11.7 SUMMARY AND CONCLUSIONS

In this chapter, we looked at some ways of evaluating the results of a discounted cash flow analysis. We also touched on some of the problems that can come up in practice. We saw that:

1. Net present value estimates depend on projected future cash flows. If there are errors in those projections, then our estimated NPVs can be misleading. We called this possibility *forecasting risk.*
2. Scenario and sensitivity analysis are useful tools for identifying which variables are critical to the success of a project and where forecasting problems can do the most damage.
3. Break-even analysis in its various forms is a particularly common type of scenario analysis that is useful for identifying critical levels of sales.
4. Operating leverage is a key determinant of break-even levels. It reflects the degree to which a project or a firm is committed to fixed costs. The degree of operating leverage tells us the sensitivity of operating cash flow to changes in sales volume.
5. Projects usually have future managerial options associated with them. These options may be very important, but standard discounted cash flow analysis tends to ignore them.
6. Capital rationing occurs when apparently profitable projects cannot be funded. Standard discounted cash flow analysis is troublesome in this case because NPV is not necessarily the appropriate criterion anymore.

The most important thing to carry away from reading this chapter is that estimated NPVs or returns should not be taken at face value. They depend critically on projected cash flows. If there is room for significant disagreement about those projected cash flows, the results from the analysis have to be taken with a grain of salt.

Despite the problems we have discussed, discounted cash flow analysis is still *the* way of attacking problems, because it forces us to ask the right questions. What we have learned in this chapter is that knowing the questions to ask does not guarantee we will get all the answers.

Chapter Review and Self-Test Problems

Use the following base-case information to work the self-test problems.

A project under consideration costs $750,000, has a five-year life, and has no salvage value. Depreciation is straight-line to zero. The required return is 17 percent, and the tax rate is 34 percent. Sales are projected at 500 units per year. Price per unit is $2,500, variable cost per unit is $1,500, and fixed costs are $200,000 per year.

11.1 Scenario Analysis Suppose you think that the unit sales, price, variable cost, and fixed cost projections given here are accurate to within 5 percent. What are the upper and lower bounds for these projections? What is the base-case NPV? What are the best- and worst-case scenario NPVs?

11.2 Break-Even Analysis Given the base-case projections in the previous problem, what are the cash, accounting, and financial break-even sales levels for this project? Ignore taxes in answering.

Answers to Chapter Review and Self-Test Problems

11.1 We can summarize the relevant information as follows:

	Base Case	Lower Bound	Upper Bound
Unit sales	500	475	525
Price per unit	$ 2,500	$ 2,375	$ 2,625
Variable cost per unit	$ 1,500	$ 1,425	$ 1,575
Fixed cost per year	$200,000	$190,000	$210,000

Depreciation is $150,000 per year; knowing this, we can calculate the cash flows under each scenario. Remember that we assign high costs and low prices and volume for the worst-case and just the opposite for the best-case scenario.

Scenario	Unit Sales	Unit Price	Unit Variable Cost	Fixed Costs	Cash Flow
Base case	500	$2,500	$1,500	$200,000	$249,000
Best case	525	2,625	1,425	190,000	341,400
Worst case	475	2,375	1,575	210,000	163,200

At 17 percent, the five-year annuity factor is 3.19935, so the NPVs are:

$$\begin{aligned}\text{Base-case NPV} &= -\$750{,}000 + 3.19935 \times \$249{,}000 \\ &= \$46{,}638 \\ \text{Best-case NPV} &= -\$750{,}000 + 3.19935 \times \$341{,}400 \\ &= \$342{,}258 \\ \text{Worst-case NPV} &= -\$750{,}000 + 3.19935 \times \$163{,}200 \\ &= -\$227{,}866\end{aligned}$$

11.2 In this case, we have $200,000 in cash fixed costs to cover. Each unit contributes $2,500 − 1,500 = $1,000 towards covering fixed costs. The cash break-even is thus $200,000/$1,000 = 200 units. We have another $150,000 in depreciation, so the accounting break-even is ($200,000 + 150,000)/$1,000 = 350 units.

To get the financial break-even, we need to find the OCF such that the project has a zero NPV. As we have seen, the five-year annuity factor is 3.19935 and the project costs $750,000, so the OCF must be such that:

$$\$750{,}000 = \text{OCF} \times 3.19935$$

So, for the project to break even on a financial basis, the project's cash flow must be $750,000/3.19935, or $234,423 per year. If we add this to the $200,000 in cash fixed costs, we get a total of $434,423 that we have to cover. At $1,000 per unit, we need to sell $434,423/$1,000 = 435 units.

Concepts Review and Critical Thinking Questions

1. **Forecasting Risk** What is forecasting risk? In general, would the degree of forecasting risk be greater for a new product or a cost-cutting proposal? Why?
2. **Sensitivity Analysis and Scenario Analysis** What is the essential difference between sensitivity analysis and scenario analysis?

3. **Marginal Cash Flows** A co-worker claims that looking at all this marginal this and incremental that is just a bunch of nonsense, and states: "Listen, if our average revenue doesn't exceed our average cost, then we will have a negative cash flow, and we will go broke!" How do you respond?
4. **Operating Leverage** At one time at least, many Japanese companies had a "no layoff" policy (for that matter, so did IBM). What are the implications of such a policy for the degree of operating leverage a company faces?
5. **Operating Leverage** Airlines offer an example of an industry in which the degree of operating leverage is fairly high. Why?
6. **Break-Even** As a shareholder of a firm that is contemplating a new project, would you be more concerned with the accounting break-even point, the cash break-even point, or the financial break-even point? Why?
7. **Break-Even** Assume a firm is considering a new project that requires an initial investment and has equal sales and costs over its life. Will the project reach the accounting, cash, or financial break-even point first? Which will it reach next? Last? Will this ordering always apply?
8. **Capital Rationing** How are soft rationing and hard rationing different? What are the implications if a firm is experiencing soft rationing? Hard rationing?
9. **Capital Rationing** Going all the way back to Chapter 1, recall that we saw that partnerships and proprietorships can face difficulties when it comes to raising capital. In the context of this chapter, the implication is that small businesses will generally face what problem?

Questions and Problems

Basic
(Questions 1–15)

1. **Calculating Costs and Break-Even** Bob's Bikes Inc. (BBI) manufactures biotech sunglasses. The variable materials cost is $.74 per unit and the variable labor cost is $2.61 per unit.
   a. What is the variable cost per unit?
   b. Suppose BBI incurs fixed costs of $610,000 during a year in which total production is 300,000 units. What are the total costs for the year?
   c. If the selling price is $7.00 per unit, does BBI break even on a cash basis? If depreciation is $150,000 per year, what is the accounting break-even point?
2. **Computing Average Cost** Everest Everwear Corporation can manufacture mountain climbing shoes for $10.94 per pair in variable raw material costs and $32 per pair in variable labor expense. The shoes sell for $95 per pair. Last year, production was 140,000 pairs. Fixed costs were $800,000. What were total production costs? What is the marginal cost per pair? What is the average cost? If the company is considering a one-time order for an extra 10,000 pairs, what is the minimum acceptable total revenue from the order? Explain.
3. **Scenario Analysis** Covington Transmissions, Inc., has the following estimates for its new gear assembly project: price = $1,850 per unit; variable costs = $160 per unit; fixed costs = $7 million; quantity = 90,000 units. Suppose the company believes all of its estimates are accurate only to within ±15 percent. What values should the company use for the four variables given here when it performs its best-case scenario analysis? What about the worst-case scenario?
4. **Sensitivity Analysis** For the company in the previous problem, suppose management is most concerned about the impact of its price estimate on the project's

Basic (*continued*)

profitability. How could you address this concern for Covington Transmissions? Describe how you would calculate your answer. What values would you use for the other forecast variables?

5. **Sensitivity Analysis and Break-Even** We are evaluating a project that costs $924,000, has a six-year life, and has no salvage value. Assume that depreciation is straight-line to zero over the life of the project. Sales are projected at 130,000 units per year. Price per unit is $34.00, variable cost per unit is $19, and fixed costs are $800,000 per year. The tax rate is 35 percent, and we require a 15 percent return on this project.
   a. Calculate the accounting break-even point. What is the degree of operating leverage at the accounting break-even point?
   b. Calculate the base-case cash flow and NPV. What is the sensitivity of NPV to changes in the sales figure? Explain what your answer tells you about a 500-unit decrease in projected sales.
   c. What is the sensitivity of OCF to changes in the variable cost figure? Explain what your answer tells you about a $1 decrease in estimated variable costs.
6. **Scenario Analysis** In the previous problem, suppose the projections given for price, quantity, variable costs, and fixed costs are all accurate to within ±10 percent. Calculate the best-case and worst-case NPV figures.
7. **Calculating Break-Even** In each of the following cases, calculate the accounting break-even and the cash break-even points. Ignore any tax effects in calculating the cash break-even.

Unit Price	Unit Variable Cost	Fixed Costs	Depreciation
$2,000	$1,675	$16,000,000	$7,000,000
40	32	60,000	150,000
7	2	500	420

8. **Calculating Break-Even** In each of the following cases, find the unknown variable.

Accounting Break-Even	Unit Price	Unit Variable Cost	Fixed Costs	Depreciation
125,400	$ 34	$26	$ 175,000	?
140,000	?	50	3,000,000	$1,250,000
5,263	100	?	145,000	90,000

9. **Calculating Break-Even** A project has the following estimated data: price = $65 per unit; variable costs = $33 per unit; fixed costs = $4,000; required return = 16 percent; initial investment = $9,000; life = three years. Ignoring the effect of taxes, what is the accounting break-even quantity? The cash break-even quantity? The financial break-even quantity? What is the degree of operating leverage at the financial break-even level of output?
10. **Using Break-Even Analysis** Consider a project with the following data: accounting break-even quantity = 18,000 units; cash break-even quantity = 12,000 units; life = five years; fixed costs = $110,000; variable costs = $20 per unit; required return = 18 percent. Ignoring the effect of taxes, find the financial break-even quantity.

Basic (*continued*)

11. Calculating Operating Leverage At an output level of 30,000 units, you calculate that the degree of operating leverage is 3. If output rises to 36,000 units, what will the percentage change in operating cash flow be? Will the new level of operating leverage be higher or lower? Explain.

12. Leverage In the previous problem, suppose fixed costs are $150,000. What is the operating cash flow at 35,000 units? The degree of operating leverage?

13. Operating Cash Flow and Leverage A proposed project has fixed costs of $30,000 per year. The operating cash flow at 7,000 units is $63,000. Ignoring the effect of taxes, what is the degree of operating leverage? If units sold rises from 7,000 to 7,300, what will be the increase in operating cash flow? What is the new degree of operating leverage?

14. Cash Flow and Leverage At an output level of 10,000 units, you have calculated that the degree of operating leverage is 3.5. The operating cash flow is $9,000 in this case. Ignoring the effect of taxes, what are fixed costs? What will the operating cash flow be if output rises to 11,000 units? If output falls to 9,000 units?

15. Leverage In the previous problem, what will be the new degree of operating leverage in each case?

Intermediate (Questions 16–22)

16. Break-Even Intuition Consider a project with a required return of $R\%$ that costs $\$I$ and will last for N years. The project uses straight-line depreciation to zero over the N-year life; there is no salvage value or net working capital requirements.

a. At the accounting break-even level of output, what is the IRR of this project? The payback period? The NPV?

b. At the cash break-even level of output, what is the IRR of this project? The payback period? The NPV?

c. At the financial break-even level of output, what is the IRR of this project? The payback period? The NPV?

17. Sensitivity Analysis Consider a three-year project with the following information: initial fixed asset investment = $420,000; straight-line depreciation to zero over the three-year life; zero salvage value; price = $26; variable costs = $18; fixed costs = $185,000; quantity sold = 110,000 units; tax rate = 34 percent. How sensitive is OCF to changes in quantity sold?

18. Operating Leverage In the previous problem, what is the degree of operating leverage at the given level of output? What is the degree of operating leverage at the accounting break-even level of output?

19. Project Analysis You are considering a new product launch. The project will cost $680,000, have a four-year life, and have no salvage value; depreciation is straight-line to zero. Sales are projected at 160 units per year; price per unit will be $19,000, variable cost per unit will be $14,000, and fixed costs will be $150,000 per year. The required return on the project is 15 percent, and the relevant tax rate is 35 percent.

a. Based on your experience, you think the unit sales, variable cost, and fixed cost projections given here are probably accurate to within ±10 percent. What are the upper and lower bounds for these projections? What is the base-case NPV? What are the best-case and worst-case scenarios?

b. Evaluate the sensitivity of your base-case NPV to changes in fixed costs.

c. What is the cash break-even level of output for this project (ignoring taxes)?

d. What is the accounting break-even level of output for this project? What is the degree of operating leverage at the accounting break-even point? How do you interpret this number?

Intermediate (*continued*)

20. Project Analysis McGilla Golf has decided to sell a new line of golf clubs. The clubs will sell for $600 per set and have a variable cost of $240 per set. The company has spent $150,000 for a marketing study that determined the company will sell 50,000 sets per year for seven years. The marketing study also determined that the company will lose sales of 12,000 sets of its high-priced clubs. The high-priced clubs sell at $1,000 and have variable costs of $550. The company will also increase sales of its cheap clubs by 10,000 sets. The cheap clubs sell for $300 and have variable costs of $100 per set. The fixed costs each year will be $7,000,000. The company has also spent $1,000,000 on research and development for the new clubs. The plant and equipment required will cost $15,400,000 and will be depreciated on a straight-line basis. The new clubs will also require an increase in net working capital of $900,000 that will be returned at the end of the project. The tax rate is 40 percent, and the cost of capital is 14 percent. Calculate the payback period, the NPV, and the IRR.

21. Scenario Analysis In the previous problem, you feel that the values are accurate to within only ±10 percent. What are the best-case and worst-case NPVs? (Hint: The price and variable costs for the two existing sets of clubs are known with certainty; only the sales gained or lost are uncertain.)

22. Sensitivity Analysis McGilla Golf would like to know the sensitivity of NPV to changes in the price of the new clubs and the quantity of new clubs sold. What is the sensitivity of the NPV to each of these variables?

Challenge (Questions 23–28)

23. Break-Even and Taxes This problem concerns the effect of taxes on the various break-even measures.

a. Show that, when we consider taxes, the general relationship between operating cash flow, OCF, and sales volume, Q, can be written as:

$$Q = \frac{\text{FC} + \dfrac{\text{OCF} - T \times D}{1 - T}}{P - v}$$

b. Use the expression in part (*a*) to find the cash, accounting, and financial break-even points for the Wettway sailboat example in the chapter. Assume a 38 percent tax rate.

c. In part (*b*), the accounting break-even should be the same as before. Why? Verify this algebraically.

24. Operating Leverage and Taxes Show that if we consider the effect of taxes, the degree of operating leverage can be written as:

$$\text{DOL} = 1 + [\text{FC} \times (1 - T) - T \times D]/\text{OCF}$$

Notice that this reduces to our previous result if $T = 0$. Can you interpret this in words?

25. Scenario Analysis Consider a project to supply Detroit with 35,000 tons of machine screws annually for automobile production. You will need an initial $1,500,000 investment in threading equipment to get the project started; the project will last for five years. The accounting department estimates that annual fixed costs will be $300,000 and that variable costs should be $200 per ton; accounting will depreciate the initial fixed asset investment straight-line to zero over the five-year project life. It also estimates a salvage value of $500,000 after dismantling costs. The marketing department estimates that the automakers will let the contract at a selling price of $230 per ton. The engineering department estimates you

Challenge (*continued*)

will need an initial net working capital investment of $450,000. You require a 13 percent return and face a marginal tax rate of 38 percent on this project.

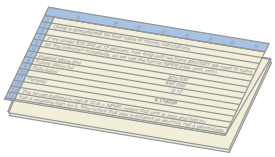
a. What is the estimated OCF for this project? The NPV? Should you pursue this project?

b. Suppose you believe that the accounting department's initial cost and salvage value projections are accurate only to within ±15 percent; the marketing department's price estimate is accurate only to within ±10 percent; and the engineering department's net working capital estimate is accurate only to within ±5 percent. What is your worst-case scenario for this project? Your best-case scenario? Do you still want to pursue the project?

26. Sensitivity Analysis In Problem 25, suppose you're confident about your own projections, but you're a little unsure about Detroit's actual machine screw requirement. What is the sensitivity of the project OCF to changes in the quantity supplied? What about the sensitivity of NPV to changes in quantity supplied? Given the sensitivity number you calculated, is there some minimum level of output below which you wouldn't want to operate? Why?

27. Break-Even Analysis Use the results of Problem 23 to find the accounting, cash, and financial break-even quantities for the company in Problem 25.

28. Operating Leverage Use the results of Problem 24 to find the degree of operating leverage for the company in Problem 25 at the base-case output level of 35,000 units. How does this number compare to the sensitivity figure you found in Problem 26? Verify that either approach will give you the same OCF figure at any new quantity level.



Spreadsheet Templates 11–5, 11–17, 11–25