

Chapter 11 Risk and Capital Budgeting

Chapter Overview

The extract on corporate finance research draws attention to the high level of use of textbook-based measures of the discount rate by companies in Australia. Some companies in the quoted survey did adopt simpler measures of the discount rate than the full versions found in finance theory; and CAPM was still the pre-eminent asset-pricing model used; but WACC was appropriately employed by many companies.

What Companies Do Discussion Questions:

1. How does WACC impact company value? In other words, why does a minimum WACC maximise company value? How can shareholders use the WACC to choose an appropriate stock for their portfolio?
2. How could Hershey further minimise its cost of capital? How easy would it be for the company to lower its cost of debt or equity or change the weights in the WACC to provide a lower cost of capital?

This chapter concludes capital budgeting with:

- 11-1. Choosing the Right Discount Rate
- 11-2. A Closer Look at Risk
- 11-3. Real Options
- 11-4. Strategy and Capital Budgeting

Technology

1. **Smart Video.** Jon Olson, CFO, Xilinx Corporation looks at strategy and capital budgeting decisions.
2. **Smart Video.** Beth Acton, former vice president and treasurer of Ford Motor Co., talks about the importance of the WACC calculation to Ford, since WACC is used in product programs, capital investments and acquisition decisions.
3. **Smart Video.** Pam Roberts, former executive director of Corporate Services for Cummins Inc., notes the difficulty in predicting future cash flow variables.
4. **Smart Video.** Andy Bryant, executive vice president and enterprise systems, chief administrative officer, Intel Corp., describes the use of option pricing theory in capital budgeting decisions.
5. **Smart Concepts** continues the *NPV* analysis – with scenario analysis.

After studying this chapter you should be able to:

- understand operating leverage and financial leverage, and the potential effect each of them has on a company's cost of capital
- estimate the company's weighted average cost of capital, both with and without the allowed tax deductibility of interest payments to bondholders
- review the roles of breakeven analysis and sensitivity analysis in evaluating investment opportunities
- explain how scenario analysis, Monte Carlo simulation and decision trees can be used to assess an investment's risk
- describe the types of real options and their role in valuing potential investments
- discuss the strategic aspects of capital budgeting with regard to competition and the role of real options in improving the quality of decisions.

Lecture Guide

This chapter brings together concepts from previous chapters. The Capital Asset Pricing Model was previously introduced. Now, the CAPM required return can be a component of a company-wide Weighted Average Cost of Capital (WACC). Note that in computing WACC it is market value weights that matter, which may be very different from book value weights. Note also that practitioners differ about what debt should be included – total liabilities, long-term debt, or all interest-bearing debt, whether it is short-term or long-term. Typically, all debt that is part of a company's permanent capital should be included whether it is long-term or short-term debt.

11-1 Choosing the Right Discount Rate

The discount rate must be a rate that compensates the investor for the project's risk. Technically the discount rate should vary with the project since few projects have identical risk, but for simplicity's sake, use a rate for debt and a rate for equity.

- Note also that debt and equity do not have to be the only components of WACC. A company may choose to finance itself with preferred equity or capital lease financing as well.

Debt financing can be treated as share financing with the CAPM. In other words, risky debt may have a beta also, indicating that it moves up and down as the market moves up and down. The inclusion of debt will increase the financial leverage, raising the share beta.

Typically debt betas are low, but it is possible to have riskier, higher beta debt. For example, junk bonds act more like equity, responding to changes in interest rates, than investment grade bonds whose prices move in response to changes in interest rates.

11-1a Cost of Equity

Marketing majors will appreciate the section on *breakeven analysis* which is used frequently in marketing decisions. With financial *breakeven analysis*, the company looks at which strategy provides more income per shareholder, in the form of earnings per share. The company looks at possible levels of EBIT and what EPS would be under each strategy. There is a trade-off – more debt financing means lower net income because there is a higher interest expense, but also means fewer common shares are needed. More equity financing means higher net income but also a higher number of shares and higher weight in the calculation of WACC. Expected EBIT must be high enough to overcome the disadvantage of additional interest expense. If expected EBIT is too low, then shareholders would be better off with less debt and more equity financing.

A Simple Case

Carbonlite Cost of Equity

This example is a graphical representation of the differences between companies with differing degrees of operating leverage. Note that the slope of the Carbonlite line is much steeper than the Fiberspeed line. Carbonlite will have higher returns because of its higher operating leverage in good times. The higher operating leverage will also magnify its losses in bad times.

Figure 11.1 Risk Adjustments to Cash Flows and Discount Rates

Table 11.1 Financial Data for Austral Carbonlite and Fiberspeed Corp.

Figure 11.2 Operating Leverage for Austral Carbonlite and Fiberspeed Corp.

Table 11.2 The Effect of Financial Leverage on Shareholder Returns

11-1b The Weighted Average Cost of Capital (WACC)

The appropriate discount rate for an all equity company is the cost of equity. Many companies, however, finance using debt and equity. It is appropriate to take the weights and costs of each component of financing. The WACC reflects the company's cost of capital, which is an input into the production process, just as raw materials and labour are inputs into the production process.

Table 11.3 Cash Distribution to Croc-in-a-Box Investors**Finding WACC for Companies with Complex Capital Structures**

While debt and equity are the most common components of WACC, some companies finance using preferred equity. If so, this can simply be added as a third component to the cost of capital. Note that the weights in the equation must add up to 100%. Note also that preferred share dividends are paid out of net income, after taxes. This means the before tax cost of preferred equity to the company is the same as the after tax cost of preferred equity.

11-1c The WACC, CAPM, and Taxes**Rules for Selecting an Appropriate Project Discount Rate**

This section summarises information on previous sections:

- 1.) If an all equity company invests in an asset with similar risks to past assets, then the all equity beta is the appropriate discount rate for NPV calculations.
- 2.) If a company with debt and equity invests in an asset that is similar to past assets, the WACC is the appropriate rate to use in NPV calculations (if weights have not changed).
- 3.) In general the WACC should be used to calculate NPV on all assets but can be misleading on assets whose risk is different from past assets.

Accounting for Taxes in Finding WACC

Note that the before tax cost of equity and preferred equity are the same as the after tax cost of equity and preferred equity. Debt is the only WACC component that needs to be adjusted for taxes. Since interest expense is tax deductible, companies using debt financing receive a tax break, making debt financing less costly than preferred equity and ordinary shares financing.

11-2 A Closer Look at Risk**11-2a Breakeven Analysis**

A company must cover its variable and fixed costs in order to be profitable. A company may want to know how many units or how much in dollar sales is necessary for the company to earn a profit. While cash flows are central to capital budgeting problems, not accounting profits, a company must ultimately turn a profit, or it will not stay in business very long. While mathematically, this is an easy calculation, from a business standpoint it is one of the most useful. Many companies, small companies in particular, have become insolvent because of their failure to recover total costs. Some of the uses for breakeven analysis include:

- Expanding operations – are greater fixed cost expenditures justified in light of projected sales and other costs?
- New products – how will a new product impact the company's breakeven point?
- New technology – will the company benefit from switching to a new technology with more fixed costs and less labour cost?
- Change in price – how would a change in price impact the quantity required to break even?

Figure 11.3A : Breakeven Point for Austral Carbonlite

In break-even analysis, take the company's fixed costs and then add variable costs to find total costs. Variable costs include those costs that vary with the level of production, typically materials and labour costs. Fixed costs include such expenses as executive salaries and overhead departments like personnel, research and development, accounting, etc. These are departments that the company must have regardless of the level of production. The idea behind breakeven analysis is that if demand falls, companies with high variable costs can adjust to lowered demand more easily than companies with high fixed costs. It is easier to lay off excess workers or reduce their hours than it is to reverse a purchase of expensive capital equipment.

Figure 11.3B: Breakeven Point for Fiberspeed

Carbonlite has higher fixed costs and a higher breakeven point than Fiberspeed. Notice that Carbonlite's total cost line has a flatter slope than Fiberspeed's. This is because Fiberspeed is relying more on variable costs and less on fixed costs. Also notice that the 'triangles' in the Carbonlite graph are larger than the triangles formed in the Fiberspeed graph. Carbonlite has an area of bigger profitability than Fiberspeed but also a bigger area of loss if production falls below the breakeven point.

11-2b Sensitivity Analysis

A sensitivity analysis is a very important part of any problem. You are never completely sure of every input into a problem. It makes sense to show sensitivity to the variables you are least sure of. While these variables can be different with every problem, typically a project may be sensitive to the level of sales, its operating costs, method of depreciation, additional capital expenditures and working capital needed. A limitation of sensitivity analysis is that you can only change one variable at a time. Scenario analysis, while it is more involved and requires more computing power, can vary multiple variables.

Table 11.4: Sensitivity Analysis of the Gyroscope Skateboard Project (Base-Case NPV = \$236)
(All Dollar Values in Thousands, Except Initial Selling Price)

11-2c Scenario Analysis and Monte Carlo Simulation

11-2d Decision Trees

These two sections extend the discussion of alternative models for evaluating impacts of investments on company value.

Fig. 11.4 Decision Tree for Odessa Investment

11-3 Real Options

11-3a Why NPV May Not Always Give the Right Answer

More and more managers are looking at real option valuation. More managers recognise that there are options embedded in projects, and that it is appropriate to use option pricing to value the projects.

- Student Emphasis: Point out the factors that can affect the value of an option:
 - Underlying asset: the present value of expected operating cash flows
 - Exercise price: For call options, this is the initial investment. For put options, this is the value of the project assets if sold and moved to a more profitable use
 - Time until expiration: When the option is no longer available
 - Risk-free rate of interest
 - Standard deviation: The standard deviation of the operating cash flows as a per cent of total investment

11-3b Types of Real Options

- Expansion options
- Abandonment options

- Follow-on investment options
- Flexibility options

Some examples of real options include:

- Wait before investing: call
- Staged investment (default during construction): series of put options
- Expand the project: call
- Contract or shut down the option: put
- Grow and build on previous investments: call

11-3c The Surprising Link Between Risk and Real Option Values

We have seen in the past that if a project is more risky, then the required return should be higher and the NPV will be lower. But this relationship does not hold with real options. Higher risk actually leads to higher real option values. This section gives an excellent example of oil extraction and production.

11-4 Strategy and Capital Budgeting

11-4a Competition and NPV

11-4b Strategic Thinking and Real Options

These sections introduce the students to the wider connections of corporate finance and its methods, and key ideas of economics and strategy.

Risk and Capital Budgeting Summary

Experience and intuition also can count in a capital budgeting decision. If managers can dissect their projects into options, they may make better decision. For example, if a project does not have to be all or nothing, perhaps managers could partially commit and then invest more money if the project goes well, or withdraw if it does not meet expectations. Identifying a real option may make it easier for managers to create and sustain competitive advantages.

Enrichment Exercise

1. Have students examine the latest opening of new Woolworths stores and decide if the WACC should be the same or different for each store (especially look at international projects).
2. Divide students into groups for the following exercise:
 - a. Half the students will represent the acquiring company
 - b. The other half will represent the target company.

Information for students representing the acquiring company

ABC Company is developing a new technology. You represent XYZ Company which is thinking of buying the new technology. You know that there is a 50% probability that the project will do well in the testing phase and will provide incremental cash flows of \$18 million in perpetuity. If the product does not meet these expectations, then it will have cash flows of \$6 million in perpetuity. You will know the results of the test a year from now. The discount rate is 10%. What will you pay for this technology?

Information for students representing the target company

ABC Company is developing a new technology. You know that there is a 50% probability that the project will do well in the testing phase and will provide incremental cash flows of \$18 million in perpetuity. If the product does not meet these expectations, then it will have cash flows of \$6 million in perpetuity. You will know the results of the test a year from now. The discount rate is 10%. You offer to sell this technology to XYZ Company for \$130 million. This is a firm price. You will not accept a lower price.

Pair up groups and have them negotiate using the above information. Very likely, this will be a very short negotiation. If the target company stands firm, and the bidder company correctly calculates the value of the project at $(50\% \times 18 + 50\% \times 6)/0.10 = \120 million, they will not be interested in paying \$130 million for an asset worth \$120 million.

Then give the groups the following information: ABC is willing to accept a cash payment of \$12 million today. XYZ can then decide one year from now to purchase (or not purchase) the technology for \$130 million. Is this a fair price for the technology?

Have the same groups negotiate with each other for the technology. Now the groups are much more likely to reach agreement.

The value of the technology with flexibility is:

Year	0	1	2
Cash flow	-12	-65**	+90*

- * $18/1.1 = 180$. Multiply 180 by 50% = \$90. Note that the perpetual cash flow of \$18 million starting in year 1, which has a 50% chance of occurring, provides a value of \$90 million in year 0. The \$6 million cash flow is not relevant, since XYZ will not purchase the technology unless it is successful.
- ** 50% probability $\times -130 = -65$. Discounting 65 in period 1 back one period yields: $-65/1.1 = -59.1$. This is the year 1 negative cash flow that XYZ will need to spend a year from now in order to purchase the successful technology. This has a value in year 0 of \$59.1 million.

The present value of the technology with flexibility is $-12 + 90 - 59.1 = \$18.9$ million. Now the project has a positive NPV to XYZ and ABC realises the \$130 it requires for the technology.

Answers to Concept Review Questions

1. The cost of equity is not appropriate to discount cash flows because it does not correctly reflect the company's cost of financing from both debt and equity sources. Capital is a resource, with a cost associated with it. The appropriate discount rate must reflect both the company's cost of debt and equity financing.
2. Two companies could have very different equity betas if they have chosen differing capital structures. The company using more debt financing will have a higher equity beta. Betas can also vary due to differences in operating leverage. Other things being equal, the company with higher operating leverage should have a higher beta.
3. If a company is thinking of expanding its existing line of business, the WACC rather than the cost of equity is the preferred discount rate because it will likely fund the expansion the same way that the overall company is financed. If the company has both debt and equity in its capital structure, then these costs should be reflected in the appropriate WACC discount rate for the expansion.
4. The cost of debt, r_d , is generally less than the cost of equity, r_e , because debt is a less risky security. A naive application of the WACC formula might suggest that a company could lower its cost of capital (thereby raising the NPV of its current and future investments) by using more debt and less equity in its capital structure. But using debt will lower the company's WACC only up to a point. At some point the company will have so much debt that lenders will perceive the company as overly risky. The cost of new debt will be very expensive, or perhaps even impossible to obtain at any cost. At this point the risk (and costs) of insolvency outweigh the lower costs of debt at lower debt levels.
5. A project that reaches the breakeven point in terms of net income could potentially be bad for shareholders because break-even analysis uses accounting numbers, EPS and EBIT. This does not necessarily indicate that a project is positive NPV. A project must recover its cost of capital for it to be acceptable.
6. In a project sensitivity analysis, the analysis is probably more sensitive to changes in the growth rate of sales. Sales drive the cash flow analysis – many other variables are based on a per cent of sales.

While depreciation has an impact, the differences in depreciation methods allowed will not be as great as the impact of sales. In particular, sales growth will likely have a large impact on the terminal value of the project.

7. The assumptions that the airline would likely need to put into place in order to run a Monte Carlo simulation on ticket prices for a new, nonstop flight between Atlanta and Tokyo might include:
 - Capacity utilisation – how many seats are likely to be sold at each pricing level (seven day advance purchase, Saturday night stay, and various other classes of tickets).
 - You could take the range of ticket prices and assume the average price was a random variable taken from a normal distribution.
8. The discount rate could vary as you move through a decision tree because parts of a project could be riskier (or less might be known about them) than others. For example, typically the beginning of a project is riskier than later parts of a project. Once the company has a history with the project, it may be better able to predict demand and costs..
9. A real world example of an expansion option would be the possibility of derivative products after the first product was introduced. For example, suppose a company develops a new aircraft. It may be able to develop derivative aircraft (larger, smaller, containing some of the same features) from its initial design at a lower cost. An abandonment option would be the ability to sell the equipment used in a project to another company for a potentially greater profit than continuing with the original project.
10. Risk lowers the value of a project (higher discount rate, lower value), but increases the value of an option. This is because as the risk becomes greater, more possibilities open up that the cash flows will move in the direction desired (up for call options and down for put options). Real options work in much the same way as do traded options: the greater the risk of an event happening, the more the risk-taker (the bank or lender) gets paid; the less the risk of something happening, the less premium will change hands.
11. Managers' intuition is useful because you must be able to explain NPV. If you have a positive NPV, then you must be able to explain the valid reasons for that NPV – real competitive advantages. If managers can break down a project into real options, they may see new possibilities to create and sustain competitive advantages.
12. The if-then conditional nature of most investments should be recognised because managers can then identify future times when they can create and sustain competitive advantage beyond the current valuation of fixed investments.

Solutions to Self-Test Problems

- ST11-1.** A financial analyst for Quality Investments, a diversified investment fund, has gathered the following information for the years 2012 and 2013 on two companies – A and B – that it is considering adding to its portfolio. Of particular concern are the operating and financial risks of each company.

	2012		2013	
	Company A	Company B	Company A	Company B
Sales (\$million)	10.7	13.9	11.6	14.6
EBIT (\$million)	5.7	7.4	6.2	8.1
Assets (\$million)			10.7	15.6
Debt (\$million)			5.8	9.3
Interest (\$million)			0.6	1.0
Equity (\$million)			4.9	6.3

- a. Use the data provided to assess the *operating leverage* of each company (using 2012 as the point of reference). Which company has more operating leverage?
- b. Use the data provided to assess the companies' *ROE* (cash to equity/ordinary shares equity) assuming the company's Return on Assets is 10% and 20% in each case. Which company has more *financial leverage*?
- c. Use your findings in parts a and b to compare and contrast the operating and financial risks of Companies A and B. Which company is more risky? Explain.

A:

$$\text{Operating leverage} = \frac{\Delta \text{EBIT}}{\text{EBIT}} \div \frac{\Delta \text{Sales}}{\text{Sales}}$$

Company A: $[(6.2 - 5.7) \div 5.7] \div [(11.6 - 10.7) \div 10.7] = 0.0877 \div 0.0841 = 1.0428$

Company B: $[(8.1 - 7.4) \div 7.4] \div [(14.6 - 13.9) \div 13.9] = 0.0946 \div 0.0504 = 1.8770$

Company B has more operating leverage than Company A given its considerably higher ratio noted above. Based on 2012 sales, Company B would experience a 1.8770% change in its EBIT for every 1% change in sales, whereas Company A would only experience a 1.0428% change in EBIT for a 1% change in sales.

	Company A	Company B
<u>When Return on Assets Equals 10%</u>		
EBIT (\$million)	$0.10 \times 10.7 = 1.07$	$0.10 \times 15.6 = 1.56$
Less: Interest (\$million)	<u>0.60</u>	<u>1.00</u>
Cash to Equity (\$million)	0.47	0.56
ROE	$0.47 \div 4.9 = 9.59\%$	$0.56 \div 6.3 = 8.89\%$
<u>When Return on Assets Equals 20%</u>		
EBIT (\$million)	$0.20 \times 10.7 = 2.14$	$0.20 \times 15.6 = 3.12$
Less: Interest (\$million)	<u>0.60</u>	<u>1.00</u>
Cash to Equity (\$million)	1.54	2.12
ROE	$1.54 \div 4.9 = 31.43\%$	$2.12 \div 6.3 = 33.65\%$

Company B has more financial leverage as demonstrated by the broader range of ROEs it experiences when the return on assets moves from 10% to 20%. Note that Company B's ROE is lower than Company A's at the 10% return on assets and it's higher than Company B's ROE at the 20% return on assets. Company B's ROE has greater variability – is more responsive to changes in return on assets – than Company A's ROE. Simply stated, Company B has more financial risk than Company A.

- c. Based on the findings in parts **a** and **b**, it is clear that Company B is riskier than Company A given that both its operating leverage (risk) and financial leverage (risk) are greater than that of Company A.

ST11-2. Sierra Vista Industries (SVI) wishes to estimate its cost of capital for use in analysing projects that are similar to those that already exist. The company's current capital structure in terms of market value includes 40 per cent debt, 10% preferred equity, and 50% ordinary shares. The company's debt has an average yield to maturity of 8.3%. Its preferred shares have a \$70 par value, an 8% dividend, and are currently selling for \$76 per share. SVI's beta is 1.05, the risk-free rate is 4%, and the return on the S&P 500 (the market proxy) is 11.4%. CVI is in the 40% tax bracket.

- a. What are SVI's pretax costs of debt, preferred shares, and ordinary shares?
- b. Calculate SVI's weighted average cost of capital (WACC) on both a pretax and after-tax basis. Which WACC should SVI use when making investment decisions?
- c. SVI is contemplating a major investment that is expected to increase both its operating and financial leverage. Its new capital structure will contain 50% debt, 10% preferred shares, and 40% ordinary shares. As a result of the proposed investment, the company's average yield to maturity on debt is expected to increase to 9%, the market value of preferred shares is expected to fall to their \$70 par value, and its beta is expected to rise to 1.15. What effect will this investment have on SVI's WACC? Explain your finding.

A:

- a. Cost of debt = 8.30%

$$\text{Cost of preferred shares} = (0.08 \times \$70) \div \$76 = \$5.60 \div \$76 = 7.37\%$$

$$\begin{aligned} \text{Cost of ordinary shares (using CAPM)} &= 4.00\% + [1.05 \times (11.40\% - 4.00\%)] \\ &= 4.00\% + 7.77\% \\ &= 11.77\% \end{aligned}$$

- b. WACC (pretax) = $(0.40 \times 8.30\%) + (0.10 \times 7.37\%) + (0.50 \times 11.77\%)$
 $= 3.32\% + 0.74\% + 5.89\%$
 $= 9.95\%$

$$\begin{aligned} \text{WACC (after-tax)} &= [(1.00 - 0.40) \times (0.40 \times 8.30\%)] + (0.10 \times 7.37\%) + (0.50 \times 11.77\%) \\ &= 1.99\% + 0.74\% + 5.89\% \\ &= 8.62\% \end{aligned}$$

- c. Cost of debt = 9.00%

$$\text{Cost of preferred shares} = (0.08 \times \$70) \div \$70 = \$5.60 \div \$70 = 8.00\%$$

$$\begin{aligned} \text{Cost of ordinary shares (using CAPM)} &= 4.00\% + [1.15 \times (11.40\% - 4.00\%)] \\ &= 4.00\% + 8.51\% \\ &= 12.51\% \end{aligned}$$

$$\begin{aligned} \text{WACC (after-tax)} &= [(1.00 - 0.40) \times (0.50 \times 9.00\%)] + (0.10 \times 8.00\%) + (0.40 \times 12.51\%) \\ &= 2.70\% + 0.80\% + 5.00\% \\ &= 8.50\% \end{aligned}$$

As a result of the proposed risk-increasing investment SVI's after-tax WACC drops slightly from 8.62% to 8.50%. This result may seem a bit inconsistent with expectations, but can be explained by the fact that the increased financial leverage resulted in a higher proportion of debt in the company's capital structure. In spite of the increased pretax costs of each source of financing, the tax-deductibility of the increased proportion of debt more than compensated for them, thereby lowering SVI's WACC.

Answers to End-of-Chapter Questions

Q11-1. Explain when companies should discount projects using the cost of equity. When should they use the WACC instead? When should they use neither?

A11-1. Only companies with no debt in their capital structure should use the cost of equity to discount project cash flows, and only those projects that are very similar to a company's existing assets should be discounted using that rate. Companies with both debt and equity should use the WACC as long as they are evaluating a project that is similar to their existing

assets. When a company is making an investment that is very different from its existing investments, then it shouldn't use the company's cost of equity or its WACC.

- Q11-2.** If a company takes actions that increase its operating leverage, we might expect to see an increase in its equity beta. Why?
- A11-2.** Operating leverage makes a company's profits and cash flows more variable and more sensitive to changes in sales. An increase in operating leverage will therefore make a company's share price more sensitive to general economic conditions, and the share's beta will increase.
- Q11-3.** Company A and Company B plan to raise \$1 million to finance identical projects. Company A finances the project with 100% equity, while company B uses a 50-50 mix of debt and equity. The interest rate on the debt equals 7%. At what rate of return on the investment (i.e., assets) will the rate of return on equity be the same for Companies A and B? (*Hint: Think through Table 11.2.*)
- A11-3.** If the rate of return on the investment is 7%, then both companies will have an ROE of 7.
- Q11-4.** Why do you think it is important to use the market values of debt and equity rather than book values to calculate a company's WACC?
- A11-4.** Market values provide a better gauge of the true degree of leverage that a company employs. A personal finance analogy may help drive this point home. Suppose someone buys a new home for \$100,000, using \$90,000 of borrowed money and \$10,000 of personal funds to finance the purchase. Suppose the value of the home doubles soon thereafter. The value of outstanding debt is \$90,000, but the market value of the home is \$200,000. If we were measuring leverage in this example using 'book value' or historical cost, the percentage of debt financing would be 90%. However, using the market value of the home rather than its cost, the fraction of the home financed through debt is just 45%. The owner of this home could easily borrow even more against the new, higher value of the home.
- Q11-5.** Assuming that there are no corporate income taxes, how can the costs of preferred equity and debt be estimated?
- A11-5.** With no taxes, if you plug a company's asset beta into the CAPM equation the resulting rate of return is the WACC. We can see this by starting with the equation for the WACC:

$$WACC = r_e \frac{E}{D + E} + r_d \frac{D}{D + E}$$

Next, plug in the CAPM expression for r_e and r_d :

$$WACC = [R_f + \beta_e(E(R_m) - R_f)] \frac{E}{D + E} + [R_f + \beta_d(E(R_m) - R_f)] \frac{D}{D + E}$$

A little manipulation of this expression yields:

$$WACC = R_f + [\beta_e \frac{E}{D + E} + \beta_d \frac{D}{D + E}](E(R_m) - R_f)$$

And this in turn simplifies to:

$$WACC = R_f + \beta_a(E(R_m) - R_f)$$

The intuition here is simply that, in the absence of taxes, the WACC measures the rate of return that a company must earn on its assets to satisfy all investors. The CAPM can also give you a required rate of return on assets simply by using the asset beta.

Q11-6. What are the three main lessons learned with regard to choosing the right discount rate for use in evaluating capital budgeting projects?

A11-6.

1. When an all-equity company invests in an asset similar to its existing assets, the cost of equity is the appropriate discount rate to use in NPV calculations.
2. When a company with both debt and equity invests in an asset similar to its existing assets, the WACC is the appropriate discount rate to use in NPV calculations.
3. The WACC reflects the return that the company must earn on average across all its assets to satisfy investors, but using the WACC to discount cash flows of a particular investment can lead to mistakes. The reason for this is that a particular investment may be more or less risky than the company's average investment, requiring a higher or lower discount rate than the WACC.

Q11-7. How does the calculation of the after-tax WACC differ from that of the before-tax WACC? Which method is typically applied in Australia? Why?

A11-7. The difference in calculating after-tax WACC is that companies are entitled to deduct interest payments on their debt from the taxable income. This opportunity reduces the after-tax cost of debt and changes the WACC formula to

$$\text{WACC} = \left(\frac{D}{D + E}\right)(1 - \tau_c)r_d + \left(\frac{E}{D + E}\right)r_e$$

Consequently, the after-tax WACC is lower than the before-tax WACC. The difference between after-tax WACC and before-tax WACC comes mainly from the higher company value due to the tax shield created by using debt. After-tax value more truly represents the cost of funds for the business owners and investors, and is widely used when these capital providers make decisions within domestic markets.

Q11-8. In what sense could one argue that if managers make decisions using break-even analysis, they are not maximising shareholder wealth? How can break-even analysis be modified to solve this problem?

A11-8. A problem with break-even analysis is that it uses accounting numbers – earnings before interest and taxes and earnings per share. Accounting numbers can be manipulated, and may not represent cash flows. Financing – the amount of interest a company pays – will affect its break-even analysis. More debt financing means a higher break-even point. This all relates to maximising shareholder wealth. A company with debt financing cannot use the cost of equity to discount its cash flows. It must look at the costs associated with both debt and equity financing and include both in its discount rate.

Q11-9. Explain the differences between *sensitivity analysis* and *scenario analysis*. Offer an argument for the proposition that scenario analysis offers a more realistic picture of a project's risk than sensitivity analysis does.

A11-9. Sensitivity analysis looks at how changes in a single variable affect a project's NPV. Scenario analysis looks at how several changes occurring simultaneously affect the NPV. Scenario analysis is probably more realistic because certain key variables in an NPV calculation are correlated. For example, if sales are lower than expected due to competition, then the output price may also be less than expected.

Q11-10. In Chapter 10, we discussed how one might calculate the NPV of earning an MBA. Suppose that you are asked to do a sensitivity analysis on the MBA decision. Which of the following factors do you think would have a larger impact on the degree's NPV?

- a. The ranking of the school you choose to attend
 - b. Your choice of a major or specialisation in the MBA.
 - c. Your Grade Point Average (GPA) or Weighted Average Market (WAM)
 - d. The state of the job market when you graduate
- A11-10.** The factor least likely to affect the NPV of getting an MBA is your GPA or WAM. There are fairly large starting salary differentials earned by graduates at different schools, and similar salary differences among graduates with different majors, so factors 'a' and 'b' are likely to be important. Though graduating during a recession rather than during a boom might reduce the NPV somewhat, this effect is largely temporary.
- Q11-11.** Suppose you want to model the value of an MBA degree with *decision trees*. What would such a decision tree look like?
- A11-11.** The first part of the tree might indicate the initial choice to get an MBA or not. Subsequent branches could model the decision about whether to attend full-time or part-time, what specialisation to take, and so on.
- Q11-12.** If you decide to invest in an MBA, what is your *follow-on investment option*? What is your *abandonment option*?
- A11-12.** The follow-on option might be to get a PhD in finance. The abandonment option is to quit school before finishing the degree.
- Q11-13.** Your company is selling the mineral rights to several hundred acres of land it owns that are believed to contain silver deposits. The current price of silver is \$18 per ounce, but of course, future prices are uncertain. Would you expect the mineral rights to sell for more or less if investors believe that silver prices will be more volatile in the future than they have been in the past? Explain.
- A11-13.** Rights would be more valuable if the price of silver is volatile. If the price is volatile, there will be periods when the price is very high and periods when it is very low. When the price is high, you can extract the silver and make a lot of money. When the price is low, you simply wait, avoiding the extraction costs.

Solutions to End-of-Chapter Problems

Choosing the Right Discount Rate

- P11-1.** Puritan Motors has a capital structure consisting almost entirely of equity.
- a. If the beta of Puritan equity equals 1.6, the risk-free rate equals 6%, and the expected return on the market portfolio equals 11%, what is its cost of equity?
 - b. Suppose that a 1% increase in expected inflation causes a 1% increase in the risk-free rate. Holding all other factors constant, what will this do to the company's cost of equity? Is it reasonable to hold all other factors constant? What other part of the calculation of the cost of equity is likely to change if expected inflation rises?
- A11-1.**
- a. Puritan Motors' cost of equity is: $6\% + 1.6(11\% - 6\%) = 14\%$
 - b. If inflation causes a 1% increase in the risk-free rate, the company's cost of equity will decrease: $7\% + 1.6(11\% - 7\%) = 13.4\%$. It is probably not reasonable to hold all other factors constant – if the risk free rate increases by 1%, it is likely that the expected return on the market, which also has an inflation compensation factor, will increase by 1%. If the expected market return and the risk-free rate both increase by 1%, then the cost of equity will also increase by 1%.

P11-2. Fournier Industries, a publicly traded waste disposal company, is a highly leveraged company with 70% debt, 0% preferred equity, and 30% common equity financing. Currently the risk-free rate is about 4.5% and the return on the S&P 500 (the market proxy) is 12.7%. The company's beta is currently estimated to be 1.65.

- What is Fournier's current cost of equity?
- If the company shifts its capital structure to a highly levered position by selling preferred shares and using the proceeds to retire debt, it expects its beta to drop to 1.20. What is its cost of equity in this case?
- If the company shifts its capital structure to a less highly leveraged position by selling additional ordinary shares and using the proceeds to retire debt, it expects its beta to drop to 0.95. What is its cost of equity in this case?
- Discuss the potential impact of the two strategies discussed in parts (b) and (c) above on Fournier's weighted-average cost of capital (WACC).

- A11-2.**
- Cost of equity can be found using CAPM: $4.5\% + 1.65(12.7\% - 4.5\%) = 18.03\%$
 - With a lower beta, cost of equity is: $4.5\% + 1.2(12.7\% - 4.5\%) = 14.34\%$
 - With a beta of 0.95, cost of equity is: $4.5\% + 0.95(12.7\% - 4.5\%) = 12.29\%$
 - The impact on WACC depends on the company's cost of debt and preferred shares, relative to the cost of equity. Typically, using debt financing is cheaper than using equity financing. Using preferred shares financing is also more costly than debt financing, partly because of the tax shield associated with debt financing. Ordinary shares financing is more costly than preferred shares financing. Unless the company's cost of equity is very high because of a high risk of insolvency, it could expect its WACC to increase if it replaces debt financing with either preferred or ordinary shares financing. The reduction in the cost of equity will lower the WACC, but may not be low enough to compensate for the loss of low cost debt financing.

P11-3. Gail and Company had the following sales and EBIT during the years 2012 to 2014.

	2012	2013	2014
Sales (\$ millions)	75.2	82.7	95.1
EBIT (\$ millions)	26.3	30.5	36.0

- Use the data provided to assess Gail and Company's operating leverage over the following periods
 - 2012–2013
 - 2013–2014
 - 2012–2014
- Compare, contrast, and discuss the company's operating leverage between the 2012–2013 period and the 2013–2014 period. Explain any differences.
- Compare the operating leverage for the entire 2012–2014 period to the values found for the two subperiods and explain the differences.

A11-3.

- $$\begin{aligned} \text{Operating leverage} &= \frac{\Delta EBIT}{EBIT} / \frac{\Delta Sales}{Sales} = \\ &= (30.5 - 26.3) / 26.3 / (82.7 - 75.2) / 75.2 \\ &= 0.1597 / 0.0997 \\ &= 1.60 \end{aligned}$$

$$(2) \text{ Operating leverage} = (36 - 30.5) / 30.5 / (95.1 - 82.7) / 82.7 = 0.1803 / 0.1499 = 1.20$$

$$(3) \text{ Operating leverage} = (36 - 26.3) / 26.3 / (95.1 - 75.2) / 75.2 = 0.3688 / 0.2646 = 1.439$$

- b. Operating leverage decreased from 2012-2013 to 2013-2014. The company had a bigger differential in EBIT compared to the difference in sales in the first time period.
- c. The operating leverage for the full period is approximately the average of the operating leverages for the first year and the second year.

P11-4. Company 1 has a capital structure with 20% debt and 80% equity. Company 2's capital structure consists of 50% debt and 50% equity. Both companies pay 7% annual interest on their debt. Finally, suppose that both companies have invested in assets worth \$100 million. Calculate the *return on equity* (ROE) for each company, assuming the following:

- a. The return on assets is 3%.
- b. The return on assets is 7%.
- c. The return on assets is 11%.

What general pattern do you observe?

A11-4.

	Return on Assets (ROA) for Each Company					
	3%		7%		11%	
	Co. 1	Co. 2	Co. 1	Co. 2	Co. 1	Co. 2
Dollar revenue (millions)	\$3	\$3	\$7	\$7	\$11	\$11
– Interest						
Company 1 ($.20 \times \$100 \times .07$)	1.4		1.4		1.4	
Company 2 ($.50 \times \$100 \times .07$)		3.5		3.5		3.5
Return to equity	\$1.6	\$–0.5	\$5.6	\$3.5	\$9.6	\$7.5
÷ Equity						
Company 1 ($.80 \times 100$)	80		80		80	
Company 2 ($.50 \times 100$)		50		50		50
Return on equity (ROE)	2%	–1%	7%	7%	12%	15%

In general, Company 1's ROE is less responsive to changes in its ROA than is Company 2's ROE. This is attributable to Company 1's lower financial leverage reflected in its 20% debt vs. Company 2's 50% debt in its capital structure.

P11-5. Company A's capital structure contains 20% debt and 80% equity. Company B's capital structure contains 50% debt and 50% equity. Both companies pay 7% annual interest on their debt. The shares of Company A have a beta of 1.0, and the shares of Company B have a beta of 1.375. The risk-free rate of interest equals 4%, and the expected return on the market portfolio equals 12%.

- a. Calculate the WACC for each company, assuming there are no taxes.
- b. Recalculate the WACC for each company, assuming that they face a tax rate of 34%.
- c. Explain how taking taxes into account in part (b) changes your answer from part (a).

A11-5. a. Company A has a cost of equity of $4\% + 1.0(12\% - 4\%)$, or 12%, and Company B has a cost of equity of $4\% + 1.375(12\% - 4\%)$, or 15%. Given these figures and the fact that both companies have a cost of debt of 7%, the WACC for Company A is $(0.20 \times 7\%) + (0.80 \times 12\%)$, or 11%, and for Company B it is $(0.50 \times 7\%) + (0.50 \times 15\%)$, also 11%.

- b. Recalculating, assuming a 34% tax rate:
WACC for A: $(0.2 \times 7\% \times (1-0.34)) + (0.8 \times 12\%) = 0.10524$, or 10.524%
WACC for B: $(0.5 \times 7\% \times (1-0.34)) + (0.5 \times 15\%) = 0.0981$, or 9.81%

- c. When there are taxes, there is a bigger advantage to debt financing. Company B, that uses a greater percentage of debt financing, has a lower weighted average cost of capital.

- P11-6.** A company has a capital structure containing 60% debt and 40% ordinary shares. Its outstanding bonds offer investors a 6.5% yield to maturity. The risk-free rate currently equals 5%, and the expected risk premium on the market portfolio equals 6%. The company's ordinary equity beta is 1.20.
- What is the company's required return on equity?
 - Ignoring taxes, use your finding in part (a) to calculate the company's WACC.
 - Assuming a 40% tax rate, recalculate the company's WACC found in part (b).
 - Compare and contrast the values for the company's WACC found in parts (b) and (c).

- A11-6.**
- The company's required return on equity is $(5\% + 1.20 \times 6\%)$, or 12.2%
 - $WACC = 0.6 \times 6.5\% + 0.4 \times 12.2\% = 8.78\%$
 - $WACC \text{ after tax} = 0.6 \times 6.5\% \times (1 - 0.4) + 0.4 \times 12.2\% = 7.22\%$
 - The after-tax WACC of the company is lower than its before tax WACC, due to the tax shield created from using debt.

- P11-7.** Dingel Inc. is attempting to evaluate three alternative capital structures – A, B, and C. The following table shows the three structures along with relevant cost data. The company is subject to a 40% tax rate. The risk-free rate is 5.3% and the market return is currently 10.7%.

Item	Capital Structure		
	A	B	C
Debt (\$ million)	35	45	55
Preferred shares (\$ million)	0	10	10
Ordinary shares (\$ million)	65	45	35
Total capital (\$ million)	100	100	100
Debt (yield to maturity)	7.0%	7.5%	8.5%
Preferred equity dividend	---	\$2.80	\$2.20
Preferred equity (price)	---	\$30.00	\$21.00
Ordinary shares beta	0.95	1.10	1.25

- Calculate the after-tax cost of debt for each capital structure
 - Calculate the cost of preferred shares for each capital structure.
 - Calculate the cost of ordinary shares for each capital structure.
 - Calculate the weighted average cost of capital (WACC) for each capital structure.
 - Compare the WACCs calculated in part (d) and discuss the impact of the company's financial leverage on its WACC and its related risk
- A11-7.**
- After tax cost of debt = Pre-tax cost of debt $\times (1 - T)$
 A: After tax cost of debt = $0.07 \times (1 - 0.4) = 0.042$
 B: After tax cost of debt = $0.075 \times (1 - 0.4) = 0.045$
 C: After tax cost of debt = $0.085 \times (1 - 0.4) = 0.051$
 - Cost of preferred shares = Dividend/Price
 B: Cost of preferred shares = $2.80/30 = 0.0933$
 C: Cost of preferred shares = $2.20/21 = 0.1048$
 - Cost of ordinary shares = risk free rate + beta \times (Market return – risk free rate)
 A: Cost of ordinary shares = $5.3\% + (10.7\% - 5.3\%)(0.95) = 10.43\%$
 B: Cost of ordinary shares = $5.3\% + (10.7\% - 5.3\%)(1.10) = 11.24\%$
 C: Cost of ordinary shares = $5.3\% + (10.7\% - 5.3\%)(1.25) = 12.05\%$

- d. Weighted average cost of capital = weight of debt \times after tax cost of debt + weight of preferred shares \times cost of preferred shares + weight of ordinary shares \times cost of ordinary shares
A: $WACC = 0.35(0.042) + 0.65(0.1043) = 0.0825$
B: $WACC = 0.45(0.045) + 0.10(0.0933) + 0.45(0.1124) = 0.0802$
C: $WACC = 0.55(0.051) + 0.10(0.1048) + 0.35(0.1205) = 0.0807$
- e. B's WACC is lower than A's WACC because of its greater use of lower cost debt financing. C uses even more debt financing; however, its cost is higher because its cost of debt financing and its cost of equity financing increased enough to put the company beyond its optimal level of debt financing.

P11-8. A company has a capital structure containing 40% debt, 20% preferred equity, and 40% ordinary shares. The company's debt has a yield to maturity of 8.1%, its preferred share's annual dividend is \$3.10, and the preferred share's current market price is \$50.00 per share. The company's ordinary shares have a beta of 0.90, and the risk-free rate and the market return are currently 4.0% and 13.5%, respectively. The company is subject to a 40% tax rate.

- What is the company's cost of preferred shares?
- What is the company's cost of ordinary shares?
- Calculate the company's after-tax WACC.
- Recalculate the company's WACC, assuming that its capital structure is deleveraged to contain 20% debt, 20% preferred shares, and 60% ordinary shares.
- Compare, contrast, and discuss your findings from parts (c) and (d).

- A11-8.**
- The company's cost of preferred shares is $3.10/50 = 6.2\%$
 - The company's cost of ordinary shares is $4\% + 0.9 (13.5\% - 4\%)$, or 12.55%.
 - To calculate after-tax WACC, we must first compute the after-tax cost of debt, which is $8.1\% \times (1 - \text{tax rate}) = 8.1\% \times 0.6 = 4.86\%$.
The WACC is $0.4 \times 4.86\% + 0.2 \times 6.2\% + 0.4 \times 12.55\%$, or 8.20%.
 - WACC with deleveraged capital structure is $0.2 (4.86\%) + 0.2 (6.2\%) + 0.6 (12.55\%)$, or 9.74%.
 - The company's WACC increased significantly after it began using less debt and more equity financing. This is because common equity is a more costly form of financing than debt. [Note: The calculation in part (d) assumes the company's component costs of debt, preferred shares, and ordinary shares do not change. In reality, all three are likely to be somewhat lower with less leverage and less financial risk, so the company's WACC would end up being lower than 9.74%.]

A Closer Look at Risk

P11-9. Alliance Pneumatic Manufacturing, a specialty machine-tool producer, has fixed costs of \$200 million per year. Across all the company's products, the average contribution margin equals \$1,200. What is Alliance's break-even point in terms of units sold?

A11-9. Fixed costs divided by the contribution margin equal the break-even point in terms of units sold. In this case, $\$200,000,000 \div \$1,200 = 166,667$ units sold is Alliance's break-even point.

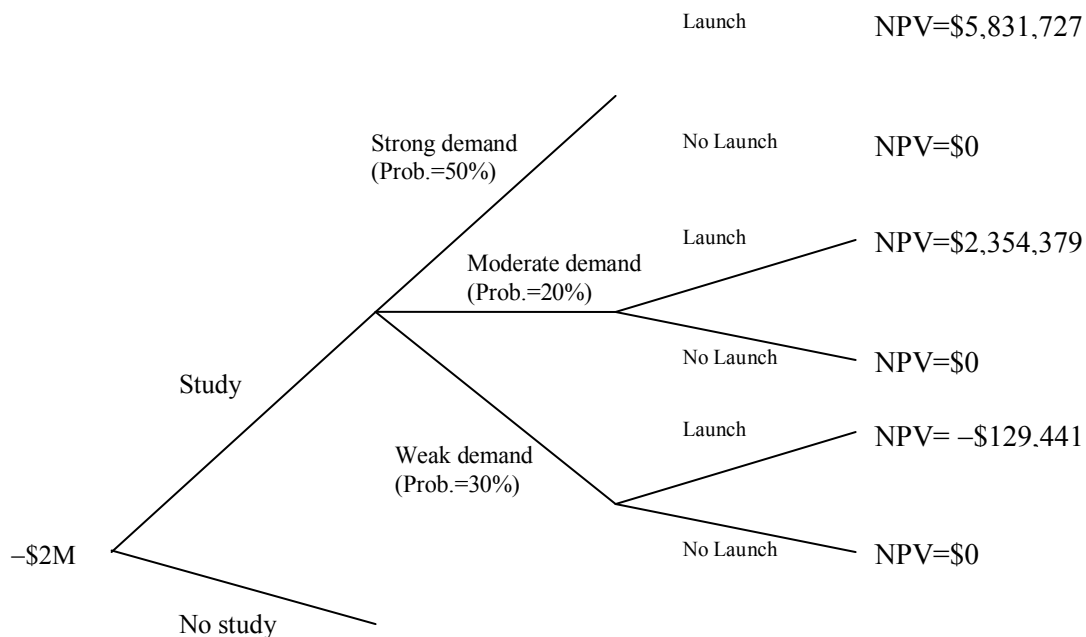
P11-10. See Table 11.4 on page 400. Determine which of the following has the greater effect on the NPV of the gyroscope skateboard project – an increase in the initial selling price of 12.5% (compared to the base case) or an increase in the size of the market of 10% in year 1 (compared to the base case).

- A11-10.** The increase in the selling price has a greater effect on the project's NPV. The increase in price from \$200 to \$225 leads to an NPV of \$960, which is a 307% increase over the base case NPV of \$236. Similarly, the increase in market size after year 1 from 500,000 units to 550,000 units leads to an increase of approximately 245% to an NPV of \$815.
- P11-11.** JK Manufacturing is considering a new product and is unsure about its price as well as the variable cost associated with it. JK's marketing department believes that the company can sell the product for \$500 per unit, but feel that if the initial market response is weak, the price may have to be 20% lower in order to be competitive with existing products. The company's best estimates of its costs are fixed costs of \$3.6 million and variable cost of \$325 per unit. Concern exists with regard to the variable cost per unit due to currently volatile raw material and labour costs. Although the company expects this cost to be about \$325 per unit, it could be as much as 8% above that value. The company expects to sell about 50,000 units per year.
- Calculate the company's *breakeven point (BEP)*, assuming its initial estimates are accurate.
 - Perform a sensitivity analysis by calculating the breakeven point for all combinations of the sale price per unit and variable cost per unit. (Hint: There are four combinations.)
 - In the best case, how many units will the company need to sell to break even?
 - In the worst case, how many units will the company need to sell to break even?
 - If each of the possible price/variable cost combinations is equally probable, what is the company's expected break-even point?
 - Based on your finding in part (e) should the company go forward with the proposed new product? Explain why or why not.
- A11-11.**
- Best case breakeven $= \text{Fixed costs} / (\text{Sales} - \text{Variable costs})$
 $= 3,600,000 / (500 - 325)$
 $= 20,571 \text{ units}$
 - Sales price = $500 (1 - 0.2) = \$400$
Variable cost = $325 (1 + 0.08) = \$351$
Worst case breakeven = $3,600,000 / (400 - 351) = 73,469 \text{ units}$
 - Sales price = \$500, Variable cost = \$351
Breakeven = $3,600,000 / (500 - 351) = 24,161 \text{ units}$
 - Sales price = \$400, Variable cost = \$325
Breakeven = $3,600,000 / (400 - 325) = 48,000 \text{ units}$
 - In the best case the breakeven point is 20,571 units
 - In the worst case the breakeven point is 73,469 units
 - e-f. If each case is equally probable, the breakeven point is $(24,161 + 48,000 + 20,575 + 73,469) / 4 = 41,550$. This is less than the expected number produced of 50,000, so the company should go ahead with the project.
- P11-12.** Consumer Products, Inc. (CPI) can pay one of its foreign suppliers \$20 million to obtain exclusive marketing rights to a new product. Demand for this product is uncertain, but CPI's preliminary estimates indicate that there is a 50% chance of strong product demand, which will result in cash inflows of \$5.2 million per year for 8 years; there is a 20% chance of moderate product demand, which will result in cash inflows of \$4.5 million per year for 8 years; and there is a 30% chance of weak demand, which will result in cash inflows of \$4.0 million per year for 8 years. For \$2 million, CPI can conduct a feasibility study that will confirm whether product demand will be strong, moderate, or weak, and then CPI can decide whether

to purchase rights to the product. CPI's cost of capital applicable to the proposed new product decision is 12%.

- Draw the decision tree associated with CPI's proposed feasibility study.
- Calculate the NPV associated with each of the possible product demand outcomes – strong, moderate, and weak.
- Find the expected NPV of performing the feasibility study.
- Based on your findings in part (c), what recommendation would you give CPI about the proposed feasibility study? Explain.

A11-12. a.



- NPV strong = \$5.83M, NPV moderate = \$2.35M, NPV weak = \$0
- NPV of performing the study is \$ 0.70M.

Calculations:

Strong demand: $NPV = -20 + 5.83 \times PVA(8 \text{ years}, 12\%)$

Moderate demand: $NPV = -20 + 4.5 \times PVA(8 \text{ years}, 12\%)$

Weak demand: $NPV = -20 + 4 \times PVA(8 \text{ years}, 12\%) < 0$, => should be considered as 0.

$NPV(2 \text{ years from now}) = 5.83M \times 0.5 + 2.35M \times 0.2 + 0 \times 0.3 = \$3.38M$, discount it back for 2 years to get $\$2.70M - \$2M = \$0.70M$.

- The project has a positive NPV so CPI should undertake the feasibility study. In case the study indicates, however, that the demand will be weak, CPI should not invest the \$20 M. CPI will be better off not doing the investment in the new products, whereas the \$2M spent on the study is a sunk cost. Therefore, the NPV is 0.

Real Options

P11-13. Stanley Marcus, a financial intern at Mega Manufacturing Company (MMC), was asked by the CFO to review the NPV calculations on a major new product investment. After analysing the cash flows and other calculations, Stanley confirmed that the NPV was \$1.5 million. In the process of investigating all aspects of the project and its cash flows, Stanley learned that should the new product be successful, it would open the door to a number of opportunities to

further expand the company's product line. Using option valuation techniques that he learned in an advanced finance course, he estimated the value of these expansion options to be \$0.45 million.

- a. Based on Stanley's analysis, what is the value of the proposed new product investment?
- b. How can Stanley explain the value found in part (a) to the CFO, who is unfamiliar with the concept of *real options*?

- A11-13.**
- a. The value of the new investment is \$1.95 million ($1.50 + 0.45$).
 - b. The value in part (a) is higher than the project's NPV because it also includes the opportunity available to the management of MMC to further expand their product line, if deemed necessary. This opportunity is not a part of the current project but it will follow the project's successful implementation, without MMC explicitly undertaking any steps. Therefore, value should be assigned to such an opportunity in order to correctly define the NPV of the current project.

- P11-14.** Tech Industries, a contract manufacturer of circuit boards, is evaluating an investment in a new production line to handle the growing demand from its customers, who produce consumer electronic products. Based on reasonable growth assumptions, the NPV of the new production line was found to be $-\$2.3$ million. Management feels obligated to therefore reject the project. It recognises that the production line would provide a high degree of output flexibility because it could be re-purposed easily and inexpensively to produce circuit boards for numerous other applications. The company's project analyst estimated the value of this *output flexibility option* to be \$3.3 million.

- a. Based on the information provided, what is the true value of Tech Industries' proposed new production line?
- b. What recommendation would you give Tech Industries regarding the proposed new production line? Explain.

- A11-14.**
- a. The true value of the new production line is \$1 million ($-\$2.3 \text{ million} + \3.3 million).
 - b. Having in mind that Tech Industries is in a very capital-intensive industry, the company should accept the new production line. Furthermore, the flexibility option is very valuable to this kind of business because of quick technological changes and quick outdated of products. By taking the project, the company will be always ready to start producing new circuit boards, or just switch production in the case of decrease in demand for one electronic product and respective increase in demand for another one.

Mini-Case

Cost of Capital and Project Risk

Cascade Water Company (CWC) currently has 30,000,000 ordinary shares outstanding that trade at a price of \$42 per share. CWC also has 500,000 bonds outstanding that currently trade at \$923.38 each. CWC has no preferred equity outstanding and has an equity beta of 2.639. The risk-free rate is 3.5%, and the market is expected to return 12.52%. The company's bonds have a 20-year life, a \$1,000 par value, a 10% coupon rate and pay interest semi-annually.

CWC is considering adding to its product mix a 'healthy' bottled water geared toward children. The initial outlay for the project is expected to be \$3,000,000, which will be depreciated using the straight-line method to a zero salvage value, and sales are expected to be 1,250,000 units per year at a price of \$1.25 per unit. Variable costs are estimated to be \$0.24 per unit, and fixed costs of the project are estimated at \$200,000 per year. The project is expected to have a 3-year life and a terminal value (excluding the operating cash flows in year 3) of \$500,000. CWC has a 34% marginal tax rate. For the purposes of this project, working capital effects will be ignored. Bottled water targeted at children is expected to have different risk characteristics from the company's current products. Therefore, CWC has decided to use the 'pure play' approach to evaluate this project. After researching the market, CWC managed to find two pure-play companies. The specifics for those two companies are:

Company	Equity Beta	D/E	Tax Rate
Fruity Water	1.72	0.43	34%
Ladybug Drinks	1.84	0.35	36%

1. Determine the current weighted average cost of capital for CWC.
2. Determine the appropriate discount rate for the healthy bottled water project.
3. Should the company undertake the healthy bottled water project? As part of your analysis, include sensitivity analysis for sales price, variable costs, fixed costs, and unit sales at $\pm 10\%$, 20% , and 30% from the base case. Also perform an analysis of the following two scenarios:
 - a. *Best case*: Selling 2,500,000 units at a price of \$1.24 per unit with variable production costs of \$0.22 per unit.
 - b. *Worst case*: Selling 950,000 units at a price of \$1.32 per unit, with variable production costs of \$0.27 per unit.

Answer:

1.

	# of securities	Price per security	Total Market Value	Weight
Equity	30,000,000	42.00	\$1,260,000,000	73.18%
Debt	500,000	923.38	\$461,690,000	26.82%
		Sum =	\$1,721,690,000	

Thus, the $w_d = 26.82\%$ and the $w_e = 73.18\%$. Using the CAPM we can determine the k_e :

$$K_e = .035 + 2.639(0.1252 - 0.035) = 27.3\%$$

$$K_d = \text{YTM} = \$923.38 = \frac{\$50}{(1+r)^1} + \frac{\$50}{(1+r)^2} + \frac{\$50}{(1+r)^3} + \dots + \frac{\$1,050}{(1+r)^{40}}; \text{ solve for } r \text{ which in this case is the YTM.}$$

$$\text{Calculator solution: } r \times 2 = 10.952\% = \text{YTM}$$

$$\text{WACC} = w_d k_d + w_e k_e = 0.2682 * 0.1095 * (1 - 0.34) + 0.7318 * 0.2730 = 21.92\%$$

2.

Company	Equity Beta	D/E	Tax Rate	Asset Beta
Fruity Water	1.72	0.43	34%	$1.72 / (1 + (1 - 0.34) * 0.43) = 1.339773$
Ladybug Drinks	1.84	0.35	36%	$1.84 / (1 + (1 - 0.36) * 0.35) = 1.503268$
Average Asset Beta =				1.42152

CWC's debt to equity ratio based on market values is $\$461,690,000 / \$1,260,000,000 = 0.3664$.

Converting the average asset beta into an equity beta for CWC:

$$1.422 * (1 - 0.34) * (0.3664) = 1.7653.$$

$$k_e \text{ for the project is } 0.035 + [1.7653 * (0.1252 - 0.035)] = 19.42\%.$$

The WACC for the project is:

$$WACC = w_d k_d + w_e k_e = 0.2682 * 0.1095 \times (1 - 0.34) + 0.7318 * 0.1942 = 16.15\%$$

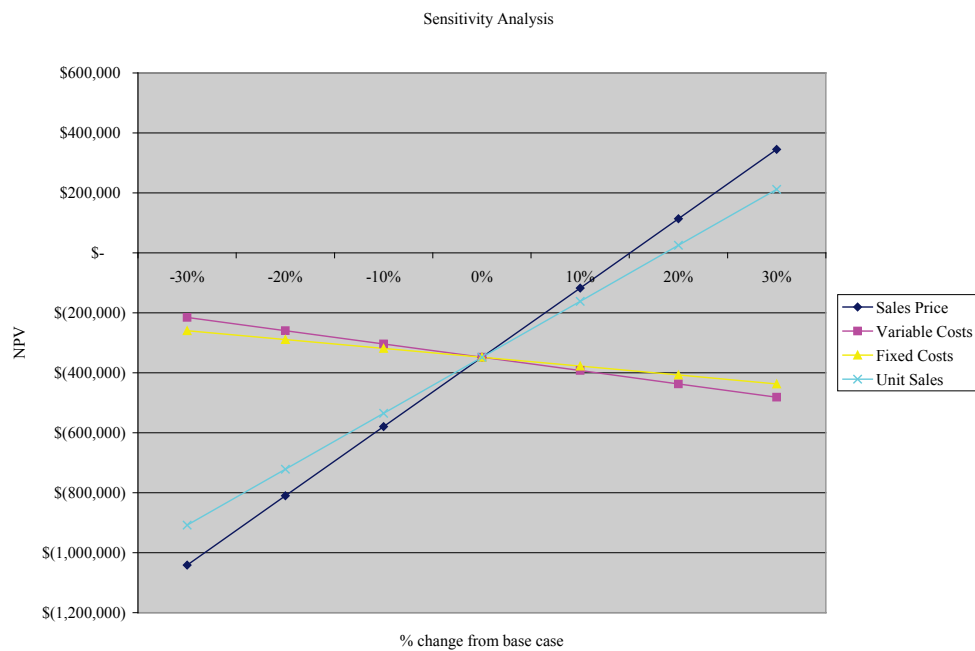
3. Based upon the information calculated below, I would not accept the project. The base case has a negative NPV. According to the sensitivity analysis, the project is rather sensitive to the sales price and unit sales. Unit sales would have to be approximately 20% higher than expected before the project is expected to generate a positive NPV and the sales price would have to be approximately 15% higher. Even if variable costs and fixed costs drop by 30% (independently of each other) the project is not expected to have a positive NPV. Also, if there is a chance that, should the worse case occur, the company would be forced into insolvency, the project should not be undertaken.

Base Case:

	1	2	3		
Sales (units)	1,250,000	1,250,000	1,250,000	\$1.25	Sales Price
Revenues	\$1,562,500	\$1,562,500	\$1,562,500	\$0.24	VC
Variable Costs	\$300,000	\$300,000	\$300,000	\$3,000,000	Initial Outlay
Fixed Costs	\$200,000	\$200,000	\$200,000	34%	Tax rate
Depreciation	\$1,000,000	\$1,000,000	\$1,000,000	16.15%	Discount Rate
Income before taxes	\$62,500	\$62,500	\$62,500		
Taxes	\$21,250	\$21,250	\$21,250		
Net Income	\$41,250	\$41,250	\$41,250		
Operating Cash Flow	\$1,041,250	\$1,041,250	\$1,041,250		
Terminal Cash Flow			\$500,000		
Net Operating Cash Flow	\$1,041,250	\$1,041,250	\$1,541,250		

NPV (\$348,226.05)

	-30%	-20%	-10%	0%	10%	20%	30%
Sales Price	\$(1,041,316)	\$(810,286)	\$(579,256)	\$(348,226)	\$(117,196)	\$113,834	\$344,864
Variable Costs	\$(215,153)	\$(259,510)	\$(303,868)	\$(348,226)	\$(392,584)	\$(436,942)	\$(481,299)
Fixed Costs	\$(259,510)	\$(289,082)	\$(318,654)	\$(348,226)	\$(377,798)	\$(407,370)	\$(436,942)
Unit Sales	\$(908,243)	\$(721,571)	\$(534,898)	\$(348,226)	\$(161,554)	\$25,119	\$211,791



Worst Case

	1	2	3		
Sales (units)	950,000	950,000	950,000	\$1.32	Sales Price
Revenues	\$1,254,000	\$1,254,000	\$1,254,000	\$0.27	VC
Variable Costs	\$256,500	\$256,500	\$256,500	\$3,000,000	Initial Outlay
Fixed Costs	\$200,000	\$200,000	\$200,000	34%	Tax rate
Depreciation	\$1,000,000	\$1,000,000	\$1,000,000	16.15%	Discount Rate
Income before taxes	\$(202,500)	\$(202,500)	\$(202,500)		
Taxes	\$(68,850)	\$(68,850)	\$(68,850)		
Net Income	\$(133,650)	\$(133,650)	\$(133,650)		
Operating Cash Flow	\$866,350	\$866,350	\$866,350		
Terminal Cash Flow			\$500,000		
Net Operating Cash Flow	\$866,350	\$866,350	\$1,366,350		
NPV	(\$740,053.13)				

Best Case

	1	2	3		
Sales (units)	2,500,000	2,500,000	2,500,000	\$1.24	Sales Price
Revenues	\$3,100,000	\$3,100,000	\$3,100,000	\$0.22	VC
Variable Costs	\$550,000	\$550,000	\$550,000	\$3,000,000	Initial Outlay
Fixed Costs	\$200,000	\$200,000	\$200,000	34%	Tax rate
Depreciation	\$1,000,000	\$1,000,000	\$1,000,000	16.15%	Discount Rate
Income before taxes	\$1,350,000	\$1,350,000	\$1,350,000		
Taxes	\$459,000	\$459,000	\$459,000		
Net Income	\$891,000	\$891,000	\$891,000		
Operating Cash Flow	\$1,891,000	\$1,891,000	\$1,891,000		
Terminal Cash Flow			\$500,000		
Net Operating Cash Flow	\$1,891,000	\$1,891,000	\$2,391,000		
NPV	\$1,555,462				