For a more detailed treatment of the issues discussed in this chapter, see: E. Arzac and L. Glosten, "A Reconsideration of Tax Shield Valuation," *European Financial Management* 11 (2005): 453–461; R. Harris and J. Pringle, "Risk-Adjusted Discount Rates—Extensions from the Average-Risk Case," *Journal of Financial Research* 8 (1985): 237–244; I. Inselbag and H. Kaufold, "Two DCF Approaches in Valuing Companies Under Alternative Financing Strategies (and How to Choose Between Them)," *Journal of Applied Corporate Finance* 10 (1997): 114–122; T. Luehrman, "Using APV: A Better Tool for Valuing Operations," *Harvard Business Review* 75 (1997): 145–154; J. Miles and J. Ezzell, "The Weighted Average Cost of Capital, Perfect Capital Markets, and Project Life: A Clarification," *Journal of Financial and Quantitative Analysis* 15 (1980): 719–730; J. Miles and J. Ezzell, "Reformulation Tax Shield Valuation: A Note," *Journal of Finance* 40 (1985): 1485–1492; R. Ruback, "Capital Cash Flows: A Simple Approach to Valuing Risky Cash Flows," *Financial Management* 31 (2002): 85–104; and R. Taggart, "Consistent Valuation and Cost of Capital Expressions with Corporate and Personal Taxes," *Financial Management* 20 (1991): 8–20.

PROBLEMS

Problems in this chapter are available in myfinancelab. *An asterisk (*) indicates problems with a higher level of difficulty.*

Overview of Key Concepts

1. Explain whether each of the following projects is likely to have risk similar to the average risk of the firm.
   a. The Clorox Company considers launching a new version of Armor All designed to clean and protect notebook computers.
   b. Google, Inc., plans to purchase real estate to expand its headquarters.
   c. Target Corporation decides to expand the number of stores it has in the southeastern United States.
   d. GE decides to open a new Universal Studios theme park in China.
2. Suppose Caterpillar, Inc., has 665 million shares outstanding with a share price of $74.77, and $25 billion in debt. If in three years, Caterpillar has 700 million shares outstanding trading for $83 per share, how much debt will Caterpillar have if it maintains a constant debt-equity ratio?
3. In 2006, Intel Corporation had a market capitalization of $112 billion, debt of $2.2 billion, cash of $9.1 billion, and EBIT of more than $11 billion. If Intel were to increase its debt by $1 billion and use the cash for a share repurchase, which market imperfections would be most relevant for understanding the consequence for Intel's value? Why?

The Weighted Average Cost of Capital Method

4. Suppose Goodyear Tire and Rubber Company is considering divesting one of its manufacturing plants. The plant is expected to generate free cash flows of $1.5 million per year, growing at a rate of 2.5% per year. Goodyear has an equity cost of capital of 8.5%, a debt cost of capital of 7%, a marginal corporate tax rate of 35%, and a debt-equity ratio of 2.6. If the plant has average risk and Goodyear plans to maintain a constant debt-equity ratio, what after-tax amount must it receive for the plant for the divestiture to be profitable?
5. Suppose Lucent Technologies has an equity cost of capital of 10%, market capitalization of $10.8 billion, and an enterprise value of $14.4 billion. Suppose Lucent's debt cost of capital is 6.1% and its marginal tax rate is 35%.
   a. What is Lucent's WACC?
   b. If Lucent maintains a constant debt-equity ratio, what is the value of a project with average risk and the following expected free cash flows?

Year	0	1	2	3
FCF	−100	50	100	70

   c. If Lucent maintains its debt-equity ratio, what is the debt capacity of the project in part (b)?

6. Acort Industries has 10 million shares outstanding and a current share price of $40 per share. It also has long-term debt outstanding. This debt is risk free, is four years away from maturity, has annual coupons with a coupon rate of 10%, and has a $100 million face value. The first of the remaining coupon payments will be due in exactly one year. The riskless interest rates for all maturities are constant at 6%. Acort has EBIT of $106 million, which is expected to remain constant each year. New capital expenditures are expected to equal depreciation and equal $13 million per year, while no changes to net working capital are expected in the future. The corporate tax rate is 40%, and Acort is expected to keep its debt-equity ratio constant in the future (by either issuing additional new debt or buying back some debt as time goes on).
   a. Based on this information, estimate Acort's WACC.
   b. What is Acort's equity cost of capital?

The Adjusted Present Value Method

7. Suppose Goodyear Tire and Rubber Company has an equity cost of capital of 8.5%, a debt cost of capital of 7%, a marginal corporate tax rate of 35%, and a debt-equity ratio of 2.6. Suppose Goodyear maintains a constant debt-equity ratio.
   a. What is Goodyear's WACC?
   b. What is Goodyear's unlevered cost of capital?
   c. Explain, intuitively, why Goodyear's unlevered cost of capital is less than its equity cost of capital and higher than its WACC.

8. You are a consultant who was hired to evaluate a new product line for Markum Enterprises. The upfront investment required to launch the product line is $10 million. The product will generate free cash flow of $750,000 the first year, and this free cash flow is expected to grow at a rate of 4% per year. Markum has an equity cost of capital of 11.3%, a debt cost of capital of 5%, and a tax rate of 35%. Markum maintains a debt-equity ratio of 0.40.
   a. What is the NPV of the new product line (including any tax shields from leverage)?
   b. How much debt will Markum initially take on as a result of launching this product line?
   c. How much of the product line's value is attributable to the present value of interest tax shields?

9. Consider Lucent's project in Problem 5.
   a. What is Lucent's unlevered cost of capital?
   b. What is the unlevered value of the project?
   c. What are the interest tax shields from the project? What is their present value?
   d. Show that the APV of Lucent's project matches the value computed using the WACC method.

The Flow-to-Equity Method

10. Consider Lucent's project in Problem 5.
   a. What is the free cash flow to equity for this project?
   b. What is its NPV computed using the FTE method? How does it compare with the NPV based on the WACC method?

11. In year 1, AMC will earn $2000 before interest and taxes. The market expects these earnings to grow at a rate of 3% per year. The firm will make no net investments (i.e., capital expenditures will equal depreciation) or changes to net working capital. Assume that the corporate tax rate equals 40%. Right now, the firm has $5000 in risk-free debt. It plans to keep a constant ratio of debt to equity every year, so that on average the debt will also grow by 3% per year. Suppose the risk-free rate equals 5%, and the expected return on the market equals 11%. The asset beta for this industry is 1.11.
   a. If AMC were an all-equity (unlevered) firm, what would its market value be?
   b. Assuming the debt is fairly priced, what is the amount of interest AMC will pay next year? If AMC's debt is expected to grow by 3% per year, at what rate are its interest payments expected to grow?

c. Even though AMC's debt is *riskless* (the firm will not default), the future growth of AMC's debt is uncertain, so the exact amount of the future interest payments is risky. Assuming the future interest payments have the same beta as AMC's assets, what is the present value of AMC's interest tax shield?
d. Using the APV method, what is AMC's total market value, V^L? What is the market value of AMC's equity?
e. What is AMC's WACC? (*Hint*: Work backward from the FCF and V^L.)
f. Using the WACC method, what is the expected return for AMC equity?
g. Show that the following holds for AMC: $\beta_A = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D$.
h. Assuming that the proceeds from any increases in debt are paid out to equity holders, what cash flows do the equity holders expect to receive in one year? At what rate are those cash flows expected to grow? Use that information plus your answer to part (f) to derive the market value of equity using the FTE method. How does that compare to your answer in part (d)?

Project-Based Costs of Capital

12. Prokter and Gramble (PG) has historically maintained a debt-equity ratio of approximately 0.20. Its current stock price is \$50 per share, with 2.5 billion shares outstanding. The firm enjoys very stable demand for its products, and consequently it has a low equity beta of 0.50 and can borrow at 4.20%, just 20 basis points over the risk-free rate of 4%. The expected return of the market is 10%, and PG's tax rate is 35%.
a. This year, PG is expected to have free cash flows of \$6.0 billion. What constant expected growth rate of free cash flow is consistent with its current stock price?
b. PG believes it can increase debt without any serious risk of distress or other costs. With a higher debt-equity ratio of 0.50, it believes its borrowing costs will rise only slightly to 4.50%. If PG announces that it will raise its debt-equity ratio to 0.5 through a leveraged recap, determine the increase in the stock price that would result from the anticipated tax savings.

13. Amarindo, Inc. (AMR), is a newly public firm with 10 million shares outstanding. You are doing a valuation analysis of AMR. You estimate its free cash flow in the coming year to be \$15 million, and you expect the firm's free cash flows to grow by 4% per year in subsequent years. Because the firm has only been listed on the stock exchange for a short time, you do not have an accurate assessment of AMR's equity beta. However, you do have beta data for UAL, another firm in the same industry:

	Equity Beta	Debt Beta	Debt-Equity Ratio
UAL	1.5	0.30	1

AMR has a much lower debt-equity ratio of 0.30, which is expected to remain stable, and its debt is risk free. AMR's corporate tax rate is 40%, the risk-free rate is 5%, and the expected return on the market portfolio is 11%.
a. Estimate AMR's equity cost of capital.
b. Estimate AMR's share price.

14. Remex (RMX) currently has no debt in its capital structure. The beta of its equity is 1.50. For each year into the indefinite future, Remex's free cash flow is expected to equal \$25 million. Remex is considering changing its capital structure by issuing debt and using the proceeds to buy back stock. It will do so in such a way that it will have a 30% debt-equity ratio after the change, and it will maintain this debt-equity ratio forever. Assume that Remex's debt cost of capital will be 6.5%. Remex faces a corporate tax rate of 35%. Except for the corporate tax rate of 35%, there are no market imperfections. Assume that the CAPM holds, the risk-free rate of interest is 5%, and the expected return on the market is 11%.

a. Using the information provided, complete the following table:

	Debt-Equity Ratio	Debt Cost of Capital	Equity Cost of Capital	Weighted Average Cost of Capital
Before change in capital structure	0	N/A		
After change in capital structure	0.30	6.5%		

b. Using the information provided and your calculations in part (a), determine the value of the tax shield acquired by Remex if it changes its capital structure in the way it is considering.

APV with Other Leverage Policies

15. You are evaluating a project that requires an investment of $90 today and provides a single cash flow of $115 for sure one year from now. You decide to use 100% debt financing, that is, you will borrow $90. The risk-free rate is 5% and the tax rate is 40%. Assume that the investment is fully depreciated at the end of the year, so without leverage you would owe taxes on the difference between the project cash flow and the investment, that is, $15.
   a. Calculate the NPV of this investment opportunity using the APV method.
   b. Using your answer to part (a), calculate the WACC of the project.
   c. Verify that you get the same answer using the WACC method to calculate NPV.
   d. Finally, show that flow-to-equity also correctly gives the NPV of this investment opportunity.

16. Tybo Corporation adjusts its debt so that its interest expenses are 20% of its free cash flow. Tybo is considering an expansion that will generate free cash flows of $2.5 million this year and is expected to grow at a rate of 4% per year from then on. Suppose Tybo's marginal corporate tax rate is 40%.
   a. If the unlevered cost of capital for this expansion is 10%, what is its unlevered value?
   b. What is the levered value of the expansion?
   c. If Tybo pays 5% interest on its debt, what amount of debt will it take on initially for the expansion?
   d. What is the debt-to-value ratio for this expansion? What is its WACC?
   e. What is the levered value of the expansion using the WACC method?

17. You are on your way to an important budget meeting. In the elevator, you review the project valuation analysis you had your summer associate prepare for one of the projects to be discussed:

	0	1	2	3	4
EBIT		10.0	10.0	10.0	10.0
Interest (5%)		–4.0	–4.0	–3.0	–2.0
Earnings Before Taxes		6.0	6.0	7.0	8.0
Taxes		–2.4	–2.4	–2.8	–3.2
Depreciation		25.0	25.0	25.0	25.0
Cap Ex	–100.0				
Additions to NWC	–20.0				20.0
Net New Debt	80.0	0.0	–20.0	–20.0	–40.0
FCFE	–40.0	28.6	8.6	9.2	9.8
NPV at 11% Equity Cost of Capital	5.9				

Looking over the spreadsheet, you realize that while all of the cash flow estimates are correct, your associate used the flow-to-equity valuation method and discounted the cash flows using

the *company's* equity cost of capital of 11%. However, the project's incremental leverage is very different from the company's historical debt-equity ratio of 0.20: For this project, the company will instead borrow $80 million upfront and repay $20 million in year 2, $20 million in year 3, and $40 million in year 4. Thus, the *project's* equity cost of capital is likely to be higher than the firm's, not constant over time—invalidating your associate's calculation.

Clearly, the FTE approach is not the best way to analyze this project. Fortunately, you have your calculator with you, and with any luck you can use a better method before the meeting starts.

a. What is the present value of the interest tax shield associated with this project?
b. What are the free cash flows of the project?
c. What is the best estimate of the project's value from the information given?

18. Your firm is considering building a $600 million plant to manufacture HDTV circuitry. You expect operating profits (EBITDA) of $145 million per year for the next 10 years. The plant will be depreciated on a straight-line basis over 10 years (assuming no salvage value for tax purposes). After 10 years, the plant will have a salvage value of $300 million (which, since it will be fully depreciated, is then taxable). The project requires $50 million in working capital at the start, which will be recovered in year 10 when the project shuts down. The corporate tax rate is 35%. All cash flows occur at the end of the year.

a. If the risk-free rate is 5%, the expected return of the market is 11%, and the asset beta for the consumer electronics industry is 1.67, what is the NPV of the project?
b. Suppose that you can finance $400 million of the cost of the plant using 10-year, 9% coupon bonds sold at par. This amount is incremental new debt associated specifically with this project and will not alter other aspects of the firm's capital structure. What is the value of the project, including the tax shield of the debt?

Other Effects of Financing

19. DFS Corporation is currently an all-equity firm, with assets with a market value of $100 million and 4 million shares outstanding. DFS is considering a leveraged recapitalization to boost its share price. The firm plans to raise a fixed amount of permanent debt (i.e., the outstanding principal will remain constant) and use the proceeds to repurchase shares. DFS pays a 35% corporate tax rate, so one motivation for taking on the debt is to reduce the firm's tax liability. However, the upfront investment banking fees associated with the recapitalization will be 5% of the amount of debt raised. Adding leverage will also create the possibility of future financial distress or agency costs; shown below are DFS's estimates for different levels of debt:

Debt amount ($ million):	0	10	20	30	40	50
Present value of expected distress and agency costs ($ million):	0.0	−0.3	−1.8	−4.3	−7.5	−11.3

a. Based on this information, which level of debt is the best choice for DFS?
b. Estimate the stock price once this transaction is announced.

20. Your firm is considering a $150 million investment to launch a new product line. The project is expected to generate a free cash flow of $20 million per year, and its unlevered cost of capital is 10%. To fund the investment, your firm will take on $100 million in permanent debt.

a. Suppose the marginal corporate tax rate is 35%. Ignoring issuance costs, what is the NPV of the investment?
b. Suppose your firm will pay a 2% underwriting fee when issuing the debt. It will raise the remaining $50 million by issuing equity. In addition to the 5% underwriting fee for the equity issue, you believe that your firm's current share price of $40 is $5 per share less than its true value. What is the NPV of the investment including any tax benefits of leverage? (Assume all fees are on an after-tax basis.)

21. Consider Avco's RFX project from Section 18.3. Suppose that Avco is receiving government loan guarantees that allow it to borrow at the 6% rate. Without these guarantees, Avco would pay 6.5% on its debt.
   a. What is Avco's unlevered cost of capital given its true debt cost of capital of 6.5%?
   b. What is the unlevered value of the RFX project in this case? What is the present value of the interest tax shield?
   c. What is the NPV of the loan guarantees? (*Hint*: Because the actual loan amounts will fluctuate with the value of the project, discount the expected interest savings at the unlevered cost of capital.)
   d. What is the levered value of the RFX project, including the interest tax shield and the NPV of the loan guarantees?

Advanced Topics in Capital Budgeting

22. Arden Corporation is considering an investment in a new project with an unlevered cost of capital of 9%. Arden's marginal corporate tax rate is 40%, and its debt cost of capital is 5%.
   a. Suppose Arden adjusts its debt continuously to maintain a constant debt-equity ratio of 50%. What is the appropriate WACC for the new project?
   b. Suppose Arden adjusts its debt once per year to maintain a constant debt-equity ratio of 50%. What is the appropriate WACC for the new project now?
   c. Suppose the project has free cash flows of $10 million per year, which are expected to decline by 2% per year. What is the value of the project in parts (a) and (b) now?

23. XL Sports is expected to generate free cash flows of $10.9 million per year. XL has permanent debt of $40 million, a tax rate of 40%, and an unlevered cost of capital of 10%.
   a. What is the value of XL's equity using the APV method?
   b. What is XL's WACC? What is XL's equity value using the WACC method?
   c. If XL's debt cost of capital is 5%, what is XL's equity cost of capital?
   d. What is XL's equity value using the FTE method?

***24.** Propel Corporation plans to make a $50 million investment, initially funded completely with debt. The free cash flows of the investment and Propel's incremental debt from the project follow:

Year	0	1	2	3
Free cash flows	–50	40	20	25
Debt	50	30	15	0

Propel's incremental debt for the project will be paid off according to the predetermined schedule shown. Propel's debt cost of capital is 8%, and its tax rate is 40%. Propel also estimates an unlevered cost of capital for the project of 12%.
   a. Use the APV method to determine the levered value of the project at each date and its initial NPV.
   b. Calculate the WACC for this project at each date. How does the WACC change over time? Why?
   c. Compute the project's NPV using the WACC method.
   d. Compute the equity cost of capital for this project at each date. How does the equity cost of capital change over time? Why?
   e. Compute the project's equity value using the FTE method. How does the initial equity value compare with the NPV calculated in parts (a) and (c)?

***25.** Gartner Systems has no debt and an equity cost of capital of 10%. Gartner's current market capitalization is $100 million, and its free cash flows are expected to grow at 3% per year. Gartner's corporate tax rate is 35%. Investors pay tax rates of 40% on interest income and 20% on equity income.

a. Suppose Gartner adds $50 million in permanent debt and uses the proceeds to repurchase shares. What will Gartner's levered value be in this case?
b. Suppose instead Gartner decides to maintain a 50% debt-to-value ratio going forward. If Gartner's debt cost of capital is 6.67%, what will Gartner's levered value be in this case?

*26. Revtek, Inc., has an equity cost of capital of 12% and a debt cost of capital of 6%. Revtek maintains a constant debt-equity ratio of 0.5, and its tax rate is 35%.
a. What is Revtek's WACC given its current debt-equity ratio?
b. Assuming no personal taxes, how will Revtek's WACC change if it increases its debt-equity ratio to 2 and its debt cost of capital remains at 6%?
c. Now suppose investors pay tax rates of 40% on interest income and 15% on income from equity. How will Revtek's WACC change if it increases its debt-equity ratio to 2 in this case?
d. Provide an intuitive explanation for the difference in your answers to parts (b) and (c).

DATA CASE

Toyota Motor Company is expanding the production of their gas-electric hybrid drive systems and plans to begin production in the United States. To enable the expansion they are contemplating investing $1.5 billion in a new plant with an expected 10-year life. The anticipated free cash flows from the new plant would be $220 million the first year of operation and grow by 10% for each of the next two years and then 5% per year for the remaining seven years. As a newly hired MBA in the capital budgeting division you have been asked to evaluate the new project using the WACC, Adjusted Present Value, and Flow-to-Equity methods. You will compute the appropriate costs of capital and the net present values with each method. Because this is your first major assignment with the firm, they want you to demonstrate that you are capable of handling the different valuation methods. You must seek out the information necessary to value the free cash flows but will be provided some directions to follow. (This is an involved assignment, but at least you don't have to come up with the actual cash flows for the project!)

1. Go to MarketWatch.com (www.marketwatch.com) and get the quote for Toyota (symbol: TM).
   a. Click "Financials." The income statements for the last four fiscal years will appear. Place the cursor in the middle of the statements and right-click the mouse. Select "Export to Microsoft Excel."
   b. Go back to the Web page and select "Balance Sheets" from the top of the page. Repeat the download procedure for the balance sheets, then copy and paste them into the same worksheet as the income statements.
   c. Click "Historical Quote" in the left column, and find Toyota's stock price for the last day of the month at the end of each of the past four fiscal years. Record the stock price on each date in your spreadsheet.
2. Create a timeline in Excel with the free cash flows for the 10 years of the project.
3. Determine the WACC using Eq. 18.1.
   a. For the cost of debt, r_D:
      i. Go to NasdBondInfo.com (http://cxa.marketwatch.com/finra/BondCenter/Default.aspx) and click to search by symbol. Enter Toyota's symbol, select the Corporate toggle, and press "Enter."
      ii. Look at the average credit rating for Toyota long-term bonds. If you find that they have very high ratings, then you can make the approximation that the cost of debt is the risk-free rate. If Toyota's credit rating has slipped, use Table 12.3 to estimate the beta of debt from the credit rating.
   b. For the cost of equity, r_E:
      i. Get the yield on the 10-year U.S. Treasury Bond from Yahoo! Finance (http://finance.yahoo.com). Scroll down to the Market Summary. Enter that yield as the risk-free rate.
      ii. Find the beta for Toyota from Nasdaq.com. Enter the symbol for Toyota and click "Summary Quote." The beta for Toyota will be listed there.

iii. Use a market risk premium of 4.50% to compute r_E using the CAPM. If you need to, repeat the exercise to compute r_D.

c. Determine the values for E and D from Eq. 18.1 for Toyota and the debt-to-value and equity-to-value ratios.
   i. To compute the net debt for Toyota, add the long-term debt and the short-term debt and subtract cash and cash equivalents for each year on the balance sheet.
   ii. Multiply the historical stock prices by the "Basic Weighted Shares Outstanding" data in the income statement to compute Toyota's market capitalization at the end of each fiscal year.
   iii. Compute Toyota's enterprise value at the end of each fiscal year by combining the values obtained for its equity market capitalization and its net debt.
   iv. Compute Toyota's debt-to-value ratio at the end of each year by dividing its net debt by its enterprise value. Use the average ratio from the last four years as an estimate for Toyota's target debt-to-value ratio.

d. Determine Toyota's tax rate by dividing the income tax by earnings before tax for each year. Take the average of the four rates as Toyota's marginal corporate tax rate.

e. Compute the WACC for Toyota using Eq. 18.1.

4. Compute the NPV of the hybrid engine expansion given the free cash flows you calculated using the WACC method of valuation.

5. Determine the NPV using the Adjusted Present Value Method, and also using the Flow-to-Equity method. In both cases, assume Toyota maintains the target leverage ratio you computed in Question 3(c).

6. Compare the results under the three methods and explain how the resulting NPVs are achieved under each of the three different methods.