CHAPTER 12

Estimating the Cost of Capital

Chapter Synopsis

12.1 The Equity Cost of Capital

The Capital Asset Pricing Model (CAPM) provides a practical way to determine the cost of equity capital. This estimate is provided by the Security Market Line equation of the CAPM, which states that, given the beta of the investment opportunity:

$$r_i = r_f + \underbrace{\beta_i \left(E[R_{\text{Mkt}}] - r_f\right)}_{\text{Risk premium for security } i}.$$

12.2 The Market Portfolio

It is not possible to observe the actual market portfolio which contains all risky assets, so an index of stocks is commonly used as a **market proxy**. Since the market portfolio is defined as the total supply of risky assets, the proportions of each asset should correspond to the proportion of the total market that each security represents. Thus, in the market portfolio of stocks, each security *i* should be proportional to its market capitalization, which is the total market value of its outstanding shares = price per share $\times$ number of shares. Such a portfolio is called a **value-weighted portfolio**.

Market indices measure the value of a portfolio of securities; popular indices include:

- The **S&P 500**, a value-weighted portfolio of 500 of the largest U.S. stocks, is the standard **market proxy** portfolio used to represent the market when using the CAPM in practice. Even though the S&P 500 includes only 500 of the more than 7,000 individual U.S. stocks, it represents more than 70% of the U.S. stock market capitalization.
- The **Wilshire 5,000** is a value-weighted index of all U.S. stocks listed on the major stock exchanges. While more representative of the overall market than the S&P 500, the correlation between the two indices' daily returns has exceeded 98% over the last 20 years.

- The **Dow Jones Industrial Average** (DJIA) is a portfolio of 30 large industrial stocks and is likely the most familiar stock index in the U.S. The DJIA is a price-weighted portfolio, which holds an equal split-adjusted number of shares of each stock, independent of their size. Thus, the index's small number of stocks and weighting scheme makes it a poor proxy for the CAPM market portfolio.

Many mutual fund companies offer **index funds** that invest in the portfolios that comprise indices such as these. There are also **exchange-traded funds** (ETFs), securities that trade on an exchange that are entirely invested in a portfolio of stocks that represent portfolios such as market indices like the S&P 500. For example, Standard and Poor's Depository Receipts (SPDRs, nicknamed "spiders") trade on the American Stock Exchange (symbol SPY) and represent ownership in the S&P 500. By investing in an index or an exchange-traded fund, an individual investor with only a small amount to invest can easily achieve the benefits of broad diversification.

The most popular approach to estimating the market risk premium, $E[R_{\text{Mkt}}] - r_f$, is to use the historical average excess return of the market over the risk-free interest rate. With this approach, it is important to use historical returns over the same time horizon as that used for the risk-free interest rate.

12.3 Beta Estimation

While the beta depends on the unobservable correlations and volatilities of the security's returns, and market's returns in the future, it is common practice to estimate beta based on the historical correlation and volatilities. This approach makes sense if a stock's beta remains relatively stable over time.

Many data sources provide estimates of beta based on historical data. Typically, these data sources estimate correlations and volatilities from two to five years of weekly or monthly returns, and use the S&P 500 as the market portfolio.

The slope coefficient in a **linear regression**, the statistical technique that identifies the best-fitting line through a set of points, is mathematically the same as the CAPM beta. Using linear regression, the following equation can be estimated:

$$(R_i - r_f) = \alpha_i + \beta_i(R_{\text{Mkt}} - r_f) + \varepsilon_i .$$

Given historical data for r_f, R_i, and R_{Mkt}, statistical packages for linear regression (available in most spreadsheet programs) can estimate β_i. The constant term α_i is the distance the stock's average return is above or below the SML. If alpha (α_i) is positive, the stock has performed better than predicted by the CAPM—its historical return is above the security market line. If alpha is negative, the stock's historical return is below the SML. Thus α_i is often used as a risk-adjusted performance measure for historical returns.

12.4 The Debt Cost of Capital

The yield to maturity of a bond is the IRR an investor will earn from holding the bond to maturity and receiving its promised payments. Therefore, if there is little risk that the firm will default, we can use the bond's yield to maturity as an estimate of investors' expected return. If there is a significant risk that the firm will default on its obligation, the yield to maturity of the firm's debt, which is its promised return, will overstate investors' expected return. Suppose a bond will default with probability p, in which case bond holders will receive only \$(1+yL), where L represents the expected loss per \$1 of debt in the event of default. Then the expected return of the bond is:

$$r_d = (1-p)y + p(y-L) = y - p \times L$$
$$= \text{Yield to Maturity} - \text{Prob(default)} \times \text{Expected Loss Rate.}$$

Alternatively, you can estimate the debt cost of capital using the CAPM. In principle it would be possible to estimate debt betas using their historical returns in the same way that we estimated equity betas. However, because bank loans and many corporate bonds are traded infrequently, if at all, as a practical matter we can rarely obtain reliable data for the returns of individual debt securities.

12.5 A Project's Cost of Capital

The most common method for estimating a project's beta is to identify comparable firms in the same line of business as the project we are considering undertaking. Then, if we can estimate the cost of capital of the assets of comparable firms, we can use that estimate as a proxy for the project's cost of capital.

The simplest setting is one in which we can find an all-equity financed firm in a single line of business that is comparable to the project. Because the firm is all equity, holding the firm's stock is equivalent to owning the portfolio of its underlying assets. Thus, if the firm's average investment has similar market risk to our project, then we can use the comparable firm's equity beta and cost of capital as estimates for beta and the cost of capital of the project.

If the comparable firm has debt, the returns of the firm's equity alone are not representative of the underlying assets; in fact, because of the firm's leverage, the equity will often be much riskier. Thus, the beta of the levered firm's equity will not be a good estimate of the beta of its assets and of our project. We can undo the effect of leverage and recreate a claim on the firm's assets by holding both its debt and equity simultaneously.

The firm's **asset cost of capital** or **unlevered cost of capital,** which is the expected return required by the firm's investors to hold the firm's underlying assets, is the weighted average of the firm's equity and debt costs of capital:

Asset or Unlevered Cost of Capital

$$r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D .$$

Because the beta of a portfolio is the weighted-average of the betas of the securities in the portfolio, we have a similar expression for the firm's **asset** or **unlevered beta,** which we can use to estimate the beta of our project:

Asset or Unlevered Beta

$$\beta_U = \frac{E}{E+D} \beta_E + \frac{D}{E+D} \beta_D .$$

12.6 Project Risk Characteristics and Financing

Firm asset betas reflect the market risk of the *average* project in a firm. However, individual projects may be more or less sensitive to market risk, so financial managers should evaluate projects based on asset betas of firms that concentrate in a similar line of business. Thus, for multi-divisional firms, identifying a set of "pure play" comparables for each division is helpful in estimating appropriate divisional costs of capital.

Another factor that can affect the market risk of a project is its degree of operating leverage, which is the relative proportion of fixed versus variable costs. Holding the cyclicality of the project's revenues fixed, a higher proportion of fixed costs will increase the sensitivity of the project's cash flows to market risk, and raise the project's beta. Thus, we should assign projects with an above-average proportion of fixed costs, and thus greater-than-average operating leverage, a higher cost of capital.

12.7 Final Thoughts on Using the CAPM

Since the assumptions of the CAPM are not completely realistic, you might be wondering: How reliable, and thus worthwhile, are the results that we can obtain following this approach? Even if the CAPM model is not perfectly accurate, it gets managers to think about risk in the correct way. Managers of widely held corporations should not worry about diversifiable risk, which shareholders can easily eliminate in their own portfolios. They should focus on, and be prepared to compensate investors for, the market risk in the decisions that they make.

Appendix: Practical Considerations When Forecasting Beta

Several practical considerations arise when estimating betas, including:

1. **The time horizon used.** For stocks, common practice is to use at least two years of weekly return data or five years of monthly return data.
2. **The index used as the market portfolio.** The S&P 500 is commonly used as the market proxy. Other proxies, such as the NYSE Composite Index, the Wilshire 5000 index of all U.S. stocks, or an even broader market index that includes both equities and fixed-income securities, are sometimes used as well. When evaluating international stocks, it is common practice to use a country or international market index.
3. **The method used to extrapolate from past betas to future betas.** The estimated beta for a firm will tend to vary over time. Since much of this variation is likely due to estimation error, you should be suspicious of estimates that are extreme relative to historical or industry norms. Also, evidence suggests that betas tend to regress toward the average beta of 1.0 over time. Thus, many practitioners use **adjusted betas**, which are calculated as a weighted average of the estimated beta and 1.0, with the estimated beta often given a weight of 2/3 and 1.0 given a weight of 1/3.
4. **The treatment of outliers in the data.** Beta estimates obtained from linear regression can be very sensitive to outliers. Thus, some practitioners advocate ignoring certain return observations with an unusually large magnitude. For example, data from 1998–2001 may be ignored to avoid distortions related to the technology, media, and telecommunications speculative bubble. On the other hand, including data from recessionary periods may be helpful in evaluating the stock's likely sensitivity to future downturns.

Selected Concepts and Key Terms

Alpha

The difference between a security's expected return, and its CAPM required return, from the security market line. According to the CAPM, all stocks and securities should be on the security market line and have an alpha of zero. If some securities have a nonzero alpha, the market portfolio is not efficient, and its performance can be improved by buying securities with positive alphas and selling those with negative alphas.

Exchange Traded Fund

Securities that trade on an exchange that are entirely invested in a portfolio of stocks that represent portfolios such as market indices like the S&P 500.

Market Portfolio, Market Proxy

The portfolio in the Capital Asset Pricing Model that contains all risky assets. Because the true market portfolio is unobservable, the **S&P 500**, a value-weighted portfolio of 500 of the largest U.S. stocks, is the standard **market proxy** portfolio used to represent the market when using the CAPM in practice.

Operating Leverage

The relative proportion of fixed versus variable costs. Holding the cyclicality of the project's revenues fixed, a higher proportion of fixed costs, and thus higher operating leverage, will increase the sensitivity of the project's cash flows to market risk, and raise the project's beta.

Concept Check Questions and Answers

12.1.1. According to the CAPM, we can determine the cost of capital of an investment by comparing it to what portfolio?

The market portfolio. Under the CAPM, the market portfolio is a well-diversified, efficient portfolio representing the non-diversifiable risk in the economy. Investments therefore have similar risk if they have the same sensitivity to market risk, as measured by their beta with the market portfolio.

12.1.2. What inputs do we need to estimate a firm's equity cost of capital using the CAPM?

Beta, the current risk-free rate, and the market risk premium, $E[R_{Mkt}] - r_f$.

12.2.1. How do you determine the weight of a stock in the market portfolio?

In a value-weighted portfolio, like the market portfolio, each security is held in proportion to its market capitalization. The weight of each stock is determined as the fraction of money invested in that stock corresponding to its share of the total market value of all securities in the portfolio.

12.2.2. What is a market proxy?

A portfolio used to represent the market when using the CAPM in practice.

12.2.3. How can you estimate the market risk premium?

The most popular approach to estimating the market risk premium, $E[R_{Mkt}] - r_f$, is to use the historical average excess return of the market over the risk-free interest rate.

12.3.1. How can you estimate a stock's beta from historical returns?

Given historical data for r_f, R_i, and R_{Mkt}, statistical packages for linear regression (available in most spreadsheet programs) can estimate β_i by estimating the following equation:

$$(R_i - r_f) = \alpha_i + \beta_i (R_{\text{Mkt}} - r_f) + \varepsilon_i .$$

It is common to use at least two years of weekly return data or five years of monthly data to estimate beta. We generally do not use daily returns due to the concern that short-term factors might influence returns that are not representative of the longer term risks affecting the stock.

12.3.2. How do we define a stock's alpha, and what is its interpretation?

The alpha of a stock is the difference between a stock's expected return and its required return according to the security market line. If alpha is positive, the stock has performed better than predicted by the CAPM—its historical return is above the security market line. If alpha is negative, the stock's historical return is below the SML. Thus alpha is often used as a risk-adjusted performance measure for historical returns.

12.4.1. Why does the yield to maturity of a firm's debt generally overestimate its debt cost of capital?

The yield to maturity of a bond is the IRR an investor will earn from holding the bond to maturity and receiving its promised payments. Therefore, if there is little risk the firm will default, we can use the bond's yield to maturity as an estimate of investors' expected return. If there is a significant risk that the firm will default on its obligation, the yield to maturity of the firm's debt, which is its promised return, will overstate investors' expected return.

12.4.2. Describe two methods that can be used to estimate a firm's debt cost of capital.

(1) By estimating the yield-to-maturity on a firm's bonds. (2) By using the CAPM. In principle it would be possible to estimate debt betas using their historical returns in the same way that we estimated equity betas. However, because bank loans and many corporate bonds are traded infrequently, if at all, as a practical matter we can rarely obtain reliable data for the returns of individual debt securities.

12.5.1. What data can we use to estimate the beta of a project?

Since firm asset betas reflect the market risk of the average project in a firm, individual projects may be more or less sensitive to market risk, so financial managers should evaluate projects based on asset betas of firms that concentrate in a similar line of business. Thus, for multi-divisional firms, identifying a set of "pure play" comparables for each division is helpful in estimating appropriate divisional costs of capital.

12.5.2. Why does the equity beta of a levered firm differ from the beta of its assets?

If the comparable firm has debt, the returns of the firm's equity alone are not representative of the underlying assets; in fact, because of the firm's leverage, the equity will often be much riskier. Thus, the beta of levered firm's equity will not be a good estimate of the beta of its assets, and of our project.

12.6.1. Why might projects within the same firm have different costs of capital?

Individual projects may be more or less sensitive to market risk so financial managers should evaluate projects based on the asset betas of firms that concentrate in a similar line of business. Thus, for multi-divisional firms, identifying a set of "pure play"

comparables for each division is helpful in estimating appropriate divisional costs of capital.

12.6.2. Under what conditions can we evaluate a project using the firm's weighted average cost of capital?

A firm's beta reflects the market risk of the average project in a firm. So, if the firm operates in one line of business, or all of the lines of business have the same amount of market risk, then the firm's weighted-average cost of capital can be used to evaluate any project.

12.7.1. Which errors in the capital budgeting process are likely to be more important than discrepancies in the cost of capital estimate?

The revenue and other cash flow projections we must make when valuing a stock or an investment in a new product are likely to be far more speculative than any we have made in estimating the cost of capital.

12.7.2. Even if the CAPM is not perfect, why might we continue to use it in corporate finance?

Even if the CAPM model is not perfectly accurate, it gets managers to think about risk in the correct way. Managers of widely held corporations should not worry about diversifiable risk, which shareholders can easily eliminate in their own portfolios. They should focus on, and be prepared to compensate investors for, the market risk in the decisions that they make.

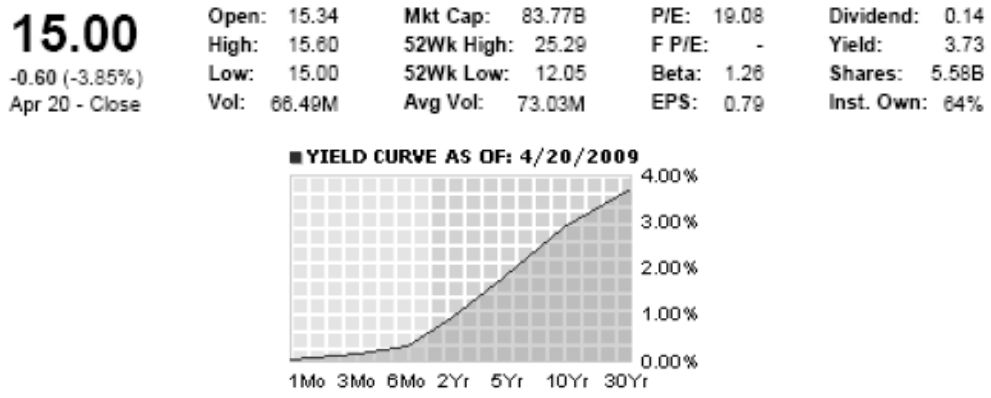
Examples with Step-by-Step Solutions

Solving Problems

Problems using the concepts in this chapter may involve estimating a firm's equity cost of capital using the capital asset pricing model (CAPM). Problems may also require the determination of a project weighted-average cost of capital, and may require using comparable firms that operate in a specific industry to estimate the beta risk of the industry. The examples below illustrate these concepts.

Examples

1. **Intel uses 15% as its cost of capital when evaluating investment projects. The company currently has no long-term debt. Based on current market data below and a stock market risk premium of 6.1% over 30-year T-bonds, is their WACC equal to 15%? If it is not, how may using 15% affect them?**



Step 1. Since they have no long-term debt, their equity cost of capital, r_E, is their WACC. So you must just determine r_E.

From the information provided, the parameters of the CAPM can be determined:

r_f = 3.5%, the 30-year T-bond yield in the graph.

β = 1.26 from the quote provided

$(E[r_{\text{mkt}}] - r_f) = 6.1\%$ from the problem

Next the CAPM expected return can be determined:

$$r_E = r_f + \beta(E[r_{\text{mkt}}] - r_f) = .035 + 1.26(.061) = .112 = 11.2\%$$

Step 2. Determine how using 15% instead of 11.2% would alter the investments they choose to accept.

Since they are using a higher discount rate, projects that would provide a return between 11.2% and 15% would be rejected because they have a negative NPV. Thus, they would likely invest in fewer projects and potentially forgo valuable investment opportunities.

2. Your firm is considering building a casino, and you are trying to determine the cost of capital in the industry. You have collected the following information on firms in the casino industry.

Company	Beta	Stock Price	Number of Shares	Debt
MGM Mirage	1.10	$72.67	143 million	$5.6 billion
Mandalay Resort Group	0.95	$70.43	65 million	$3.0 billion
Caesars Entertainment	1.20	$19.88	304 million	$4.6 billion

The risk-free rate is 5%, and the historical market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 6%.

[A] What is the equity cost of capital for an unlevered firm in the industry?

[B] What is the equity cost of capital for a firm in the industry with a debt-to-equity ratio of 1?

Step 1. Measure the unlevered betas.

The unlevered beta, β_U, measures the market risk of the firm without leverage, which is equivalent to the beta of the firm's assets. The unlevered asset beta therefore measures the market risk of the firm's business activities, ignoring any additional risk due to leverage, and can be estimated using:

$$\beta_{assets} = \beta_{unlevered} = \beta_{equity} \frac{E}{E + D} .$$

E, the market value of equity, can be calculated as stock price $\times$ number of shares.

Company	Stock Price	Number of Shares	E
MGM Mirage	$72.67	143 million	$10.4 billion
Mandalay Resort Group	$70.43	65 million	$4.6 billion
Caesars Entertainment	$19.88	304 million	$6.0 billion

Now, unlevered betas can be calculated:

$$\beta_{\text{Assets}}^{\text{MGM}} = \frac{10.4}{10.4 + 5.6}1.10 = 0.72,$$

$$\beta_{\text{Assets}}^{\text{Mandalay}} = \frac{4.6}{4.6 + 3.0}0.95 = 0.58,$$

$$\beta_{\text{Assets}}^{\text{Caesars}} = \frac{6.0}{6.0 + 4.6}1.2 = 0.68 .$$

Step 3. Calculate the unlevered equity cost of capital based on the average unlevered betas of the comparable firms. A common method is to use the average of the unlevered betas of the comparison firms.

The average unlevered beta is $\frac{0.72 + 0.58 + 0.68}{3} = 0.66.$

The equity cost of capital can be determined from the CAPM:

$$E[R] = r_f + \beta_i^{\text{Mkt}}(E[R_{\text{Mkt}}] - r_f) = 0.05 + 0.66(0.06) = 9.0\%.$$

Step 4. Calculate the levered beta when D/E = 1.0.

When a firm changes its capital structure without changing its investments, its unlevered beta will remain unaltered. However, its equity beta will change to reflect the effect of the capital structure change on its risk, and the levered equity beta can be calculated as:

$$\beta_{\text{Equity}} = \left(1 + \frac{D}{E}\right)\beta_{\text{Assets}} = \left(1 + \frac{1}{1}\right)0.66 = 1.32.$$

Step 5. Calculate the levered equity cost of capital based on the average unlevered beta of the comparable firms levered to reflect a D/E ratio of 1.0.

The equity cost of capital can now be determined from the CAPM:

$$E[R] = r_f + \beta_i^{\text{Mkt}}(E[R_{\text{Mkt}}] - r_f) = 0.05 + 1.32(0.06) = 12.9\%$$

3. Nordstrom is spinning off its casual clothing segment and you are trying to determine the value of the spun-off entity. You estimate that the division's free cash flow in the coming year to be $100 million, and you expect the free cash flows will grow by 3% per year in subsequent years. Because the spin-off isn't publicly traded yet, you do not have an accurate assessment of the division's equity beta. However, you do have beta data for Gap, Inc., a firm it closely resembles. Gap has an equity beta of 1.1, a debt beta of 0, and a debt-equity ratio of 0.20.

Nordstrom has a beta of 2.2, a debt-equity ratio of 1.0 (the spun-off firm will maintain this leverage ratio), and has been told by its investment bankers that the debt cost of capital will be 6%. The corporate tax rate is 40%, the risk-free rate is 5%, and the historical market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 6%.

[A] Estimate the division's WACC.

[B] Estimate the spun-off unit's share value based on the 100 million shares that will be outstanding after the spinoff.

Step 1. Unlever the Gap beta.

The unlevered beta, β_U, measures the market risk of the firm without leverage, which is equivalent to the beta of the firm's assets. The unlevered asset beta therefore measures the

market risk of the firm's business activities, ignoring any additional risk due to leverage, and can be estimated using:

$$\beta_{\text{assets}} = \beta_{\text{unlevered}} = \beta_{\text{equity}} \frac{E}{E + D}$$

$$\beta_{\text{assets}} = \left(\frac{E}{E + D} \right) \beta_{\text{equity}} = \left(\frac{1}{1 + 0.2} \right) 1.1 = 0.92$$

Step 2. Relever the beta to reflect the division's debt-equity ratio of 1.0.

$$\beta_{\text{equity}} = \beta_{\text{assets}} \left(1 + \frac{D}{E} \right) = 0.92 \left(1 + \frac{1}{1} \right) = 1.84$$

Step 3. Calculate the levered cost of equity.

$$E[r] = r_f + \beta(E[R_{\text{Mkt}}] - r_f) = 0.05 + 1.84(0.06) = 0.16.0\%$$

Step 4. Calculate the WACC.

$$WACC = \frac{D}{D+E} r_D (1-t) + \frac{E}{D+E} r_E = \frac{1}{1+1} 0.06(1 - 0.4) + \frac{1}{1+1} 0.16 = 0.018 + 0.08 = 0.098$$

Step 5. The value of the division can be determined.

The value of the levered firm using the WACC method is:

$$V_0^{\text{Levered Firm}} = \sum_{t=1}^{\infty} \frac{\text{FCF}_t}{r_{\text{WACC}} - g} = \frac{\$100 \text{ million}}{0.098 - 0.03} = \$1.471 \text{ billion}.$$

The WACC method values the division as a whole, so the equity value is:

$E = V - D$ = \$1.471 billion – 0.50(\$1.471) = \$735 million,

and the per share value is \$735 million/100 million = \$7.35.

Questions and Problems

1. The following information is what your firm, which has a beta of 1.4, relies on to determine its equity cost of capital:

Current Treasury-Bill Yield	Average S&P 500 Return 1926-2004	Average Treasury-Bill Yield 1926-2004
2.4%	12.3%	3.9%

   What is the best estimate of your firm's equity cost of capital?

2. Your firm manufactures keyboards for Dell. It has 20 million shares trading at \$50 per share, an equity beta of 1.8, \$500 million of AA-rated bonds with a yield-to maturity of 7% and a coupon rate of 10%, and intends to maintain this degree of leverage. The firm is considering expanding its manufacturing operations in Phoenix by producing voting booths. The tax rate is 35%, T-bonds are yielding 5%, and the market risk premium is 8.6% above T-bonds. The only public voting machine manufacturer has 75% debt financing and an equity beta of 1.2. What cost of capital should be used to evaluate the project?

3. Investor #1 is considering adding one of the following stocks into a diversified portfolio. Investor #2 is considering investing all of his money in one of the following stocks.

Stock	Beta	Standard Deviation
El Paso Electric	0.65	56%
General Electric	1.20	34%

Which one of the stocks is least risky to each of these investors?

4. You call your personal retirement portfolio the S&P 3, a value-weighted portfolio with $1 million invested in the 3 stocks below. Every quarter you rebalance the portfolio to return it to its equally weighted state. Determine how many shares should be invested in each stock as of 12/31/2006.

Stock	12/31/2006 Price	Shares Outstanding
Starbucks	$30	1 billion
Goldman Sachs	$150	400 million
Nordstrom	$50	200 million

5. In mid-2009, Amco Corp. had outstanding 8-year bonds with a yield to maturity of 8% and a BB rating. If corresponding risk-free rates were 3%, and the market risk premium is 5%, estimate the expected return of Amco's debt.

Solutions to Questions and Problems

1. The CAPM is typically applied using the current Treasury yield as the risk-free rate, and the historical market risk premium as measured by the average return on the S&P 500 minus the average return on corresponding term Treasury securities.

$$E[R_i] = r_i = r_f + \beta_i^{\text{Mkt}}(E[R_{\text{Mkt}}] - r_f) = 2.4\% + 1.4(12.3\% - 3.9\%) = 14.2\%$$

2. First, determine your capital structure.

   E = the market value of equity = $50(20 million) = $1 billion

   D = the market or book value of long-term debt = $500 million

   Next, find the cost of equity.

   First, unlever the equity beta of the voting booth manufacturer. The unlevered beta, β_U, measures the market risk of the firm without leverage, which is equivalent to the beta of the firm's assets. Since the comparison firm has 75% debt, you can use D =.75 and E = .25.

$$\beta_{\text{assets}} = \beta_{\text{unlevered}} = \beta_{\text{equity}}\left(\frac{E}{E + D}\right) = 1.2\left(\frac{.25}{.25 + .75}\right) = 0.30$$

   Now, lever the Beta with your capital structure:

$$\beta_{\text{equity}} = \beta_{\text{assets}}\left(1 + \frac{D}{E}\right) = 0.30\left(1 + \frac{.50}{1}\right) = 0.45.$$

   You can now use the CAPM to estimate your cost of equity.

$$r_E = r_f + \beta(E[r_{mkt}] - r_f) = .05 + 0.45(.086) = .0887 = 8.87\%$$

   For the debt cost of capital, you can use the current yield-to-maturity, 7%, which reflects the market's required return on your bonds and the AA-rated bonds have a very small probability of default.

Finally, determine the after-tax weighted-average cost of capital.

$$\text{WACC} = \frac{D}{D+E} r_D (1-t) + \frac{E}{D+E} r_E = \frac{.5}{.5+1}(.07)(1-0.35) + \frac{1}{.5+1}(.0887)$$
$$= .01517 + .0591 = .074, \textit{ or } 7.4\%$$

3. Investor #1 should select El Paso Electric because it has a lower beta, and beta measures the amount of risk that a stock will add to a diversified portfolio.

   Since investor #2 does not have a diversified portfolio, beta is not the correct measure of risk. In this situation, General Electric is the least risky because it has lower total risk as measured by standard deviation. However, investor #2 should not expect to be compensated for bearing a higher level of risk.

4. The total value of all 3 stocks is:

$$= (\$30 \times 1{,}000{,}000) + (\$150 \times 400{,}000{,}000) + (\$50 \times 200{,}000{,}000) = \$100 \text{ billion}$$

Stock	Portfolio Weight	Number of Shares
Starbucks	$\frac{\$30 \times 1{,}000{,}000{,}000}{100{,}000{,}000{,}000} = 30\%$	$\frac{0.30 \times \$1{,}000{,}000}{\$30} = 10{,}000$
Goldman Sachs	$\frac{\$150 \times 400{,}000{,}000}{100{,}000{,}000{,}000} = 60\%$	$\frac{0.60 \times \$1{,}000{,}000}{\$150} = 4{,}000$
Nordstrom	$\frac{\$50 \times 200{,}000{,}000}{100{,}000{,}000{,}000} = 10\%$	$\frac{0.10 \times \$1{,}000{,}000}{\$50} = 2{,}000$

5. Given the low rating of debt, as well as the recessionary economic conditions at the time, we know the yield to maturity of KB Home's debt is likely to significantly overstate its expected return. Using the recession estimates in Table 12.3 and an expected loss rate of 60%, from Eq. 12.7, we have:

$$r_d = (1-p)y + p(y-L) = y - p \times L$$
$$= \text{Yield to Maturity} - \text{Prob(default)} \times \text{Expected Loss Rate}$$
$$= 8.5\% - 8\%(0.60) = 3.2\%$$