fund manager to concentrate on stock selection. Knowing the strengths of fund managers can also help investors choose an investment fund.

Determining how much of performance is the result of the selection of asset classes, sectors, individual securities, and currencies is known as **performance attribution**. Example 6 provides an illustration of performance attribution.

#### EXAMPLE 6. PERFORMANCE ATTRIBUTION

Consider a fund manager who manages a portfolio that has a value of £100 million on 1 January, the start of an annual evaluation period. The benchmark for this fund comprises three equity market indices:

- the FTSE 100 (United Kingdom),
- the S&P 500 (United States), and
- the Nikkei 225 (Japan).

The mandate specifies that the benchmark will be 60% of the performance of the FTSE 100, 30% of the S&P 500, and 10% of the Nikkei 225. We can show this as

$$\begin{aligned} \text{Benchmark composition} &= (60\% \times \text{FTSE 100}) + (30\% \times \text{S\&P 500}) \\ &\quad + (10\% \times \text{Nikkei 225}) \end{aligned}$$

The fund manager is expected to outperform the benchmark by 1% per year.

Over the course of the year, assume the three financial indices produce the returns shown in Exhibit 6. For simplicity, the full-year return is equal to the sum of the returns for the two six-month periods—that is, we ignore compounding.

**Exhibit 6 Index and Benchmark Performance over One Year**

Index	Weight	Return		
		1 January to 30 June	1 July to 31 December	1 January to 31 December
FTSE 100	60%	6.0%	10.0%	16.0%
S&P 500	30	5.0	8.0	13.0
Nikkei 225	10	15.0	−10.0	5.0
Benchmark	100%	6.6%	7.4%	14.0%

Source: Andrew Clare and Chris Wagstaff, *The Trustee Guide to Investment* (London: Palgrave Macmillan, 2011).

Over the full year, the benchmark generated a return of 14%, composed of 6.6% in the first half of the year and 7.4% in the second half. Although the returns are positive, the components of the benchmark were actually quite volatile over these two periods. In particular, the Japanese index was up 15% over the first half of the year, but down 10% over the second half.

Assume that over the full year, the fund manager achieved a return of 15%. The manager thus satisfied the mandate—the return on the fund (15%) is 1% higher than the benchmark's return (14%). But where did the performance come from? To understand this question, an investor needs more information about the fund manager's decisions. In particular, an investor needs to know the proportions of the funds that the manager allocated to UK, US, and Japanese equities over the course of the year.

Exhibit 7 shows the fund manager's allocation to the three markets.

**Exhibit 7 Fund Manager Asset Allocation Decisions**

Markets	Fund Allocations	
	1 January to 30 June	1 July to 31 December
UK equities	60%	50%
US equities	30	20
Japanese equities	10	30
Total	100%	100%

Source: Andrew Clare and Chris Wagstaff, *The Trustee Guide to Investment* (London: Palgrave Macmillan, 2011).

Exhibit 7 shows that the fund manager reduced the proportion of both UK and US equities by 10 percentage points each before the second half of the year and increased the holding of Japanese equities by 20 percentage points.

It is possible to calculate the returns that the fund manager would have achieved based on the fund's allocations to the three markets and the returns achieved by the indices. In the first half of the year, the fund would have achieved the following return:

Return from 1 January to 30 June

$$= (60\% \times \text{FTSE 100}) + (30\% \times \text{S\&P 500}) + (10\% \times \text{Nikkei 225})$$

$$= (60\% \times 6\%) + (30\% \times 5\%) + (10\% \times 15\%)$$

$$= 6.60\%$$

In the second half of the year, the fund would have achieved the following return:

Return from 1 July to 31 December

$$= (50\% \times \text{FTSE 100}) + (20\% \times \text{S\&P 500}) + (30\% \times \text{Nikkei 225})$$

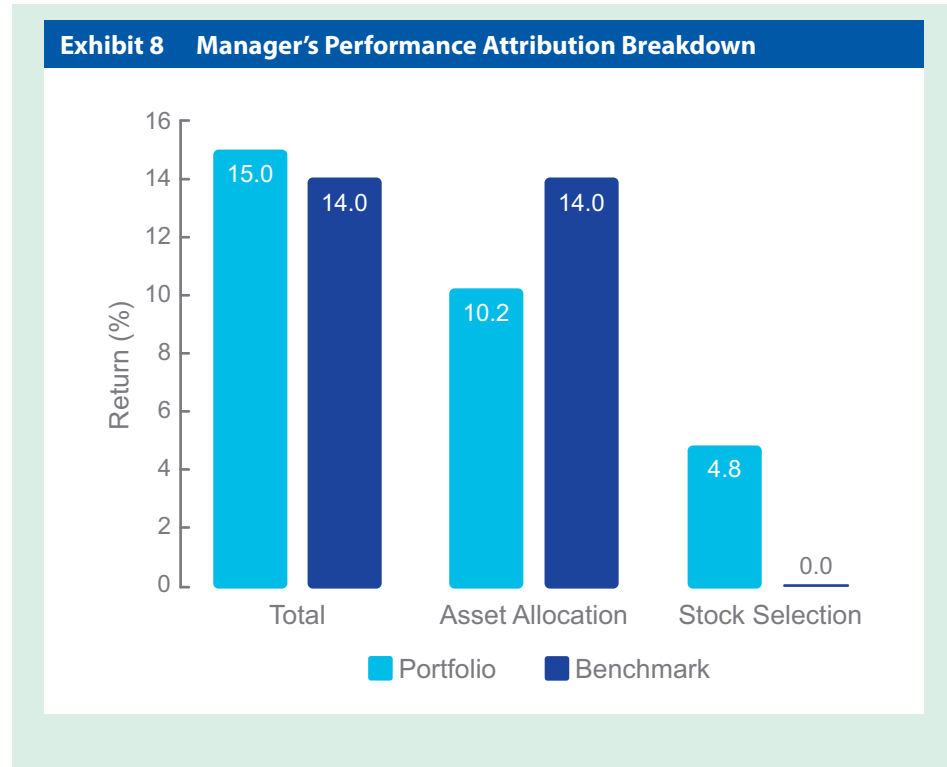
$$= (50\% \times 10\%) + (20\% \times 8\%) + (30\% \times -10\%)$$

$$= 3.60\%$$

This analysis suggests a return of approximately 10.2% for the full year. However, the fund manager actually achieved a return of 15%, which means that 4.8% (15.0% – 10.2%) of the return came from a source other than broad asset allocation decisions. In fact, had the manager held the equity funds passively, in line with the benchmark proportions, the manager would have achieved a return of 14% over the year—that is, the return for the full year reported in Exhibit 6. This result means that the fund manager's asset allocation decisions cost the fund 3.8% (14% – 10.2%).

So, the fund manager outperformed the benchmark by 1% even though the asset allocation decision lost 3.8%. This result means that the manager added 4.8% to the portfolio from a source other than asset allocation. It is possible that this portion of the return may have been from stock selection or from currency exposure, which is the change in the relative value of the currencies involved (the pound, dollar, and yen).

Using the type of techniques outlined here, it would be possible to further explore the fund manager's performance to understand whether this manager chose good US, Japanese, and UK stocks or good stocks in all of these markets. This attribution analysis is summarised in Exhibit 8.



In Example 6, it was assumed that the return that did not come from the manager's asset allocation decision was instead attributable to stock selection or to changes in currency exchange rates. With more detailed attribution analysis, an investor could reveal how much of the performance was from exchange rate movements, how much of the performance in the Japanese fund was from sector selection, and so on.

Modern performance attribution software can allow investment management companies to drill down into the detail of a fund to reveal all of this performance information. By doing so, the company may conclude that a particular fund manager is very good at stock selection but weaker in sector selection. Given this information, the company might ask another manager with better sector selection skills to make sector-related decisions, allowing the first manager to continue to add value through picking stocks.

## SUMMARY

- Performance evaluation is a crucial process for individual and institutional investors, investment management companies, and fund managers. It includes a number of separate but related steps: measuring absolute returns, adjusting returns for risk, measuring relative returns, and attributing performance.
- Absolute returns include two components: a capital gain or loss component and an income component.

- Returns need to be measured by taking into account the cash flows into and out of a fund over time.
- Fund or portfolio returns should be calculated using the time-weighted rate of return method. Time-weighted rates of return are not distorted by cash flows, so they reflect the true performance of the fund or portfolio.
- Standard deviation is a commonly used measure of investment return risk.
- Downside deviation is similar to standard deviation, except that it only includes negative deviations, which are outcomes less than the mean or a specified return target.
- The Sharpe and Treynor ratios are important reward-to-risk ratios that compare a portfolio's excess return with a measure of portfolio risk. Each reflects the return achieved per unit of risk taken.
- Relative returns allow for the comparison of a fund's return with the return of an appropriate benchmark.
- The use of a benchmark allows for the calculation of additional measures of risk, such as tracking error and the information ratio, and also a measure of fund manager skill, known as alpha.
- The use of financial market indices allows for the identification of how much of a fund's return is attributable to the fund manager's choice of asset classes, sectors, or individual securities or currencies.