GLOBAL EDITION

Fundamentals of Investing

FOURTEENTH EDITION

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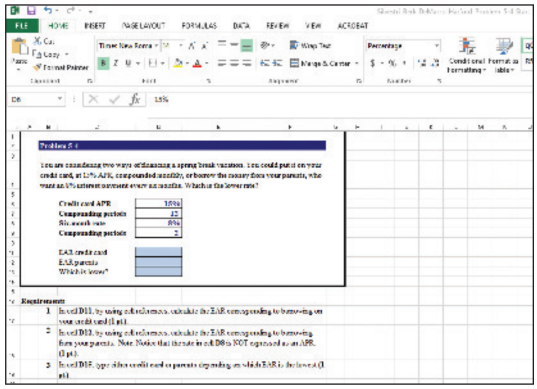

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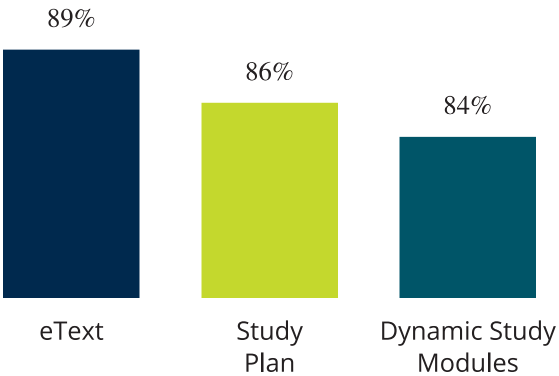

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Principles of Portfolio Planning

LG1 LG2

Investors benefit from holding portfolios of securities rather than just one or two investments. Without necessarily sacrificing returns, investors who hold portfolios can reduce risk. Surprisingly, the volatility of a portfolio may be less than the volatilities of the individual assets that make up the portfolio. In other words, when it comes to portfolios and risk, the whole is less than the sum of its parts!

A *portfolio* is a collection of investments assembled to meet one or more investment goals. Of course, different investors have different objectives for their portfolios. The primary goal of a **growth-oriented portfolio** is long-term price appreciation. An **income-oriented portfolio** is designed to produce regular dividends and interest payments.

Portfolio Objectives

Setting portfolio objectives involves tradeoffs, such as the tradeoff between risk and return or between potential price appreciation and income. How investors evaluate these tradeoffs depends on their tax bracket, income needs, and risk tolerance. One objective that should appeal to every investor is to establish an **efficient portfolio**, one that provides the highest return for a given risk level. Efficient portfolios aren't necessarily easy to identify. Investors usually must search out investment alternatives to get the best combinations of risk and return.

Portfolio Return and Standard Deviation

The first step in forming a portfolio is to analyze the characteristics of the securities that an investor might include in the portfolio. Two of the most important characteristics to examine are the returns that each asset might be expected to earn and the uncertainty surrounding that expected return. As a starting point, we will examine historical data to see what returns stocks have earned in the past and how much those returns have fluctuated to get a feel for what the future might hold.

The portfolio return, r_p, is just a weighted average of returns on the assets (i.e., the investments) that make up the portfolio, as Equation 5.1 demonstrates. The portfolio return depends on the returns of each asset, r_j, and on the fraction invested in each asset, w_j.

Equation 5.1

$$\text{Portfolio Return} = \left(\begin{array}{c}\text{Proportion of}\\ \text{portfolio's total}\\ \text{dollar value}\\ \text{invested in}\\ \text{asset 1}\end{array} \times \begin{array}{c}\text{Return}\\ \text{on asset}\\ 1\end{array}\right) + \left(\begin{array}{c}\text{Proportion of}\\ \text{portfolio's total}\\ \text{dollar value}\\ \text{invested in}\\ \text{asset 2}\end{array} \times \begin{array}{c}\text{Return}\\ \text{on asset}\\ 2\end{array}\right) + \cdots + \left(\begin{array}{c}\text{Proportion of}\\ \text{portfolio's total}\\ \text{dollar value}\\ \text{invested in}\\ \text{asset } n\end{array} \times \begin{array}{c}\text{Return}\\ \text{on asset}\\ n\end{array}\right) = \sum_{j=1}^{n}\left(\begin{array}{c}\text{Proportion of}\\ \text{portfolio's total}\\ \text{dollar value}\\ \text{invested in}\\ \text{asset } j\end{array} \times \begin{array}{c}\text{Return}\\ \text{on asset}\\ j\end{array}\right)$$

Equation 5.1a

$$r_p = (w_1 \times r_1) + (w_2 \times r_2) + \cdots + (w_n \times r_n) = \sum_{j=1}^{n}(w_j \times r_j)$$

The fraction invested in each asset, w_j, is called a portfolio weight because it indicates the weight that each asset receives in the portfolio. Of course, $\sum_{j=1}^{n} w_j = 1$, which means that the sum of the portfolio weights must equal 100%. In other words, the value of the portfolio equals the sum of its parts.

Panel A of Table 5.1 shows the historical annual returns on two stocks, Walmart Stores Inc. (WMT) and Century Casinos Inc. (CNTY), from 2008 through 2017. Over that period, Walmart earned an average annual return of 11.7%, but Century earned a spectacular 33.7% average annual return. Although Century may not repeat that kind of performance over the next decade, it is still instructive to examine the historical figures.

Suppose we want to calculate the return on a portfolio containing investments in both Walmart and Century. The first step in that calculation is to determine how much of each stock to hold. In other words, we must to decide what weight each stock

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TABLE 5.1 INDIVIDUAL AND PORTFOLIO RETURNS AND STANDARD DEVIATION OF RETURNS FOR WALMART STORES INC. (WMT) AND CENTURY CASINOS INC. (CNTY)

A. Individual and Portfolio Returns

	(1)	(2)	(3)		(4)
	Historical Returns*		Portfolio Weights		Portfolio Return
Year (t)	R_{WMT}	R_{CNTY}	$W_{WMT} = 0.80$	$W_{CNTY} = 0.20$	r_p
2008	19.9%	15.8%	(0.80 × 19.9%) + (0.20 × 15.8%) =		19.1%
2009	−2.6%	163.7%	(0.80 × −2.6%) + (0.20 × 163.7%) =		30.7%
2010	3.2%	−9.3%	(0.80 × 3.2%) + (0.20 × −9.3%) =		0.7%
2011	13.8%	3.7%	(0.80 × 13.8%) + (0.20 × 3.7%) =		11.8%
2012	16.9%	12.2%	(0.80 × 16.9%) + (0.20 + 12.2%) =		16.0%
2013	18.2%	83.4%	(0.80 × 18.2%) + (0.20 × 83.4%) =		31.2%
2014	11.8%	−3.1%	(0.80 × 11.8%) + (0.20 × −3.1%) =		8.8%
2015	−26.6%	54.1%	(0.80 × −26.6%) + (0.20 × 54.1%) =		−10.5%
2016	16.0%	5.8%	(0.80 × 16.0%) + (0.20 × 5.8%) =		14.0%
2017	46.5%	10.9%	(0.80 × 46.5%) + (0.20 × 10.9%) =		39.4%
Average Return	11.7%	33.7%			16.1%

B. Individual and Portfolio Standard Deviations

Standard Deviation Calculation for WMT:

$$s_{WMT} = \sqrt{\frac{\sum_{t=1}^{10}(r_t - \bar{r})^2}{n-1}} = \sqrt{\frac{(19.9\% - 11.7\%)^2 + \ldots + (46.5\% - 11.7\%)^2}{10-1}} = \sqrt{\frac{3114.1\%^2}{10-1}} = 18.6\%$$

Standard Deviation Calculation for CNTY:

$$s_{CNTY} = \sqrt{\frac{\sum_{t=1}^{10}(r_t - \bar{r})^2}{n-1}} = \sqrt{\frac{(15.8\% - 33.7\%)^2 + \ldots + (10.9\% - 33.7\%)^2}{10-1}} = \sqrt{\frac{2{,}5970.4\%^2}{10-1}} = 53.7\%$$

Standard Deviation Calculation for Portfolio:

$$S_p = \sqrt{\frac{\sum_{t=1}^{10}(r_t - \bar{r})^2}{n-1}} = \sqrt{\frac{(19.1\% - 16.1\%)^2 + \ldots + (39.4\% - 16.1\%)^2}{10-1}} = \sqrt{\frac{2010.9\%^2}{10-1}} = 14.9\%$$

should receive in the portfolio. Let's assume that we want to invest 80% of our money in Walmart and 20% in Century. What kind of return would such a portfolio earn?

We know that over this period Century earned much higher returns than Walmart, so intuitively we might expect that a portfolio containing both stocks would earn a return higher than Walmart's but lower than Century's. Furthermore, Walmart accounts for most (i.e., 80%) of the portfolio, so it's natural to guess that the portfolio's return would be closer to Walmart's than to Century's.

Columns 3 and 4 in Panel A show the portfolio's return each year. The portfolio's average annual return was 16.1%, and as expected, it is higher than Walmart's average return and lower than Century's. Investing in both Walmart and Century produced a higher return than holding only Walmart.

What about the portfolio's risk? To examine the risk of this portfolio, start by measuring each stock's risk. Recall that one measure of risk is the standard deviation of returns. Panel B of Table 5.1 applies the formula for standard deviation introduced earlier to calculate the standard deviation of returns on Walmart and Century stock. The Excel spreadsheet that follows also shows how to do these calculations using preprogrammed functions. The standard deviation of Walmart's returns was 18.6%, and for Century's stock returns the standard deviation was 53.7%. Here again we see evidence of the tradeoff between risk and return. Century's stock earned much higher returns than Walmart's stock, but Century's returns fluctuated a great deal more as well.

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	A	B	C	D
1	STANDARD DEVIATION OF RETURNS FOR WMT, CNTY, AND PORTFOLIO			
2	Year (t)	r_{WMT}	r_{CNTY}	r_p
3	2008	19.9%	15.8%	19.1%
4	2009	−2.6%	163.7%	30.7%
5	2010	3.2%	−9.3%	0.7%
6	2011	13.8%	3.7%	11.8%
7	2012	16.9%	12.2%	16.0%
8	2013	18.2%	83.4%	31.2%
9	2014	11.8%	−3.1%	8.8%
10	2015	−26.6%	54.1%	−10.5%
11	2016	16.0%	5.8%	14.0%
12	2017	46.5%	10.9%	39.4%
13	Standard deviation	18.6%	53.7%	14.9%

Entries in Cells B13, C13, and D13 are =STDEV(B3:B12), =STDEV(C3:C12), and =STDEV(D3:D12), respectively.

Because Century's returns are more volatile than Walmart's, you might expect that a portfolio containing both stocks would have a standard deviation that is higher than Walmart's but lower than Century's. In fact, that's not what happens. The final calculation in Panel B inserts the Walmart-Century portfolio return data from column 4 in Panel A into the standard deviation formula to calculate the portfolio's standard deviation. Panel B shows the surprising result that the portfolio's returns are less volatile than are the returns of either stock in the portfolio! The portfolio's standard deviation is just 14.9%. This is great news for investors. An investor who held only Walmart shares would have earned an average return of only 11.7%, but to achieve that return the investor would have had to endure Walmart's 18.6% standard deviation. By selling a few Walmart shares and using the proceeds to buy a few Century shares (resulting in the 0.80 and 0.20 portfolio weights shown in Table 5.1), an investor could have simultaneously increased the return to 16.1% and reduced the standard deviation to 14.9%—a win-win situation. This means that an investor who owns nothing but Walmart shares holds an *inefficient portfolio*—a portfolio that fails to provide the highest return for a given level of risk. To say it differently, holding nothing but Walmart is inefficient because another portfolio exists that has a better return-to-risk tradeoff. That's the power of diversification. Next, we will see that the key factor in making this possible is a low correlation between Walmart and Century returns.

Correlation and Diversification

Diversification means including different investments in a portfolio, and it is a necessary step in creating an efficient portfolio. The statistical concept of correlation drives the benefits of diversification. Effective portfolio planning requires an understanding of how correlation and diversification influence a portfolio's risk.

Correlation **Correlation** is a statistical measure of the relationship between two series of numbers. If two series tend to move in the same direction, they are **positively correlated**. For instance, if each day we record the hours of sunshine and the temperature, we would expect those two series to display positive correlation. Days with more-than-average sunshine tend to be days with higher-than-average temperatures. If the series tend to move in opposite directions, they are **negatively correlated**. For example, if each day we record the hours of sunshine and the amount of rainfall, we would expect those two series to display negative correlation because rainfall tends to be below average on days with above-average sunshine. Finally, if two series bear no relationship to each other, then they are **uncorrelated**. We would probably expect no correlation between the hours of sunshine on a particular day and the change in the value of the U.S. dollar against other world currencies. There is no obvious connection between sunshine and world currency markets.

The degree of correlation—whether positive or negative—is measured by the **correlation coefficient**, which is usually represented by the Greek symbol rho (ρ). It's easy to use Excel to calculate the correlation coefficient between Walmart and Century stock returns, as shown in the following spreadsheet.

Excel reveals that the correlation coefficient between Walmart and Century during the 2008–2017 period was −0.35. The negative figure means that there was a tendency over this period for the two stocks to move in opposite directions. In other words,

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	A	B	C
1	CORRELATION COEFFICIENT OF RETURNS FOR WMT AND CNTY		
2	Year (t)	r_{WMT}	r_{CNTY}
3	2008	19.9%	15.8%
4	2009	−2.6%	163.7%
5	2010	3.2%	−9.3%
6	2011	13.8%	3.7%
7	2012	16.9%	12.2%
8	2013	18.2%	83.4%
9	2014	11.8%	−3.1%
10	2015	−26.6%	54.1%
11	2016	16.0%	5.8%
12	2017	45.5%	10.9%
13		Correlation coefficient	−0.35

Entry in Cell B13 is =CORREL(B3:B12,C3:C12).

years in which Walmart's return was *better* than average tended to be years in which Century's return was *worse* than average, and vice versa. A negative correlation between two stocks is somewhat unusual because most stocks are affected in the same way by large, macroeconomic forces. In other words, most stocks tend to move in the same direction as the overall economy, which means that most stocks will display at least some positive correlation with each other.

Because Walmart is a major discount retailer and Century Casinos operates casinos, hotels, restaurants, and even horse-racing facilities, it is not too surprising that the correlation between them is not strongly positive. The companies compete in entirely different industries, have different customers and suppliers, and operate within very different regulatory constraints. Even so, stocks from different industries usually display at least some positive correlation. The relatively large (i.e., −0.35) magnitude of the negative correlation here raises questions about whether the negative correlation will persist over time. Perhaps the sample period we are using to estimate this correlation is too short or is not truly representative of the investment performance of these two stocks, leading to an unwarranted conclusion about how these stocks are likely to behave in the future. One way to address this concern is to measure the correlation over a longer time period, thus increasing the number of yearly observations. Regardless, it seems safe to say that the correlation between these two stocks will remain quite low.

For any pair of investments that we might want to study, the correlation coefficient ranges from +1.0 for **perfectly positively correlated** series to −1.0 for **perfectly negatively correlated** series. Figure 5.1 illustrates these two extremes for two pairs of investments: M and P, and M and N. M and P represent the returns on two investments that move perfectly in sync, so they are perfectly positively correlated. In the real world it is extremely rare to find two investments that are perfectly correlated like this, but you could think of M and P as representing two companies that operate in the same industry, or even two mutual funds that invest in the same types of stocks. In contrast, returns on investments M and N move in exactly opposite directions and are perfectly negatively correlated. While these two extreme cases can be illustrative, the correlations between most stocks' returns exhibit some degree (ranging from high to low) of positive correlation. Negative correlation is the exception.

Diversification As a general rule, the lower the correlation between any two assets, the greater the risk reduction that investors can achieve by combining those assets in a portfolio. Figure 5.2 demonstrates this principle by tracking the performance of two

FIGURE 5.1

The Correlations of Returns Between Investments M and P and Investments M and N.

Investments M and P produce returns that are perfectly positively correlated and move exactly together. On the other hand, returns on investments M and N move in exactly opposite directions and are perfectly negatively correlated. In most cases, the correlation between any two investments will fall between these two extremes.

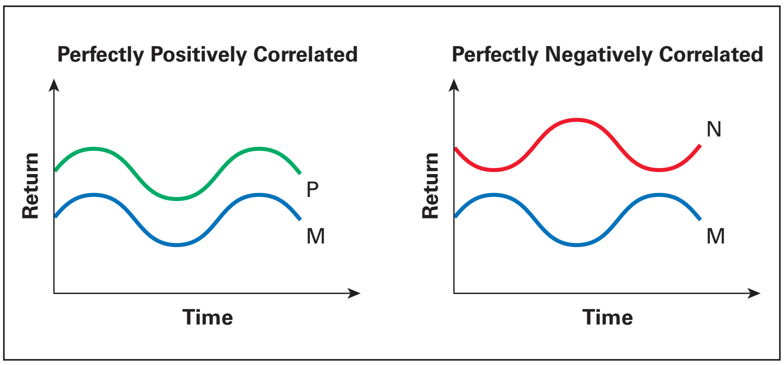

FIGURE 5.2

The Effect of Correlation on Portfolio Volatility Panel

Panel A plots the returns on Duke Energy, Consolidated Edison, and an equally weighted portfolio of those two stocks from 2016 to 2017. Movements in Duke and Consolidated Edison almost perfectly mirror each other, so the portfolio behaves much like the individual stocks. With the high correlation between Duke and Consolidated Edison, diversifying does little to reduce risk. Panel B plots the returns on two exchange-traded funds: the Vanguard S&P 500 and the Proshares Short S&P 500. By design the two ETFs have an almost perfect negative correlation, so a portfolio invested equally in each shows almost no volatility at all. The general principle is that the lower the correlation between assets, the greater the risk reduction achieved through diversification.