Chapter 8

Risk and Return: Capital Market Theory

Agenda

- Principles Used in This Chapter
  1. Portfolio Returns and Portfolio Risk
  2. Systematic Risk and the Market Portfolio
  3. The Security Market Line and the CAPM

Learning Objectives

1. Calculate the expected rate of return and volatility for a portfolio of investments
2. Describe how diversification affects the returns to a portfolio of investments.
3. Understand the concept of systematic risk for an individual investment
4. Calculate portfolio systematic risk (beta).
5. Estimate an investor's required rate of return using capital asset pricing model.

Principles Used in This Chapter

- Principle 2: There is a Risk-Return Tradeoff.
  - We extend our risk return analysis to consider portfolios of risky investments and the beneficial effects of portfolio diversification on risk.
  - In addition, we will learn more about what types of risk are associated with both higher and lower expected rates of return.

8.1 Portfolio Returns and Portfolio Risk

Portfolio Returns and Portfolio Risk

- With appropriate diversification, we can lower the risk of the portfolio without lowering the portfolio's expected rate of return.
- Some risk can be eliminated by diversification, and <u>those risks that can be eliminated are not rewarded in the financial marketplace.</u>
  - The market will not reward you for bearing risk <u>needlessly</u>

Expected Return of a Portfolio

- To calculate a portfolio's expected rate of return, we *weight* each individual investment's expected rate of return using the fraction of the portfolio that is invested in each investment.
  - Price per share×Number of shares/Value of Portfolio

Expected Return of a Portfolio

- Example 8.1 : If you invest
  - 25%of your money in the stock of Citi bank (C) with an expected rate of return of -32%
  - 75% of your money in the stock of Apple (AAPL) with an expected rate of return of 120%
  - What will be the expected rate of return on this portfolio?

Expected Return of a Portfolio

- Expected rate of return

  = .25(-32%) + .75 (120%)

  = 82%

Expected Return of a Portfolio

Portfolio Expected Rate of Return

$$E(r_{portfolio}) = [W_1 \times E(r_1)] + [W_2 \times E(r_2)] + [W_3 \times E(r_3)] + \cdots + [W_n \times E(r_n)]$$

- $E(r_{portfolio})$ = the expected rate of return on a portfolio of n assets.
- W_i = the portfolio weight for asset i.
  - Percentage of the total portfolio by value
- $E(r_i)$ = the expected rate of return earned by asset i.
- $W_1 \times E(r_1)$ = the contribution of asset 1 to the portfolio expected return.

Checkpoint 8.1

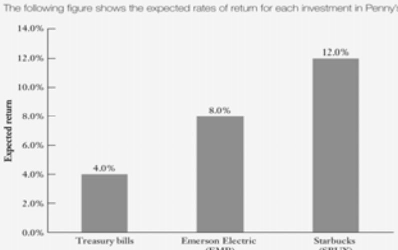
Calculating a Portfolio's Expected Rate of Return

Penny Simpson has her first full-time job and is considering how to invest her savings. Her dad suggested she invest no more than 25% of her savings in the stock of her employer, Emerson Electric (EMR), so she is considering investing the remaining 75% in a combination of a risk-free investment in U.S. Treasury bills, currently paying 4%, and Starbucks (SBUX) common stock. Penny's father has invested in the stock market for many years and suggested that Penny might expect to earn 9% on the Emerson shares and 12% from the Starbucks shares. Penny decides to put 25% in Emerson, 25% in Starbucks, and the remaining 50% in Treasury bills. Given Penny's portfolio allocation, what rate of return should she expect to receive on her investment?

Checkpoint 8.1

STEP 1: Picture the problem

The following figure shows the expected rates of return for each investment in Penny's portfolio.



The expected rate of return for Penny's portfolio can be calculated as a weighted average of these expected rates of return, where the weights are the proportions of each investment.

Checkpoint 8.1

STEP 2: Decide on a solution strategy

The portfolio expected rate of return is simply a weighted average of the expected rates of return of the investments in the portfolio. So we use Equation (8–1) to calculate the expected rate of return for Penny's portfolio. Fill in the shaded cells under the "Product" column in the following table to calculate a weighted average.

	E(Return) ×	Weight =	Product
U.S. Treasury bills	4.0%	0.50	
Emerson Electric (EMR)	8.0%	0.25	
Starbucks (SBUX)	12.0%	0.25	
Portfolio E(Return) = Sum of product column			

Checkpoint 8.1

STEP 3: Solve

We can use Equation (8–1) to calculate the expected rate of return for the portfolio as follows:

$$E(r_{portfolio}) = W_{Treasury\ Bills}E(r_{Treasury\ Bills}) + W_{EMR}E(r_{EMR}) + W_{SBUX}E(r_{SBUX})$$

$$= (1/2 \times .04) + (1/4 \times .08) + (1/4 \times .12) = .07 \text{ or } 7\%$$

Alternatively, by filling out the table described above we get the same result.

	E(Return)	Weight	Product
Treasury bills	4.0%	0.50	2.0%
Emerson Electric (EMR)	8.0%	0.25	2.0%
Starbucks (SBUX)	12.0%	0.25	3.0%
	Portfolio E(Return) =		7.0%

Checkpoint 8.1

STEP 4: Analyze

The expected rate of return for the portfolio composed of 50% invested in Treasury bills, 25% in Emerson Electric stock, and the remaining 25% in Starbucks stock is 7%. Note that we have referred to the Treasury bill rate as its expected rate of return. This is technically accurate because this return is assumed to be risk-free. That is, if you purchase a Treasury bill that promises to pay you 4%, because this security is risk-free, this is the only possible outcome. This is not the case for either of the other investment alternatives. We can calculate the expected rate of return for the portfolio in exactly the same way regardless of the risk of the investments contained in the portfolio. However, as we learn next, the risk of the portfolio is affected by the riskiness of the returns of the individual investments contained in the portfolio.

Evaluating Portfolio Risk

- Unlike expected return, standard deviation is not generally equal to the a weighted average of the standard deviations of the returns of investments held in the portfolio.
- This is because of diversification effects.

Portfolio Diversification

- The effect of reducing risks by including a large number of investments in a portfolio is called **diversification**.
- As a consequence of diversification, the standard deviation of the returns of a portfolio is typically less than the average of the standard deviation of the returns of each of the individual investments.

Portfolio Diversification

- The diversification gains achieved by adding more investments will depend on the degree of correlation among the investments.
- The degree of correlation is measured by using the **correlation coefficient**.

Portfolio Diversification

- The correlation coefficient can range from -1.0 (perfect negative correlation), meaning two variables move in perfectly opposite directions to +1.0 (perfect positive correlation), which means the two assets move exactly together.
- A correlation coefficient of 0 means that there is no relationship between the returns earned by the two assets.

Portfolio Diversification

- As long as the investment returns are not perfectly positively correlated, there will be diversification benefits.
- However, the diversification benefits will be greater when the correlations are low or positive.
- The returns on most investment assets tend to be positively correlated (tend to move up and down together).

Diversification Lessons

1. A portfolio can be less risky than the average risk of its individual investments in the portfolio.
2. The key to reducing risk through diversification is to combine investments whose returns do not move together.

Calculating the Standard Deviation of a Portfolio Returns

$$\sigma_{portfolio} = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\rho_{1,2}\sigma_1\sigma_2}$$

Important Definitions and Concepts:

- $\sigma_{portfolio}$ = the standard deviation in portfolio returns,
- W_i = the proportion of the portfolio that is invested in asset i,
- σ_i = the standard deviation in the rate of return earned by asset i, and
- $\rho_{i,j}$ = the correlation coefficient between the rates of return earned by assets i and j. The symbol $\rho_{i,j}$ (pronounced "rho") represents the correlation coefficient between the rates of return for asset 1 and asset 2.

Calculating the Standard Deviation of a Portfolio Returns

- Determine the expected return and standard deviation of the following portfolio consisting of two stocks that have a correlation coefficient of .75.

Portfolio	Weight	Expected Return	Standard Deviation
Apple	.50	.14	.20
Coca-Cola	.50	.14	.20

Calculating the Standard Deviation of a Portfolio Returns

- Expected Return = .5 (.14) + .5 (.14)

  = .14 or 14%

Calculating the Standard Deviation of a Portfolio Returns

- Standard deviation of portfolio
  $= \sqrt{\{(.5^2 x .2^2)+(.5^2 x .2^2)+(2 x .5 x .5 x .75 x .2 x .2)\}}$
  $= \sqrt{.035}$
  = .187 or 18.7%

Correlation Coefficient

Checkpoint 8.2

Evaluating a Portfolio's Risk and Return

Sarah Marshall Tipton is considering her 401(k) retirement portfolio and wonders if she should move some of her money into international investments. To this point in her short working life (she graduated just four years ago), she has simply put her retirement savings into a mutual fund whose investment strategy mimicked the returns of the S&P 500 stock index (large company stocks). This fund has historically earned a return averaging 12% over the last 80 or so years, but recently the returns were depressed somewhat, as the economy was languishing in a mild recession. Sarah Is considering an international mutual fund that diversifies its holdings around the industrialized economies of the world and has averaged a 14% annual rate of return. The international fund's higher average return is offset by the fact that the standard deviation in its returns is 30% compared to only 20% for the domestic index fund. Upon closer investigation, Sarah learned that the domestic and international funds tend to earn high returns and low returns at about the same times in the business cycle such that the correlation coefficient is .75. If Sarah were to move half her money into the international fund and leave the remainder in the domestic fund, what would her expected portfolio return and standard deviation in portfolio return be for the combined portfolio?

Checkpoint 8.2

STEP 1: Picture the problem

We can visualize the expected rates of return and corresponding standard deviations as follows:

Investment Fund	Expected Return	Standard Deviation	Investment Proportion
S&P 500 Fund	12%	20%	50%
International Fund	14%	30%	50%
Portfolio			100%

The challenge Sarah faces is estimating the portfolio's expected return and standard deviation when she places half her money in each of the two mutual funds. She needs answers to place in the shaded squares in the grid on the previous page.

STEP 2: Decide on a solution strategy

The portfolio expected rate of return is simply a weighted average of the expected rates of return of the investments in the portfolio. However, the standard deviation is a bit more complicated as diversification can lead to a reduction in the standard deviation below the weighted average of the standard deviations of the investments in the portfolio. We use Equations (8–1) and (8–2) to calculate the expected rate of return and standard deviation for the portfolio.

Checkpoint 8.2

STEP 3: Solve

Calculating the Expected Return for the Portfolio.

We use Equation (8–1) to calculate the expected rate of return for the portfolio as follows:

$$E(r_{portfolio}) = W_{S\&P\,500}E(r_{S\&P\,500}) + W_{International}E(r_{International})$$

$$= (1/2 \times .12) + (1/2 \times .14) = .13 \text{ or } 13\%$$

Calculating the Standard Deviation for the Portfolio.

The standard deviation can be calculated using Equation (8–2) as follows:

$$\sigma_{portfolio} = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\rho_{1,2}\sigma_1\sigma_2}$$

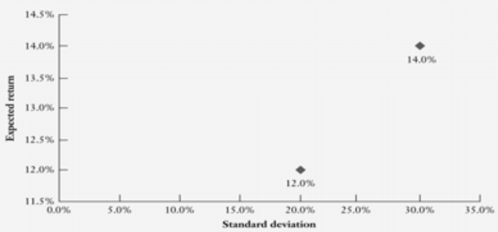
$$= \sqrt{(.5^2 \times .20^2) + (.5^2 \times .30^2) + (2 \times .5 \times .5 \times .75 \times .20 \times .30)}$$

$$= .235 \text{ or } 23.5\%$$

Checkpoint 8.2

STEP 4: Analyze

The expected rate of return for the portfolio comprised of 50% in the S&P 500 fund and 50% in the international fund is 13%, which plots exactly half way between the two investments' expected returns on the following graph:



However, the standard deviation of the portfolio is not equal to 25%, the mid-point between the standard deviations of 20% and 30% (i.e., the weighted average of the two investments' standard deviations). It is, instead, equal to only 23.5%, which shows that we gain something from diversifying between the international and domestic markets. The returns in these two markets are not perfectly positively correlated, so there is some reduction in the standard deviation of the portfolio that is gained by putting the two investment alternatives together.

Checkpoint 8.2: *Check Yourself*

Evaluate the expected return and standard deviation of the portfolio where the correlation is assumed to be .20 and Sarah still places half of her money in each of the funds.

Step 1: Picture the Problem

- We can visualize the expected return, standard deviation and weights as follows:

Investment Fund	Expected Return	Standard Deviation	Investment Weight
S&P500 fund	12%	20%	50%
International Fund	14%	30%	50%
Portfolio			100%

- Sarah needs to determine the answers to place in the empty squares.

Step 2: Decide on a Solution Strategy

- The portfolio expected return is a simple weighted average of the expected rates of return of the two investments given by equation 8-1.

- The standard deviation of the portfolio can be calculated using equation 8-2. We are given the correlation to be equal to .20.

Step 3: Solve

Portfolio Expected Rate of Return

$$E(r_{portfolio}) = [W_1 \times E(r_1)] + [W_2 \times E(r_2)] + [W_3 \times E(r_3)] + \cdots + [W_n \times E(r_n)]$$

- $E(r_{portfolio})$
  $= W_{S\&P500}\, E(r_{S\&P500}) + W_{International}\, E(r_{International})$
  $= .5\,(12) + .5(14)$
  $= 13\%$

Step 3: Solve

$$\sigma_{portfolio} = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\rho_{1,2}\sigma_1\sigma_2}$$

- Standard deviation of Portfolio
  $= \sqrt{ (.5^2 x .2^2)+(.5^2 x .3^2)+(2 x .5 x .5 x .20 x .2 x .3)}$
  $= \sqrt{.0385}$
  = .1962 or 19.62%

Step 4: Analyze

- The standard deviation of the portfolio is less than 25% at 19.62% because of the diversification benefits.
- Since the correlation between the two funds is less than 1, combining the two funds into one portfolio results in portfolio risk reduction.

8.2 Systematic Risk and the Market Portfolio

Systematic Risk and Market Portfolio

- It would be an onerous task to calculate the correlations when we have thousands of possible investments.
- Capital Asset Pricing Model or the CAPM provides a relatively simple measure of risk.

Systematic Risk and Market Portfolio

- CAPM assumes that investors chose to hold the optimally diversified portfolio that includes all risky investments.
- This optimally diversified portfolio that includes all of the economy's assets is referred to as the **market portfolio.**

Systematic Risk and Market Portfolio

- According to the CAPM, the relevant risk of an investment relates to how the investment contributes to the risk of this market portfolio.

Systematic Risk and Market Portfolio

- To understand how an investment contributes to the risk of the portfolio, we categorize the risks of the individual investments into two categories:
  - Systematic risk, and
  - Unsystematic risk

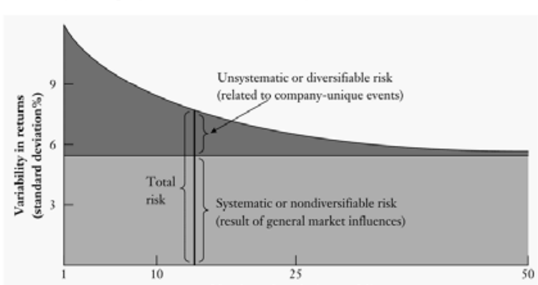
Systematic Risk and Market Portfolio

- The **systematic risk** component measures the contribution of the investment to the risk of the market.
  - For example: War, hike in corporate tax rate.
- The **unsystematic risk** is the element of risk that does not contribute to the risk of the market.
- This component is diversified away when the investment is combined with other investments.
  - For example: Product recall, labor strike, change of management.

Figure 8.2

Portfolio Risk and the Number of Investments in the Portfolio

Adding more investments to a portfolio that are not highly correlated with the other assets in the portfolio can dramatically reduce the portfolio's risk. In fact, for randomly selected shares of common stock, the benefits of diversification can be virtually fully achieved with a portfolio of less than 50 stocks (assuming equal investment in each stock).



Systematic Risk and Beta

- Systematic risk is measured by the **beta coefficient,**
  - **Beta** estimates the extent to which a particular investment's returns vary with the returns on the market portfolio.
- In practice, it is estimated as the slope of a straight line (see figure 8-3)

Figure 8.3

Estimating Google's (GOOG) Beta Coefficient

A firm's beta coefficient is the slope of a straight line that fits the relationship between the firm's stock returns and those of a broad market index. In the graph below the market index used is the Standard and Poor's (S&P) 500 Index.

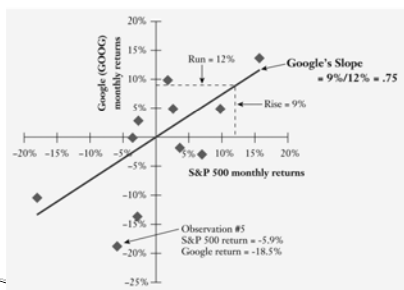


Figure 8.3 cont.

Beta

- Beta could be estimated using excel or financial calculator, or readily obtained from various sources on the internet (such as Yahoo Finance and Money Central.com)

Table 8.1 Beta Coefficients for Selected Companies

This table contains two sources of beta estimates (Yahoo.com and MSN.com). These estimates were accessed on the same day and can vary over time since historical stock and market returns are used to calculate the beta estimates.

Company	Yahoo Finance (Yahoo.com)	Microsoft Money Central (MSN.com)
Computers and Software		
Apple Inc. (AAPL)	2.90	2.58
Dell Inc. (DELL)	1.81	1.37
Hewlett Packard (HPQ)	1.27	1.47
Utilities		
American Electric Power Co. (AEP)	0.74	0.73
Duke Energy Corp. (DUK)	0.40	0.56
Centerpoint Energy (CNP)	0.82	0.91

Beta

- Table 8-1 illustrates the wide variation in Betas for various companies.
- Utilities companies can be considered less risky because of their lower betas.
  - A 1% drop in market could lead to a .74% drop in AEP and
  - A much larger 2.9% drop in AAPL.

Calculating Portfolio Beta

- The portfolio beta measures the systematic risk of the portfolio
- Portfolio beta is calculated by taking a simple weighted average of the betas for the individual investments contained in the portfolio.
  - Same portfolio weights we have been using

Calculating Portfolio Beta

Portfolio Beta

$$\text{Portfolio Beta} = \begin{pmatrix}\text{Proportion of Portfolio Invested in Asset 1 } (W_1) \times \text{Beta for Asset 1 } (\beta_1)\end{pmatrix} + \begin{pmatrix}\text{Proportion of Portfolio Invested in Asset 2 } (W_2) \times \text{Beta for Asset 2 } (\beta_2)\end{pmatrix} + \cdots + \begin{pmatrix}\text{Proportion of Portfolio Invested in Asset } n\ (W_n) \times \text{Beta for Asset } n\ (\beta_n)\end{pmatrix}$$

Important Definitions and Concepts:

- W_i = the proportion of the portfolio that is invested in the Asset i,
- β_i = the beta coefficient for Asset i, and
- $\beta_{portfolio}$ = the portfolio beta which is a weighted average of the betas for the individual assets contained in the portfolio.

Calculating Portfolio Beta

- Example 8.2 Consider a portfolio that is comprised of four investments with betas equal to 1.5, .75, 1.8 and .60.
- If you invest equal amount in each investment, what will be the beta for the portfolio?

Calculating Portfolio Beta

Portfolio Beta

$$\text{Portfolio Beta} = \begin{pmatrix}\text{Proportion of Portfolio Invested in Asset 1 } (W_1) \times \text{Beta for Asset 1 } (\beta_1)\end{pmatrix} + \begin{pmatrix}\text{Proportion of Portfolio Invested in Asset 2 } (W_2) \times \text{Beta for Asset 2 } (\beta_2)\end{pmatrix} + \cdots + \begin{pmatrix}\text{Proportion of Portfolio Invested in Asset } n\ (W_n) \times \text{Beta for Asset } n\ (\beta_n)\end{pmatrix}$$

- Portfolio Beta
  = .25(1.5) + .25(.75) + .25(1.8) + .25 (.6)
  = 1.16

8.3 The Security Market Line and the CAPM

The Security Market Line and the CAPM

- CAPM also describes how the betas relate to the expected rates of return that investors require on their investments.
- The key insight of CAPM is that investors will require a higher rate of return on investments with higher betas.

The Security Market Line and the CAPM

$$E(r_{portfolio}) = r_f + \beta_{portfolio}[E(r_M) - r_f]$$

- Figure 8-4 provides the expected returns and betas for a variety of portfolios comprised of market portfolio and risk-free asset. However, the figure applies to all investments, not just portfolios consisting of the market and the risk-free rate.

Figure 8.4

Risk and Return for Portfolios Containing the Market and the Risk-Free Security

The following graph depicts the systematic risk and expected rate of return for portfolios comprised of the risk-free security (with beta of zero) plus the market portfolio of all risky assets (with a beta of 1). In the most extreme case, we invest 120% in the market portfolio by borrowing 20% of the funds and paying the risk-free rate. The risk-free rate is assumed to be 6%, and the market risk premium (difference in the expected rate of return on the market portfolio and the risk-free rate) is 5%.

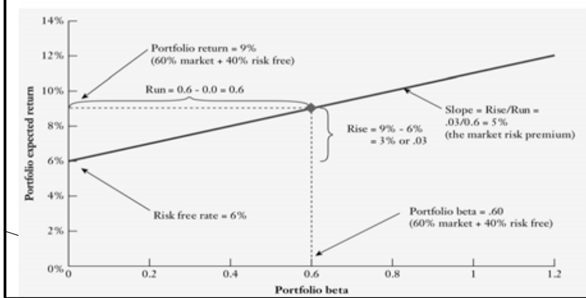


Figure 8.4 cont.

Legend:

% Market Portfolio, W_{Market}	% Risk-Free Asset, $W_{Risk\text{-}free}$	Portfolio Beta, $\beta_{Portfolio}$	Expected Portfolio Return, $E(r_{Portfolio})$
0%	100%	0.0	6.0%
20%	80%	0.2	7.0%
40%	60%	0.4	8.0%
60%	**40%**	**0.6**	**9.0%**
80%	20%	0.8	10.0%
100%	0%	1.0	11.0%
120%	−20%	1.2	12.0%

The Security Market Line and the CAPM

- The straight line relationship between the betas and expected returns in Figure 8-4 is called the **security market line (SML),**
  - Its slope is often referred to as the reward to risk ratio.
- SML is a graphical representation of the CAPM.

The Security Market Line and the CAPM

- SML can be expressed as the following equation, which is also referred to as the CAPM pricing equation:

$$E\left(r_{Asset\,j}\right) = r_f + \beta_{Asset\,j}\left[E(r_{market}) - r_f\right]$$

The Security Market Line and the CAPM

- The higher the systematic risk of an investment, the higher the expected rate of return an investor would require to invest in the asset.
- This is consistent with Principle 2:
  There is a Risk-Return Tradeoff.

Using the CAPM to Estimate Required Rates of Return

- Example 8.2 What will be the expected rate of return on AAPL stock with
  - a beta of 1.49
  - if the risk-free rate of interest is 2% and
  - if the **market risk premium** is estimated to be 8%?

Using the CAPM to Estimate Required Rates of Return

$$E\left(r_{Asset\,j}\right) = r_f + \beta_{Asset\,j}\left[E(r_{market}) - r_f\right]$$

- $E(r_{AAPL}) = .02 + 1.49\ (.08)$
  $= .1392$ or 13.92%

Checkpoint 8.3

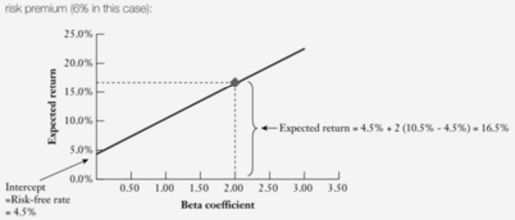
Estimating the Expected Rate of Return Using the CAPM

Jerry Allen graduated from the University of Texas with a finance degree in the spring of 2010 and took a job with a Houstonbased investment banking firm as a financial analyst. One of his first assignments is to investigate the investor-expected rates of return for three technology firms: Apple (APPL), Dell (DELL), and Hewlett Packard (HPQ). Jerry's supervisor suggests that he make his estimates using the CAPM where the risk-free rate is 4.5%, the expected return on the market is 10.5%, and the risk premium for the market as a whole (the difference between the expected return on the market and the risk-free rate) is 6%. Use the two estimates of beta provided for these firms in Table 8.1 to calculate two estimates of the investor-expected rates of return for the sample firms.

Checkpoint 8.3

STEP 1: Picture the problem

Calculating the expected rates of return using the CAPM can be viewed graphically using the security market line where the intercept of the line equals the risk-free rate (4.5% in this case), and the slope is equal to the market risk premium (6% in this case):



Thus, using Equation (8–6) and a beta coefficient of 2.00, the investor's expected rate of return is 16.5%.

Checkpoint 8.3

STEP 2: Decide on a solution strategy

Although the expected rates of return plot along the security market line, we can solve for them directly by substituting into the CAPM formula found in Equation (8–6):

$$E(r_j) = r_f + \beta_j[E(r_{Market}) - r_f]$$

STEP 3: Solve

Solving for the expected return for Apple using the beta from Yahoo and the Beta from MSN and a risk-free rate of 4.5% and a market risk premium of 6% yields the following:

- Apple expected return assuming a beta of 2.90 (the Yahoo estimate of beta): 4.5% + 2.90(6.0%) = 4.5% + 17.4% = 21.9%
- Apple expected return assuming a beta of 2.58 (the MSN estimate of beta): 4.5% + 2.58(6.0%) = 4.5% + 15.48% = 19.98%

Calculating the expected return with the CAPM equation using each of the beta estimates found in Table 8.1 for the three technology firms yields the following results:

	Beta		E(return)	
	Yahoo	MSN	Yahoo	MSN
Apple Inc. (APPL)	2.90	2.58	21.90%	19.98%
Dell Inc. (DELL)	1.81	1.37	15.36%	12.72%
Hewlett Packard (HPQ)	1.27	1.47	12.12%	13.32%

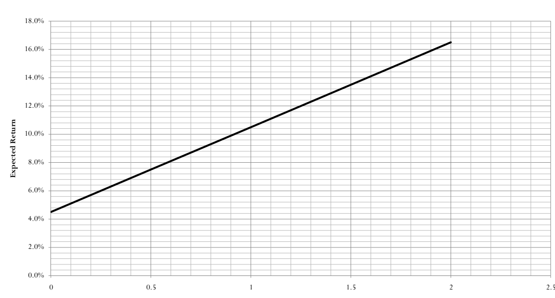
STEP 4: Analyze

The expected rate of return for the individual stocks varies somewhat depending upon the source of the beta estimate. This raises a question as to whether it makes sense to carry our estimates out to multiple decimal places.

Checkpoint 8.3: *Check Yourself*

Estimate the expected rates of return for the three utility companies, found in Table 8-1, using the 4.5% risk-free rate and market risk premium of 6%

Step 1: Picture the Problem



Step 1: Picture the Problem

- The graph shows that as beta increases, the expected return also increases.
- When beta = 0, the expected return is equal to the risk free rate of 4.5%.

Step 2: Decide on a Solution Strategy

- We can determine the required rate of return by using CAPM equation 8-6. The betas for the three utilities companies (Yahoo Finance estimates) are:
  - AEP = 0.74
  - DUK = 0.40
  - CNP = 0.82

Step 3: Solve

$$E\left(r_{Asset\,j}\right) = r_f + \beta_{Asset\,j}\left[E(r_{market}) - r_f\right]$$

- E(return): (AEP) = 4.5% + 0.74(6) = **8.94%**
- E(return): (DUK) = 4.5% + 0.40(6) = **6.9%**
- E(return): (CNP) = 4.5% + 0.82(6) = **9.42%**

Step 4: Analyze

- The expected rates of return on the stocks vary depending on their beta.
- Higher the beta, higher is the expected return.