

# Chapter 1

## An Overview of Corporate Finance and The Financial Environment

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 1-1
- a. A proprietorship, or sole proprietorship, is a business owned by one individual. A partnership exists when two or more persons associate to conduct a business. In contrast, a corporation is a legal entity created by a state. The corporation is separate and distinct from its owners and managers.
  - b. In a limited partnership, limited partners' liabilities, investment returns and control are limited, while general partners have unlimited liability and control. A limited liability partnership (LLP), sometimes called a limited liability company (LLC), combines the limited liability advantage of a corporation with the tax advantages of a partnership. A professional corporation (PC), known in some states as a professional association (PA), has most of the benefits of incorporation but the participants are not relieved of professional (malpractice) liability.
  - c. Stockholder wealth maximization is the appropriate goal for management decisions. The risk and timing associated with expected earnings per share and cash flows are considered in order to maximize the price of the firm's common stock.
  - d. A money market is a financial market for debt securities with maturities of less than one year (short-term). The New York money market is the world's largest. Capital markets are the financial markets for long-term debt and corporate stocks. The New York Stock Exchange is an example of a capital market. Primary markets are the markets in which newly issued securities are sold for the first time. Secondary markets are where securities are resold after initial issue in the primary market. The New York Stock Exchange is a secondary market.

- e. In private markets, transactions are worked out directly between two parties and structured in any manner that appeals to them. Bank loans and private placements of debt with insurance companies are examples of private market transactions. In public markets, standardized contracts are traded on organized exchanges. Securities that are issued in public markets, such as common stock and corporate bonds, are ultimately held by a large number of individuals. Private market securities are more tailor-made but less liquid, whereas public market securities are more liquid but subject to greater standardization. Derivatives are claims whose value depends on what happens to the value of some other asset. Futures and options are two important types of derivatives, and their values depend on what happens to the prices of other assets, say IBM stock, Japanese yen, or pork bellies. Therefore, the value of a derivative security is derived from the value of an underlying real asset.
- f. An investment banker is a middleman between businesses and savers. Investment banking houses assist in the design of corporate securities and then sell them to savers (investors) in the primary markets. Financial service corporations offer a wide range of financial services such as brokerage operations, insurance, and commercial banking. A financial intermediary buys securities with funds that it obtains by issuing its own securities. An example is a common stock mutual fund that buys common stocks with funds obtained by issuing shares in the mutual fund.
- g. A mutual fund is a corporation that sells shares in the fund and uses the proceeds to buy stocks, long-term bonds, or short-term debt instruments. The resulting dividends, interest, and capital gains are distributed to the fund's shareholders after the deduction of operating expenses. Different funds are designed to meet different objectives. Money market funds are mutual funds which invest in short-term debt instruments and offer their shareholders check writing privileges; thus, they are essentially interest-bearing checking accounts.
- h. Physical location exchanges, such as the New York Stock Exchange, facilitate communication between buyers and sellers of securities. Each physical location exchange is a physical entity at a particular location and is governed by an elected board of governors. A computer/telephone network, such as Nasdaq, consists of all the facilities that provide for security transactions not conducted at a physical location exchange. These facilities are, basically, the communications network that links the buyers and sellers.
- i. An open outcry auction is a method of matching buyers and sellers. In an auction, the buyers and sellers are face-to-face, with each stating the prices and which they will buy or sell. In a dealer market, a dealer holds an inventory of the security and makes a market by offering to buy or sell. Others who wish to buy or sell can see

the offers made by the dealers, and can contact the dealer of their choice to arrange a transaction. In an ECN, orders from potential buyers and sellers are automatically matched, and the transaction is automatically completed.

- j. Production opportunities are the returns available within an economy from investment in productive assets. The higher the production opportunities, the more producers would be willing to pay for required capital. Consumption time preferences refer to the preferred pattern of consumption. Consumer's time preferences for consumption establish how much consumption they are willing to defer, and hence save, at different levels of interest.
- k. The real risk-free rate is that interest rate which equalizes the aggregate supply of, and demand for, riskless securities in an economy with zero inflation. The real risk-free rate could also be called the pure rate of interest since it is the rate of interest that would exist on very short-term, default-free U.S. Treasury securities if the expected rate of inflation were zero. It has been estimated that this rate of interest, denoted by  $r^*$ , has fluctuated in recent years in the United States in the range of 2 to 4 percent. The nominal risk-free rate of interest, denoted by  $r_{RF}$ , is the real risk-free rate plus a premium for expected inflation. The short-term nominal risk-free rate is usually approximated by the U.S. Treasury bill rate, while the long-term nominal risk-free rate is approximated by the rate on U.S. Treasury bonds. Note that while T-bonds are free of default and liquidity risks, they are subject to risks due to changes in the general level of interest rates.
- l. The inflation premium is the premium added to the real risk-free rate of interest to compensate for the expected loss of purchasing power. The inflation premium is the average rate of inflation expected over the life of the security. Default risk is the risk that a borrower will not pay the interest and/or principal on a loan as they become due. Thus, a default risk premium (DRP) is added to the real risk-free rate to compensate investors for bearing default risk. Liquidity refers to a firm's cash and marketable securities position, and to its ability to meet maturing obligations. A liquid asset is any asset that can be quickly sold and converted to cash at its "fair" value. Active markets provide liquidity. A liquidity premium is added to the real risk-free rate of interest, in addition to other premiums, if a security is not liquid.
- m. Interest rate risk arises from the fact that bond prices decline when interest rates rise. Under these circumstances, selling a bond prior to maturity will result in a capital loss, and the longer the term to maturity, the larger the loss. Thus, a maturity risk premium must be added to the real risk-free rate of interest to compensate for interest rate risk. Reinvestment rate risk occurs when a short-term debt security must be "rolled over." If interest rates have fallen, the reinvestment of principal will be at a lower rate, with correspondingly lower interest payments and ending value. Note that long-term debt securities also have some reinvestment rate risk because their interest payments have to be reinvested at prevailing rates.

- n. The term structure of interest rates is the relationship between yield to maturity and term to maturity for bonds of a single risk class. The yield curve is the curve that results when yield to maturity is plotted on the Y-axis with term to maturity on the X-axis.
  - o. When the yield curve slopes upward, it is said to be “normal,” because it is like this most of the time. Conversely, a downward-sloping yield curve is termed “abnormal” or “inverted.”
  - p. The expectations theory states that the slope of the yield curve depends on expectations about future inflation rates and interest rates. Thus, if the annual rate of inflation and future interest rates are expected to increase, the yield curve will be upward sloping, whereas the curve will be downward sloping if the annual rates are expected to decrease.
  - r. A foreign trade deficit occurs when businesses and individuals in the U. S. import more goods from foreign countries than are exported. Trade deficits must be financed, and the main source of financing is debt. Therefore, as the trade deficit increases, the debt financing increases, driving up interest rates. U. S. interest rates must be competitive with foreign interest rates; if the Federal Reserve attempts to set interest rates lower than foreign rates, foreigners will sell U.S. bonds, decreasing bond prices, resulting in higher U. S. rates. Thus, if the trade deficit is large relative to the size of the overall economy, it may hinder the Fed’s ability to combat a recession by lowering interest rates.
- 1-2 Sole proprietorship, partnership, and corporation are the three principal forms of business organization. The advantages of the first two include the ease and low cost of formation. The advantages of the corporation include limited liability, indefinite life, ease of ownership transfer, and access to capital markets.
- The disadvantages of a sole proprietorship are (1) difficulty in obtaining large sums of capital; (2) unlimited personal liability for business debts; and (3) limited life. The disadvantages of a partnership are (1) unlimited liability, (2) limited life, (3) difficulty of transferring ownership, and (4) difficulty of raising large amounts of capital. The disadvantages of a corporation are (1) double taxation of earnings and (2) requirements to file state and federal reports for registration, which are expensive, complex and time-consuming.
- 1-3 The three primary determinants of a firm’s cash flows are: (1) sales revenues; (2) operating expenses, such as raw materials costs and labor costs; and (3) the necessary investments in operating capital, such as buildings, equipment, and inventory.
- 1-4 Financial intermediaries are business organizations that receive funds in one form and repackage them for the use of those who need funds. Through financial intermediation,

resources are allocated more effectively, and the real output of the economy is thereby increased.

- 1-5 Short-term rates are more volatile because (1) the Fed operates mainly in the short-term sector, hence Federal Reserve intervention has its major effect here, and (2) long-term rates reflect the average expected inflation rate over the next 20 to 30 years, and this average does not change as radically as year-to-year expectations.
- 1-6 a. If transfers between the two markets were costly, interest rates would be different in the two areas. Area Y, with the relatively young population, would have less in savings accumulation and stronger loan demand. Area O, with the relatively old population, would have more savings accumulation and weaker loan demand as the members of the older population have already purchased their houses, and are less consumption oriented. Thus, supply/demand equilibrium would be at a higher rate of interest in Area Y.
- b. Yes. Nationwide branching, and so forth, would reduce the cost of financial transfers between the areas. Thus, funds would flow from Area O with excess relative supply to Area Y with excess relative demand. This flow would increase the interest rate in Area O and decrease the interest rate in Y until the rates were roughly equal, the difference being the transfer cost.
- 1-7 a. The immediate effect on the yield curve would be to lower interest rates in the short-term end of the market, since the Fed deals primarily in that market segment. However, people would expect higher future inflation, which would raise long-term rates. The result would be a much steeper yield curve.
- b. If the policy is maintained, the expanded money supply will result in increased rates of inflation and increased inflationary expectations. This will cause investors to increase the inflation premium on all debt securities, and the entire yield curve would rise; that is, all rates would be higher.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

1-1  $r^* = 3\%$ ;  $I_1 = 2\%$ ;  $I_2 = 4\%$ ;  $I_3 = 4\%$ ;  $MRP = 0$ ;  $r_{T-2} = ?$ ;  $r_{T-3} = ?$

$$r = r^* + IP + DRP + LP + MRP.$$

Since these are Treasury securities,  $DRP = LP = 0$ .

$$r_{T-2} = r^* + IP_2$$

$$IP_2 = (2\% + 4\%)/2 = 3\%$$

$$r_{T-2} = 3\% + 3\% = 6\%.$$

$$r_{T-3} = r^* + IP_3$$

$$IP_3 = (2\% + 4\% + 4\%)/3 = 3.33\%$$

$$r_{T-3} = 3\% + 3.33\% = 6.33\%.$$

1-2  $r_{T-10} = 6\%$ ;  $r_{C-10} = 8\%$ ;  $LP = 0.5\%$ ;  $DRP = ?$

$$r = r^* + IP + DRP + LP + MRP.$$

$$r_{T-10} = 6\% = r^* + IP + MRP; DRP = LP = 0.$$

$$r_{C-10} = 8\% = r^* + IP + DRP + 0.5\% + MRP.$$

Because both bonds are 10-year bonds the inflation premium and maturity risk premium on both bonds are equal. The only difference between them is the liquidity and default risk premiums.

$r_{C-10} = 8\% = r^* + IP + MRP + 0.5\% + DRP$ . But we know from above that  $r^* + IP + MRP = 6\%$ ; therefore,

$$r_{C-10} = 8\% = 6\% + 0.5\% + DRP$$

$$1.5\% = DRP.$$

1-3  $r^* = 3\%$ ;  $IP = 3\%$ ;  $r_{T-2} = 6.2\%$ ;  $MRP_2 = ?$

$$r_{T-2} = r^* + IP + MRP = 6.2\%$$

$$r_{T-2} = 3\% + 3\% + MRP = 6.2\%$$

$$MRP = 0.2\%.$$

1-4  $r = r^* + IP + MRP + DRP + LP.$   
 $r^* = 0.03.$   
 $IP = [0.03 + 0.04 + (5)(0.035)]/7 = 0.035.$   
 $MRP = 0.0005(6) = 0.003.$   
 $DRP = 0.$   
 $LP = 0.$

$$r = 0.03 + 0.035 + 0.003 = 0.068 = 6.8\%.$$

1-5 First, note that we will use the equation  $r_t = 3\% + IP_t + MRP_t.$  We have the data needed to find the IPs:

$$IP_5 = \frac{8\% + 5\% + 4\% + 4\% + 4\%}{5} = \frac{25\%}{5} = 5\%.$$

$$IP_2 = \frac{8\% + 5\%}{2} = 6.5\%.$$

Now we can substitute into the equation:

$$r_2 = 3\% + 6.5\% + MRP_2 = 10\%. \quad r_5 = 3\% + 5\% + MRP_5 = 10\%.$$

Now we can solve for the MRPs, and find the difference:

$$MRP_5 = 10\% - 8\% = 2\%. \quad MRP_2 = 10\% - 9.5\% = 0.5\%.$$

$$\text{Difference} = (2\% - 0.5\%) = 1.5\%.$$

1-6 Basic relevant equations:

$$r_t = r^* + IP_t + DRP_t + MRP_t + LP_t.$$

But here IP is the only premium, so  $r_t = r^* + IP_t$ .

$$IP_t = \text{Avg. inflation} = (I_1 + I_2 + \dots)/N.$$

We know that  $I_1 = IP_1 = 3\%$  and  $r^* = 2\%$ . Therefore,

$$r_1 = 2\% + 3\% = 5\%. \quad r_3 = r_1 + 2\% = 5\% + 2\% = 7\%. \quad \text{But,}$$

$$r_3 = r^* + IP_3 = 2\% + IP_3 = 7\%, \text{ so}$$

$$IP_3 = 7\% - 2\% = 5\%.$$

We also know that  $I_t = \text{Constant}$  after  $t = 1$ .

We can set up this table:

	<u><math>r^*</math></u>	<u><math>I</math></u>	<u>Avg. <math>I = IP_t</math></u>	<u><math>r = r^* + IP_t</math></u>
1	2	3	$3\%/1 = 3\%$	5%
2	2	I	$(3\% + I)/2 = IP_2$	
3	2	I	$(3\% + I + I)/3 = IP_3$	$r_3 = 7\%$ , so $IP_3 = 7\% - 2\% = 5\%$ .

$$\text{Avg. } I = IP_3 = (3\% + 2I)/3 = 5\%$$

$$2I = 12\%$$

$$I = 6\%.$$

1-7	a.	Real Risk-Free	IP**	MRP	$r_T = r^* + IP + MRP$	
	Years to Maturity	Rate (r*)				
	1	2%		7.00%	0.2%	9.20%
	2	2			6.00	0.4
8.40	3	2			5.00	0.6
7.60	4	2			4.50	0.8
7.30	5	2			4.20	1.0
7.20	10	2			3.60	1.0
6.60	20	2			3.30	1.0
6.30						

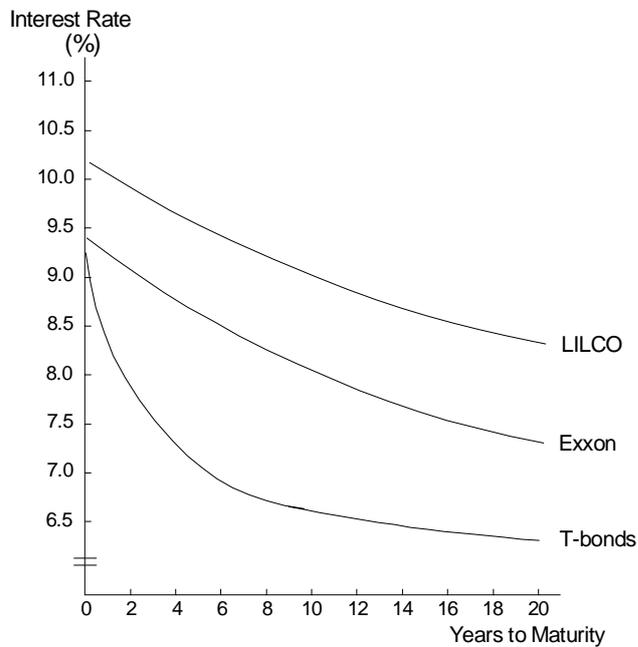
\*\*The computation of the inflation premium is as follows:

Year	Expected Inflation	Average Expected Inflation
1	7%	7.00%
2	5	6.00
3	3	5.00
4	3	4.50
5	3	4.20
10	3	3.60
20	3	3.30

For example, the calculation for 3 years is as follows:

$$\frac{7\% + 5\% + 3\%}{3} = 5.00\%$$

Thus, the yield curve would be as follows:



- b. The interest rate on the Exxon bonds has the same components as the Treasury securities, except that the Exxon bonds have default risk, so a default risk premium must be included. Therefore,

$$r_{\text{Exxon}} = r^* + \text{IP} + \text{MRP} + \text{DRP}.$$

For a strong company such as Exxon, the default risk premium is virtually zero for short-term bonds. However, as time to maturity increases, the probability of default, although still small, is sufficient to warrant a default premium. Thus, the yield risk curve for the Exxon bonds will rise above the yield curve for the Treasury securities. In the graph, the default risk premium was assumed to be 1.0 percentage point on the 20-year Exxon bonds. The return should equal  $6.3\% + 1\% = 7.3\%$ .

- c. LILCO bonds would have significantly more default risk than either Treasury securities or Exxon bonds, and the risk of default would increase over time due to possible financial deterioration. In this example, the default risk premium was assumed to be 1.0 percentage point on the 1-year LILCO bonds and 2.0 percentage points on the 20-year bonds. The 20-year return should equal  $6.3\% + 2\% = 8.3\%$ .

## SOLUTION TO SPREADSHEET PROBLEM

---

- 1-8 The detailed solution for the spreadsheet problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 01 P08 Build a Model.xls*) and on the instructor's side of the textbook's web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**Assume that you recently graduated with a degree in finance and have just reported to work as an investment advisor at the brokerage firm of Balik and Kiefer Inc. One of the firm's clients is Michelle Dellatorre, a professional tennis player who has just come to the United States from Chile. Dellatorre is a highly ranked tennis player who would like to start a company to produce and market apparel that she designs. She also expects to invest substantial amounts of money through Balik and Kiefer. Dellatorre is also very bright, and, therefore, she would like to understand, in general terms, what will happen to her money. Your boss has developed the following set of questions which you must ask and answer to explain the U.S. financial system to Dellatorre.**

**a. Why is corporate finance important to all managers?**

**Answer:** Corporate finance provides the skills managers need to: (1) identify and select the corporate strategies and individual projects that add value to their firm; and (2) forecast the funding requirements of their company, and devise strategies for acquiring those funds.

**b. Describe the organizational forms a company might have as it evolves from a start-up to a major corporation. List the advantages and disadvantages of each form.**

**Answer:** The three main forms of business organization are (1) sole proprietorships, (2) partnerships, and (3) corporations. In addition, several hybrid forms are gaining popularity. These hybrid forms are the limited partnership, the limited liability partnership, the professional corporation, and the S corporation.

The proprietorship has three important advantages: (1) it is easily and inexpensively formed, (2) it is subject to few government regulations, and (3) the business pays no corporate income taxes. The proprietorship also has three important limitations: (1) it is difficult for a proprietorship to obtain large sums of capital; (2) the proprietor has unlimited personal liability for the business's debts, and (3) the life of a business organized as a proprietorship is limited to the life of the individual who created it.

The major advantage of a partnership is its low cost and ease of formation. The disadvantages are similar to those associated with proprietorships: (1) unlimited liability, (2) limited life of the organization, (3) difficulty of transferring ownership, and (4) difficulty of raising large amounts of capital. The tax treatment of a partnership is similar to that for proprietorships, which is often an advantage.

The corporate form of business has three major advantages: (1) unlimited life, (2) easy transferability of ownership interest, and (3) limited liability. While the corporate form offers significant advantages over proprietorships and partnerships, it does have two primary disadvantages: (1) corporate earnings may be subject to double taxation and (2) setting up a corporation and filing the many required state and federal reports is more complex and time-consuming than for a proprietorship or a partnership.

In a limited partnership, the limited partners are liable only for the amount of their investment in the partnership; however, the limited partners typically have no control. The limited liability partnership form of organization combines the limited liability advantage of a corporation with the tax advantages of a partnership. Professional corporations provide most of the benefits of incorporation but do not relieve the participants of professional liability. S corporations are similar in many ways to limited liability partnerships, but LLPS frequently offer more flexibility and benefits to their owners.

**c. How do corporations “go public” and continue to grow? What are agency problems?**

**Answer:** A company goes public when it sells stock to the public in an initial public offering as the firm grows, it might issue additional stock or debt. An agency problem occurs when the managers of the firm act in their own self interests and not in the interests of the shareholders.

**d. What should be the primary objective of managers?**

**Answer:** The corporation’s primary goal is stockholder wealth maximization, which translates to maximizing the price of the firm’s common stock.

**d. 1. Do firms have any responsibilities to society at large?**

**Answer:** Firms have an ethical responsibility to provide a safe working environment, to avoid polluting the air or water, and to produce safe products. However, the most significant cost-increasing actions will have to be put on a mandatory rather than a voluntary basis to ensure that the burden falls uniformly on all businesses.

**d. 2. Is stock price maximization good or bad for society?**

**Answer:** The same actions that maximize stock prices also benefit society. Stock price maximization requires efficient, low-cost operations that produce high-quality goods and services at the lowest possible cost. Stock price maximization requires the development of products and services that consumers want and need, so the profit motive leads to new technology, to new products, and to new jobs. Also, stock price maximization necessitates efficient and courteous service, adequate stocks of merchandise, and well-located business establishments--factors that are all necessary to make sales, which are necessary for profits.

**d. 3. Should firms behave ethically?**

**Answer:** Yes. Results of a recent study indicate that the executives of most major firms in the United States believe that firms do try to maintain high ethical standards in all of their business dealings. Furthermore, most executives believe that there is a positive correlation between ethics and long-run profitability. Conflicts often arise between profits and ethics. Companies must deal with these conflicts on a regular basis, and a failure to handle the situation properly can lead to

huge product liability suits and even to bankruptcy. There is no room for unethical behavior in the business world.

**e. What three aspects of cash flows affect the value of any investment?**

**Answer:** (1) amount of expected cash flows; (2) timing of the cash flow stream; and (3) riskiness of the cash flows.

**f. What are free cash flows? What are the three determinants of free cash flows?**

**Answer:** free cash flows are the cash flows available for distribution to all investors (stockholders and creditors) after paying expenses (including taxes) and making the necessary investments to support growth. Three factors determine cash flows: (1) current level and growth rates of sales; (2) operating expenses; and (3) capital expenses.

**g. What is the weighted average cost of capital? What affects it?**

**Answer:** The weighted average cost of capital (WACC) is the average rate of return required by all of the company's investors (stockholders and creditors). It is affected by the firm's capital structure, interest rates, the firm's risk, and the market's overall attitude toward risk.

**h. How do free cash flows and the weighted average cost of capital interact to determine a firm's value?**

**Answer:** A firm's value is the sum of all future expected free cash flows, converted into today's dollars.

$$\text{Value} = \frac{\text{FCF}_1}{(1 + \text{WACC})^1} + \frac{\text{FCF}_2}{(1 + \text{WACC})^2} + \dots + \frac{\text{FCF}_\infty}{(1 + \text{WACC})^\infty}$$

**i. What are financial assets? Describe some financial instruments.**

**Answer:** Financial assets are pieces of paper with contractual obligations. Some short-term (i.e., they mature in less than a year) are instruments with low default risk are u.s. treasury bills, banker's acceptances, commercial paper, negotiable CDs, and eurodollar deposits. Commercial loans (which have maturities up to seven years) have rates that are usually tied to the prime rate (i.e., the rate that U.S. banks charge to their best customers) or LIBOR (the London Interbank Offered Rate, which is the rate that banks in the U.K. charge one another). U.S. treasury notes and bonds have maturities from two to thirty years; they are free of default risk. Mortgages have maturities up to thirty years. Municipal bonds have maturities of up to thirty years; their interest is exempt from most taxes. Corporate bonds have maturities up to forty years. Municipal and corporate bonds are subject to default risk. Some preferred stocks have no maturity date, some do have a specific maturity date. Common stock has no maturity date, and is riskier than preferred stock.

**j. Who are the providers (savers) and users (borrowers) of capital? How is capital transferred between savers and borrowers?**

**Answer:** Households are net savers. Non-financial corporations are net borrowers. Governments are net borrowers, although the U.S. government is a net saver when it runs a surplus. Non-financial corporations (i.e., financial intermediaries) are slightly net borrowers, but they are almost breakeven. Capital is transferred through: (1) direct transfer (e.g., corporation issues commercial paper to insurance company); (2) an investment banking house (e.g., IPO, seasoned equity offering, or debt placement); (3) a financial intermediary (e.g., individual deposits money in bank, bank makes commercial loan to a company).

**k. List some financial intermediaries.**

**Answer:** Commercial banks, savings & loans, mutual savings banks, and credit unions, life insurance companies, mutual funds, and pension funds are financial intermediaries.

**l. What are some different types of markets?**

**Answer:** A market is a method of exchanging one asset (usually cash) for another asset. Some types of markets are: physical assets vs. financial assets; spot versus future markets; money versus capital markets; primary versus secondary markets.

**m. How are secondary markets organized?**

**Answer:** They are categorized by “location” (physical location exchanges or computer/telephone networks) and by the way that orders from buyers and sellers are matched (open outcry auctions, dealers (i.e., market makers), and electronic communications networks (ECNS)).

**m. 1. List some physical location markets and some computer/telephone networks.**

**Answer:** Physical location exchanges include the NYSE, AMEX, CBOT, and Tokyo stock exchange. Computer/telephone networks include Nasdaq, government bond markets, and foreign exchange markets.

**m. 2. Explain the differences between open outcry auctions, dealer markets, and electronic communications networks (ECNS).**

**Answer:** The NYSE and AMEX are the two largest auction markets for stocks (NYSE is a modified auction, with a “specialist”). Participants have a seat on the exchange, meet face-to-face, and place orders for themselves or for their clients; e.g., CBOT. Some orders are market orders, which are executed at the current market price, some are limit orders, which specify that the trade should occur only at a certain price within a certain time period (or the trade does not occur at all). In dealer markets, “dealers” keep an inventory of the stock (or other financial asset) and place bid and ask “advertisements,” which are prices at which they are willing to buy and sell. A computerized quotation system keeps track of bid and ask prices, but does not automatically match buyers and sellers. Some examples of dealer markets are the Nasdaq national market,

the Nasdaq small cap market, the London SEAQ, and the German Neuer market. ECNS are computerized systems that match orders from buyers and sellers and automatically execute the trades. Some examples are Instinet (US, stocks), Eurex (Swiss-German, futures contracts), sets (London, stocks). In the old days, securities were kept in a safe behind the counter, and passed “over the counter” when they were sold. Now the OTC market is the equivalent of a computer bulletin board, which allows potential buyers and sellers to post an offer. However, the OTC has no dealers and very poor liquidity.

<p>n. <b>What do we call the price that a borrower must pay for debt capital? What is the price of equity capital? What are the four most fundamental factors that affect the cost of money, or the general level of interest rates, in the economy?</b></p>
--

**Answer:** The interest rate is the price paid for borrowed capital, while the return on equity capital comes in the form of dividends plus capital gains. The return that investors require on capital depends on (1) production opportunities, (2) time preferences for consumption, (3) risk, and (4) inflation.

Production opportunities refer to the returns that are available from investment in productive assets: the more productive a producer firm believes its assets will be, the more it will be willing to pay for the capital necessary to acquire those assets.

Time preference for consumption refers to consumers’ preferences for current consumption versus savings for future consumption: consumers with low preferences for current consumption will be willing to lend at a lower rate than consumers with a high preference for current consumption.

Inflation refers to the tendency of prices to rise, and the higher the expected rate of inflation, the larger the required rate of return.

Risk, in a money and capital market context, refers to the chance that a loan will not be repaid as promised--the higher the perceived default risk, the higher the required rate of return.

Risk is also linked to the maturity and liquidity of a security. The longer the maturity and the less liquid (marketable) the security, the higher the required rate of return, other things constant.

The preceding discussion related to the general level of money costs, but the level of interest rates will also be influenced by such things as fed policy, fiscal and foreign trade deficits, and the level of economic activity. Also, individual securities will have higher yields than the risk-free rate because of the addition of various premiums as discussed below.

**o. What is the real risk-free rate of interest ( $r^*$ ) and the nominal risk-free rate ( $r_{RF}$ )? How are these two rates measured?**

**Answer:** Keep these equations in mind as we discuss interest rates. We will define the terms as we go along:

$$r = r^* + IP + DRP + LP + MRP.$$

$$r_{RF} = r^* + IP.$$

The real risk-free rate,  $r^*$ , is the rate that would exist on default-free securities in the absence of inflation.

The nominal risk-free rate,  $r_{rf}$ , is equal to the real risk-free rate plus an inflation premium which is equal to the average rate of inflation expected over the life of the security.

There is no truly riskless security, but the closest thing is a short-term U. S. Treasury bill (t-bill), which is free of most risks. The real risk-free rate,  $r^*$ , is estimated by subtracting the expected rate of inflation from the rate on short-term treasury securities. It is generally assumed that  $r^*$  is in the range of 1 to 4 percentage points. The t-bond rate is used as a proxy for the long-term risk-free rate. However, we know that all long-term bonds contain interest rate risk, so the t-bond rate is not really riskless. It is, however, free of default risk.

**p. Define the terms inflation premium (IP), default risk premium (DRP), liquidity premium (LP), and maturity risk premium (MRP). Which of these premiums is included when determining the interest rate on (1) short-term U.S. treasury securities, (2) long-term U.S. treasury securities, (3) short-term corporate securities, and (4) long-term corporate securities? Explain how the premiums would vary over time and among the different securities listed above.**

**Answer:** The inflation premium (IP) is a premium added to the real risk-free rate of interest to compensate for expected inflation.

The default risk premium (DRP) is a premium based on the probability that the issuer will default on the loan, and it is measured by the difference between the interest rate on a U.S. treasury bond and a corporate bond of equal maturity and marketability.

A liquid asset is one that can be sold at a predictable price on short notice; a liquidity premium is added to the rate of interest on securities that are not liquid.

The maturity risk premium (MRP) is a premium which reflects interest rate risk; longer-term securities have more interest rate risk (the risk of capital loss due to rising interest rates) than do shorter-term securities, and the MRP is added to reflect this risk.

1. Short-term treasury securities include only an inflation premium.
2. Long-term treasury securities contain an inflation premium plus a maturity risk premium. Note that the inflation premium added to long-term securities will differ from that for short-term securities unless the rate of inflation is expected to remain constant.
3. The rate on short-term corporate securities is equal to the real risk-free rate plus premiums for inflation, default risk, and liquidity. The size of the default and liquidity premiums will vary depending on the financial strength of the issuing corporation and its degree of liquidity, with larger corporations generally having greater liquidity because of more active trading.

4. The rate for long-term corporate securities also includes a premium for maturity risk. Thus, long-term corporate securities generally carry the highest yields of these four types of securities.

**q. What is the term structure of interest rates? What is a yield curve?**

**Answer:** The term structure of interest rates is the relationship between interest rates, or yields, and maturities of securities. When this relationship is graphed, the resulting curve is called a yield curve.

**r. Suppose most investors expect the inflation rate to be 5 percent next year, 6 percent the following year, and 8 percent thereafter. The real risk-free rate is 3 percent. The maturity risk premium is zero for securities that mature in 1 year or less, 0.1 percent for 2-year securities, and then the MRP increases by 0.1 percent per year thereafter for 20 years, after which it is stable. What is the interest rate on 1-year, 10-year, and 20-year treasury securities? Draw a yield curve with these data. What factors can explain why this constructed yield curve is upward sloping?**

**Answer:** Step 1: find the average expected inflation rate over years 1 to 20:

$$\text{Yr } 1: \text{ IP} = 5.0\%.$$

$$\text{Yr } 10: \text{ IP} = (5 + 6 + 8 + 8 + 8 + \dots + 8)/10 = 7.5\%.$$

$$\text{Yr } 20: \text{ IP} = (5 + 6 + 8 + 8 + \dots + 8)/20 = 7.75\%.$$

Step 2: find the maturity premium in each year:

$$\text{Yr } 1: \text{ MRP} = 0.0\%.$$

$$\text{Yr } 10: \text{ MRP} = 0.1 \times 9 = 0.9\%.$$

$$\text{Yr } 20: \text{ MRP} = 0.1 \times 19 = 1.9\%.$$

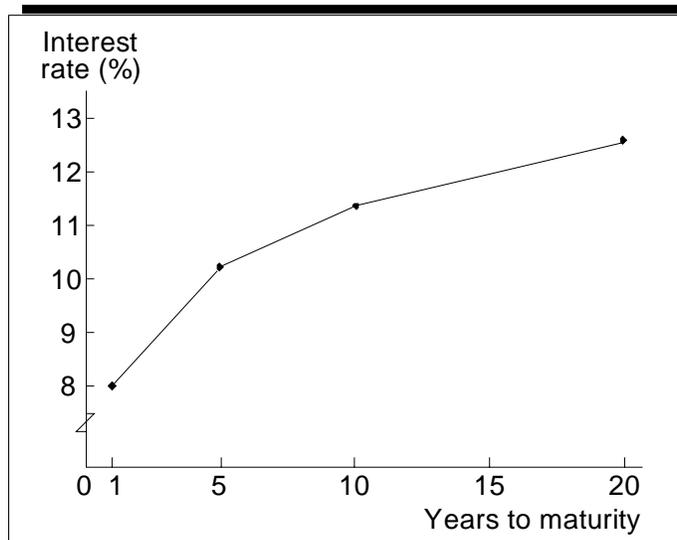
Step 3: sum the IPS and MRPS, and add  $r^* = 3\%$ :

$$\text{Yr } 1: r_{\text{RF}} = 3\% + 5.0\% + 0.0\% = 8.0\%.$$

$$\text{Yr } 10: r_{\text{RF}} = 3\% + 7.5\% + 0.9\% = 11.4\%.$$

$$\text{Yr } 20: r_{\text{RF}} = 3\% + 7.75\% + 1.9\% = 12.65\%.$$

The shape of the yield curve depends primarily on two factors:  
 (1) expectations about future inflation and (2) the relative riskiness of securities with different maturities.

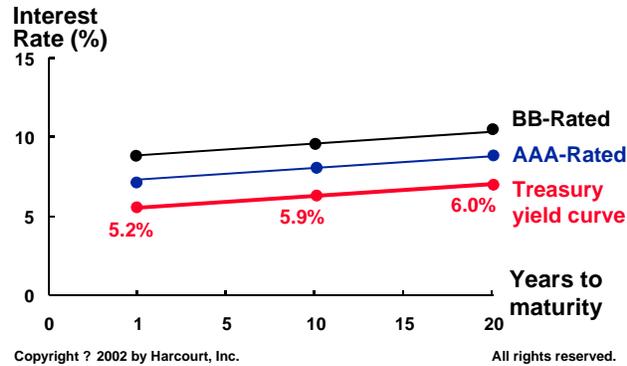


The constructed yield curve is upward sloping. This is due to increasing expected inflation and an increasing maturity risk premium.

s. **At any given time, how would the yield curve facing an AAA-rated company compare with the yield curve for U. S. Treasury securities? At any given time, how would the yield curve facing a BB-rated company compare with the yield curve for U. S. Treasury securities? Draw a graph to illustrate your answer.**

**Answer:** The yield curve normally slopes upward, indicating that short-term interest rates are lower than long-term interest rates. Yield curves can be drawn for government securities or for the securities of any corporation, but corporate yield curves will always lie above government yield curves, and the riskier the corporation, the higher its yield curve. The spread between a corporate yield curve and the treasury curve widens as the corporate bond rating decreases.

### Hypothetical Treasury and Corporate Yield Curves



**t. What is the pure expectations theory? What does the pure expectations theory imply about the term structure of interest rates?**

**Answer:** The pure expectations theory assumes that investors establish bond prices and interest rates strictly on the basis of expectations for interest rates. This means that they are indifferent with respect to maturity in the sense that they do not view long-term bonds as being riskier than short-term bonds. If this were true, then the maturity risk premium would be zero, and long-term interest rates would simply be a weighted average of current and expected future short-term interest rates. If the pure expectations theory is correct, you can use the yield curve to “back out” expected future interest rates.

**u. Finally, Dellatorre is also interested in investing in countries other than the United States. Describe the various types of risks that arise when investing overseas.**

**Answer:** First, Dellatorre should consider country risk, which refers to the risk that arises from investing or doing business in a particular country. This risk depends on the country's economic, political, and social environment. Country risk also includes the risk that property will be expropriated without adequate compensation, as well as new host country stipulations about local production, sourcing or hiring practices, and damage or destruction of facilities due to internal strife.

Second, Dellatorre should consider exchange rate risk. Dellatorre needs to keep in mind when investing overseas that more often than not the security will be denominated in a currency other than the dollar, which means that the value of the investment will depend on what happens to exchange rates. Two factors can lead to exchange rate fluctuations. Changes in relative inflation will lead to changes in exchange rates. Also, an increase in country risk will also cause the country's currency to fall. Consequently, inflation risk, country risk, and exchange rate risk are all interrelated.

## Chapter 2

### Time Value of Money

---

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 2-1
- a. PV (present value) is the value today of a future payment, or stream of payments, discounted at the appropriate rate of interest. PV is also the beginning amount that will grow to some future value. The parameter  $i$  is the periodic interest rate that an account pays. The parameter INT is the dollars of interest earned each period.  $FV_n$  (future value) is the ending amount in an account, where  $n$  is the number of periods the money is left in the account.  $PVA_n$  is the value today of a future stream of equal payments (an annuity) and  $FVA_n$  is the ending value of a stream of equal payments, where  $n$  is the number of payments of the annuity. PMT is equal to the dollar amount of an equal, or constant cash flow (an annuity). In the EAR equation,  $m$  is used to denote the number of compounding periods per year, while  $i_{Nom}$  is the nominal, or quoted, interest rate.
  - b.  $FVIF_{i,n}$  is the future value interest factor for a lump sum left in an account for  $n$  periods paying  $i$  percent interest per period.  $PVIF_{i,n}$  is the present value interest factor for a lump sum received  $n$  periods in the future discounted at  $i$  percent per period.  $FVIFA_{i,n}$  is the future value interest factor for an ordinary annuity of  $n$  periodic payments paying  $i$  percent interest per period.  $PVIFA_{i,n}$  is the present value interest factor for an ordinary annuity of  $n$  periodic payments discounted at  $i$  percent interest per period. All the above factors represent the appropriate PV or  $FV_n$  when the lump sum or ordinary annuity payment is \$1. Note that the above factors can also be defined using formulas.
  - c. The opportunity cost rate ( $i$ ) of an investment is the rate of return available on the best alternative investment of similar risk.
  - d. An annuity is a series of payments of a fixed amount for a specified number of periods. A single sum, or lump sum payment, as opposed to an annuity, consists of one payment occurring now or at some future time. A cash flow can be an inflow (a receipt) or an outflow (a deposit, a cost, or an amount paid). We distinguish between the terms cash flow and PMT. We use the term cash flow for uneven streams, while we use the term PMT for annuities, or constant payment amounts. An uneven cash flow stream is a series of cash flows in which the amount varies from one period to the next. The PV (or  $FV_n$ ) of an uneven payment stream is merely the sum of the present values (or future values) of each individual payment.
  - e. An ordinary annuity has payments occurring at the end of each period. A deferred annuity is just another name for an ordinary annuity. An annuity due has payments occurring at the beginning of each period. Most financial calculators will accommodate either type of annuity. The payment period must be equal to the compounding period.
  - f. A perpetuity is a series of payments of a fixed amount that last indefinitely. In other words, a perpetuity is an annuity where  $n$  equals infinity. Consol is another term for perpetuity. Consols were originally bonds issued by England in 1815 to consolidate past debt.
  - g. An outflow is a deposit, a cost, or an amount paid, while an inflow is a receipt. A time line is an important tool used in time value of money analysis; it is a graphical representation which is used to show the timing of cash flows. The terminal value is the future value of an uneven cash flow stream.

- h. Compounding is the process of finding the future value of a single payment or series of payments. Discounting is the process of finding the present value of a single payment or series of payments; it is the reverse of compounding.
- i. Annual compounding means that interest is paid once a year. In semiannual, quarterly, monthly, and daily compounding, interest is paid 2, 4, 12, and 365 times per year respectively. When compounding occurs more frequently than once a year, you earn interest on interest more often, thus increasing the future value. The more frequent the compounding, the higher the future value.
- j. The effective annual rate is the rate that, under annual compounding, would have produced the same future value at the end of 1 year as was produced by more frequent compounding, say quarterly. The nominal (quoted) interest rate,  $i_{\text{Nom}}$ , is the rate of interest stated in a contract. If the compounding occurs annually, the effective annual rate and the nominal rate are the same. If compounding occurs more frequently, the effective annual rate is greater than the nominal rate. The nominal annual interest rate is also called the annual percentage rate, or APR. The periodic rate,  $i_{\text{PER}}$ , is the rate charged by a lender or paid by a borrower each period. It can be a rate per year, per 6-month period, per quarter, per month, per day, or per any other time interval (usually one year or less).
- k. An amortization schedule is a table that breaks down the periodic fixed payment of an installment loan into its principal and interest components. The principal component of each payment reduces the remaining principal balance. The interest component is the interest payment on the beginning-of-period principal balance. An amortized loan is one that is repaid in equal periodic amounts (or "killed off" over time).

2-2 The opportunity cost rate is the rate of interest one could earn on an alternative investment with a risk equal to the risk of the investment in question. This is the value of  $i$  in the TVM equations, and it is shown on the top of a time line, between the first and second tick marks. It is not a single rate--the opportunity cost rate varies depending on the riskiness and maturity of an investment, and it also varies from year to year depending on inflationary expectations.

2-3 True. The second series is an uneven payment stream, but it contains an annuity of \$400 for 8 years. The series could also be thought of as a \$100 annuity for 10 years plus an additional payment of \$100 in Year 2, plus additional payments of \$300 in Years 3 through 10.

2-4 True, because of compounding effects--growth on growth. The following example demonstrates the point. The annual growth rate is  $i$  in the following equation:

$$\$1(1 + i)^{10} = \$2.$$

The term  $(1 + i)^{10}$  is the FVIF for  $i$  percent, 10 years. We can find  $i$  in one of two ways:

1. Using a financial calculator input  $N = 10$ ,  $PV = -1$ ,  $PMT = 0$ ,  $FV = 2$ , and  $I = ?$ . Solving for  $I$  you obtain 7.18%.
2. Using a financial calculator, input  $N = 10$ ,  $I = 10$ ,  $PV = -1$ ,  $PMT = 0$ , and  $FV = ?$ . Solving for  $FV$  you obtain \$2.59. This formulation recognizes the "interest on interest" phenomenon.

2-5 For the same stated rate, daily compounding is best. You would earn more "interest on interest."

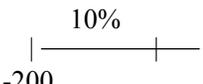


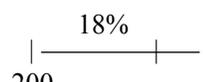


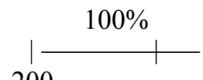
2-3

a.   $\$400 = \$200(FVIF_{7\%,n})$   
 $2 = FVIF_{7\%,n}$   
 $n \approx 10$  years.

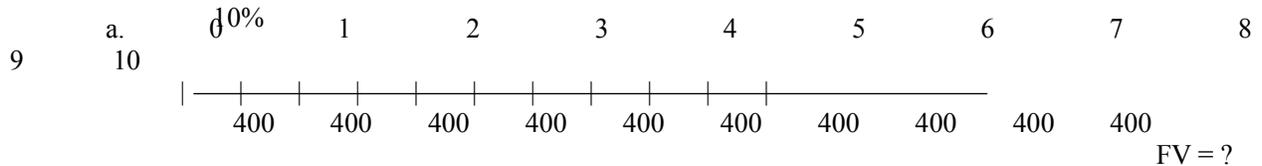
With a financial calculator, enter  $I = 7$ ,  $PV = -200$ ,  $PMT = 0$ , and  $FV = 400$ . Then press the  $N$  key to find  $N = 10.24$ . Override  $I$  with the other values to find  $N = 7.27$ ,  $4.19$ , and  $1.00$ .

b.   $2 = FVIF_{10\%,n}$   
 $n \approx 7$  years.

c.   $2 = FVIF_{18\%,n}$   
 $n \approx 4$  years.

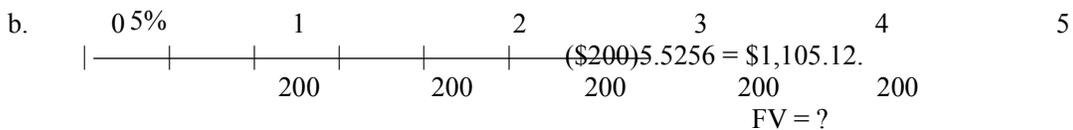
d.   $2 = FVIF_{100\%,n}$   
 $n = 1$  year.

2-4 The general formula is  $FVA_n = PMT(FVIFA_{i,n})$ .

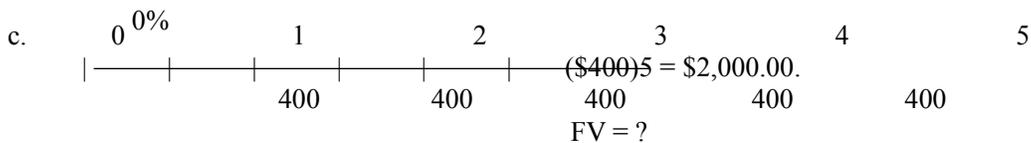
a. 

$$FVA_{10} = (\$400)15.9374 = \$6,374.96.$$

With a financial calculator, enter  $N = 10$ ,  $I = 10$ ,  $PV = 0$ , and  $PMT = -400$ . Then press the  $FV$  key to find  $FV = \$6,374.97$ .

b. 

With a financial calculator, enter  $N = 5$ ,  $I = 5$ ,  $PV = 0$ , and  $PMT = -200$ . Then press the  $FV$  key to find  $FV = \$1,105.13$ .

c. 

With a financial calculator, enter  $N = 5$ ,  $I = 0$ ,  $PV = 0$ , and  $PMT = -400$ . Then press the  $FV$  key to find  $FV = \$2,000$ .



With a financial calculator, simply enter the known values and then press the key for the unknowns. Except for rounding errors, the answers are as given below.

b.  $5\%$  1 2 3 4 5  
 $PV = ?$  |-----|-----|-----|-----|-----|  
 200 200 200 200 200  
 $\$200(4.3295) = \$865.90.$

c.  $0\%$  1 2 3 4 5  
 $PV = ?$  |-----|-----|-----|-----|-----|  
 400 400 400 400 400  
 $\$400(5) = \$2,000.00.$

8 d. (1)  $10\%$  1 2 3 4 5 6 7  
 9 |-----|-----|-----|-----|-----|-----|-----|  
 10 400 400 400 400 400 400 400 400 400 400 PV  
 = ?

$PVA_n$  (Annuity due) =  $PMT(PVIFA_{i,n})(1 + i)$ . Therefore,  
 $\$400(6.1446)(1.10) = \$2,703.62.$

(2)  $5\%$  1 2 3 4 5  
 |-----|-----|-----|-----|-----|  
 200 200 200 200 200

$PVA_n$  (Annuity due) =  $\$200(4.3295)(1.05) = \$909.20.$

(3)  $0\%$  1 2 3 4 5  
 |-----|-----|-----|-----|-----|  
 400 400 400 400 400

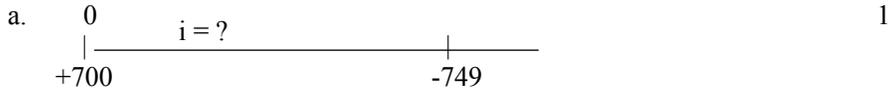
$PV = ?$   
 $PVA_n$  (Annuity due) =  $\$400(5)(1.00) = \$2,000.00.$

2-6 a. Cash Stream A Cash  
Stream B 0 1 2 3 4 5 0 1  
 $8\%$   $8\%$   
 |-----|-----|-----|-----|-----|-----|-----|  
 $PV = ?$  100 400 400 400 300  $PV = ?$  300 400 400  
 400 100

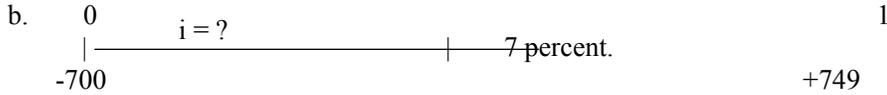
With a financial calculator, simply enter the cash flows (be sure to enter  $CF_0 = 0$ ), enter  $I = 8$ , and press the NPV key to find  $NPV = PV = \$1,251.25$  for the first problem. Override  $I = 8$  with  $I = 0$  to find the next PV for Cash Stream A. Repeat for Cash Stream B to get  $NPV = PV = \$1,300.32$ .

b.  $PV_A = \$100 + \$400 + \$400 + \$400 + \$300 = \$1,600.$   
 $PV_B = \$300 + \$400 + \$400 + \$400 + \$100 = \$1,600$

2-7 These problems can all be solved using a financial calculator by entering the known values shown on the time lines and then pressing the I button.

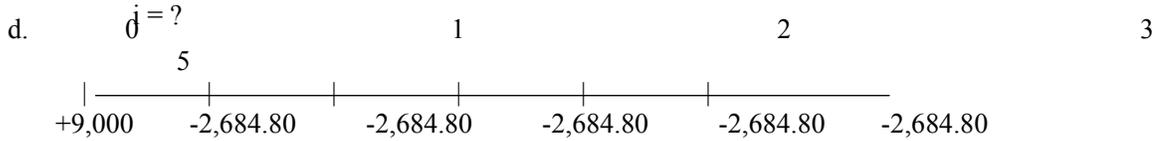


7 percent:  $\$700 = \$749(\text{PVIF}_{i,1})$ ;  $\text{PVIF}_{i,1} = 0.9346$ .

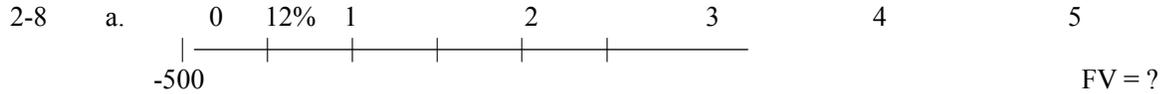


$\$201,229/\$85,000 = 2.3674 = \text{FVIF}_{i,10}$ ;  $i = 9\%$ .

4

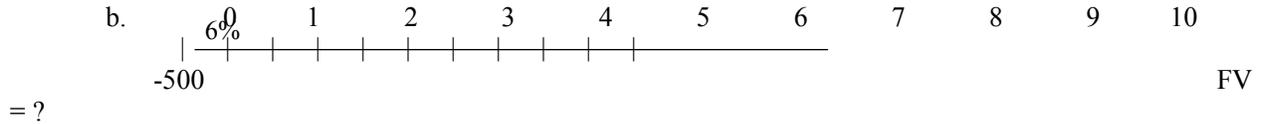


$\$9,000/\$2,684.80 = 3.3522 = \text{PVIFA}_{i,5}$ ;  $i = 15\%$ .



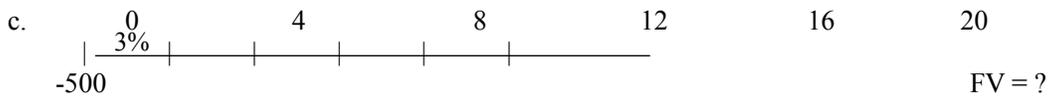
With a financial calculator, enter  $N = 5$ ,  $I = 12$ ,  $PV = -500$ , and  $PMT = 0$ , and then press  $FV$  to obtain  $FV = \$881.17$ . With a regular calculator, proceed as follows:

$$FV_n = PV(1 + i)^n = \$500(1.12)^5 = \$500(1.7623) = \$881.15.$$



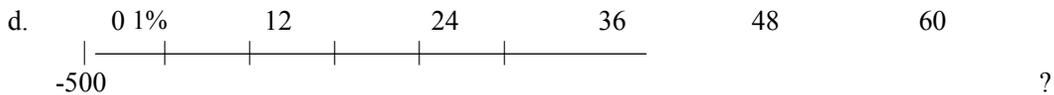
**Enter the time line values into a financial calculator to obtain  $FV = \$895.42$ , or**

$$\begin{aligned} PV_n &= PV \left( 1 + \frac{i}{m} \right)^{nm} \\ &= \$500 \left( 1 + \frac{0.12}{2} \right)^{2(5)} = \$500(1.06)^{10} \\ &= \$500(\text{FVIF}_{6\%, 10}) = \$500(1.7908) = \$895.40. \end{aligned}$$



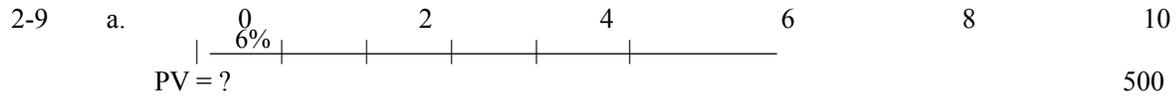
**Enter the time line values into a financial calculator to obtain  $FV = \$903.06$ , or**

$$FV_n = \$500 \left( 1 + \frac{0.12}{4} \right)^{4(5)} = \$500(1.03)^{20} = \$500(1.8061) = \$903.05.$$



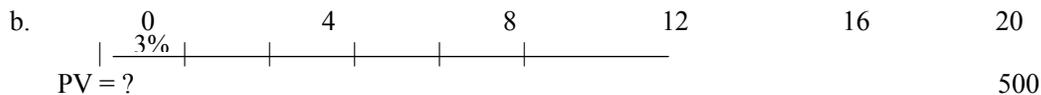
**Enter the time line values into a financial calculator to obtain  $FV = \$908.35$ , or**

$$FV_n = \$500 \left( 1 + \frac{0.12}{12} \right)^{12(5)} = \$500(1.01)^{60} = \$500(1.8167) = \$908.35.$$



Enter the time line values into a financial calculator to obtain  $PV = \$279.20$ , or

$$\begin{aligned}
 PV &= FV_n \left( \frac{1}{1 + \frac{i}{m}} \right)^{mn} = \$500 \left( \frac{1}{1 + \frac{0.12}{2}} \right)^{2(5)} \\
 &= \$500 \left( \frac{1}{1.06} \right)^{10} = \$500(PVIF_{6\%, 10}) = \$500(0.5584) = \$279.20.
 \end{aligned}$$



Enter the time line values into a financial calculator to obtain  $PV = \$276.84$ , or

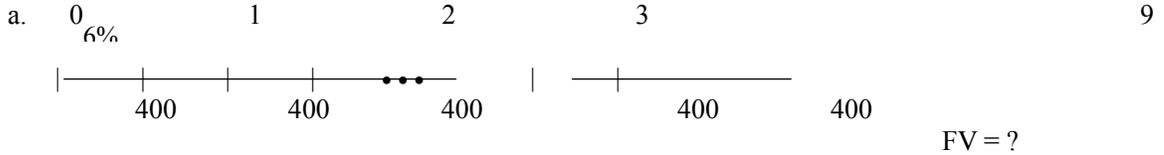
$$PV = \$500 \left( \frac{1}{1 + \frac{0.12}{4}} \right)^{4(5)} = \$500 \left( \frac{1}{1.03} \right)^{20} = \$500(0.5537) = \$276.85.$$



Enter the time line values into a financial calculator to obtain  $PV = \$443.72$ , or

$$\begin{aligned}
 PV &= \$500 \left( \frac{1}{1 + \frac{0.12}{12}} \right)^{12(1)} \\
 &= \$500 \left( \frac{1}{1.01} \right)^{12} = \$500(1.01)^{-12} = \$500(0.8874) = \$443.70.
 \end{aligned}$$

2-10  
10



Enter  $N = 5 \times 2 = 10$ ,  $I = 12/2 = 6$ ,  $PV = 0$ ,  $PMT = -400$ , and then press FV to get  $FV = \$5,272.32$ .

b. Now the number of periods is calculated as  $N = 5 \times 4 = 20$ ,  $I = 12/4 = 3$ ,  $PV = 0$ , and  $PMT = -200$ . The calculator solution is  $\$5,374.07$ .

Note that the solution assumes that the nominal interest rate is compounded at the annuity period.

- c. The annuity in Part b earns more because some of the money is on deposit for a longer period of time and thus earns more interest. Also, because compounding is more frequent, more interest is earned on interest.

2-11 a. Universal Bank: Effective rate = 7%.

Regional Bank:

$$\text{Effective rate} = \left(1 + \frac{0.06}{4}\right)^4 - 1.0 = (1.015)^4 - 1.0$$

$$= 1.0614 - 1.0 = 0.0614 = 6.14\%.$$

With a financial calculator, you can use the interest rate conversion feature to obtain the same answer. You would choose the Universal Bank.

- b. If funds must be left on deposit until the end of the compounding period (1 year for Universal and 1 quarter for Regional), and you think there is a high probability that you will make a withdrawal during the year, the Regional account might be preferable. For example, if the withdrawal is made after 10 months, you would earn nothing on the Universal account but  $(1.015)^3 - 1.0 = 4.57\%$  on the Regional account.

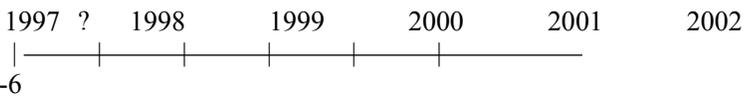
Ten or more years ago, most banks and S&Ls were set up as described above, but now virtually all are computerized and pay interest from the day of deposit to the day of withdrawal, provided at least \$1 is in the account at the end of the period.

- 2-12 a. With a financial calculator, enter N = 5, I = 10, PV = -25000, and FV = 0, and then press the PMT key to get PMT = \$6,594.94. Then go through the amortization procedure as described in your calculator manual to get the entries for the amortization table.

<u>Year</u>	<u>Payment</u>	<u>Repayment Interest</u>	<u>Remaining of Principal</u>	<u>Balance</u>
1	\$ 6,594.94	\$2,500.00	\$ 4,094.94	\$20,905.06
2	6,594.94	2,090.51	4,504.43	16,400.63
3	6,594.94	1,640.06	4,954.88	11,445.75
4	6,594.94	1,144.58	5,450.36	5,995.39
5	<u>6,594.93*</u>	<u>599.54</u>	<u>5,995.39</u>	0
	<u>\$32,974.69</u>	<u>\$7,974.69</u>	<u>\$25,000.00</u>	

\*The last payment must be smaller to force the ending balance to zero.

- b. Here the loan size is doubled, so the payments also double in size to \$13,189.87.
- c. The annual payment on a \$50,000, 10-year loan at 10 percent interest would be \$8,137.27. Because the payments are spread out over a longer time period, more interest must be paid on the loan, which raises the amount of each payment. The total interest paid on the 10-year loan is \$31,372.70 versus interest of \$15,949.37 on the 5-year loan.

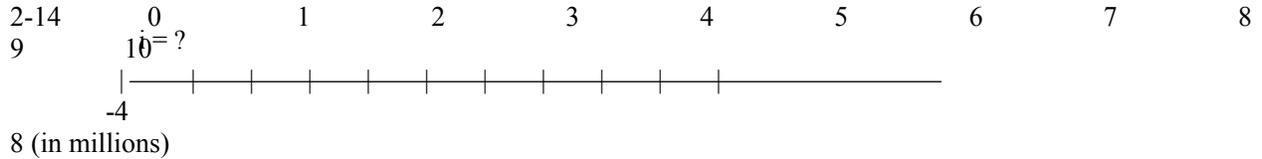
- 2-13 a.  12 (in millions)

With a calculator, enter N = 5, PV = -6, PMT = 0, FV = 12, and then solve for I = 14.87%.

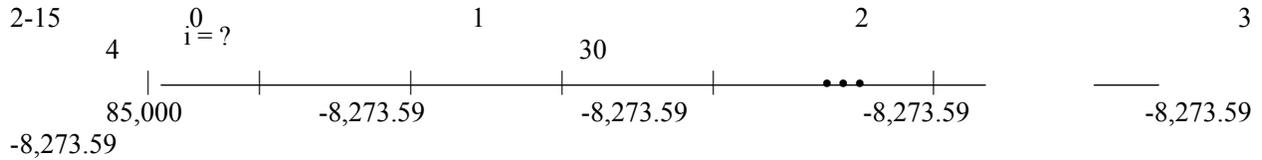
- b. The calculation described in the quotation fails to take account of the compounding effect. It can be demonstrated to be incorrect as follows:

$$\$6,000,000(1.20)^5 = \$6,000,000(2.4883) = \$14,929,800,$$

**which is greater than \$12 million. Thus, the annual growth rate is less than 20 percent; in fact, it is about 15 percent, as shown in Part a.**

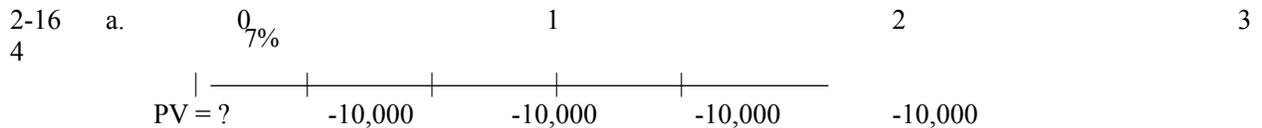


$\$4,000,000/\$8,000,000 = 0.50$ , which is slightly less than the  $PVIF_{i,n}$  for 7 percent in 10 years. Thus, the expected rate of return is just over 7 percent. With a calculator, enter  $N = 10$ ,  $PV = -4$ ,  $PMT = 0$ ,  $FV = 8$ , and then solve for  $I = 7.18\%$ .



$\$85,000/\$8,273.59 = 10.2737 = PVIFA_{i,n}$  for a 30-year annuity.

With a calculator, enter  $N = 30$ ,  $PV = 85000$ ,  $PMT = -8273.59$ ,  $FV = 0$ , and then solve for  $I = 9\%$ .



With a calculator, enter  $N = 4$ ,  $I = 7$ ,  $PMT = -10000$ , and  $FV = 0$ . Then press  $PV$  to get  $PV = \$33,872.11$ .

- b. (1) At this point, we have a 3-year, 7% annuity whose value is \$26,243.16. You can also think of the problem as follows:

$$\$33,872(1.07) - \$10,000 = \$26,243.04.$$

- (2) Zero after the last withdrawal.

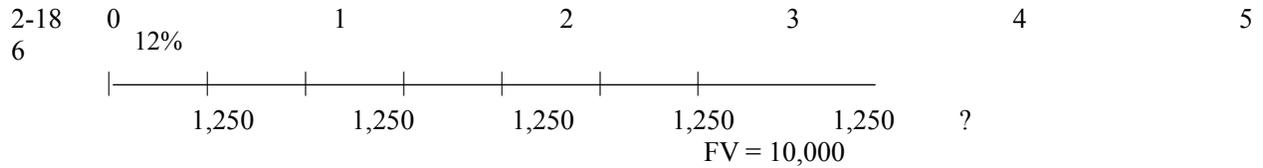


$$PVA_n = PMT(PVIFA_{i,n}).$$

$$\$12,000 = \$1,500(PVIFA_{9\%,n})$$

$$PVIFA_{9\%,n} = 8.000.$$

With a calculator, enter  $I = 9$ ,  $PV = 12000$ ,  $PMT = -1500$ , and  $FV = 0$ . Press  $N$  to get  $N = 14.77 \approx 15$  years. Therefore, it will take approximately 15 years to pay back the loan.

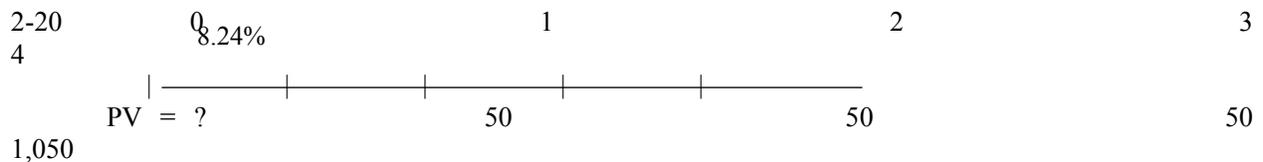


With a financial calculator, get a "ballpark" estimate of the years by entering  $I = 12$ ,  $PV = 0$ ,  $PMT = -1250$ , and  $FV = 10000$ , and then pressing the  $N$  key to find  $N = 5.94$  years. This answer assumes that a payment of \$1,250 will be made 94/100th of the way through Year 5.

Now find the FV of \$1,250 for 5 years at 12%; it is \$7,941.06. Compound this value for 1 year at 12% to obtain the value in the account after 6 years and before the last payment is made; it is  $\$7,941.06(1.12) = \$8,893.99$ . Thus, you will have to make a payment of  $\$10,000 - \$8,893.99 = \$1,106.01$  at Year 6, so the answer is: it will take 6 years, and \$1,106.01 is the amount of the last payment.

2-19  $PV = \$100/0.07 = \$1,428.57$ .  $PV = \$100/0.14 = \$714.29$ .

When the interest rate is doubled, the PV of the perpetuity is halved.



Discount rate: Effective rate on bank deposit:

$$EAR = (1 + 0.08/4)^4 - 1 = 8.24\%$$

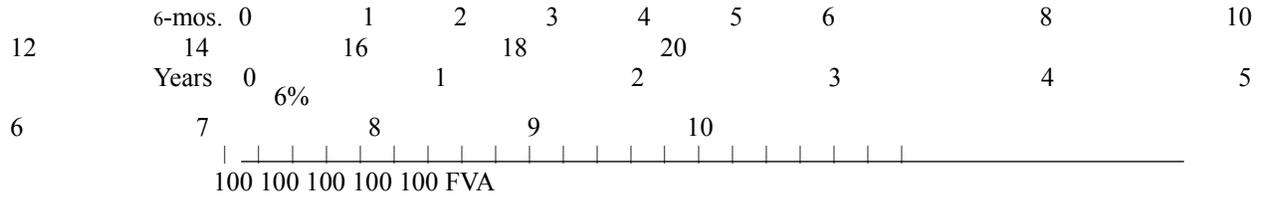
Find PV of above stream at 8.24%:

$$PV = \$893.26 \text{ using the cash flow register.}$$

Also get  $PV = \$893.26$  using the TVM register, inputting  $N = 4$ ,  $I = 8.24$ ,  $PMT = 50$ , and  $FV = 1000$ .



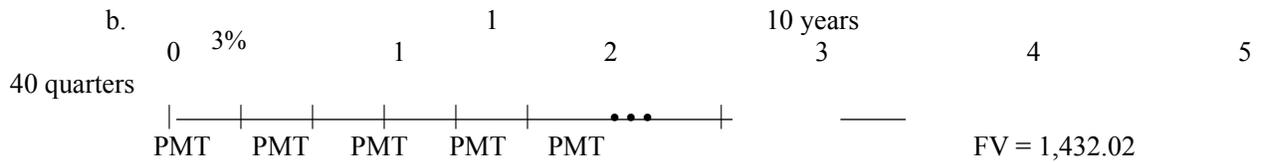
2-23 a. Begin with a time line:



Since the first payment is made today, we have a 5-period annuity due. The applicable interest rate is  $I = 12/2 = 6$  per period,  $N = 5$ ,  $PV = 0$ , and  $PMT = -100$ . Setting the calculator on "BEG," we find  $FVA$  (Annuity due) = \$597.53. That will be the value at the 5<sup>th</sup> 6-month period, which is  $t = 2.5$ . Now we must compound out to  $t = 10$ , or for 7.5 years at an EAR of 12.36%, or 15 semiannual periods at 6%.

$$\$597.53 \rightarrow 20 - 5 = 15 \text{ periods @ } 6\% \rightarrow \$1,432.02,$$

or  $\$597.53 \rightarrow 10 - 2.5 = 7.5 \text{ years @ } 12.36\% \rightarrow \$1,432.02.$



The time line depicting the problem is shown above. Because the payments only occur for 5 periods throughout the 40 quarters, this problem cannot be immediately solved as an annuity problem. The problem can be solved in two steps:

- (1) Discount the \$1,432.02 back to the end of Quarter 5 to obtain the PV of that future amount at Quarter 5.
- (2) Then solve for PMT using the value solved in Step 1 as the FV of the five-period annuity due.

Step 1: Input the following into your calculator:  $N = 35$ ,  $I = 3$ ,  $PMT = 0$ ,  $FV = 1432.02$ , and solve for PV at Quarter 5.  $PV = \$508.92$ .

Step 2: The PV found in Step 1 is now the FV for the calculations in this step. Change your calculator to the BEGIN mode. Input the following into your calculator:  $N = 5$ ,  $I = 3$ ,  $PV = 0$ ,  $FV = 508.92$ , and solve for  $PMT = \$93.07$ .

2-24 Here we want to have the same effective annual rate on the credit extended as on the bank loan that will be used to finance the credit extension.

First, we must find the EAR = EFF% on the bank loan. Enter NOM% = 15, N = P/YR = 12, and press EFF% to get EAR = 16.08%.

Now recognize that giving 3 months of credit is equivalent to quarterly compounding--interest is earned at the end of the quarter, so it is available to earn interest during the next quarter. Therefore, enter P/YR = 4, EFF% = EAR = 16.08%, and press NOM% to find the nominal rate of 15.19 percent.

Therefore, if a 15.19 percent nominal rate is charged and credit is given for 3 months, the cost of the bank loan will be covered.

Alternative solution: We need to find the effective annual rate (EAR) the bank is charging first. Then, we can use this EAR to calculate the nominal rate that should be quoted to the customers.

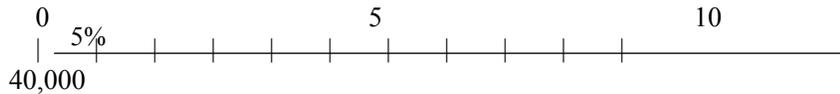
$$\text{Bank EAR: } \text{EAR} = (1 + i_{\text{Nom}}/m)^m - 1 = (1 + 0.15/12)^{12} - 1 = 16.08\%.$$

Nominal rate that should be quoted to customers:

$$\begin{aligned} 16.08\% &= (1 + i_{\text{Nom}}/4)^4 - 1 \\ 1.1608 &= (1 + i_{\text{Nom}}/4)^4 \\ 1.0380 &= 1 + i_{\text{Nom}}/4 \\ i_{\text{Nom}} &= 0.0380(4) = 15.19\%. \end{aligned}$$

2-25 Information given:

1. Will save for 10 years, then receive payments for 25 years.
2. Wants payments of \$40,000 per year in today's dollars for first payment only. Real income will decline. Inflation will be 5 percent. Therefore, to find the inflated fixed payments, we have this time line:



FV = ?

Enter N = 10, I = 5, PV = -40000, PMT = 0, and press FV to get FV = \$65,155.79.

3. He now has \$100,000 in an account which pays 8 percent, annual compounding. We need to find the FV of the \$100,000 after 10 years. Enter N = 10, I = 8, PV = -100000, PMT = 0, and press FV to get FV = \$215,892.50.
4. He wants to withdraw, or have payments of, \$65,155.79 per year for 25 years, with the first payment made at the beginning of the first retirement year. So, we have a 25-year annuity due with PMT = 65,155.79, at an interest rate of 8 percent. (The interest rate is 8 percent annually, so no adjustment is required.) Set the calculator to "BEG" mode, then enter N = 25, I = 8, PMT = 65155.79, FV = 0, and press PV to get PV = \$751,165.35. This amount must be on hand to make the 25 payments.
5. Since the original \$100,000, which grows to \$215,892.50, will be available, we must save enough to accumulate  $\$751,165.35 - \$215,892.50 = \$535,272.85$ .
6. The \$535,272.85 is the FV of a 10-year ordinary annuity. The payments will be deposited in the bank and earn 8 percent interest. Therefore, set the calculator to "END" mode and enter N = 10, I = 8, PV = 0, FV = 535272.85, and press PMT to find PMT = \$36,949.61.

## SOLUTION TO SPREADSHEET PROBLEM

---

- 2-26 The detailed solution for the spreadsheet problem is available both on the instructor's resource CD-ROM (in the file *Solution for Ch 02 P26 Build a Model.xls*) and on the instructor's side of the textbook's web site, [brigham.swcollege.com](http://brigham.swcollege.com).

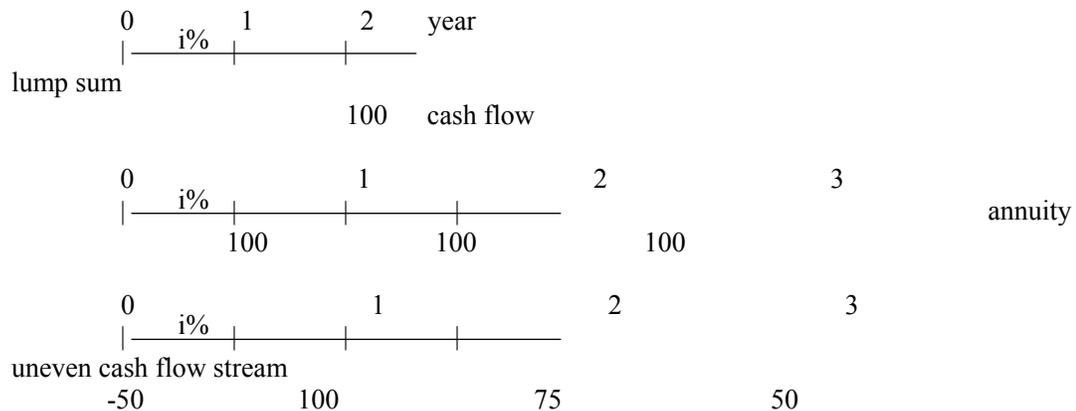
## MINI CASE

---

Assume that you are nearing graduation and that you have applied for a job with a local bank. As part of the bank's evaluation process, you have been asked to take an examination which covers several financial analysis techniques. The first section of the test addresses discounted cash flow analysis. See how you would do by answering the following questions.

a. Draw time lines for (a) a \$100 lump sum cash flow at the end of year 2, (b) an ordinary annuity of \$100 per year for 3 years, and (c) an uneven cash flow stream of -\$50, \$100, \$75, and \$50 at the end of years 0 through 3.

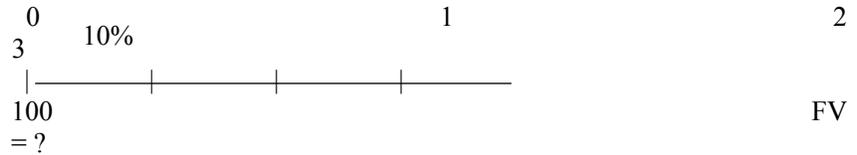
**Answer:** (Begin by discussing basic discounted cash flow concepts, terminology, and solution methods.) A time line is a graphical representation which is used to show the timing of cash flows. The tick marks represent end of periods (often years), so time 0 is today; time 1 is the end of the first year, or 1 year from today; and so on.



A lump sum is a single flow; for example, a \$100 inflow in year 2, as shown in the top time line. An annuity is a series of equal cash flows occurring over equal intervals, as illustrated in the middle time line. An uneven cash flow stream is an irregular series of cash flows which do not constitute an annuity, as in the lower time line. -50 represents a cash outflow rather than a receipt or inflow.

**b. 1. What is the future value of an initial \$100 after 3 years if it is invested in an account paying 10 percent annual interest?**

**Answer:** Show dollars corresponding to question mark, calculated as follows:



After 1 year:

$$FV_1 = PV + i_1 = PV + PV(i) = PV(1 + i) = \$100(1.10) = \$110.00.$$

Similarly:

$$\begin{aligned} FV_2 &= FV_1 + i_2 = FV_1 + FV_1(i) = FV_1(1 + i) \\ &= \$110(1.10) = \$121.00 = PV(1 + i)(1 + i) = PV(1 + i)^2. \end{aligned}$$

$$\begin{aligned} FV_3 &= FV_2 + i_3 = FV_2 + FV_2(i) = FV_2(1 + i) \\ &= \$121(1.10) = \$133.10 = PV(1 + i)^2(1 + i) = PV(1 + i)^3. \end{aligned}$$

In general, we see that:

$$\begin{aligned} FV_n &= PV(1 + i)^n, \\ \text{SO } FV_3 &= \$100(1.10)^3 = \$100(1.3310) = \$133.10. \end{aligned}$$

Note that this equation has 4 variables:  $FV_n$ ,  $PV$ ,  $i$ , and  $n$ . Here we know all except  $FV_n$ , so we solve for  $FV_n$ . We will, however, often solve for one of the other three variables. By far, the easiest way to work all time value problems is with a financial calculator. Just plug in any 3 of the four values and find the 4th.

Finding future values (moving to the right along the time line) is called compounding. Note that there are 3 ways of finding  $FV_3$ : using a regular calculator, financial calculator, or spreadsheets. For simple problems, we show only the regular calculator and financial calculator methods.

(1) regular calculator:

$$1. \quad \$100(1.10)(1.10)(1.10) = \$133.10.$$

$$2. \quad \$100(1.10)^3 = \$133.10.$$

(2) financial calculator:

This is especially efficient for more complex problems, including exam problems. Input the following values:  $N = 3$ ,  $I = 10$ ,  $PV = -100$ ,  $pmt = 0$ , and solve for  $FV = \$133.10$ .

**b. 2. What is the present value of \$100 to be received in 3 years if the appropriate interest rate is 10 percent?**

**Answer:** Finding present values, or discounting (moving to the left along the time line), is the reverse of compounding, and the basic present value equation is the reciprocal of the compounding equation:



$FV_n = PV(1 + i)^n$  transforms to:

$$PV = \frac{FV_n}{(1+i)^n} = FV_n \left( \frac{1}{1+i} \right)^n = FV_n(1+i)^{-n}$$

**thus:**

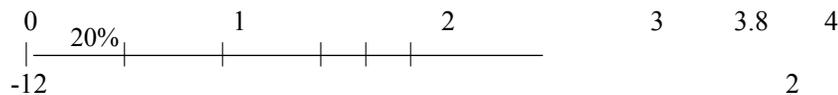
$$PV = \$100 \left( \frac{1}{1.10} \right)^3 = \$100(PVIF_{i,n}) = (0.7513) = \$75.13.$$

**The same methods used for finding future values are also used to find present values.**

Using a financial calculator input N = 3, I = 10, pmt = 0, FV = 100, and then solve for PV = \$75.13.

**c. We sometimes need to find how long it will take a sum of money (or anything else) to grow to some specified amount. For example, if a company's sales are growing at a rate of 20 percent per year, how long will it take sales to double?**

**Answer:** We have this situation in time line format:

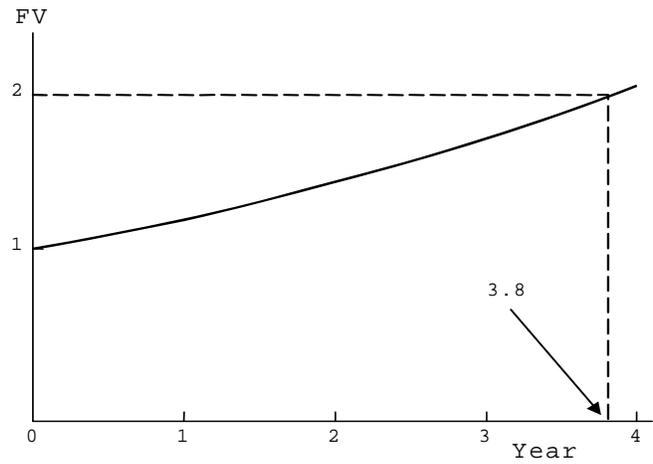


**Say we want to find out how long it will take us to double our money at an interest rate of 20%. We can use any numbers, say \$1 and \$2, with this equation:**

$$\begin{aligned} FV_n = \$2 &= \$1(1+i)^n = \$1(1.20)^n \\ (1.2)^n &= \$2/\$1 = 2 \\ n \text{ LN}(1.2) &= \text{LN}(2) \\ n &= \text{LN}(2)/\text{LN}(1.2) \\ n &= 0.693/0.182 = 3.8. \end{aligned}$$

Alternatively, we could use a financial calculator. We would plug  $I = 20$ ,  $PV = -1$ ,  $PMT = 0$ , and  $FV = 2$  into our calculator, and then press the N button to find the number of years it would take 1

(or any other beginning amount) to double when growth occurs at a 20% rate. The answer is 3.8 years, but some calculators will round this value up to the next highest whole number. The graph also shows what is happening.



**d. If you want an investment to double in three years, what interest rate must it earn?**

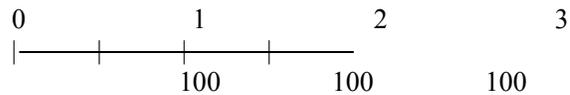
**Answer:**

	0		1		2
3	----- ----- -----				
	-1				
2		$1(1+i)$	$1(1+i)^2$	$1(1+i)^3$	
	$FV = \$1(1+i)^3$		$= \$2.$		
	$\$1(1+i)^3$		$= \$2.$		
	$(1+i)^3$		$= \$2/\$1 = 2.$		
	$1+i$		$= (2)^{1/3}$		
	$1+i$		$= 1.2599$		
	<b>i</b>		<b>= 25.99%.</b>		

Use a financial calculator to solve: enter N = 3, PV = -1, PMT = 0, FV = 2, then press the I button to find I = 25.99%.

Calculators can find interest rates quite easily, even when periods and/or interest rates are not even numbers, and when uneven cash flow streams are involved. (With uneven cash flows, we must use the "CFLO" function, and the interest rate is called the IRR, or "internal rate of return;" we will use this feature in capital budgeting.)

**e. What is the difference between an ordinary annuity and an annuity due? What type of annuity is shown below? How would you change it to the other type of annuity?**

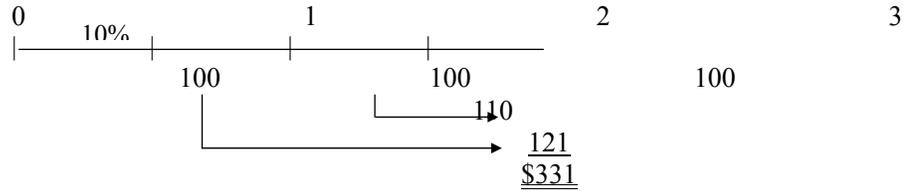


**Answer:** This is an ordinary annuity--it has its payments at the end of each period; that is, the first payment is made 1 period from today. Conversely, an annuity due has its first payment today. In other words, an ordinary annuity has end-of-period payments, while an annuity due has beginning-of-period payments.

The annuity shown above is an ordinary annuity. To convert it to an annuity due, shift each payment to the left, so you end up with a payment under the 0 but none under the 3.

**f. 1. What is the future value of a 3-year ordinary annuity of \$100 if the appropriate interest rate is 10 percent?**

**Answer:**



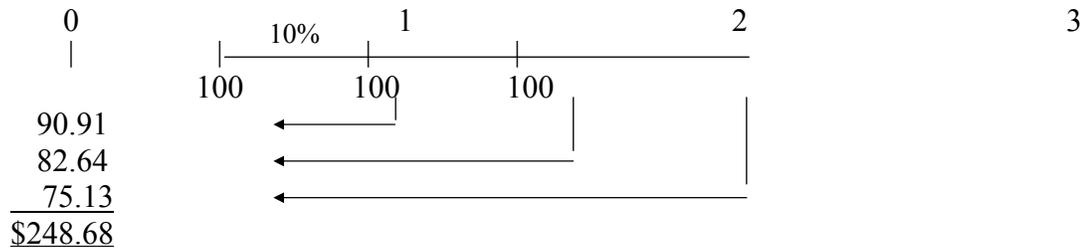
**Go through the following discussion. One approach would be to treat each annuity flow as a lump sum. Here we have**

$$\begin{aligned} FVA_n &= \$100(1) + \$100(1.10) + \$100(1.10)^2 \\ &= \$100[1 + (1.10) + (1.10)^2] = \$100(3.3100) = \$331.00. \end{aligned}$$

**Using a financial calculator, N = 3, I = 10, PV = 0, PMT = -100. This gives FV = \$331.00.**

**f. 2. What is the present value of the annuity?**

**Answer:**



**The present value of the annuity is \$248.68. Using a financial calculator, input N = 3, I = 10, PMT = 100, FV = 0, and press the PV button.**

Spreadsheets are useful for time lines with multiple cash flows. The following spreadsheet shows this problem:

	A	B	C	D
1	0	1	2	3
2		100	100	100
3	248.69			

**The excel formula in cell A3 is = NPV(10%,B2:D2). This gives a result of 248.69. Note that the interest rate can be either 10% or 0.10, not just 10. Also, note that the range does not include any cash flow at time zero.**

Excel also has special functions for annuities. For ordinary annuities, the excel formula is = PV(interest rate, number of periods, payment). In this problem, = PV(10%,3,-100), gives a result of 248.96. For the future value, it would be = FV(10%,3,-100), with a result of 331.

**f. 3. What would the future and present values be if the annuity were an annuity due?**

**Answer:** If the annuity were an annuity due, each payment would be shifted to the left, so each payment is compounded over an additional period or discounted back over one less period.

To find the future value of an annuity due use the following formula:

$$FVA_n(\text{Annuity Due}) = FVA_n(1 + i).$$

In our situation, the future value of the annuity due is \$364.10:

$$FVA_3(\text{Annuity Due}) = \$331.00(1.10)^1 = \$364.10.$$

**This same result could be obtained by using the time line: \$133.10 + \$121.00 + \$110.00 = \$364.10.**

The best way to work annuity due problems is to switch your calculator to "beg" or beginning or "due" mode, and go through the normal process. Note that it's critical to remember to change back to "end" mode after working an annuity due problem with your calculator.

This formula could be used to find the present value of an annuity due:

$$PVA_n(\text{Annuity Due}) = PVA_n(1 + i) = PMT(PVIFA_{i,n})(1 + i).$$

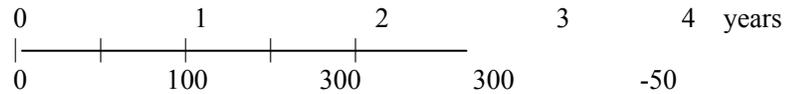
**In our situation, the present value of the annuity due is \$273.56:**

$$PVA_3(\text{Annuity Due}) = \$248.69(1.10)^1 = \$273.56.$$

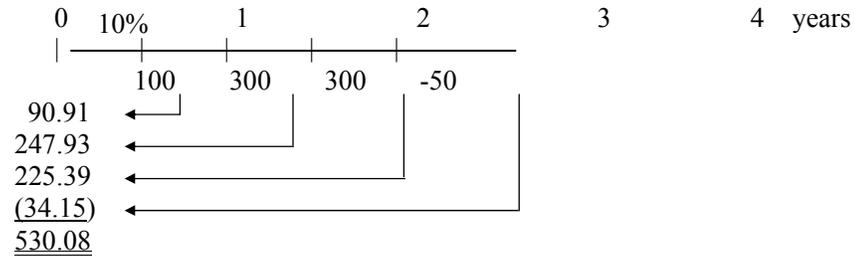
The Excel function is = PV(10%,3,-100,0,1). The fourth term, 0, tells Excel there are no additional cash flows. The fifth term, 1, tells Excel it is an annuity due. The result is \$273.56.

A similar modification gives the future value: = FV(10%,3,-100,0,1), with a result of 364.10.

**g. What is the present value of the following uneven cash flow stream? The appropriate interest rate is 10 percent, compounded annually.**



**Answer:** Here we have an uneven cash flow stream. The most straightforward approach is to find the PVs of each cash flow and then sum them as shown below:



Note (1) that the \$50 year 4 outflow remains an outflow even when discounted. There are numerous ways of finding the present value of an uneven cash flow stream. But by far the easiest way to deal with uneven cash flow streams is with a financial calculator or a spreadsheet. Calculators have a function which on the HP 17B is called "CFLO," for "cash flow." other calculators could use other designations such as  $cf_0$  and  $CF_i$ , but they explain how to use them in the manual. You would input the cash flows, so they are in the calculator's memory, then input the interest rate,  $I$ , and then press the NPV or PV button to find the present value.

Spreadsheets are especially useful for uneven cash flows. The following spreadsheet shows this problem:

	A	B	C	D	E
1	0	1	2	3	4
2		100	300	300	-50
3	530.09				

The Excel formula in cell A3 is = NPV(10%,B2:E2), with a result of 530.09.

**h. 1. Define (a) the stated, or quoted, or nominal rate, ( $i_{Nom}$ ), and (b) the periodic rate ( $i_{Per}$ ).**

**ANSWER:** The quoted, or nominal, rate is merely the quoted percentage rate of return. The periodic rate is the rate charged by a lender or paid by a borrower each period (periodic rate =  $i_{nom}/m$ ).

**h. 2. Will the future value be larger or smaller if we compound an initial amount more often than annually, for example, every 6 months, or semiannually, holding the stated interest rate constant? Why?**

**Answer:** Accounts that pay interest more frequently than once a year, for example, semiannually, quarterly, or daily, have future values that are higher because interest is earned on interest more often. Virtually all banks now pay interest daily on passbook and money fund accounts, so they use daily compounding.

**h. 3. What is the future value of \$100 after 5 years under 12 percent annual compounding? Semiannual compounding? Quarterly compounding? Monthly compounding? Daily compounding**

**Answer:** Under annual compounding, the \$100 is compounded over 5 annual periods at a 12.0 percent periodic rate:

$$i_{\text{Nom}} = 12\%.$$
$$FV_n = PV \left( 1 + \frac{i_{\text{Nom}}}{m} \right)^{mn} = \$100 \left( 1 + \frac{0.12}{1} \right)^{1*5} = \$100(1.12)^5 = \$176.23.$$

Under semiannual compounding, the \$100 is compounded over 10 semiannual periods at a 6.0 percent periodic rate:

$$i_{\text{Nom}} = 12\%.$$
$$FV_n = PV \left( 1 + \frac{i_{\text{Nom}}}{m} \right)^{mn} = \$100 \left( 1 + \frac{0.12}{2} \right)^{2*5} = \$100(1.06)^{10} = \$179.08.$$

quarterly:  $FV_n = \$100(1.03)^{20} = \$180.61.$

monthly:  $FV_n = \$100(1.01)^{60} = \$181.67.$

daily:  $FV_n = \$100(1 + 0.12/365)^{365*5} = \$182.19.$

**h. 4. What is the effective annual rate (EAR)? What is the ear for a nominal rate of 12 percent, compounded semiannually? Compounded quarterly? Compounded monthly? Compounded daily?**

**Answer:** The effective annual rate is the annual rate that causes the PV to grow to the same FV as under multi-period compounding. For 12 percent semiannual compounding, the ear is 12.36 percent:

$$\text{EAR} = \text{Effective Annual Rate} = \left( \frac{1 + i_{\text{Nom}}}{m} \right)^m - 1.0.$$

IF  $i_{\text{Nom}} = 12\%$  and interest is compounded semiannually, then:

$$\text{EAR} = \left( 1 + \frac{0.12}{2} \right)^2 - 1.0 = (1.06)^2 - 1.0 = 1.1236 - 1.0 = 0.1236 = 12.36\%.$$

For quarterly compounding, the effective annual rate is:

$$(1.03)^4 - 1.0 = 12.55\%.$$

For monthly compounding, the effective annual rate is:

$$(1.01)^{12} - 1.0 = 12.55\%.$$

For daily compounding, the effective annual rate is:

$$(1 + 0.12/365)^{365} - 1.0 = 12.75\%.$$

**i. Will the effective annual rate ever be equal to the nominal (quoted) rate?**

**Answer:** If annual compounding is used, then the nominal rate will be equal to the effective annual rate. If more frequent compounding is used, the effective annual rate will be above the nominal rate.



- The interest component is an expense which is deductible to a business or a homeowner, and it is taxable income to the lender. If you buy a house, you will get a schedule constructed like ours, but longer, with  $30 \times 12 = 360$  monthly payments if you get a 30-year, fixed rate mortgage.
- The payment may have to be increased by a few cents in the final year to take care of rounding errors and make the final payment produce a zero ending balance.
- The lender received a 10% rate of interest on the average amount of money that was invested each year, and the \$1,000 loan was paid off. This is what amortization schedules are designed to do.
- Most financial calculators have amortization functions built in.

k. Suppose on January 1 you deposit \$100 in an account that pays a nominal, or quoted, interest rate of 11.33463 percent, with interest added (compounded) daily. How much will you have in your account on October 1, or after 9 months?

**Answer:** The daily periodic interest rate is  $r_{per} = 11.3346\%/365 = 0.031054\%$ . There are 273 days between January 1 and October 1. Calculate FV as follows:

$$FV_{273} = \$100(1.00031054)^{273} \\ = \mathbf{\$108.85.}$$

Using a financial calculator, input  $n = 273$ ,  $i = 0.031054$ ,  $PV = -100$ , and  $PMT = 0$ . Pressing FV gives \$108.85.

An alternative approach would be to first determine the effective annual rate of interest, with daily compounding, using the formula:

$$EAR = \left(1 + \frac{0.1133463}{365}\right)^{365} - 1 = 0.12 = 12.0\%.$$

(Some calculators, e.g., the hp 10b and 17b, have this equation built in under the ICNV [interest conversion] function.)

**Thus, if you left your money on deposit for an entire year, you would earn \$12 of interest, and you would end up with \$112. The question, though, is this: how much will be in your account on October 1, 2002?**

**Here you will be leaving the money on deposit for  $9/12 = 3/4 = 0.75$  of a year.**

0			$12\% \mathbf{0.75}$		1
-100			FV = ?		112

**You would use the regular set-up, but with a fractional exponent:**

$$FV_{0.75} = \$100(1.12)^{0.75} = \$100(1.088713) = \$108.87.$$

This is slightly different from our earlier answer, because  $n$  is actually  $273/365 = 0.7479$  rather than 0.75.

### Fractional time periods

Thus far all of our examples have dealt with full years. Now we are going to look at the situation when we are dealing with fractional years, such as 9 months, or 10 years. In these situations, proceed as follows:

- As always, start by drawing a time line so you can visualize the situation.
- Then think about the interest rate--the nominal rate, the compounding periods per year, and the effective annual rate. If you have been given a nominal rate, you may have to convert to the ear, using this formula:

$$EAR = \left(1 + \frac{i_{\text{Nom}}}{m}\right)^m - 1.$$

- If you have the effective annual rate--either because it was given to you or after you calculated it with the formula--then you can find the PV of a lump sum by applying this equation:

$$PV = FV_t \left(\frac{1}{1 + EAR}\right)^t.$$

- Here  $t$  can be a fraction of a year, such as 0.75, if you need to find the PV of \$1,000 due in 9 months, or  $450/365 = 1.2328767$  if the payment is due in 450 days.
- If you have an annuity with payments different from once a year, say every month, you can always work it out as a series of lump sums. That procedure always works. We can also use annuity formulas and calculator functions, but you have to be careful.



**1. 3. Is the stream an annuity?**

**Answer:** The payment stream is an annuity in the sense of constant amounts at regular intervals, but the intervals do not correspond with the compounding periods. This kind of situation occurs often. In this situation the interest is compounded semiannually, so with a quoted rate of 10%, the ear will be 10.25%. Here we could find the effective rate and then treat it as an annuity. Enter  $N = 3$ ,  $I = 10.25$ ,  $PMT = 100$ , and  $FV = 0$ . Now press PV to get \$247.59.

**1. 4. An important rule is that you should *never* show a nominal rate on a time line or use it in calculations unless what condition holds? (Hint: think of annual compounding, when  $i_{Nom} = EAR = i_{Per}$ .) What would be wrong with your answer to questions 1(1) and 1(2) if you used the nominal rate (10%) rather than the periodic rate ( $i_{Nom}/2 = 10\%/2 = 5\%$ )?**

**Answer:**  $i_{Nom}$  can only be used in the calculations when annual compounding occurs. If the nominal rate of 10% was used to discount the payment stream the present value would be overstated by  $\$272.32 - \$247.59 = \$24.73$ .

**m.** Suppose someone offered to sell you a note calling for the payment of \$1,000 15 months from today. They offer to sell it to you for \$850. You have \$850 in a bank time deposit which pays a 6.76649 percent nominal rate with daily compounding, which is a 7 percent effective annual interest rate, and you plan to leave the money in the bank unless you buy the note. The note is not risky--you are sure it will be paid on schedule. Should you buy the note? Check the decision in three ways: (1) by comparing your future value if you buy the note versus leaving your money in the bank, (2) by comparing the PV of the note with your current bank account, and (3) by comparing the ear on the note versus that of the bank account.

**Answer:** You can solve this problem in three ways--(1) by compounding the \$850 now in the bank for 15 months and comparing that FV with the \$1,000 the note will pay, (2) by finding the PV of the note and then comparing it with the \$850 cost, and (3) finding the effective annual rate of return on the note and comparing that rate with the 7% you are now earning, which is your opportunity cost of capital. All three procedures lead to the same conclusion. Here is the time line:



- (1)  $FV = \$850(1.07)^{1.25} = \$925.01$  = amount in bank after 15 months versus \$1,000 if you buy the note. (Again, you can find this value with a financial calculator. Note that certain calculators like the hp 12c perform a straight-line interpolation for values in a fractional time period analysis rather than an effective interest rate interpolation. The value that the hp 12c calculates is \$925.42.) This procedure indicates that you should buy the note.

Alternatively, 15 months = (1.25 years)(365 days per year) = 456.25 ~ 456 days.

$$FV_{456} = \$850(1.00018538)^{456} \\ = \$924.97.$$

The slight difference is due to using  $n = 456$  rather than  $n = 456.25$ .

- (2)  $PV = \$1,000/(1.07)^{-1.25} = \$918.90$ . Since the present value of the note is greater than the \$850 cost, it is a good deal. You should buy it.

Alternatively,  $PV = \$1000/(1.00018538)^{456} = \$918.95$ .

- (3)  $FV_n = PV(1 + i)^n$ , SO  $\$1,000 = \$850(1 + i)^{1.25} = \$1,000$ . Since we have an equation with one unknown, we can solve it for  $i$ . You will get a value of  $i = 13.88\%$ . The easy way is to plug values into your calculator. Since this return is greater than your 7% opportunity cost, you should buy the note. This action will raise the rate of return on your asset portfolio.

Alternatively, we could solve the following equation:

$$\$1,000 = \$850(1 + i)^{456} \text{ for a daily } i = 0.00035646,$$

With a result of  $EAR = EFF\% = (1.00035646)^{365} - 1 = 13.89\%$ .

## Chapter 3

### Financial Statements, Cash Flow, and Taxes

---

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 3-1
- a. The annual report is a report issued annually by a corporation to its stockholders. It contains basic financial statements, as well as management's opinion of the past year's operations and the firm's future prospects. A firm's balance sheet is a statement of the firm's financial position at a specific point in time. It specifically lists the firm's assets on the left-hand side of the balance sheet, while the right-hand side shows its liabilities and equity, or the claims against these assets. An income statement is a statement summarizing the firm's revenues and expenses over an accounting period. Net sales are shown at the top of each statement, after which various costs, including income taxes, are subtracted to obtain the net income available to common stockholders. The bottom of the statement reports earnings and dividends per share.
  - b. Common Stockholders' Equity (Net Worth) is the capital supplied by common stockholders--capital stock, paid-in capital, retained earnings, and, occasionally, certain reserves. Paid-in capital is the difference between the stock's par value and what stockholders paid when they bought newly issued shares. Retained earnings is the portion of the firm's earnings that have been saved rather than paid out as dividends.
  - c. The statement of retained earnings shows how much of the firm's earnings were retained in the business rather than paid out in dividends. Note that retained earnings represents a claim against assets, not assets per se. Firms retain earnings primarily to expand the business, not to accumulate cash in a bank account. The statement of cash flows reports the impact of a firm's operating, investing, and financing activities on cash flows over an accounting period.
  - d. Depreciation is a non-cash charge against tangible assets, such as buildings or machines. It is taken for the purpose of showing an asset's estimated dollar cost of the capital equipment used up in the production process. Amortization is a non-cash charge against intangible assets, such as goodwill. EBITDA is earnings before interest, taxes, depreciation, and amortization.
  - e. Operating current assets are the current assets used to support operations, such as cash, accounts receivable, and inventory. It does not include short-term investments. Operating current liabilities are the current liabilities that are a natural consequence of the firm's operations, such as accounts payable and accruals. It does not include notes payable or any other short-term debt that charges interest. Net operating working capital is operating current assets minus operating current liabilities. Total net operating capital is sum of net operating working capital and operating long-term assets, such as net plant and equipment. Operating capital also is equal to the net amount of capital raised from investors. This is the amount of interest-bearing debt plus preferred stock plus common equity minus short-term investments.
  - f. Accounting profit is a firm's net income as reported on its income statement. Net cash flow, as opposed to accounting net income, is the sum of net income plus non-cash adjustments. NOPAT, net operating profit after taxes, is the amount of profit a company would generate if it had no debt

- and no financial assets. Free cash flow is the cash flow actually available for distribution to investors after the company has made all investments in fixed assets and working capital necessary to sustain ongoing operations.
- g. Market value added is the difference between the market value of the firm (i.e., the sum of the market value of common equity, the market value of debt, and the market value of preferred stock) and the book value of the firm's common equity, debt, and preferred stock. If the book values of debt and preferred stock are equal to their market values, then MVA is also equal to the difference between the market value of equity and the amount of equity capital that investors supplied. Economic value added represents the residual income that remains after the cost of all capital, including equity capital, has been deducted.
  - h. A progressive tax means the higher one's income, the larger the percentage paid in taxes. Taxable income is defined as gross income less a set of exemptions and deductions which are spelled out in the instructions to the tax forms individuals must file. Marginal tax rate is defined as the tax rate on the last unit of income. Average tax rate is calculated by taking the total amount of tax paid divided by taxable income.
  - i. Capital gain (loss) is the profit (loss) from the sale of a capital asset for more (less) than its purchase price. Ordinary corporate operating losses can be carried backward for 2 years or forward for 20 years to offset taxable income in a given year.
  - j. Improper accumulation is the retention of earnings by a business for the purpose of enabling stockholders to avoid personal income taxes on dividends. An S corporation is a small corporation which, under Subchapter S of the Internal Revenue Code, elects to be taxed as a proprietorship or a partnership yet retains limited liability and other benefits of the corporate form of organization.
- 3-2 The four financial statements contained in most annual reports are the balance sheet, income statement, statement of retained earnings, and statement of cash flows.
- 3-3 No, because the \$20 million of retained earnings would probably not be held as cash. The retained earnings figure represents the reinvestment of earnings by the firm. Consequently, the \$20 million would be an investment in all of the firm's assets.
- 3-5 Operating capital is the amount of interest bearing debt, preferred stock, and common equity used to acquire the company's net operating assets. Without this capital a firm cannot exist, as there is no source of funds with which to finance operations.
- 3-6 NOPAT is the amount of net income a company would generate if it had no debt and held no financial assets. NOPAT is a better measure of the performance of a company's operations because debt lowers income. In order to get a true reflection of a company's operating performance, one would want to take out debt to get a clearer picture of the situation.**
- 3-7 Free cash flow is the cash flow actually available for distribution to investors after the company has made all the investments in fixed assets and working capital necessary to sustain ongoing operations. It is the most important measure of cash flows because it shows the exact amount available to all investors.**

- 3-8 If the business were organized as a partnership or a proprietorship, its income could be taken out by the owners without being subject to double taxation. Also, if you expected to have losses for a few years while the company was getting started, if you were *not* incorporated, and if you had outside income, the business losses could be used to offset your other income and reduce your total tax bill. These factors would lead you to *not* incorporate the business. An alternative would be to organize as an S Corporation, if requirements are met.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

3-1 Corporate yield = 9%; T = 35.5%  
 AT yield =  $9\%(1 - T)$   
 $= 9\%(0.645) = 5.76\%$ .

3-2 Corporate bond yields 8%. Municipal bond yields 6%.

$$\begin{aligned} \text{Equivalent pretax yield} &= \frac{\text{Yield on muni}}{(1 - T)} \\ \text{on taxable bond} & \\ 8\% &= \frac{6\%}{(1 - T)} \\ 0.08 - 0.08T &= 0.06 \\ -0.08T &= -0.02 \\ T &= 25\%. \end{aligned}$$

3-2	Income	\$365,000
	Less Interest deduction	(50,000)
	Plus: Dividends received <sup>a</sup>	<u>4,500</u>
	Taxable income	<u>\$319,500</u>

<sup>a</sup>For a corporation, 70% of dividends received are excluded from taxes; therefore, taxable dividends are calculated as  $\$15,000(1 - 0.70) = \$4,500$ .

$$\text{Tax} = \$22,250 + (\$319,500 - \$100,000)(0.39) = \$22,250 + \$85,605 = \$107,855.$$

After-tax income:

Taxable income	\$319,500
Taxes	(107,855)
Plus Non-taxable dividends received <sup>b</sup>	<u>10,500</u>
Net income	<u>\$222,145</u>

<sup>b</sup>Non-taxable dividends are calculated as  $\$15,000 \times 0.7 = \$10,500$ .

The company's marginal tax rate is 39 percent. The company's average tax rate is  $\$107,855/\$319,500 = 33.76\%$ .

- 3-4 a. Tax =  $\$3,400,000 + (\$10,500,000 - \$10,000,000)(0.35) = \$3,575,000$ .
- b. Tax =  $\$1,000,000(0.35) = \$350,000$ .

c. Tax =  $(\$1,000,000)0.30(0.35) = \$105,000$ .

3-5 A-T yield on FLA bond = 5%.

A-T yield on AT&T bond =  $7.5\% - \text{Taxes} = 7.5\% - 7.5\%(0.35) = 4.875\%$ .

Check: Invest \$10,000 @ 7.5% = \$750 interest.

Pay 35% tax, so A-T income =  $\$750(1 - T) = \$750(0.65) = \$487.50$ .

A-T rate of return =  $\$487.50/\$10,000 = 4.875\%$ .

A-T yield on AT&T preferred stock:

A-T yield =  $6\% - \text{Taxes} = 6\% - 0.3(6\%)(0.35) = 6\% - 0.63\% = 5.37\%$ .

Therefore, invest in AT&T preferred stock. We could make this a harder problem by asking for the tax rate that would cause the company to prefer the Florida bond or the AT&T bond.

3-6 EBIT = \$750,000; DEP = \$200,000; 100% Equity; T = 40%  
 NI = ?; NCF = ?; OCF = ?

First, determine net income by setting up an income statement:

EBIT	\$750,000
Interest	<u>0</u>
EBT	\$750,000
Taxes (40%)	<u>300,000</u>
NI	<u>\$450,000</u>

NCF = NI + DEP =  $\$450,000 + \$200,000 = \$650,000$ .

3-7

a.

<u>Income Statement</u>	
Sales revenues	\$12,000,000
Costs except depreciation	9,000,000
Depreciation	<u>1,500,000</u>
EBT	\$ 1,500,000
Taxes (40%)	<u>600,000</u>
Net income	\$ 900,000
Add back depreciation	<u>1,500,000</u>
Net cash flow	<u>\$ 2,400,000</u>

- b. If depreciation doubled, taxable income would fall to zero and taxes would be zero. Thus, net income would decrease to zero, but net cash flow would rise to \$3,000,000. Menendez would save \$600,000 in taxes, thus increasing its cash flow:

$$\Delta CF = T(\Delta \text{Depreciation}) = 0.4(\$1,500,000) = \$600,000.$$

- c. If depreciation were halved, taxable income would rise to \$2,250,000 and taxes to \$900,000. Therefore, net income would rise to \$1,350,000, but net cash flow would fall to \$2,100,000.
- d. You should prefer to have higher depreciation charges and higher cash flows. Net cash flows are the funds that are available to the owners to withdraw from the firm and, therefore, cash flows should be more important to them than net income.

- 3-8
- $$\begin{aligned} \text{NOPAT} &= \text{EBIT}(1 - \text{Tax rate}) \\ &= \$150,000,000(0.6) \\ &= \$90,000,000. \end{aligned}$$
  - $$\begin{aligned} \text{NOWC}_{03} &= \text{Operating CA} - \text{operating CL} \\ &= \$360,000,000 - (\$90,000,000 + \$60,000,000) \\ &= \$210,000,000. \end{aligned}$$

$$\text{NOWC}_{04} = \$372,000,000 - \$180,000,000 = \$192,000,000.$$
  - $$\begin{aligned} \text{Operating capital}_{03} &= \begin{array}{l} \text{Net plant} \\ \text{and equipment} \end{array} + \begin{array}{l} \text{Net operating} \\ \text{working capital} \end{array} \\ &= \$250,000,000 + \$210,000,000 \\ &= \$460,000,000. \end{aligned}$$

$$\begin{aligned} \text{Operating capital}_{04} &= \$300,000,000 + \$192,000,000 \\ &= \$492,000,000. \end{aligned}$$
  - $$\begin{aligned} \text{FCF} &= \text{NOPAT} - \text{Net investment in operating capital} \\ &= \$90,000,000 - (\$492,000,000 - \$460,000,000) \\ &= \$58,000,000. \end{aligned}$$
  - The large increase in dividends for 2004 can most likely be attributed to a large increase in free cash flow from 2003 to 2004, since FCF represents the amount of cash available to be paid out to stockholders after the company has made all investments in fixed assets and working capital necessary to sustain the business.

3-9

Prior Years	2002	2003
Profit earned	\$150,000	\$150,000
Carry-back credit	150,000	150,000
Adjusted profit	\$ 0	0
Tax previously paid (40%)		60,000
Tax refund: Taxes		60,000

previously paid                      \$ 60,000    \$ 60,000

Total check from U.S. Treasury = \$60,000 + \$60,000 = \$120,000.

<u>2009</u>	<u>Future Years</u>	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>  </u>
	Estimated profit	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000
	Carry-forward credit	<u>150,000</u>	<u>150,000</u>	<u>50,000</u>	<u>0</u>	<u>  </u>
<u>0</u>	Adjusted profit	\$ 0	\$ 0	\$100,000	\$150,000	<u>  </u>
\$150,000	Tax (at 40%)	<u>0</u>	<u>\$ 0</u>	<u>\$ 40,000</u>	<u>\$ 60,000</u>	<u>  </u>
<u>\$ 60,000</u>						

## **SOLUTION TO SPREADSHEET PROBLEM**

---

**3-13** The detailed solution for the spreadsheet problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 03 P13 Build a Model.xls*) and on the instructor's side of the book's web site, <http://brigham.swcollege.com>.

## MINI CASE

Donna Jamison, a recent graduate of the University of Tennessee with four years of banking experience, was recently brought in as assistant to the chairman of the board of Computron Industries, a manufacturer of electronic calculators.

The company doubled its plant capacity, opened new sales offices outside its home territory, and launched an expensive advertising campaign. Computron's results were not satisfactory, to put it mildly. Its board of directors, which consisted of its president and vice-president plus its major stockholders (who were all local business people), was most upset when directors learned how the expansion was going. Suppliers were being paid late and were unhappy, and the bank was complaining about the deteriorating situation and threatening to cut off credit. As a result, Al Watkins, Computron's president, was informed that changes would have to be made, and quickly, or he would be fired. Also, at the board's insistence Donna Jamison was brought in and given the job of assistant to Fred Campo, a retired banker who was Computron's chairman and largest stockholder. Campo agreed to give up a few of his golfing days and to help nurse the company back to health, with Jamison's help.

Jamison began by gathering financial statements and other data. Assume that you are Jamison's assistant, and you must help her answer the following questions for Campo.

### Balance Sheets

<u>Assets</u>	2003	2004
Cash	\$ 9,000	\$ 7,282
Short-term investments.	48,600	20,000
Accounts receivable	351,200	632,160
Inventories	715,200	1,287,360
total current assets	\$ 1,124,000	\$ 1,946,802
Gross fixed assets	491,000	1,202,950
Less: accumulated depreciation	146,200	263,160
net fixed assets	\$ 344,800	\$ 939,790
Total assets	\$ 1,468,800	\$ 2,886,592
<u>Liabilities and equity</u>	2003	2004
Accounts payable	\$ 145,600	\$ 324,000
Notes payable	200,000	720,000
Accruals	136,000	284,960
total current liabilities	\$ 481,600	\$ 1,328,960
Long-term debt	323,432	1,000,000
Common stock (100,000 shares)	460,000	460,000
Retained earnings	203,768	97,632
total equity	\$ 663,768	\$ 557,632
Total liabilities and equity	\$ 1,468,800	\$ 2,886,592

**Income Statements**

	2003	2004
Sales	\$ 3,432,000	\$ 5,834,400
Cost of goods sold	2,864,000	4,980,000
Other expenses	340,000	720,000
Depreciation	18,900	116,960
total operating costs	\$ 3,222,900	\$ 5,816,960
EBIT	\$ 209,100	\$ 17,440
Interest expense	62,500	176,000
EBT	\$ 146,600	\$ (158,560)
Taxes (40%)	58,640	(63,424)
Net income	\$ 87,960	\$ (95,136)

<b>Other data</b>	2002	2003
Stock price	\$ 8.50	\$ 6.00
Shares outstanding	100,000	100,000
EPS	\$ 0.880	\$ (0.951)
DPS	\$ 0.220	\$ 0.110

**Statement of retained earnings, 2004**

Balance of retained earnings, 12/31/2003	\$ 203,768
add: net income, 2004	\$ (95,136)
less: dividend paid, 2004	\$ (11,000)
Balance of retained earnings, 12/31/2004	\$ 97,632

**Statement of Cash Flows**

**Operating activities**

Net income	\$ (95,136)
Adjustments:	
noncash adjustments:	
depreciation	116,960
changes in working capital:	
change in accounts receivable	(280,960)
change in inventories	(572,160)
change in accounts payable	178,400
change in accruals	148,960
Net cash provided by operating activities	\$ (503,936)

**Long-term investing activities**

Cash used to acquire fixed assets	\$ (711,950)
-----------------------------------	--------------

**Financing activities**

change in short term investments	\$ 28,600
change in notes payable	\$ 520,000
change in long-term debt	\$ 676,568
change in common stock	\$ -
payment of cash dividends	\$ (11,000)
Net cash provided by financing activities	\$ 1,214,168

**Summary**

Net change in cash	\$ (1,718)
Cash at beginning of year	9,000
Cash at end of year	\$ 7,282

**a. What effect did the expansion have on sales and net income? What effect did the expansion have on the asset side of the balance sheet? What effect did it have on liabilities and equity?**

**Answer:** Sales increased by over by over \$2.4 million, but net income fell by over \$190,000. Assets almost doubled. Debt and funds provided by suppliers increased, but retained earnings fell due to the year's loss.

**b. What do you conclude from the statement of cash flows?**

**Answer:** Net CF from operations = -\$503,936, because of negative net income and increases in working capital. The firm spent \$711,950 on FA. The firm borrowed heavily and sold some short-term investments to meet its cash requirements. Even after borrowing, the cash account fell by \$1,718.

**c. What is free cash flow? Why is it important? What are the five uses of FCF?**

**Answer:** FCF is the amount of cash available from operations for distribution to all investors (including stockholders and debtholders) after making the necessary investments to support operations. A company's value depends upon the amount of FCF it can generate.

1. Pay interest on debt.
2. Pay back principal on debt.
3. Pay dividends.
4. Buy back stock.
5. Buy nonoperating assets (e.g., marketable securities, investments in other companies, etc.)

**d. What are operating current assets? What are operating current liabilities? How much net operating working capital and total net operating capital does Computron have?**

**Answer:** Operating current assets are the CA needed to support operations. OP CA include: cash, inventory, receivables. OP CA exclude: short-term investments, because these are not a part of operations. Operating current liabilities are the CL resulting as a normal part of operations. OP CL include: accounts payable and accruals. OP CA exclude: notes payable, because this is a source of financing, not a part of operations.

$$\text{NOWC} = \text{operating CA} - \text{operating CL}$$

$$\begin{aligned}\text{NOWC}_{04} &= (\$7,282 + \$632,160 + \$1,287,360) - (\$324,000 + \$284,960) \\ &= \$1,317,842.\end{aligned}$$

$$\text{NOWC}_{03} = \$793,800.$$

$$\text{Total operating working capital} = \text{NOWC} + \text{net fixed assets}.$$

$$\begin{aligned}\text{Operating capital in 2004} &= \$1,317,842 + \$939,790 \\ &= \$2,257,632.\end{aligned}$$

$$\text{Operating capital in 2003} = \$1,138,600.$$

**e. What are Computron's net operating profit after taxes (NOPAT) and free cash flow (FCF)?**

**ANSWER:**  $\text{NOPAT} = \text{EBIT}(1 - \text{TAX RATE})$

$$\begin{aligned}\text{NOPAT}_{04} &= \$17,440(1 - 0.4) \\ &= \$10,464.\end{aligned}$$

$$\text{NOPAT}_{03} = \$125,460.$$

$$\begin{aligned}\text{FCF} &= \text{NOPAT} - \text{NET INVESTMENT IN CAPITAL} \\ &= \$10,464 - (\$2,257,632 - \$1,138,600) \\ &= \$10,464 - \$1,119,032 \\ &= -\$1,108,568.\end{aligned}$$

f. Calculate Computron's return on invested capital. Computron has a 10% cost of capital (WACC). Do you think Computron's growth added value?

ANSWER: ROIC = NOPAT / TOTAL NET OPERATING CAPITAL.

$$\begin{aligned}\text{ROIC}_{04} &= \$10,464 / \$2,257,632 \\ &= 0.5\%.\end{aligned}$$

$$\text{ROIC}_{03} = 11.0\%.$$

The ROIC of 0.5% is less than the WACC of 10%. Investors did not get the return they require. Note: high growth usually causes negative FCF (due to investment in capital), but that's ok if ROIC > WACC. For example, home depot has high growth, negative FCF, but a high ROIC.

g. Jamison also has asked you to estimate Computron's EVA. She estimates that the after-tax cost of capital was 10 percent in both years.

ANSWER: EVA = NOPAT - (WACC)(CAPITAL).

$$\begin{aligned}\text{EVA}_{04} &= \$10,464 - (0.1)(\$2,257,632) \\ &= \$10,464 - \$225,763 \\ &= -\$215,299.\end{aligned}$$

$$\begin{aligned}\text{EVA}_{03} &= \$125,460 - (0.10)(\$1,138,600) \\ &= \$125,460 - \$113,860 \\ &= \$11,600.\end{aligned}$$

h. What happened to Computron's market value added (MVA)?

Answer: MVA = market value of the firm - book value of the firm.

Market value = (# shares of stock)(price per share) + value of debt.

Book value = total common equity + value of debt.

If the market value of debt is close to the book value of debt, then MVA is market value of equity minus book value of equity. Assume market value of debt equals book value of debt.

$$\text{Market value of equity 2003} = (100,000)(\$6.00) = \$600,000.$$

$$\text{Book value of equity 2003} = \$557,632.$$

$$\text{MVA}_{03} = \$600,000 - \$557,632 = \$42,368.$$

$$\text{MVA}_{02} = \$850,000 - \$663,768 = \$186,232.$$

i. Assume that a corporation has \$100,000 of taxable income from operations plus \$5,000 of interest income and \$10,000 of dividend income. What is the company's tax liability?

**Answer:** Calculation of the company's tax liability:

Taxable operating income	\$100,000
Taxable interest income	5,000
Taxable dividend income ( $0.3 \times \$10,000$ )	<u>3,000</u>
Total taxable income	<u>\$108,000</u>

$$\text{Tax} = \$22,250 + (\$108,000 - \$100,000)0.39 = \$25,370.$$

$$\begin{aligned}\text{taxable dividend income} &= \text{dividends} - \text{exclusion} \\ &= \$10,000 - 0.7(\$10,000) \\ &= \$3,000.\end{aligned}$$

j. Assume that you are in the 27 percent marginal tax bracket and that you have \$5,000 to invest. You have narrowed your investment choices down to California bonds with a yield of 7 percent or equally risky Exxon bonds with a yield of 10 percent. Which one should you choose and why? At what marginal tax rate would you be indifferent to the choice between California and Exxon bonds?

**Answer:** After-tax return income at  $t = 27\%$ :

$$\text{Exxon} = 0.10(\$5,000) - (0.10)(\$5,000)(0.27) = \$365.$$

$$\text{California} = 0.07(\$5,000) - \$0 = \$350.$$

Alternatively, calculate after-tax yields:

$$\text{A-T yield}_{\text{Exxon}} = 10.0\%(1 - t) = 10\%(1 - 0.27) = 7.3\%.$$

$$\text{A-T yield}_{\text{Calif.}} = 7.0\%.$$

At what marginal tax rate would you be indifferent?

$$7.0\% = 10.0\%(1 - t). \quad \text{Solve for } t.$$

$$7.0\% = 10.0\% - 10.0\%(t)$$

$$10.0\%(t) = 3\%$$

$$t = 30\%.$$

# Chapter 4

## Risk and Return: The Basics

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 4-1
- a. Stand-alone risk is only a part of total risk and pertains to the risk an investor takes by holding only one asset. Risk is the chance that some unfavorable event will occur. For instance, the risk of an asset is essentially the chance that the asset's cash flows will be unfavorable or less than expected. A probability distribution is a listing, chart or graph of all possible outcomes, such as expected rates of return, with a probability assigned to each outcome. When in graph form, the tighter the probability distribution, the less uncertain the outcome.
  - b. The expected rate of return ( $\hat{r}$ ) is the expected value of a probability distribution of expected returns.
  - c. A continuous probability distribution contains an infinite number of outcomes and is graphed from  $-\infty$  and  $+\infty$ .
  - d. The standard deviation ( $\sigma$ ) is a statistical measure of the variability of a set of observations. The variance ( $\sigma^2$ ) of the probability distribution is the sum of the squared deviations about the expected value adjusted for deviation. The coefficient of variation (CV) is equal to the standard deviation divided by the expected return; it is a standardized risk measure which allows comparisons between investments having different expected returns and standard deviations.
  - e. A risk averse investor dislikes risk and requires a higher rate of return as an inducement to buy riskier securities. A realized return is the actual return an investor receives on their investment. It can be quite different than their expected return.
  - f. A risk premium is the difference between the rate of return on a risk-free asset and the expected return on Stock *i* which has higher risk. The market risk premium is the difference between the expected return on the market and the risk-free rate.
  - g. CAPM is a model based upon the proposition that any stock's required rate of return is equal to the risk free rate of return plus a risk premium reflecting only the risk re-maining after diversification.
  - h. The expected return on a portfolio,  $\hat{r}_p$ , is simply the weighted-average expected return of the individual stocks in the portfolio, with the weights being the fraction of total portfolio value invested in each stock. The market portfolio is a portfolio consisting of all stocks.
  - i. Correlation is the tendency of two variables to move together. A correlation coefficient ( $\rho$ ) of +1.0 means that the two variables move up and down in perfect synchronization, while a coefficient of -1.0 means the variables always move in opposite directions. A correlation coefficient of zero suggests that the two variables are not related to one another; that is, they are independent.

- j. Market risk is that part of a security's total risk that cannot be eliminated by diversification. It is measured by the beta coefficient. Diversifiable risk is also known as company specific risk, that part of a security's total risk associated with random events not affecting the market as a whole. This risk can be eliminated by proper diversification. The relevant risk of a stock is its contribution to the riskiness of a well-diversified portfolio.
- k. The beta coefficient is a measure of a stock's market risk, or the extent to which the returns on a given stock move with the stock market. The average stock's beta would move on average with the market so it would have a beta of 1.0.
- l. The security market line (SML) represents in a graphical form, the relationship between the risk of an asset as measured by its beta and the required rates of return for individual securities. The SML equation is essentially the CAPM,  $r_i = r_{RF} + b_i(r_M - r_{RF})$ .
- m. The slope of the SML equation is  $(r_M - r_{RF})$ , the market risk premium. The slope of the SML reflects the degree of risk aversion in the economy. The greater the average investors aversion to risk, then the steeper the slope, the higher the risk premium for all stocks, and the higher the required return.
- 4-2 a. The probability distribution for complete certainty is a vertical line.
- b. The probability distribution for total uncertainty is the X axis from  $-\infty$  to  $+\infty$ .
- 4-3 Security A is less risky if held in a diversified portfolio because of its lower beta and negative correlation with other stocks. In a single-asset portfolio, Security A would be more risky because  $\sigma_A > \sigma_B$  and  $CV_A > CV_B$ .
- 4-4 a. No, it is not riskless. The portfolio would be free of default risk and liquidity risk, but inflation could erode the portfolio's purchasing power. If the actual inflation rate is greater than that expected, interest rates in general will rise to incorporate a larger inflation premium (IP) and the value of the portfolio would decline.
- b. No, you would be subject to reinvestment rate risk. You might expect to "roll over" the Treasury bills at a constant (or even increasing) rate of interest, but if interest rates fall, your investment income will decrease.
- c. A U.S. government-backed bond that provided interest with constant purchasing power (that is, an indexed bond) would be close to riskless.
- 4-5 The risk premium on a high beta stock would increase more.
- $$RP_j = \text{Risk Premium for Stock } j = (r_M - r_{RF})b_j.$$
- If risk aversion increases, the slope of the SML will increase, and so will the market risk premium  $(r_M - r_{RF})$ . The product  $(r_M - r_{RF})b_j$  is the risk premium of the jth stock. If  $b_j$  is low (say, 0.5), then the product will be small;  $RP_j$  will increase by only half the increase in  $RP_M$ . However, if  $b_j$  is large (say, 2.0), then its risk premium will rise by twice the increase in  $RP_M$ .
- 4-6 According to the Security Market Line (SML) equation, an increase in beta will increase a company's expected return by an amount equal to the market risk premium times the change in beta. For example, assume that the risk-free rate is 6 percent, and the market risk premium is 5 percent. If the

company's beta doubles from 0.8 to 1.6 its expected return increases from 10 percent to 14 percent. Therefore, in general, a company's expected return will not double when its beta doubles.

- 4-7 Yes, if the portfolio's beta is equal to zero. In practice, however, it may be impossible to find individual stocks that have a nonpositive beta. In this case it would also be impossible to have a stock portfolio with a zero beta. Even if such a portfolio could be constructed, investors would probably be better off just purchasing Treasury bills, or other zero beta investments.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

4-1  $\hat{r} = (0.1)(-50\%) + (0.2)(-5\%) + (0.4)(16\%) + (0.2)(25\%) + (0.1)(60\%)$   
 $= 11.40\%$ .

$$\sigma^2 = (-50\% - 11.40\%)^2(0.1) + (-5\% - 11.40\%)^2(0.2) + (16\% - 11.40\%)^2(0.4)$$

$$+ (25\% - 11.40\%)^2(0.2) + (60\% - 11.40\%)^2(0.1)$$

$\sigma^2 = 712.44$ ;  $\sigma = 26.69\%$ .

$$CV = \frac{26.69\%}{11.40\%} = 2.34.$$

4-2	Investment	Beta
	\$35,000	0.8
	<u>40,000</u>	1.4
	Total <u>\$75,000</u>	

$$(\$35,000/\$75,000)(0.8) + (\$40,000/\$75,000)(1.4) = 1.12.$$

4-3  $r_{RF} = 5\%$ ;  $RP_M = 6\%$ ;  $r_M = ?$

$$r_M = 5\% + (6\%)1 = 11\%.$$

$r_s$  when  $b = 1.2 = ?$

$$r_s = 5\% + 6\%(1.2) = 12.2\%.$$

4-4  $r_{RF} = 6\%$ ;  $r_M = 13\%$ ;  $b = 0.7$ ;  $r_s = ?$

$$r_s = r_{RF} + (r_M - r_{RF})b$$

$$= 6\% + (13\% - 6\%)0.7$$

$$= 10.9\%.$$

4-5 a.  $\hat{r}_m = (0.3)(15\%) + (0.4)(9\%) + (0.3)(18\%) = 13.5\%$ .

b.  $\hat{r}_j = (0.3)(20\%) + (0.4)(5\%) + (0.3)(12\%) = 11.6\%$ .  
 $\sigma_M = [(0.3)(15\% - 13.5\%)^2 + (0.4)(9\% - 13.5\%)^2 + (0.3)(18\% - 13.5\%)^2]^{1/2}$   
 $= \sqrt{14.85\%} = 3.85\%$ .

$\sigma_J = [(0.3)(20\% - 11.6\%)^2 + (0.4)(5\% - 11.6\%)^2 + (0.3)(12\% - 11.6\%)^2]^{1/2}$   
 $= \sqrt{38.64\%} = 6.22\%$ .

c.  $CV_M = \frac{3.85\%}{13.5\%} = 0.29$ .

$CV_J = \frac{6.22\%}{11.6\%} = 0.54$ .

4-6 a.  $r_A = r_{RF} + (r_M - r_{RF})b_A$   
 $12\% = 5\% + (10\% - 5\%)b_A$   
 $12\% = 5\% + 5\%(b_A)$   
 $7\% = 5\%(b_A)$   
 $1.4 = b_A$ .

b.  $r_A = 5\% + 5\%(b_A)$   
 $r_A = 5\% + 5\%(2)$   
 $r_A = 15\%$ .

4-7 a.  $r_i = r_{RF} + (r_M - r_{RF})b_i = 9\% + (14\% - 9\%)1.3 = 15.5\%$ .

b. 1.  $r_{RF}$  increases to 10%:

$r_M$  increases by 1 percentage point, from 14% to 15%.

$r_i = r_{RF} + (r_M - r_{RF})b_i = 10\% + (15\% - 10\%)1.3 = 16.5\%$ .

2.  $r_{RF}$  decreases to 8%:

$r_M$  decreases by 1%, from 14% to 13%.

$r_i = r_{RF} + (r_M - r_{RF})b_i = 8\% + (13\% - 8\%)1.3 = 14.5\%$ .

c. 1.  $r_M$  increases to 16%:

$r_i = r_{RF} + (r_M - r_{RF})b_i = 9\% + (16\% - 9\%)1.3 = 18.1\%$ .

2.  $r_M$  decreases to 13%:

$r_i = r_{RF} + (r_M - r_{RF})b_i = 9\% + (13\% - 9\%)1.3 = 14.2\%$ .

$$4-8 \quad \text{Old portfolio beta} = \frac{\$142,500}{\$150,000}(b) + \frac{\$7,500}{\$150,000}(1.00)$$

$$1.12 = 0.95b + 0.05$$

$$1.07 = 0.95b$$

$$1.13 = b.$$

$$\text{New portfolio beta} = 0.95(1.13) + 0.05(1.75) = 1.16.$$

Alternative Solutions:

$$1. \quad \text{Old portfolio beta} = 1.12 = (0.05)b_1 + (0.05)b_2 + \dots + (0.05)b_{20}$$

$$1.12 = (\Sigma b_i)(0.05)$$

$$\Sigma b_i = 1.12/0.05 = 22.4.$$

$$\text{New portfolio beta} = (22.4 - 1.0 + 1.75)(0.05) = 1.1575 = 1.16.$$

$$2. \quad \Sigma b_i \text{ excluding the stock with the beta equal to } 1.0 \text{ is } 22.4 - 1.0 = 21.4, \text{ so the beta of the portfolio excluding this stock is } b = 21.4/19 = 1.1263. \quad \text{The beta of the new portfolio is:}$$

$$1.1263(0.95) + 1.75(0.05) = 1.1575 = 1.16.$$

$$4-9 \quad \text{Portfolio beta} = \frac{\$400,000}{\$4,000,000}(1.50) + \frac{\$600,000}{\$4,000,000}(-0.50)$$

$$+ \frac{\$1,000,000}{\$4,000,000}(1.25) + \frac{\$2,000,000}{\$4,000,000}(0.75)$$

$$= 0.1(1.5) + (0.15)(-0.50) + (0.25)(1.25) + (0.5)(0.75)$$

$$= 0.15 - 0.075 + 0.3125 + 0.375 = 0.7625.$$

$$r_p = r_{RF} + (r_M - r_{RF})(b_p) = 6\% + (14\% - 6\%)(0.7625) = 12.1\%.$$

Alternative solution: First compute the return for each stock using the CAPM equation [ $r_{RF} + (r_M - r_{RF})b$ ], and then compute the weighted average of these returns.

$$r_{RF} = 6\% \text{ and } r_M - r_{RF} = 8\%.$$

	Stock	Investment	Beta	$r = r_{RF} + (r_M - r_{RF})b$	Weight
0.10	A	\$ 400,000	1.50		18%
0.15	B	600,000	(0.50)		2
0.25	C	1,000,000	1.25		16
0.50	D	<u>2,000,000</u>	0.75		12
<u>1.00</u>	Total				<u>\$4,000,000</u>

$$r_p = 18\%(0.10) + 2\%(0.15) + 16\%(0.25) + 12\%(0.50) = 12.1\%.$$

4-10 First, calculate the beta of what remains after selling the stock:

$$b_p = 1.1 = (\$100,000/\$2,000,000)0.9 + (\$1,900,000/\$2,000,000)b_R$$

$$1.1 = 0.045 + (0.95)b_R$$

$$b_R = 1.1105.$$

$$b_N = (0.95)1.1105 + (0.05)1.4 = 1.125.$$

4-11 We know that  $b_R = 1.50$ ,  $b_S = 0.75$ ,  $r_M = 13\%$ ,  $r_{RF} = 7\%$ .

$$r_i = r_{RF} + (r_M - r_{RF})b_i = 7\% + (13\% - 7\%)b_i.$$

$$r_R = 7\% + 6\%(1.50) = 16.0\%$$

$$r_S = 7\% + 6\%(0.75) = \underline{11.5}$$

$$\underline{\underline{4.5\%}}$$

4-12 The answers to a, b, c, and d are given below:

	2000	$r_A$ (18.00%)	$r_B$ (14.50%)	Portfolio (16.25%)
		2001	33.00	21.80
27.40		2002	15.00	30.50
22.75		2003	(0.50)	(7.60)
(4.05)				

26.65	2004	27.00	26.30
11.30	Mean	11.30	11.30
20.13	Std Dev	20.79	20.78
	CV	1.84	1.84
	1.78		

e. A risk-averse investor would choose the portfolio over either Stock A or Stock B alone, since the portfolio offers the same expected return but with less risk. This result occurs because returns on A and B are not perfectly positively correlated ( $\rho_{AB} = 0.88$ ).

4-13 a.  $b_X = 1.3471$ ;  $b_Y = 0.6508$ .

b.  $r_X = 6\% + (5\%)1.3471 = 12.7355\%$ .  
 $r_Y = 6\% + (5\%)0.6508 = 9.2540\%$ .

c.  $b_p = 0.8(1.3471) + 0.2(0.6508) = 1.2078$ .  
 $r_p = 6\% + (5\%)1.2078 = 12.04\%$ .  
Alternatively,  
 $r_p = 0.8(12.7355\%) + 0.2(9.254\%) = 12.04\%$ .

d. Stock X is undervalued, because its expected return exceeds its required rate of return.

## SOLUTION TO SPREADSHEET PROBLEM

---

- 4-14 The detailed solution for the spreadsheet problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 04 P14 Build a Model.xls*) and on the instructor's side of the textbook's web site, [brigham.swcollege.com](http://brigham.swcollege.com).

## MINI CASE

Assume that you recently graduated with a major in finance, and you just landed a job as a financial planner with Barney Smith Inc., a large financial services corporation. Your first assignment is to invest \$100,000 for a client. Because the funds are to be invested in a business at the end of one year, you have been instructed to plan for a one-year holding period. Further, your boss has restricted you to the following investment alternatives, shown with their probabilities and associated outcomes. (Disregard for now the items at the bottom of the data; you will fill in the blanks later.)

<u>Returns On Alternative Investments</u>							
<u>Estimated Rate Of Return</u>							
	State of the Market		T- 2-stock		Alta Repo		Am.
<u>economy</u>	<u>prob.</u>	<u>Bills</u>	<u>Inds</u>	<u>Men</u>	<u>Foam</u>	<u>portfolio</u>	<u>portfolio</u>
Recession	0.1	8.0%	-22.0%	28.0%	10.0%*	-13.0%	3.0%
Below avg	0.2	8.0	-2.0	14.7	-10.0	1.0	
Average	0.4	8.0	20.0	0.0	7.0	15.0	10.0
Above avg	0.2	8.0	35.0	-10.0	45.0	29.0	
Boom	0.1	8.0	50.0	-20.0	30.0	43.0	15.0
r-hat ( $\hat{r}$ )				1.7%	13.8%	15.0%	
Std dev ( $\sigma$ )	0.0		13.4	18.8	15.3		
		Coef of var (cv)		7.9	1.4	1.0	
		beta (b)		-0.86	0.68		

\*Note that the estimated returns of American Foam do not always move in the same direction as the overall economy. For example, when the economy is below average, consumers purchase fewer mattresses than they would if the economy was stronger. However, if the economy is in a flat-out recession, a large number of consumers who were planning to purchase a more expensive inner spring mattress may purchase, instead, a cheaper foam mattress. Under these circumstances, we would expect American Foam's stock price to be higher if there is a recession than if the economy was just below average.

Barney Smith's economic forecasting staff has developed probability estimates for the state of the economy, and its security analysts have developed a sophisticated computer program which was used to estimate the rate of return on each alternative under each state of the economy. Alta Industries is an electronics firm; Repo Men collects past-due debts; and American Foam manufactures mattresses and other foam products. Barney Smith also maintains an "index fund" which owns a market-weighted fraction of all publicly traded stocks; you can invest in that fund, and thus obtain average stock market results. Given the situation as described, answer the following questions.

**a. What are investment returns? What is the return on an investment that costs \$1,000 and is sold after one year for \$1,100?**

**Answer:** Investment return measures the financial results of an investment. They may be expressed in either dollar terms or percentage terms.

The dollar return is  $\$1,100 - \$1,000 = \$100$ . The percentage return is  $\$100/\$1,000 = 0.10 = 10\%$ .

**b. 1. Why is the t-bill's return independent of the state of the economy? Do t-bills promise a completely risk-free return?**

**Answer:** The 8 percent t-bill return does not depend on the state of the economy because the treasury must (and will) redeem the bills at par regardless of the state of the economy.

The t-bills are risk-free in the default risk sense because the 8 percent return will be realized in all possible economic states. However, remember that this return is composed of the real risk-free rate, say 3 percent, plus an inflation premium, say 5 percent. Since there is uncertainty about inflation, it is unlikely that the realized real rate of return would equal the expected 3 percent. For example, if inflation averaged 6 percent over the year, then the realized real return would only be  $8\% - 6\% = 2\%$ , not the expected 3%. Thus, in terms of purchasing power, t-bills are not riskless.

Also, if you invested in a portfolio of T-bills, and rates then declined, your nominal income would fall; that is, t-bills are exposed to reinvestment rate risk. So, we conclude that there are no truly risk-free securities in the United States. If the treasury sold inflation-indexed, tax-exempt bonds, they would be truly riskless, but all actual securities are exposed to some type of risk.

**b. 2. Why are Alta Ind.'s returns expected to move with the economy whereas Repo Men's are expected to move counter to the economy?**

**Answer:** Alta Industries' returns move with, hence are positively correlated with, the economy, because the firm's sales, and hence profits, will generally experience the same type of ups and downs as the economy. If the economy is booming, so will Alta. On the other hand, Repo Men is considered by many investors to be a hedge against both bad times and high inflation, so if the stock market crashes, investors in this stock should do relatively well. Stocks such as Repo Men are thus negatively correlated with (move counter to) the economy. (note: in actuality, it is almost impossible to find stocks that are expected to move counter to the economy. Even Repo Men shares have positive (but low) correlation with the market.)

**c. Calculate the expected rate of return on each alternative and fill in the blanks on the row for  $\hat{r}$  in the table above.**

**Answer:** The expected rate of return,  $\hat{r}$ , is expressed as follows:

$$\hat{r} = \sum_{i=1}^n P_i r_i.$$

Here  $P_i$  is the probability of occurrence of the  $i$ th state,  $r_i$  is the estimated rate of return for that state, and  $n$  is the number of states. Here is the calculation for Alta Inds.:

$$\begin{aligned}\hat{r}_{\text{Alta Inds}} &= 0.1(-22.0\%) + 0.2(-2.0\%) + 0.4(20.0\%) + 0.2(35.0\%) + 0.1(50.0\%) \\ &= 17.4\%.\end{aligned}$$

We use the same formula to calculate  $r$ 's for the other alternatives:

$$\hat{r}_{\text{T-bills}} = 8.0\%.$$

$$\hat{r}_{\text{Repo Men}} = 1.7\%.$$

$$\hat{r}_{\text{Am Foam}} = 13.8\%.$$

$$\hat{r}_M = 15.0\%.$$

**d. You should recognize that basing a decision solely on expected returns is only appropriate for risk-neutral individuals. Since your client, like virtually everyone, is risk averse, the**

**riskiness of each alternative is an important aspect of the decision. One possible measure of risk is the standard deviation of returns.**

- 1. Calculate this value for each alternative, and fill in the blank on the row for  $\sigma$  in the table above.**

**Answer:** The standard deviation is calculated as follows:

$$\sigma = \sqrt{\sum_{i=1}^n (r_i - \hat{r}_i)^2 P_i}$$

$$\begin{aligned}\sigma_{\text{Alta}} &= [(-22.0 - 17.4)^2(0.1) + (-2.0 - 17.4)^2(0.2) + (20.0 - 17.4)^2(0.4) \\ &\quad + (35.0 - 17.4)^2(0.2) + (50.0 - 17.4)^2(0.1)]^{0.5} \\ &= \sqrt{401.4} = 20.0\%.\end{aligned}$$

Here are the standard deviations for the other alternatives:

$$\sigma_{\text{T-bills}} = 0.0\%.$$

$$\sigma_{\text{Repo}} = 13.4\%.$$

$$\sigma_{\text{Am Foam}} = 18.8\%.$$

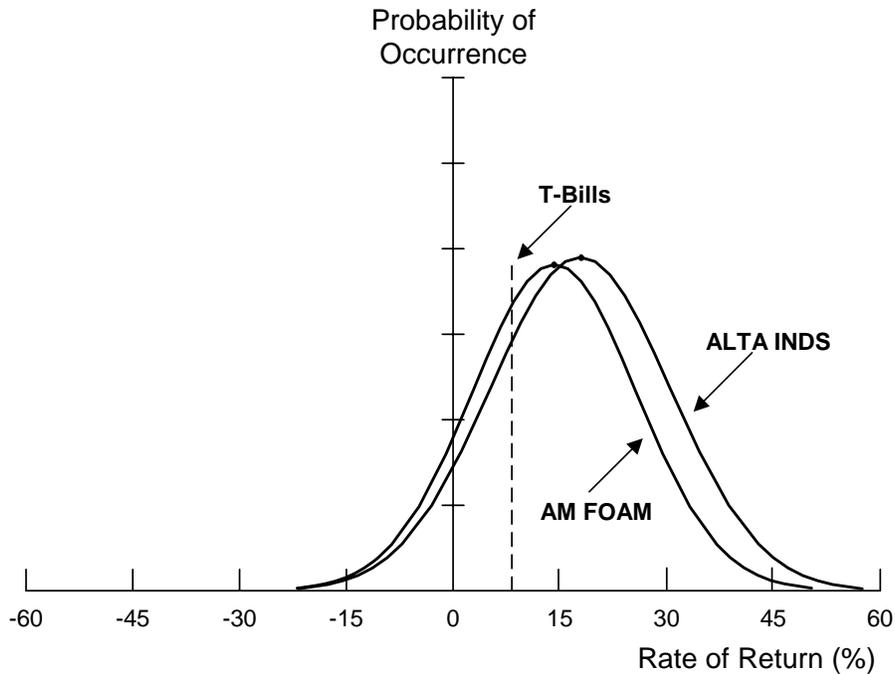
$$\sigma_{\text{M}} = 15.3\%.$$

- d. 2. What type of risk is measured by the standard deviation?**

**Answer:** The standard deviation is a measure of a security's (or a portfolio's) stand-alone risk. The larger the standard deviation, the higher the probability that actual realized returns will fall far below the expected return, and that losses rather than profits will be incurred.

- d. 3. Draw a graph which shows *roughly* the shape of the probability distributions for Alta Inds, Am Foam, and T-bills.**

**Answer:**



Based on these data, Alta Inds is the most risky investment, t-bills the least risky.

e. Suppose you suddenly remembered that the coefficient of variation (CV) is generally regarded as being a better measure of stand-alone risk than the standard deviation when the alternatives being considered have widely differing expected returns. Calculate the missing CVs, and fill in the blanks on the row for CV in the table above. Does the CV produce the same risk rankings as the standard deviation?

**Answer:** The coefficient of variation (CV) is a standardized measure of dispersion about the expected value; it shows the amount of risk per unit of return.

$$CV = \frac{\sigma}{\hat{r}}$$

$$CV_{T\text{-bills}} = 0.0\% / 8.0\% = 0.0.$$

$$CV_{Alta\ Inds} = 20.0\% / 17.4\% = 1.1.$$

$$CV_{\text{Repo Men}} = 13.4\%/1.7\% = 7.9.$$

$$CV_{\text{Am Foam}} = 18.8\%/13.8\% = 1.4.$$

$$CV_M = 15.3\%/15.0\% = 1.0.$$

When we measure risk per unit of return, Repo Men, with its low expected return, becomes the most risky stock. The CV is a better measure of an asset's stand-alone risk than  $\sigma$  because CV considers both the expected value and the dispersion of a distribution--a security with a low expected return and a low standard deviation could have a higher chance of a loss than one with a high  $\sigma$  but a high  $\hat{r}$ .

**f. Suppose you created a 2-stock portfolio by investing \$50,000 in Alta Inds and \$50,000 in Repo Men.**

1. Calculate the expected return ( $\hat{r}_p$ ), the standard deviation ( $\sigma_p$ ), and the coefficient of variation ( $cv_p$ ) for this portfolio and fill in the appropriate blanks in the table above.

**Answer:** To find the expected rate of return on the two-stock portfolio, we first calculate the rate of return on the portfolio in each state of the economy. Since we have half of our money in each stock, the portfolio's return will be a weighted average in each type of economy. For a recession, we have:  $r_p = 0.5(-22\%) + 0.5(28\%) = 3\%$ . We would do similar calculations for the other states of the economy, and get these results:

<u>State</u>	<u>Portfolio</u>
Recession	3.0%
Below Average	6.4
Average	10.0
Above Average	12.5
Boom	15.0

Now we can multiply probabilities times outcomes in each state to get the expected return on this two-stock portfolio, 9.6%.

Alternatively, we could apply this formula,

$$R = w_i \times r_i = 0.5(17.4\%) + 0.5(1.7\%) = 9.6\%,$$

Which finds  $r$  as the weighted average of the expected returns of the individual securities in the portfolio.

It is tempting to find the standard deviation of the portfolio as the weighted average of the standard deviations of the individual securities, as follows:

$$\sigma_p \neq w_i(\sigma_i) + w_j(\sigma_j) = 0.5(20\%) + 0.5(13.4\%) = 16.7\%.$$

However, this is not correct--it is necessary to use a different formula, the one for  $\sigma$  that we used earlier, applied to the two-stock portfolio's returns.

The portfolio's  $\sigma$  depends jointly on (1) each security's  $\sigma$  and (2) the correlation between the securities' returns. The best way to approach the problem is to estimate the portfolio's risk and return in each state of the economy, and then to estimate  $\sigma_p$  with the  $\sigma$  formula. Given the distribution of returns for the portfolio, we can calculate the portfolio's  $\sigma$  and CV as shown below:

$$\begin{aligned}\sigma_p &= [(3.0 - 9.6)^2(0.1) + (6.4 - 9.6)^2(0.2) + (10.0 - 9.6)^2(0.4) \\ &\quad + (12.5 - 9.6)^2(0.2) + (15.0 - 9.6)^2(0.1)]^{0.5} \\ &= 3.3\%.\end{aligned}$$

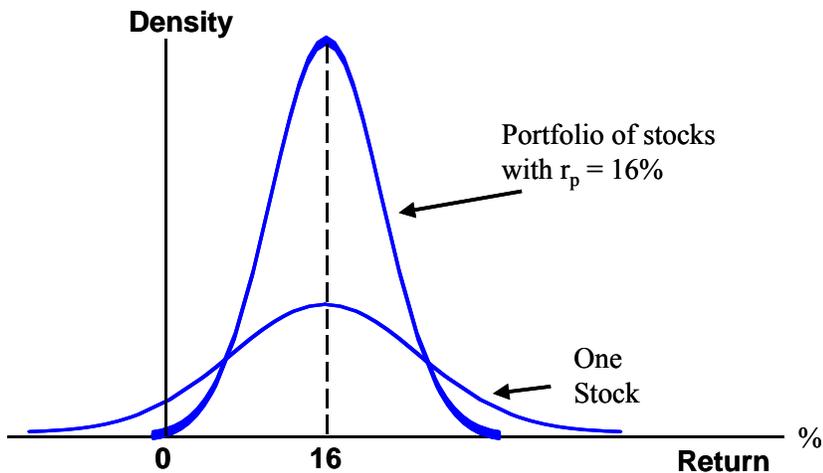
$$CV_p = 3.3\%/9.6\% = 0.3.$$

**f. 2. How does the riskiness of this 2-stock portfolio compare with the riskiness of the individual stocks if they were held in isolation?**

**Answer:** Using either  $\sigma$  or CV as our stand-alone risk measure, the stand-alone risk of the portfolio is significantly less than the stand-alone risk of the individual stocks. This is because the two stocks are negatively correlated--when Alta Inds is doing poorly, Repo Men is doing well, and vice versa. Combining the two stocks diversifies away some of the risk inherent in each stock if it were held in isolation, i.e., in a 1-stock portfolio.

**g. Suppose an investor starts with a portfolio consisting of one randomly selected stock. What would happen (1) to the riskiness and (2) to the expected return of the portfolio as more and more randomly selected stocks were added to the portfolio? What is the implication for investors? Draw a graph of the two portfolios to illustrate your answer.**

**Answer:**



The standard deviation gets smaller as more stocks are combined in the portfolio, while  $r_p$  (the portfolio's return) remains constant. Thus, by adding stocks to your portfolio, which initially started as a 1-stock portfolio, risk has been reduced.

In the real world, stocks are positively correlated with one another--if the economy does well, so do stocks in general, and vice versa. Correlation coefficients between stocks generally range from +0.5 to +0.7. A single stock selected at random would on average have a standard deviation of about 35 percent. As additional stocks are added to the portfolio, the portfolio's standard deviation decreases because the added stocks are not perfectly positively correlated. However, as more and more stocks are added, each new stock has less of a risk-reducing impact, and eventually adding additional stocks has virtually no effect on the portfolio's risk as measured by  $\sigma$ . In fact,  $\sigma$  stabilizes at about 20.4 percent when 40 or more randomly selected stocks are added. Thus, by combining stocks into well-diversified portfolios, investors can eliminate almost one-half the riskiness of holding individual stocks. (Note: it is not completely costless to diversify, so even the largest institutional investors hold less than all stocks. Even index funds generally hold a smaller portfolio which is highly correlated with an index such as the S&P 500 rather than hold all the stocks in the index.)

The implication is clear: investors should hold well-diversified portfolios of stocks rather than individual stocks. (In fact, individuals can hold diversified portfolios through mutual fund investments.) By doing so, they can eliminate about half of the riskiness inherent in individual stocks.

**h. 1. Should portfolio effects impact the way investors think about the riskiness of individual stocks?**

**Answer:** Portfolio diversification does affect investors' views of risk. A stock's stand-alone risk as measured by its  $\sigma$  or CV, may be important to an undiversified investor, but it is not relevant to a well-diversified investor. A rational, risk-averse investor is more interested in the impact that the stock has on the riskiness of his or her portfolio than on the stock's stand-alone risk. Stand-alone

risk is composed of diversifiable risk, which can be eliminated by holding the stock in a well-diversified portfolio, and the risk that remains is called market risk because it is present even when the entire market portfolio is held.

**h. 2. If you decided to hold a 1-stock portfolio, and consequently were exposed to more risk than diversified investors, could you expect to be compensated for all of your risk; that is, could you earn a risk premium on that part of your risk that you could have eliminated by diversifying?**

**Answer:** If you hold a one-stock portfolio, you will be exposed to a high degree of risk, but you won't be compensated for it. If the return were high enough to compensate you for your high risk, it would be a bargain for more rational, diversified investors. They would start buying it, and these buy orders would drive the price up and the return down. Thus, you simply could not find stocks in the market with returns high enough to compensate you for the stock's diversifiable risk.

**i. How is market risk measured for individual securities? How are beta coefficients calculated?**

**Answer:** Market risk, which is relevant for stocks held in well-diversified portfolios, is defined as the contribution of a security to the overall riskiness of the portfolio. It is measured by a stock's beta coefficient, which measures the stock's volatility relative to the market.

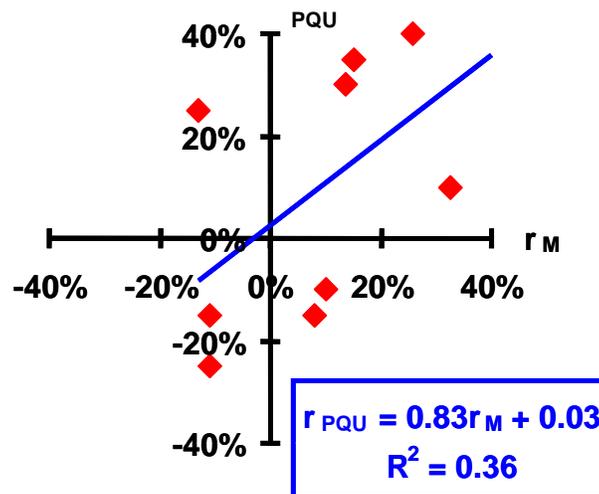
Run a regression with returns on the stock in question plotted on the y axis and returns on the market portfolio plotted on the x axis.

The slope of the regression line, which measures relative volatility, is defined as the stock's beta coefficient, or  $b$ .

**j. Suppose you have the following historical returns for the stock market and for another company, P.Q. Unlimited. Explain how to calculate beta, and use the historical stock returns to calculate the beta for PQU. Interpret your results.**

<u>YEAR</u>	<u>MARKET</u>	<u>PQU</u>
1	25.7%	40.0%
2	8.0%	-15.0%
3	-11.0%	-15.0%
4	15.0%	35.0%
5	32.5%	10.0%
6	13.7%	30.0%
7	40.0%	42.0%
8	10.0%	-10.0%
9	-10.8%	-25.0%
10	-13.1%	25.0%

**Answer:** Betas are calculated as the slope of the “characteristic” line, which is the regression line showing the relationship between a given stock and the general stock market.



Show the graph with the regression results. Point out that the beta is the slope coefficient, which is 0.83. State that an average stock, by definition, moves with the market. Beta coefficients measure the relative volatility of a given stock relative to the stock market. The average stock’s beta is 1.0. Most stocks have betas in the range of 0.5 to 1.5. Theoretically, betas can be negative, but in the real world they are generally positive.

In practice, 4 or 5 years of monthly data, with 60 observations, would generally be used. Some analysts use 52 weeks of weekly data. Point out that the  $r^2$  of 0.36 is slightly higher than the typical value of about 0.29. A portfolio would have an  $r^2$  greater than 0.9.

k. The expected rates of return and the beta coefficients of the alternatives as supplied by barney smith's computer program are as follows:

<u>Security</u>	<u>Return (<math>\hat{r}</math>)</u>	<u>Risk (Beta)</u>
Alta Inds	17.4%	1.29
Market	15.0	1.00
Am. Foam	13.8	0.68
T-Bills	8.0	0.00
Repo Men	1.7	(0.86)

(1) Do the expected returns appear to be related to each alternative's market risk?  
 (2) Is it possible to choose among the alternatives on the basis of the information developed thus far?

Answer: The expected returns are related to each alternative's market risk--that is, the higher the alternative's rate of return the higher its beta. Also, note that t-bills have 0 risk.

We do not yet have enough information to choose among the various alternatives. We need to know the required rates of return on these alternatives and compare them with their expected returns.

l. 1. Write out the security market line (SML) equation, use it to calculate the required rate of return on each alternative, and then graph the relationship between the expected and required rates of return.

Answer: Here is the SML equation:

$$r_i = r_{rf} + (r_m - r_{rf})b_i.$$

If we use the t-bill yield as a proxy for the risk-free rate, then  $r_{RF} = 8\%$ . Further, our estimate of  $r_m = \hat{r}_m$  is 15%. Thus, the required rates of return for the alternatives are as follows:

$$\text{Alta Inds: } 8\% + (15\% - 8\%)1.29 = 17.03\% \approx 17.0\%.$$

$$\text{Market: } 8\% + (15\% - 8\%)1.00 = 15.0\%.$$

$$\text{Am Foam: } 8\% + (15\% - 8\%)0.68 = 12.76\% \approx 12.8\%.$$

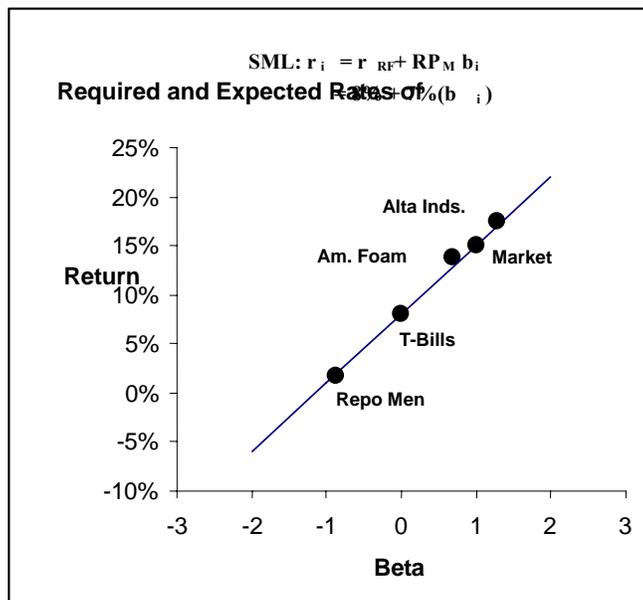
$$\text{T-Bills: } 8\% + (15\% - 8\%)1.29 = 17.03\% \approx 17.0\%.$$

$$\text{Repo Men: } 8\% + (15\% - 8\%)(-0.86) = 1.98\% \approx 2\%.$$

l. 2. How do the expected rates of return compare with the required rates of return?

Answer: We have the following relationships:

SECURITY	Expected Return ( $\hat{r}$ )	Required Return (r)	CONDITION
Alta Inds	17.4%	17.0%	Undervalued: $\hat{r} > R$
Market	15.0	15.0	Fairly Valued (Market Equilibrium)
Am Foam	13.8	12.8	Undervalued: $\hat{r} > R$
T-Bills	8.0	8.0	Fairly Valued
Repo Men	1.7	2.0	Overvalued: $R > \hat{r}$



(Note: the plot looks somewhat unusual in that the x axis extends to the left of zero. We have a negative beta stock, hence a required return that is less than the risk-free rate.) The t-bills and market portfolio plot on the SML, Alta Inds. And Am. Foam plot above it, and Repo Men plots below it. Thus, the t-bills and the market portfolio promise a fair return, Alta Inds and Am. Foam are good deals because they have expected returns above their required returns, and Repo Men has an expected return below its required return.

**1. 3. Does the fact that Repo Men has an expected return which is less than the t-bill rate make any sense?**

**Answer:** Repo Men is an interesting stock. Its negative beta indicates negative market risk--including it in a portfolio of "normal" stocks will lower the portfolio's risk. Therefore, its required rate of return is below the risk-free rate. Basically, this means that Repo Men is a valuable security to rational, well-diversified investors. To see why, consider this question: would any rational investor ever make an investment which has a negative expected return? The answer is "yes"--just think of the purchase of a life or fire insurance policy. The fire insurance policy has a negative expected return because of commissions and insurance company profits, but businesses buy fire insurance because they pay off at a time when normal operations are in bad shape. Life insurance is similar--it has a high return when work income ceases. A negative beta stock is conceptually similar to an insurance policy.

**1. 4. What would be the market risk and the required return of a 50-50 portfolio of Alta Inds and Repo Men? Of Alta Inds and Am. Foam?**

**Answer:** Note that the beta of a portfolio is simply the weighted average of the betas of the stocks in the portfolio. Thus, the beta of a portfolio with 50 percent Alta Inds and 50 percent Repo Men is:

$$b_p = \sum_{i=1}^n w_i b_i.$$

$$\begin{aligned} b_p &= 0.5(b_{\text{Alta}}) + 0.5(b_{\text{Repo}}) = 0.5(1.29) + 0.5(-0.86) \\ &= 0.215, \end{aligned}$$

$$\begin{aligned} r_p &= r_{\text{RF}} + (r_{\text{M}} - r_{\text{RF}})b_p = 8.0\% + (15.0\% - 8.0\%)(0.215) \\ &= 8.0\% + 7\%(0.215) = 9.51\% \approx 9.5\%. \end{aligned}$$

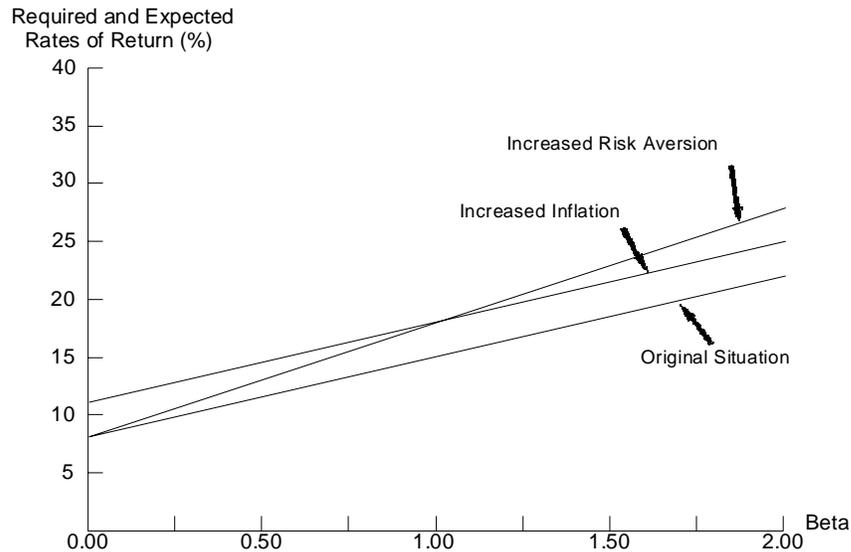
For a portfolio consisting of 50% Alta Inds plus 50% Am. Foam, the required return would be 14.9%:

$$b_p = 0.5(1.29) + 0.5(0.68) = 0.985.$$

$$r_p = 8.0\% + 7\%(0.985) = 14.9\%.$$

**m. 1. Suppose investors raised their inflation expectations by 3 percentage points over current estimates as reflected in the 8 percent t-bill rate. What effect would higher inflation have on the SML and on the returns required on high- and low-risk securities?**

**Answer:**



Here we have plotted the SML for betas ranging from 0 to 2.0. The base case SML is based on  $r_{RF} = 8\%$  and  $r_M = 15\%$ . If inflation expectations increase by 3 percentage points, with no change in risk aversion, then the entire SML is shifted upward (parallel to the base case SML) by 3 percentage points. Now,  $r_{RF} = 11\%$ ,  $r_M = 18\%$ , and all securities' required returns rise by 3 percentage points. Note that the market risk premium,  $r_M - r_{RF}$ , remains at 7 percentage points.

**m. 2. Suppose instead that investors' risk aversion increased enough to cause the market risk premium to increase by 3 percentage points. (inflation remains constant.) What effect would this have on the SML and on returns of high- and low-risk securities?**

**Answer:** When investors' risk aversion increases, the SML is rotated upward about the y-intercept ( $r_{RF}$ ).  $r_{RF}$  remains at 8 percent, but now  $r_M$  increases to 18 percent, so the market risk premium increases to 10 percent. The required rate of return will rise sharply on high-risk (high-beta) stocks, but not much on low-beta securities.

**Optional question (cover if time is available)**

**Financial managers are more concerned with investment decisions relating to real assets such as plant and equipment than with investments in financial assets such as securities. How does the analysis that we have gone through relate to real asset investment decisions, especially corporate capital budgeting decisions?**

**Answer:** There is a great deal of similarity between your financial asset decisions and a firm's capital budgeting decisions. Here is the linkage:

1. A company may be thought of as a portfolio of assets. If the company diversifies its assets, and especially if it invests in some projects that tend to do well when others are doing badly, it can lower the variability of its returns.
2. Companies obtain their investment funds from investors, who buy the firm's stocks and bonds. When investors buy these securities, they require a risk premium which is based on the company's risk as they (investors) see it. Further, since investors in general hold well-diversified portfolios of stocks and bonds, the risk that is relevant to them is the security's market risk, not its stand-alone risk. Thus, investors view the risk of the firm from a market risk perspective.
3. Therefore, when a manager makes a decision to build a new plant, the riskiness of the investment in the plant that is relevant to the firm's investors (its owners) is its market risk, not its stand-alone risk. Accordingly, managers need to know how physical asset investment decisions affect their firm's beta coefficient. A particular asset may look quite risky when viewed in isolation, but if its returns are negatively correlated with returns on most other stocks, the asset may really have low risk. We will discuss all this in more detail in our capital budgeting discussions.

# Chapter 5

## Risk and Return: Portfolio Theory and Asset Pricing Models

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 5-1 a. A portfolio is made up of a group of individual assets held in combination. An asset that would be relatively risky if held in isolation may have little, or even no risk if held in a well-diversified portfolio.

The feasible, or attainable, set represents all portfolios that can be constructed from a given set of stocks. This set is only efficient for part of its combinations.

An efficient portfolio is that portfolio which provides the highest expected return for any degree of risk. Alternatively, the efficient portfolio is that which provides the lowest degree of risk for any expected return.

The efficient frontier is the set of efficient portfolios out of the full set of potential portfolios. On a graph, the efficient frontier constitutes the boundary line of the set of potential portfolios.

- b. An indifference curve is the risk/return trade-off function for a particular investor and reflects that investor's attitude toward risk. The indifference curve specifies an investor's required rate of return for a given level of risk. The greater the slope of the indifference curve, the greater is the investor's risk aversion.

The optimal portfolio for an investor is the point at which the efficient set of portfolios--the efficient frontier--is just tangent to the investor's indifference curve. This point marks the highest level of satisfaction an investor can attain given the set of potential portfolios.

- c. The Capital Asset Pricing Model (CAPM) is a general equilibrium market model developed to analyze the relationship between risk and required rates of return on assets when they are held in well-diversified portfolios. The SML is part of the CAPM.

The Capital Market Line (CML) specifies the efficient set of portfolios an investor can attain by combining a risk-free asset and the risky market portfolio M. The CML states that the expected return on any efficient portfolio is equal to the riskless rate plus a risk premium, and thus describes a linear relationship between expected return and risk.

- d. The characteristic line for a particular stock is obtained by regressing the historical returns on that stock against the historical returns on the general stock market. The slope of the characteristic line is the stock's beta, which measures the amount by which the stock's expected return increases for a given increase in the expected return on the market.

The beta coefficient ( $\beta$ ) is a measure of a stock's market risk. It measures the stock's volatility relative to an average stock, which has a beta of 1.0.

- e. Arbitrage Pricing Theory (APT) is an approach to measuring the equilibrium risk/return relationship for a given stock as a function of multiple factors, rather than the single factor (the market return) used by the CAPM. The APT is based on complex mathematical and statistical

theory, but can account for several factors (such as GNP and the level of inflation) in determining the required return for a particular stock.

The Fama-French 3-factor model has one factor for the excess market return (the market return minus the risk free rate), a second factor for size (defined as the return on a portfolio of small firms minus the return on a portfolio of big firms), and a third factor for the book-to-market effect (defined as the return on a portfolio of firms with a high book-to-market ratio minus the return on a portfolio of firms with a low book-to-market ratio).

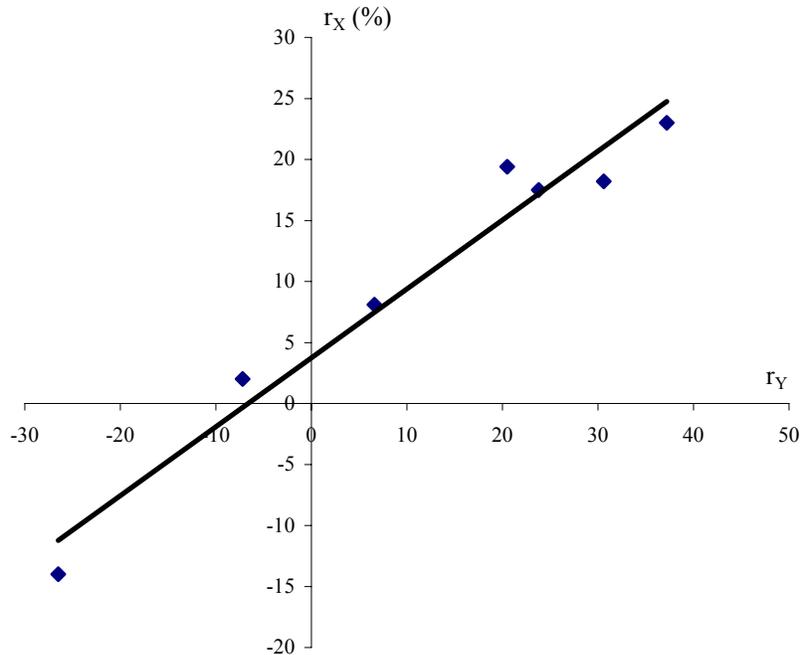
Most people don't behave rationally in all aspects of their personal lives, and behavioral finance assume that investors have the same types of psychological behaviors in their financial lives as in their personal lives.

- 5-2 Security A is less risky if held in a diversified portfolio because of its lower beta and negative correlation with other stocks. In a single-asset portfolio, Security A would be more risky because  $\sigma_A > \sigma_B$  and  $CV_A > CV_B$ .

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

- 5-1 a. A plot of the approximate regression line is shown in the following figure:



Using Excel, the regression equation estimates are: Beta = 0.56; Intercept = 0.037;  $R^2 = 0.96$ .

- b. The arithmetic average return for Stock X is calculated as follows:

$$\bar{r}_{\text{Avg}} = \frac{(-14.0 + 23.0 + \dots + 18.2)}{7} = 10.6\%$$

The arithmetic average rate of return on the market portfolio, determined similarly, is 12.1%.

For Stock X, the estimated standard deviation is 13.1 percent:

$$\sigma_X = \sqrt{\frac{(-14.0 - 10.6)^2 + (23.0 - 10.6)^2 + \dots + (18.2 - 10.6)^2}{7 - 1}} = 13.1\%$$

The standard deviation of returns for the market portfolio is similarly determined to be 22.6 percent. The results are summarized below:

	<u>Stock X</u>	<u>Market Portfolio</u>
Average return, $\bar{r}_{Avg}$	10.6%	12.1%
Standard deviation, $\sigma$	13.1	22.6

Several points should be noted: (1)  $\sigma_M$  over this particular period is higher than the historic average  $\sigma_M$  of about 15 percent, indicating that the stock market was relatively volatile during this period; (2) Stock X, with  $\sigma_X = 13.1\%$ , has much less total risk than an average stock, with  $\sigma_{Avg} = 22.6\%$ ; and (3) this example demonstrates that it is possible for a very low-risk single stock to have less risk than a portfolio of average stocks, since  $\sigma_X < \sigma_M$ .

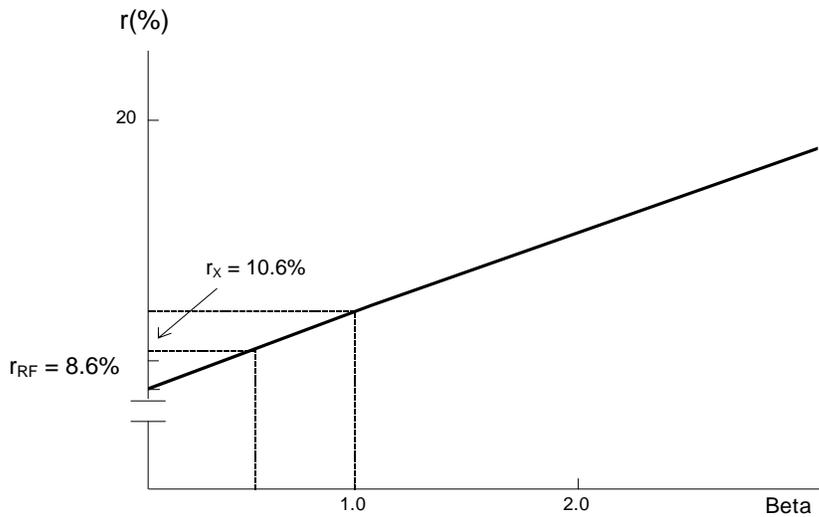
- c. Since Stock X is in equilibrium and plots on the Security Market Line (SML), and given the further assumption that  $\hat{r}_X = \hat{r}_X$  and  $\hat{r}_M = \bar{r}_M$  --and this assumption often does *not* hold--then this equation must hold:

$$\bar{r}_X = r_{RF} + (\bar{r} - r_{RF})b_X.$$

This equation can be solved for the risk-free rate,  $r_{RF}$ , which is the only unknown:

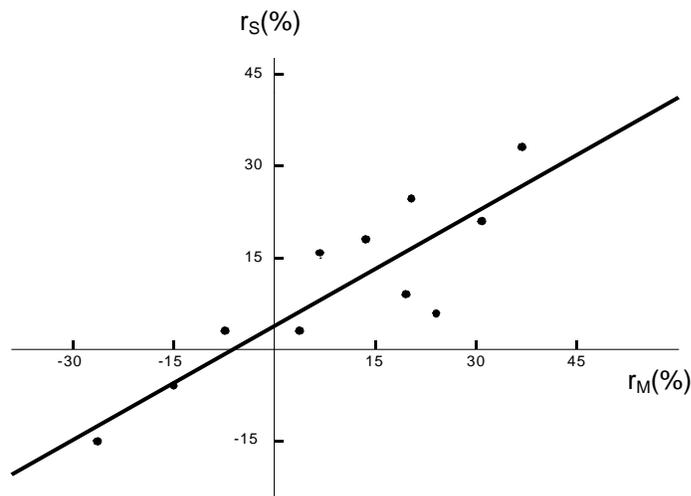
$$\begin{aligned} 10.6 &= r_{RF} + (12.1 - r_{RF})0.56 \\ 10.6 &= r_{RF} + 6.8 - 0.56r_{RF} \\ 0.44r_{RF} &= 10.6 - 6.8 \\ r_{RF} &= 3.8 / 0.44 = 8.6\%. \end{aligned}$$

- d. The SML is plotted below. Data on the risk-free security ( $b_{RF} = 0$ ,  $r_{RF} = 8.6\%$ ) and Security X ( $b_X = 0.56$ ,  $\bar{r}_X = 10.6\%$ ) provide the two points through which the SML can be drawn.  $r_M$  provides a third point.



- e. In theory, you would be indifferent between the two stocks. Since they have the same beta, their relevant risks are identical, and in equilibrium they should provide the same returns. The two stocks would be represented by a single point on the SML. Stock Y, with the higher standard deviation, has more diversifiable risk, but this risk will be eliminated in a well-diversified portfolio, so the market will compensate the investor only for bearing market or relevant risk. In practice, it is possible that Stock Y would have a slightly higher required return, but this premium for diversifiable risk would be small.

- a. The regression graph is shown above. Using a spreadsheet, we find  $b = 0.62$ .



- b. Because  $b = 0.62$ , Stock Y is about 62 percent as volatile as the market; thus, its relative risk is about 62 percent of that of an average firm.

- c. 1. Total risk ( $\sigma_Y^2$ ) would be greater because the second term of the firm's risk equation,  $\sigma_Y^2 = b_Y^2 \sigma_M^2 + \sigma_{eY}^2$ , would be greater.

**2. CAPM assumes that company-specific risk will be eliminated in a portfolio, so the risk premium under the CAPM would not be affected.**

- d. 1. The stock's variance would not change, but the risk of the stock to an investor holding a diversified portfolio would be greatly reduced.
2. It would now have a negative correlation with  $r_M$ .
3. Because of a relative scarcity of such stocks and the beneficial net effect on portfolios that include it, its "risk premium" is likely to be very low or even negative. Theoretically, it should be negative.

5-3 a. 
$$r_i = r_{RF} + (r_M - r_{RF})b_i = r_{RF} + (r_M - r_{RF}) \frac{\rho_{iM} \sigma_i}{\sigma_M}$$

b. CML:  $\hat{r}_p = r_{RF} + \left( \frac{\hat{r}_M - r_{RF}}{\sigma_M} \right) \sigma_p$ . SML:  $r_i = r_{RF} + \left( \frac{r_M - r_{RF}}{\sigma_M} \right) r_{iM} \sigma_i$ .

With some arranging, the similarities between the CML and SML are obvious. When in this form, both have the same market price of risk, or slope,  $(r_M - r_{RF})/\sigma_M$ .

The measure of risk in the CML is  $\sigma_p$ . Since the CML applies only to efficient portfolios,  $\sigma_p$  not only represents the portfolio's total risk, but also its market risk. However, the SML applies to all portfolios and individual securities. Thus, the appropriate risk measure is not  $\sigma_i$ , the total risk, but the market risk, which in this form of the SML is  $r_{iM}\sigma_i$ , and is less than for all assets except those which are perfectly positively correlated with the market, and hence have  $r_{iM} = +1.0$ .

5-4

a. Using the CAPM:

$$r_i = r_{RF} + (r_M - r_{RF})b_i = 7\% + (1.1)(6.5\%) = 14.15\%$$

b. Using the 3-factor model:

$$\begin{aligned} r_i &= r_{RF} + (r_M - r_{RF})b_i + (r_{SMB})c_i + (r_{HML})d_i \\ &= 7\% + (1.1)(6.5\%) + (5\%)(0.7) + (4\%)(-0.3) = 16.45\% \end{aligned}$$

## MINI CASE

To begin, briefly review the Chapter 4 Mini Case. Then, extend your knowledge of risk and return by answering the following questions.

- a. Suppose asset A has an expected return of 10 percent and a standard deviation of 20 percent. Asset B has an expected return of 16 percent and a standard deviation of 40 percent. If the correlation between A and B is 0.4, what are the expected return and standard deviation for a portfolio comprised of 30 percent asset A and 70 percent asset B?

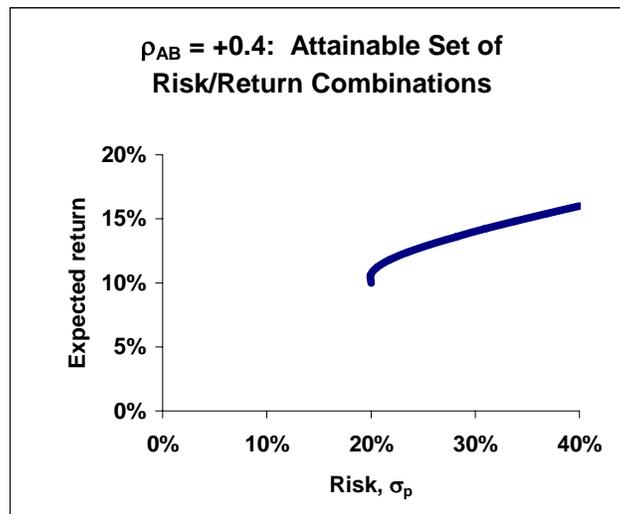
Answer:

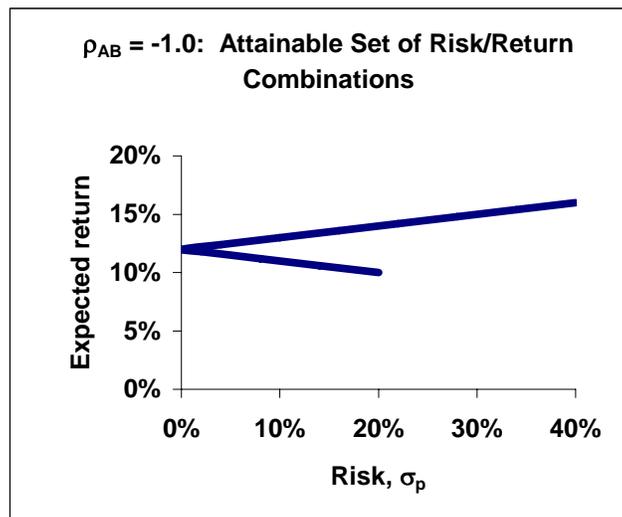
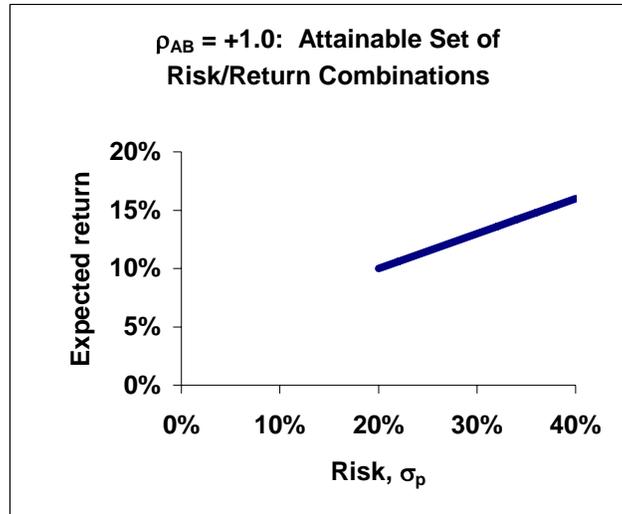
$$\begin{aligned}\hat{r}_p &= w_A \hat{r}_A + (1 - w_A) \hat{r}_B \\ &= 0.3(0.1) + 0.7(0.16) \\ &= 0.142 = 14.2\%\end{aligned}$$

$$\begin{aligned}\sigma_p &= \sqrt{w_A^2 \sigma_A^2 + (1 - w_A)^2 \sigma_B^2 + 2w_A(1 - w_A)\rho_{AB}\sigma_A\sigma_B} \\ &= \sqrt{0.3^2(0.2^2) + 0.7^2(0.4^2) + 2(0.3)(0.7)(0.4)(0.2)(0.4)} \\ &= 0.309\end{aligned}$$

- b. Plot the attainable portfolios for a correlation of 0.4. Now plot the attainable portfolios for correlations of +1.0 and -1.0.

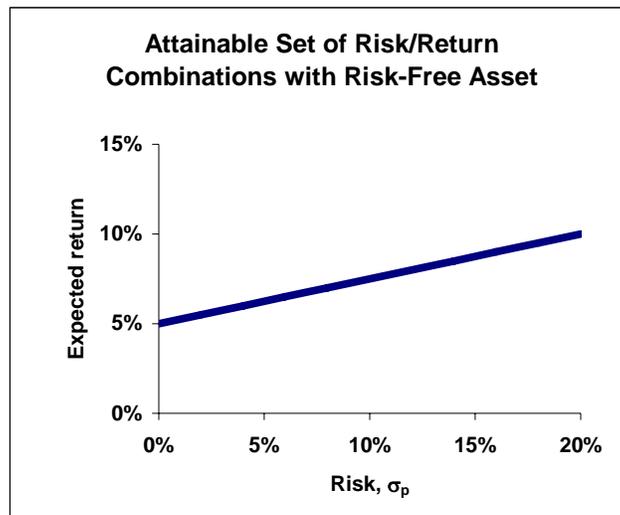
Answer:





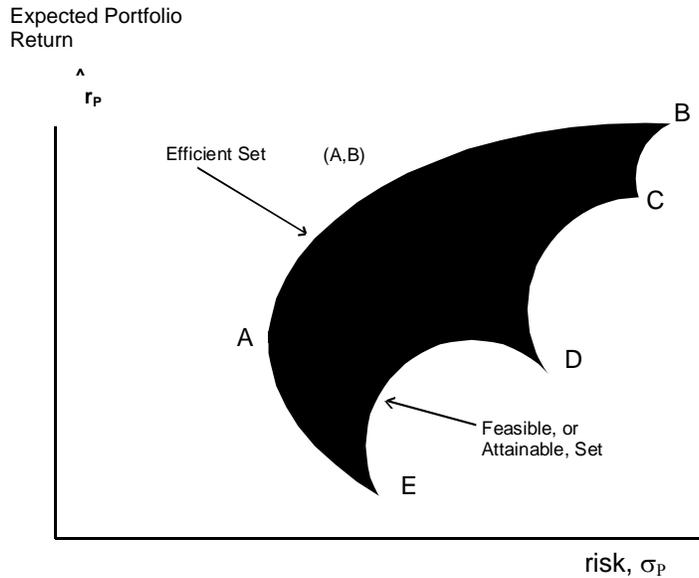
c. Suppose a risk-free asset has an expected return of 5 percent. By definition, its standard deviation is zero, and its correlation with any other asset is also zero. Using only asset A and the risk-free asset, plot the attainable portfolios.

Answer:



d. Construct a reasonable, but hypothetical, graph which shows risk, as measured by portfolio standard deviation, on the x axis and expected rate of return on the y axis. Now add an illustrative feasible (or attainable) set of portfolios, and show what portion of the feasible set is efficient. What makes a particular portfolio efficient? Don't worry about specific values when constructing the graph—merely illustrate how things look with "reasonable" data.

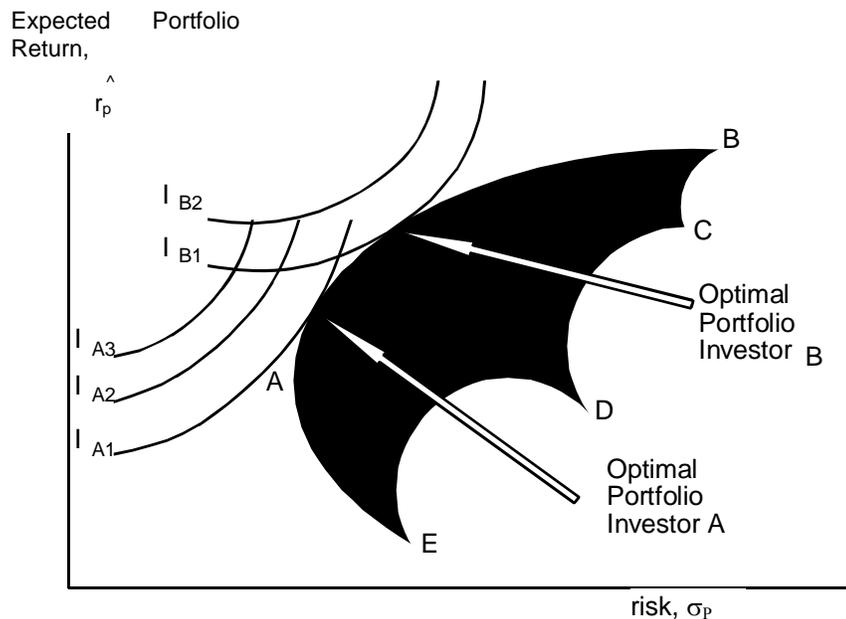
Answer:



The figure above shows the *feasible* set of portfolios. The points B, C, D, and E represent single securities (or portfolios containing only one security). All the other points in the shaded area, including its boundaries, represent portfolios of two or more securities. The shaded area is called the *feasible, or attainable, set*.

The boundary AB defines the *efficient set* of portfolios, which is also called the *efficient frontier*. Portfolios to the left of the efficient set are not possible because they lie outside the attainable set. Portfolios to the right of the boundary line (interior portfolios) are inefficient because some other portfolio would provide either a higher return with the same degree of risk or a lower level of risk for the same rate of return.

e. Now add a set of indifference curves to the graph created for part B. What do these curves represent? What is the optimal portfolio for this investor? Finally, add a second set of indifference curves which leads to the selection of a different optimal portfolio. Why do the two investors choose different portfolios?



**Answer:**

The figure above shows the *indifference curves* for two hypothetical investors, A and B. To determine the optimal portfolio for a particular investor, we must know the investor's attitude towards risk as reflected in his or her risk/return tradeoff function, or indifference curve. Curves  $I_{a1}$ ,  $I_{a2}$ , and  $I_{a3}$  represent the indifference curves for individual A, with the higher curve ( $I_{a3}$ ) denoting a greater level of satisfaction (or utility). Thus,  $I_{a3}$  is better than  $I_{a2}$  for any level of risk.

The optimal portfolio is found at the tangency point between the efficient set of portfolios and one of the investor's indifference curves. This tangency point marks the highest level of satisfaction the investor can attain. The arrows point toward the optimal portfolios for both investors A and B.

The investors choose different optimal portfolios because their risk aversion is different. Investor A chooses the portfolio with the lower expected return, but the riskiness of that portfolio is also lower than investor's B optimal portfolio, because investor a is more risk averse.

**f. What is the capital asset pricing model (CAPM)? What are the assumptions that underlie the model?**

**Answer:** The *Capital Asset Pricing Model (CAPM)* is an equilibrium model which specifies the relationship between risk and required rates of return on assets when they are held in well-diversified portfolios. The CAPM requires an extensive set of assumptions:

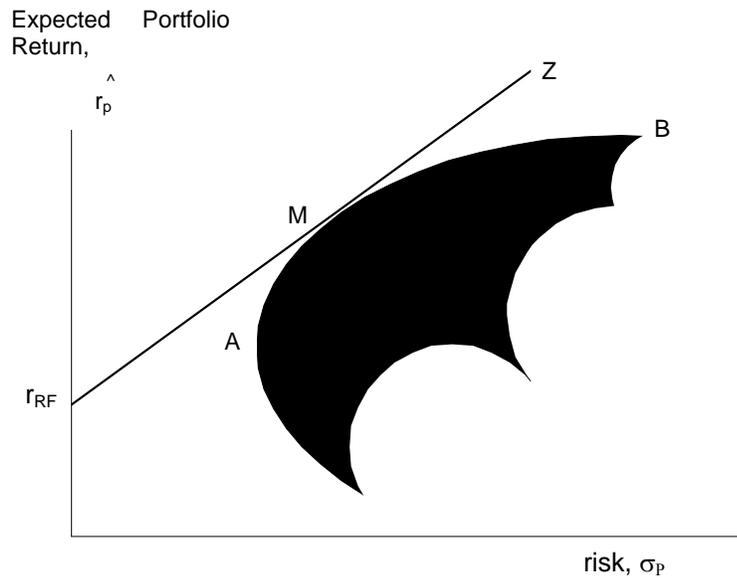
- All investors are single-period expected utility of terminal wealth maximizers, who choose among alternative portfolios on the basis of each portfolio's expected return and standard deviation.

- All investors can borrow or lend an unlimited amount at a given risk-free rate of interest.
- Investors have homogeneous expectations (that is, investors have identical estimates of the expected values, variances, and covariances of returns among all assets).
- All assets are perfectly divisible and perfectly marketable at the going price, and there are no transactions costs.
- There are no taxes.
- All investors are price takers (that is, all investors assume that their own buying and selling activity will not affect stock prices).
- The quantities of all assets are given and fixed.

**g. Now add the risk-free asset. What impact does this have on the efficient frontier?**

**Answer:** The risk-free asset by definition has zero risk, and hence  $\sigma = 0\%$ , so it is plotted on the vertical axis. Now, given the possibility of investing in the risk-free asset, investors can create new portfolios that *combine the risk-free asset with a portfolio of risky assets*. This enables them to achieve any combination of risk and return that lies along any straight line connecting  $r_{RF}$  with any portfolio in the feasible set of risky portfolios. However, the straight line connecting  $r_{RF}$  with  $m$ , the point of tangency between the line and the portfolio's efficient set curve, is the one that all investors would choose. Since all portfolios on the line  $r_{RF}mZ$  are preferred to the other risky portfolio opportunities on the efficient frontier  $AB$ , the points on the line  $r_{RF}mZ$  now represent the best attainable combinations of risk and return. Any combination under the  $r_{RF}mZ$  line offers less return for the same amount of risk, or offers more risk for the same amount of return. Thus, everybody wants to hold portfolios which are located on the  $r_{RF}mZ$  line.

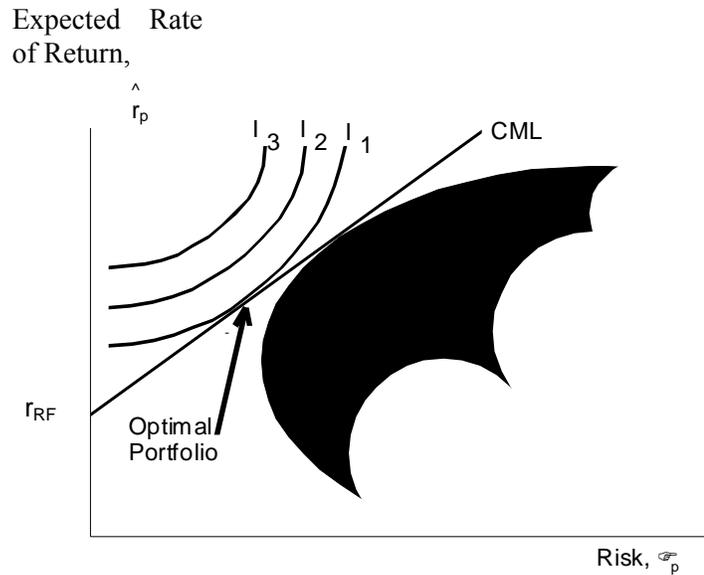
**h. Write out the equation for the capital market line (CML) and draw it on the graph. Interpret the CML. Now add a set of indifference curves, and illustrate how an investor's optimal portfolio is some combination of the risky portfolio and the risk-free asset. What is the composition of the risky portfolio?**



**Answer:** The line  $r_{RF}MZ$  in the figure above is called the *capital market line (CML)*. It has an intercept of  $r_{RF}$  and a slope of  $(\hat{r}_M - r_{RF})/\sigma_M$ . Therefore the equation for the capital market line may be expressed as follows:

$$\text{CML: } \hat{r}_p = r_{RF} + \left( \frac{\hat{r}_M - r_{RF}}{\sigma_M} \right) \sigma_p.$$

The CML tells us that the expected rate of return on any efficient portfolio (that is, any portfolio on the CML) is equal to the risk-free rate plus a risk premium, and the risk premium is equal to  $(\hat{r}_M - r_{RF})/\sigma_M$  multiplied by the portfolio's standard deviation,  $\sigma_p$ . Thus, the CML specifies a linear relationship between expected return and risk, with the slope of the CML being equal to the expected return on the market portfolio of risky stocks,  $\hat{r}_M$ , minus the risk-free rate,  $r_{RF}$ , which is called the market risk premium, all divided by the standard deviation of returns on the market portfolio,  $\sigma_m$ .



The figure above shows a set of indifference curves ( $i_1$ ,  $i_2$ , and  $i_3$ ), with  $i_1$  touching the CML. This point of tangency defines the optimal portfolio for this investor, and he or she will buy a combination of the market portfolio and the risk-free asset.

The risky portfolio,  $m$ , must contain every asset in exact proportion to that asset's fraction of the total market value of all assets; that is, if security  $g$  is  $x$  percent of the total market value of all securities,  $x$  percent of the market portfolio must consist of security  $g$ .

**i. What is a characteristic line? How is this line used to estimate a stock's beta coefficient? Write out and explain the formula that relates total risk, market risk, and diversifiable risk.**

**Answer:** Betas are calculated as the slope of the *characteristic line*, which is the regression line formed by plotting returns on a given stock on the y axis against returns on the general stock market on the x

axis. In practice, 5 years of monthly data, with 60 observations, would be used, and a computer would be used to obtain a least squares regression line.

The relationship between stock J's total risk, market risk, and diversifiable risk can be expressed as follows:

TOTAL RISK = VARIANCE = MARKET RISK + DIVERSIFIABLE RISK

$$\sigma_J^2 = b_J^2 \sigma_M^2 + \sigma_{eJ}^2$$

Here  $\sigma_J^2$  is the variance or total risk of stock j,  $\sigma_M^2$  is the variance of the market,  $b_J$  is stock J's beta coefficient, and  $\sigma_{eJ}^2$  is the variance of stock J's regression error term. If stock J is held in isolation, then the investor must bear its total risk. However, when stock J is held as part of a well-diversified portfolio, the regression error term,  $\sigma_{eJ}^2$  is driven to zero; hence, only the market risk remains.

**j. What are two potential tests that can be conducted to verify the CAPM? What are the results of such tests? What is roll's critique of CAPM tests?**

**Answer:** Since the CAPM was developed on the basis of a set of unrealistic assumptions, empirical tests should be used to verify the CAPM. The first test looks for stability in historical betas. If betas have been stable in the past for a particular stock, then its historical beta would probably be a good proxy for its *ex-ante*, or expected beta. Empirical work concludes that the betas of individual securities are not good estimators of their future risk, but that betas of portfolios of ten or more randomly selected stocks are reasonably stable, hence that past *portfolio* betas are good estimators of future portfolio volatility.

The second type of test is based on the *slope of the SML*. As we have seen, the CAPM states that a linear relationship exists between a security's required rate of return and its beta. Further, when the SML is graphed, the vertical axis intercept should be  $r_{RF}$ , and the required rate of return for a stock (or portfolio) with beta = 1.0 should be  $r_m$ , the required rate of return on the market. Various researchers have attempted to test the validity of the CAPM model by calculating betas and realized rates of return, plotting these values in graphs, and then observing whether or not (1) the intercept is equal to  $r_{RF}$ , (2) the regression line is linear, and (3) the SML passes through the point  $b = 1.0, r_m$ . Evidence shows a more-or-less linear relationship between realized returns and market risk, but the slope is less than predicted. Tests that attempt to assess the relative importance of market and company-specific risk do not yield definitive results, so the irrelevance of diversifiable risk specified in the CAPM model can be questioned.

*Roll* questioned whether it is even conceptually possible to test the CAPM. *Roll* showed that the linear relationship which prior researchers had observed in graphs resulted from the mathematical properties of the models being tested, hence that a finding of linearity proved nothing about the validity of the CAPM. *Roll's* work did not disprove the CAPM theory, but he did show that it is virtually impossible to prove that investors behave in accordance with the theory.

In general, evidence seems to support the CAPM model when it is applied to portfolios, but the evidence is less convincing when the CAPM is applied to individual stocks. Nevertheless, the CAPM provides a rational way to think about risk and return as long as one recognizes the limitations of the CAPM when using it in practice.

**k. Briefly explain the difference between the CAPM and the arbitrage pricing theory**

(APT).

**Answer:** The CAPM is a single-factor model, while the *Arbitrage Pricing Theory (APT)* can include any number of risk factors. It is likely that the required return is dependent on many fundamental factors such as the GNP growth, expected inflation, and changes in tax laws, and that different groups of stocks are affected differently by these factors. Thus, the apt seems to have a stronger theoretical footing than does the CAPM. However, the apt faces several major hurdles in implementation, the most severe being that the apt does not identify the relevant factors--a complex mathematical procedure called factor analysis must be used to identify the factors. To date, it appears that only three or four factors are required in the apt, but much more research is required before the apt is fully understood and presents a true challenge to the CAPM.

**1.** Suppose you are given the following information. The beta of company,  $b_i$ , is 0.9, the risk free rate,  $r_{RF}$ , is 6.8%, and the expected market premium,  $r_M - r_{RF}$ , is 6.3%. Because your company is larger than average and more successful than average (i.e., it has a lower book-to-market ratio), you think the Fama-French 3-factor model might be more appropriate than the CAPM. You estimate the additional coefficients from the Fama-French 3-factor model: the coefficient for the size effect,  $C_i$ , is -0.5, and the coefficient for the book-to-market effect,  $d_i$ , is -0.3. If the expected value of the size factor is 4% and the expected value of the book-to-market factor is 5%, what is the required return using the Fama-French 3-factor model? (assume that  $A_i = 0.0$ .) What is the required return using CAPM?

**Answer:** The Fama-French model:

$$\begin{aligned}r_i &= r_{RF} + (r_m - r_{RF})b_i + (r_{smb})c_i + (r_{hmb})d_i \\r_i &= 6.8\% + (6.3\%)(0.9) + (4\%)(-0.5) + (5\%)(-0.3) \\&= 8.97\%\end{aligned}$$

The CAPM:

$$\begin{aligned}r_i &= r_{rf} + (r_m - r_{rf})b_i \\r_i &= 6.8\% + (6.3\%)(0.9) \\&= 12.47\%\end{aligned}$$

# Chapter 6

## Bonds and Their Valuation

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 6-1 a. A bond is a promissory note issued by a business or a governmental unit. Treasury bonds, sometimes referred to as government bonds, are issued by the Federal government and are not exposed to default risk. Corporate bonds are issued by corporations and are exposed to default risk. Different corporate bonds have different levels of default risk, depending on the issuing company's characteristics and on the terms of the specific bond. Municipal bonds are issued by state and local governments. The interest earned on most municipal bonds is exempt from federal taxes, and also from state taxes if the holder is a resident of the issuing state. Foreign bonds are issued by foreign governments or foreign corporations. These bonds are not only exposed to default risk, but are also exposed to an additional risk if the bonds are denominated in a currency other than that of the investor's home currency.
- b. The par value is the nominal or face value of a stock or bond. The par value of a bond generally represents the amount of money that the firm borrows and promises to repay at some future date. The par value of a bond is often \$1,000, but can be \$5,000 or more. The maturity date is the date when the bond's par value is repaid to the bondholder. Maturity dates generally range from 10 to 40 years from the time of issue. A call provision may be written into a bond contract, giving the issuer the right to redeem the bonds under specific conditions prior to the normal maturity date. A bond's coupon, or coupon payment, is the dollar amount of interest paid to each bondholder on the interest payment dates. The coupon is so named because bonds used to have dated coupons attached to them which investors could tear off and redeem on the interest payment dates. The coupon interest rate is the stated rate of interest on a bond.
- c. In some cases, a bond's coupon payment may vary over time. These bonds are called floating rate bonds. Floating rate debt is popular with investors because the market value of the debt is stabilized. It is advantageous to corporations because firms can issue long-term debt without committing themselves to paying a historically high interest rate for the entire life of the loan. Zero coupon bonds pay no coupons at all, but are offered at a substantial discount below their par values and hence provide capital appreciation rather than interest income. In general, any bond originally offered at a price significantly below its par value is called an original issue discount bond (OID).
- d. Most bonds contain a call provision, which gives the issuing corporation the right to call the bonds for redemption. The call provision generally states that if the bonds are called, the company must pay the bondholders an amount greater than the par value, a call premium. Redeemable bonds give investors the right to sell the bonds back to the corporation at a price that is usually close to the par value. If interest rates rise, investors can redeem the bonds and reinvest at the higher rates. A sinking fund provision facilitates the orderly retirement of a bond issue. This can be achieved in one of two ways: The company can call in for redemption (at par value) a certain percentage of bonds each year. The company may buy the required amount of bonds on the open market.
- e. Convertible bonds are securities that are convertible into shares of common stock, at a fixed price, at the option of the bondholder. Bonds issued with warrants are similar to convertibles. Warrants are options which permit the holder to buy stock for a stated price, thereby providing a

- capital gain if the stock price rises. Income bonds pay interest only if the interest is earned. These securities cannot bankrupt a company, but from an investor's standpoint they are riskier than "regular" bonds. The interest rate of an indexed, or purchasing power, bond is based on an inflation index such as the consumer price index (CPI), so the interest paid rises automatically when the inflation rate rises, thus protecting the bondholders against inflation.
- f. Bond prices and interest rates are inversely related; that is, they tend to move in the opposite direction from one another. A fixed-rate bond will sell at par when its coupon interest rate is equal to the going rate of interest,  $r_d$ . When the going rate of interest is above the coupon rate, a fixed-rate bond will sell at a "discount" below its par value. If current interest rates are below the coupon rate, a fixed-rate bond will sell at a "premium" above its par value.
  - g. The current yield on a bond is the annual coupon payment divided by the current market price. YTM, or yield to maturity, is the rate of interest earned on a bond if it is held to maturity. Yield to call (YTC) is the rate of interest earned on a bond if it is called. If current interest rates are well below an outstanding callable bond's coupon rate, the YTC may be a more relevant estimate of expected return than the YTM, since the bond is likely to be called.
  - h. The shorter the maturity of the bond, the greater the risk of a decrease in interest rates. The risk of a decline in income due to a drop in interest rates is called reinvestment rate risk. Interest rates fluctuate over time, and people or firms who invest in bonds are exposed to risk from changing interest rates, or interest rate risk. The longer the maturity of the bond, the greater the exposure to interest rate risk. Interest rate risk relates to the value of the bonds in a portfolio, while reinvestment rate risk relates to the income the portfolio produces. No fixed-rate bond can be considered totally riskless. Bond portfolio managers try to balance these two risks, but some risk always exists in any bond. Another important risk associated with bonds is default risk. If the issuer defaults, investors receive less than the promised return on the bond. Default risk is influenced by both the financial strength of the issuer and the terms of the bond contract, especially whether collateral has been pledged to secure the bond. The greater the default risk, the higher the bond's yield to maturity.
  - i. Corporations can influence the default risk of their bonds by changing the type of bonds they issue. Under a mortgage bond, the corporation pledges certain assets as security for the bond. All such bonds are written subject to an indenture, which is a legal document that spells out in detail the rights of both the bondholders and the corporation. A debenture is an unsecured bond, and as such, it provides no lien against specific property as security for the obligation. Debenture holders are, therefore, general creditors whose claims are protected by property not otherwise pledged. Subordinated debentures have claims on assets, in the event of bankruptcy, only after senior debt as named in the subordinated debt's indenture has been paid off. Subordinated debentures may be subordinated to designated notes payable or to all other debt.
  - j. A development bond is a tax-exempt bond sold by state and local governments whose proceeds are made available to corporations for specific uses deemed (by Congress) to be in the public interest. Municipalities can insure their bonds, in which an insurance company guarantees to pay the coupon and principal payments should the issuer default. This reduces the risk to investors who are willing to accept a lower coupon rate for an insured bond issue vis-a-vis an uninsured issue. Bond issues are normally assigned quality ratings by major rating agencies, such as Moody's Investors Service and Standard & Poor's Corporation. These ratings reflect the probability that a bond will go into default. Aaa (Moody's) and AAA (S&P) are the highest ratings. Rating assignments are based on qualitative and quantitative factors including the firm's debt/assets ratio, current ratio, and coverage ratios. Because a bond's rating is an indicator of its

default risk, the rating has a direct, measurable influence on the bond's interest rate and the firm's cost of debt capital. Junk bonds are high-risk, high-yield bonds issued to finance leveraged buyouts, mergers, or troubled companies. Most bonds are purchased by institutional investors rather than individuals, and many institutions are restricted to investment grade bonds, securities with ratings of Baa/BBB or above.

- 6-2 False. Short-term bond prices are less sensitive than long-term bond prices to interest rate changes because funds invested in short-term bonds can be reinvested at the new interest rate sooner than funds tied up in long-term bonds.
- 6-3 The price of the bond will fall and its YTM will rise if interest rates rise. If the bond still has a long term to maturity, its YTM will reflect long-term rates. Of course, the bond's *price* will be less affected by a change in interest rates if it has been outstanding a long time and matures shortly. While this is true, it should be noted that the YTM will increase only for buyers who purchase the bond after the change in interest rates and not for buyers who purchased previous to the change. If the bond is purchased and held to maturity, the bondholder's YTM will not change, regardless of what happens to interest rates.
- 6-4 If interest rates decline significantly, the values of callable bonds will not rise by as much as those of bonds without the call provision. It is likely that the bonds would be called by the issuer before maturity, so that the issuer can take advantage of the new, lower rates.
- 6-5 From the corporation's viewpoint, one important factor in establishing a sinking fund is that its own bonds generally have a higher yield than do government bonds; hence, the company saves more interest by retiring its own bonds than it could earn by buying government bonds. This factor causes firms to favor the second procedure. Investors also would prefer the annual retirement procedure if they thought that interest rates were more likely to rise than to fall, but they would prefer the government bond purchases program if they thought rates were likely to fall. In addition, bondholders recognize that, under the government bond purchase scheme, each bondholder would be entitled to a given amount of cash from the liquidation of the sinking fund if the firm should go into default, whereas under the annual retirement plan, some of the holders would receive a cash benefit while others would benefit only indirectly from the fact that there would be fewer bonds outstanding.

On balance, investors seem to have little reason for choosing one method over the other, while the annual retirement method is clearly more beneficial to the firm. The consequence has been a pronounced trend toward annual retirement and away from the accumulation scheme.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

6-1 With your financial calculator, enter the following:

$$N = 10; I = \text{YTM} = 9\%; \text{PMT} = 0.08 \times 1,000 = 80; \text{FV} = 1000; \text{PV} = V_B = ? \\ \text{PV} = \$935.82.$$

Alternatively,

$$V_B = \$80(\text{PVIFA}_{9\%,10}) + \$1,000(\text{PVIF}_{9\%,10}) \\ = \$80((1 - 1/1.09^{10})/0.09) + \$1,000(1/1.09^{10}) \\ = \$80(6.4177) + \$1,000(0.4224) \\ = \$513.42 + \$422.40 = \$935.82.$$

6-2 With your financial calculator, enter the following:

$$N = 12; \text{PV} = -850; \text{PMT} = 0.10 \times 1,000 = 100; \text{FV} = 1000; I = \text{YTM} = ? \\ \text{YTM} = 12.48\%.$$

6-3 With your financial calculator, enter the following to find YTM:

$$N = 10 \times 2 = 20; \text{PV} = -1100; \text{PMT} = 0.08/2 \times 1,000 = 40; \text{FV} = 1000; I = \text{YTM} = ? \\ \text{YTM} = 3.31\% \times 2 = 6.62\%.$$

With your financial calculator, enter the following to find YTC:

$$N = 5 \times 2 = 10; \text{PV} = -1100; \text{PMT} = 0.08/2 \times 1,000 = 40; \text{FV} = 1050; I = \text{YTC} = ? \\ \text{YTC} = 3.24\% \times 2 = 6.49\%.$$

6-4 With your financial calculator, enter the following to find the current value of the bonds, so you can then calculate their current yield:

$$N = 7; I = \text{YTM} = 8; \text{PMT} = 0.09 \times 1,000 = 90; \text{FV} = 1000; \text{PV} = V_B = ? \\ \text{PV} = \$1,052.06. \quad \text{Current yield} = \$90/\$1,052.06 = 8.55\%.$$

Alternatively,

$$V_B = \$90(\text{PVIFA}_{8\%,7}) + \$1,000(\text{PVIF}_{8\%,7}) \\ = \$90((1 - 1/1.08^7)/0.08) + \$1,000(1/1.08^7) \\ = \$90(5.2064) + \$1,000(0.5835) \\ = \$468.58 + \$583.50 = \$1,052.08.$$

$$\text{Current yield} = \$90/\$1,052.08 = 8.55\%.$$

6-5 The problem asks you to find the price of a bond, given the following facts:

$$N = 16; I = 8.5/2 = 4.25; PMT = 45; FV = 1000.$$

With a financial calculator, solve for  $PV = \$1,028.60$

6-6 a. 
$$V_B = PMT(PVIFA_{i,n}) + FV(PVIF_{i,n})$$
$$= PMT\left(\frac{1 - 1/(1+i)^n}{i}\right) + FV(1/(1+i)^n)$$

1. 5%: Bond L:  $V_B = \$100(10.3797) + \$1,000(0.4810) = \$1,518.97$ .  
Bond S:  $V_B = (\$100 + \$1,000)(0.9524) = \$1,047.64$ .

2. 8%: Bond L:  $V_B = \$100(8.5595) + \$1,000(0.3152) = \$1,171.15$ .  
Bond S:  $V_B = (\$100 + \$1,000)(0.9259) = \$1,018.49$ .

3. 12%: Bond L:  $V_B = \$100(6.8109) + \$1,000(0.1827) = \$863.79$ .  
Bond S:  $V_B = (\$100 + \$1,000)(0.8929) = \$982.19$ .

Calculator solutions:

1. 5%: Bond L: Input  $N = 15, I = 5, PMT = 100, FV = 1000, PV = ?, PV = \$1,518.98$ .  
Bond S: Change  $N = 1, PV = ? PV = \$1,047.62$ .

2. 8%: Bond L: From Bond S inputs, change  $N = 15$  and  $I = 8, PV = ?, PV = \$1,171.19$ .  
Bond S: Change  $N = 1, PV = ? PV = \$1,018.52$ .

3. 12%: Bond L: From Bond S inputs, change  $N = 15$  and  $I = 12, PV = ? PV = \$863.78$ .  
Bond S: Change  $N = 1, PV = ? PV = \$982.14$ .

- b. Think about a bond that matures in one month. Its present value is influenced primarily by the maturity value, which will be received in only one month. Even if interest rates double, the price of the bond will still be close to \$1,000. A one-year bond's value would fluctuate more than the one-month bond's value because of the difference in the timing of receipts. However, its value would still be fairly close to \$1,000 even if interest rates doubled. A long-term bond paying semiannual coupons, on the other hand, will be dominated by distant receipts, receipts which are multiplied by  $1/(1 + r_d/2)^t$ , and if  $r_d$  increases, these multipliers will decrease significantly. Another way to view this problem is from an opportunity point of view. A one-month bond can be reinvested at the new rate very quickly, and hence the opportunity to invest at this new rate is not lost; however, the long-term bond locks in subnormal returns for a long period of time.

6-7 a. 
$$V_B = \sum_{t=1}^N \frac{INT}{(1+r_d)^t} + \frac{M}{(1+r_d)^N}$$

$$= PMT((1 - 1/(1+r_d)^N)/r_d) + FV(1/(1+r_d)^N).$$

$$M = \$1,000. \quad INT = 0.09(\$1,000) = \$90.$$

1.  $\$829 = \$90((1 - 1/(1+r_d^4))/r_d) + \$1,000(1/(1+r_d)^4).$

**The YTM can be found by trial-and-error. If the YTM was 9 percent, the bond value would be its maturity value. Since the bond sells at a discount, the YTM must be greater than 9 percent. Let's try 10 percent.**

At 10%,  $V_B = \$285.29 + \$683.00$   
**= \$968.29.**

$\$968.29 > \$829.00$ ; therefore, the bond's YTM is greater than 10 percent.

Try 15 percent.

At 15%,  $V_B = \$256.95 + \$571.80$   
 $= \$828.75.$

Therefore, the bond's YTM is approximately 15 percent.

2.  $\$1,104 = \$90((1 - 1/(1+r_d^4))/r_d) + \$1,000(1/(1+r_d)^4).$

The bond is selling at a premium; therefore, the YTM must be below 9 percent. Try 6 percent.

At 6%,  $V_B = \$311.86 + \$792.10$   
**= \$1,103.96.**

Therefore, when the bond is selling for \$1,104, its YTM is approximately 6 percent.

Calculator solution:

1. Input  $N = 4$ ,  $PV = -829$ ,  $PMT = 90$ ,  $FV = 1000$ ,  $I = ?$   $I = 14.99\%$ .

2. Change  $PV = -1104$ ,  $I = ?$   $I = 6.00\%$ .

- b. Yes. At a price of \$829, the yield to maturity, 15 percent, is greater than your required rate of return of 12 percent. If your required rate of return were 12 percent, you should be willing to buy the bond at any price below \$908.88.

6-8  $\$1,000 = \$140\left(\frac{1 - 1/(1+r_d)^6}{r_d}\right) + \$1,090/(1+r_d)^6$ .

Try 18 percent:

$PV_{18\%} = \$140(3.4976) + \$1,090(0.3704) = \$489.66 + \$403.74 = \$893.40$ .  
18 percent is too high.

Try 15 percent:

$PV_{15\%} = \$140(3.7845) + \$1,090(0.4323) = \$529.83 + \$471.21 = \$1,001.04$ .

15 percent is slightly low.

The rate of return is approximately 15.03 percent, found with a calculator using the following inputs.

$N = 6; PV = -1000; PMT = 140; FV = 1090; I = ?$  Solve for  $I = 15.03\%$ .

6-9 a. Using a financial calculator, input the following:

$N = 20, PV = -1100, PMT = 60, FV = 1000$ , and solve for  $I = 5.1849\%$ .

However, this is a periodic rate. The nominal annual rate =  $5.1849\%(2) = 10.3699\% \approx 10.37\%$ .

b. The current yield =  $\$120/\$1,100 = 10.91\%$ .

c.  $YTM = \text{Current Yield} + \text{Capital Gains (Loss) Yield}$   
 $10.37\% = 10.91\% + \text{Capital Loss Yield}$   
 $-0.54\% = \text{Capital Loss Yield}$ .

d. Using a financial calculator, input the following:

$N = 8, PV = -1100, PMT = 60, FV = 1060$ , and solve for  $I = 5.0748\%$ .

However, this is a periodic rate. The nominal annual rate =  $5.0748\%(2) = 10.1495\% \approx 10.15\%$ .

6-10 The problem asks you to solve for the YTM, given the following facts:

$N = 5$ ,  $PMT = 80$ , and  $FV = 1000$ . In order to solve for I we need PV.

However, you are also given that the current yield is equal to 8.21%. Given this information, we can find PV.

Current yield = Annual interest/Current price

$$0.0821 = \$80/PV$$

$$PV = \$80/0.0821 = \$974.42.$$

Now, solve for the YTM with a financial calculator:

$N = 5$ ,  $PV = -974.42$ ,  $PMT = 80$ , and  $FV = 1000$ . Solve for  $I = YTM = 8.65\%$ .

6-11 The problem asks you to solve for the current yield, given the following facts:  $N = 14$ ,  $I = 10.5883/2 = 5.2942$ ,  $PV = -1020$ , and  $FV = 1000$ . In order to solve for the current yield we need to find PMT. With a financial calculator, we find  $PMT = \$55.00$ . However, because the bond is a semiannual coupon bond this amount needs to be multiplied by 2 to obtain the annual interest payment:  $\$55.00(2) = \$110.00$ . Finally, find the current yield as follows:

Current yield = Annual interest/Current Price =  $\$110/\$1,020 = 10.78\%$ .

6-12 The bond is selling at a large premium, which means that its coupon rate is much higher than the going rate of interest. Therefore, the bond is likely to be called--it is more likely to be called than to remain outstanding until it matures. Thus, it will probably provide a return equal to the YTC rather than the YTM. So, there is no point in calculating the YTM--just calculate the YTC. Enter these values:

$N = 10$ ,  $PV = -1353.54$ ,  $PMT = 70$ ,  $FV = 1050$ , and then solve for I.

The periodic rate is 3.24 percent, so the nominal YTC is  $2 \times 3.24\% = 6.47\%$ . This would be close to the going rate, and it is about what the firm would have to pay on new bonds.

- 6-13 a. The bonds now have an 8-year, or a 16-semiannual period, maturity, and their value is calculated as follows:

$$V_B = \sum_{t=1}^{16} \frac{\$50}{(1.03)^t} + \frac{\$1,000}{(1.03)^{16}} = \$50(12.5611) + \$1,000(0.6232) \\ = \$628.06 + \$623.20 = \$1,251.26.$$

Calculator solution: Input N = 16, I = 3, PMT = 50, FV = 1000, PV = ? PV = \$1,251.22.

b.  $V_B = \$50(10.1059) + \$1,000(0.3936) = \$505.30 + \$393.60 = \$898.90.$

Calculator solution: Change inputs from Part a to I = 6, PV = ? PV = \$898.94.

- c. The price of the bond will decline toward \$1,000, hitting \$1,000 (plus accrued interest) at the maturity date 8 years (16 six-month periods) hence.

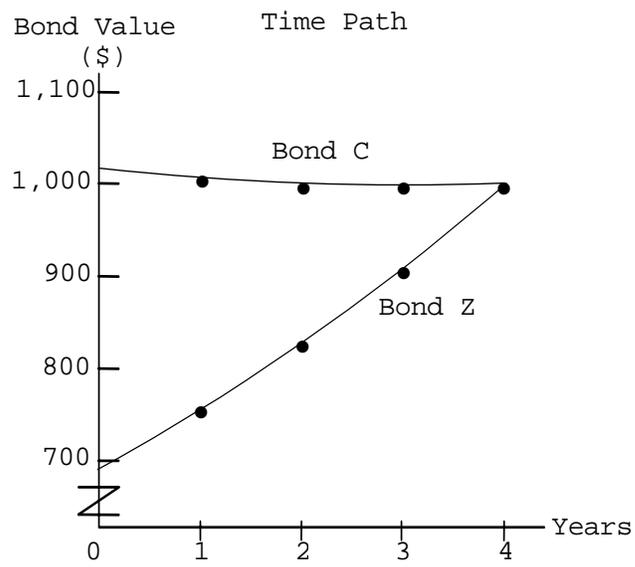
6-14

	Price at 8%	Price at 7%	Pctge. change
10-year, 10% annual coupon	\$1,134.20	\$1,210.71	6.75%
10-year zero	463.19	508.35	9.75
5-year zero	680.58	712.99	4.76
30-year zero	99.38	131.37	32.19
\$100 perpetuity	1,250.00	1,428.57	14.29

6-15 a.

t	Price of Bond C	Price of Bond Z
0	\$1,012.79	\$ 693.04
1	1,010.02	759.57
2	1,006.98	832.49
3	1,003.65	912.41
4	1,000.00	1,000.00

b.



SOLUTION TO SPREADSHEET PROBLEM

---

- 6-16 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 06 P16 Build a Model.xls*) and on the instructor's side of the book's web site, [brigham.swcollege.com](http://brigham.swcollege.com).



## MINI CASE

---

**Sam Strother and Shawna Tibbs are vice-presidents of Mutual of Seattle Insurance Company and co-directors of the company's pension fund management division. A major new client, the Northwestern Municipal Alliance, has requested that Mutual of Seattle present an investment seminar to the mayors of the represented cities, and Strother and Tibbs, who will make the actual presentation, have asked you to help them by answering the following questions. Because the Boeing Company operates in one of the league's cities, you are to work Boeing into the presentation.**

a. What are the key features of a bond?

**Answer:**

1. Par or face value. We generally assume a \$1,000 par value, but par can be anything, and often \$5,000 or more is used. With registered bonds, which is what are issued today, if you bought \$50,000 worth, that amount would appear on the certificate.
2. Coupon rate. The dollar coupon is the "rent" on the money borrowed, which is generally the par value of the bond. The coupon rate is the annual interest payment divided by the par value, and it is generally set at the value of  $r$  on the day the bond is issued.
3. Maturity. This is the number of years until the bond matures and the issuer must repay the loan (return the par value).
4. Issue date. This is the date the bonds were issued.
5. Default risk is inherent in all bonds except treasury bonds--will the issuer have the cash to make the promised payments? Bonds are rated from AAA to D, and the lower the rating the riskier the bond, the higher its default risk premium, and, consequently, the higher its required rate of return,  $r$ .

b. What are call provisions and sinking fund provisions? Do these provisions make bonds more or less risky?

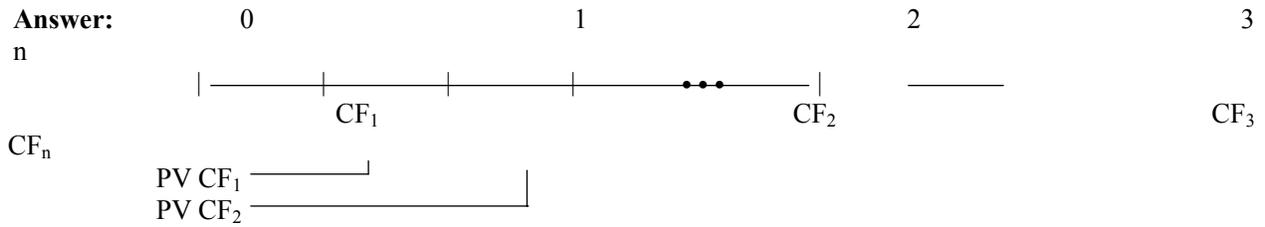
**Answer:** A call provision is a provision in a bond contract that gives the issuing corporation the right to redeem the bonds under specified terms prior to the normal maturity date. The call provision generally states that the company must pay the bondholders an amount greater than the par value if they are called. The additional sum, which is called a call premium, is typically set equal to one year's interest if the bonds are called during the first year, and the premium declines at a constant rate of  $INT/n$  each year thereafter.

A sinking fund provision is a provision in a bond contract that requires the issuer to retire a portion of the bond issue each year. A sinking fund provision facilitates the orderly retirement of the bond issue.

The call privilege is valuable to the firm but potentially detrimental to the investor, especially if the bonds were issued in a period when interest rates were cyclically high. Therefore, bonds with a call provision are riskier than those without a call provision. Accordingly, the interest rate on a new issue of callable bonds will exceed that on a new issue of noncallable bonds.

Although sinking funds are designed to protect bondholders by ensuring that an issue is retired in an orderly fashion, it must be recognized that sinking funds will at times work to the detriment of bondholders. On balance, however, bonds that provide for a sinking fund are regarded as being safer than those without such a provision, so at the time they are issued sinking fund bonds have lower coupon rates than otherwise similar bonds without sinking funds.

c. How is the value of any asset whose value is based on expected future cash flows determined?



The value of an asset is merely the present value of its expected future cash flows:

$$\text{VALUE} = \text{PV} = \frac{\text{CF}_1}{(1+r)^1} + \frac{\text{CF}_2}{(1+r)^2} + \frac{\text{CF}_3}{(1+r)^3} + \dots + \frac{\text{CF}_n}{(1+r)^n} = \sum_{t=1}^n \frac{\text{CF}_t}{(1+r)^t}$$

If the cash flows have widely varying risk, or if the yield curve is not horizontal, which signifies that interest rates are expected to change over the life of the cash flows, it would be logical for each period's cash flow to have a different discount rate. However, it is very difficult to make such adjustments; hence it is common practice to use a single discount rate for all cash flows.

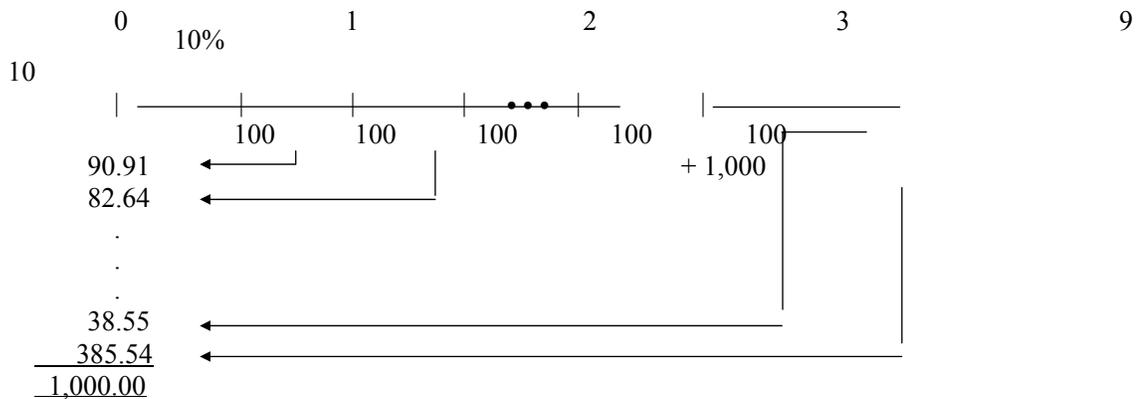
The discount rate is the opportunity cost of capital; that is, it is the rate of return that could be obtained on alternative investments of similar risk. Thus, the discount rate depends primarily on factors discussed back in chapter 1:

$$r_i = r^* + \text{IP} + \text{LP} + \text{MRP} + \text{DRP}$$

d. How is the value of a bond determined? What is the value of a 10-year, \$1,000 par value bond with a 10 percent annual coupon if its required rate of return is 10 percent?

**Answer:** A bond has a specific cash flow pattern consisting of a stream of constant interest payments plus the return of par at maturity. The annual coupon payment is the cash flow:  $\text{pmt} = (\text{coupon rate}) \times (\text{par value}) = 0.1(\$1,000) = \$100$ .

For a 10-year, 10 percent annual coupon bond, the bond's value is found as follows:



Expressed as an equation, we have:

$$V_B = \frac{\$100}{(1+r)^1} + \dots + \frac{\$100}{(1+r)^{10}} + \frac{\$1,000}{(1+r)^{10}}$$

$$= \$90.91 + \dots + \$38.55 + \$385.54 = \$1,000.$$

or:

$$V_B = \$100(\text{PVIFA}_{10\%,10}) + \$1,000(\text{PVIF}_{10\%,10})$$

$$= \$100 \left( \frac{1 - 1/(1.1)^{10}}{0.10} \right) + \$1,000 (1/(1+0.10)^{10}).$$

The bond consists of a 10-year, 10% annuity of \$100 per year plus a \$1,000 lump sum payment at  $t = 10$ :

$$\begin{aligned} \text{PV Annuity} &= \$ 614.46 \\ \text{PV Maturity Value} &= \underline{385.54} \\ \text{Value Of Bond} &= \underline{\underline{\$1,000.00}} \end{aligned}$$

The mathematics of bond valuation is programmed into financial calculators which do the operation in one step, so the easy way to solve bond valuation problems is with a financial calculator. Input  $n = 10$ ,  $r_d = i = 10$ ,  $\text{PMT} = 100$ , and  $\text{FV} = 1000$ , and then press PV to find the bond's value, \$1,000. Then change  $n$  from 10 to 1 and press PV to get the value of the 1-year bond, which is also \$1,000.

**e. 1. What would be the value of the bond described in part d if, just after it had been issued, the expected inflation rate rose by 3 percentage points, causing investors to require a 13 percent return? Would we now have a discount or a premium bond?**

**Answer:** with a financial calculator, just change the value of  $r = i$  from 10% to 13%, and press the PV button to determine the value of the bond:

$$10\text{-year} = \$837.21.$$

Using the formulas, we would have, at  $r = 13$  percent,

$$\begin{aligned}V_{B(10\text{-YR})} &= \$100(\text{PVIFA}_{13\%,10}) + \$1,000(\text{PVIF}_{13\%,10}) \\ &= \$100 \left( (1 - 1/(1+0.13)^{10})/0.13 \right) + \$1,000 (1/(1+0.13)^{10}) \\ &= \$542.62 + \$294.59 = \$837.21.\end{aligned}$$

In a situation like this, where the required rate of return,  $r$ , rises above the coupon rate, the bonds' values fall below par, so they sell at a discount.

**e. 2. What would happen to the bonds' value if inflation fell, and  $r_d$  declined to 7 percent? Would we now have a premium or a discount bond?**

**Answer:** In the second situation, where  $r$  falls to 7 percent, the price of the bond rises above par. Just change  $r$  from 13% to 7%. We see that the 10-year bond's value rises to \$1,210.71.

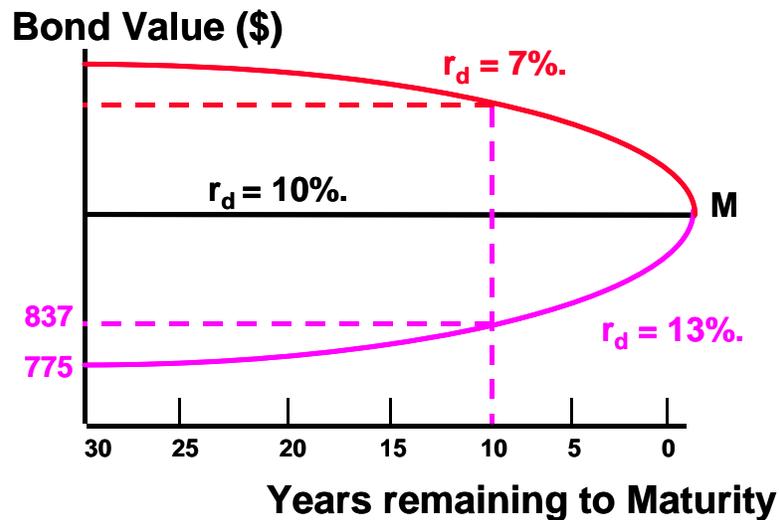
With tables, we have:

$$\begin{aligned}V_{B(10\text{-YR})} &= \$100(\text{PVIFA}_{7\%,10}) + \$1,000(\text{PVIF}_{7\%,10}) \\ &= \$100 \left( (1 - 1/(1+0.07)^{10})/0.07 \right) + \$1,000 (1/(1+0.07)^{10}) \\ &= \$702.36 + \$508.35 = \$1,210.71.\end{aligned}$$

Thus, when the required rate of return falls below the coupon rate, the bonds' value rises above par, or to a premium. Further, the longer the maturity, the greater the price effect of any given interest rate change.

- e. 3. What would happen to the value of the 10-year bond over time if the required rate of return remained at 13 percent, or if it remained at 7 percent? (Hint: with a financial calculator, enter PMT, I, FV, and N, and then change (override) n to see what happens to the PV as the bond approaches maturity.)

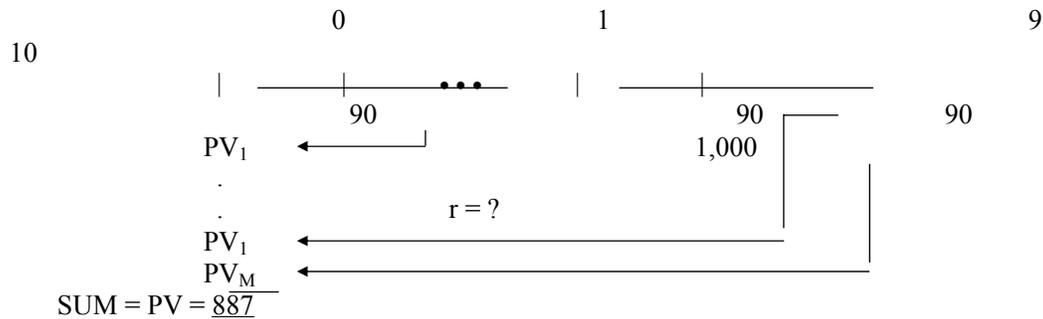
**Answer:** Assuming that interest rates remain at the new levels (either 7% or 13%), we could find the bond's value as time passes, and as the maturity date approaches. If we then plotted the data, we would find the situation shown below:



At maturity, the value of any bond must equal its par value (plus accrued interest). Therefore, if interest rates, hence the required rate of return, remain constant over time, then a bond's value must move toward its par value as the maturity date approaches, so the value of a premium bond decreases to \$1,000, and the value of a discount bond increases to \$1,000 (barring default).

- f. 1. What is the yield to maturity on a 10-year, 9 percent annual coupon, \$1,000 par value bond that sells for \$887.00? That sells for \$1,134.20? What does the fact that a bond sells at a discount or at a premium tell you about the relationship between  $r_d$  and the bond's coupon rate?

**Answer:** The yield to maturity (YTM) is that discount rate which equates the present value of a bond's cash flows to its price. In other words, it is the promised rate of return on the bond. (Note that the expected rate of return is less than the YTM if some probability of default exists.) On a time line, we have the following situation when the bond sells for \$887:



We want to find  $r$  in this equation:

$$V_B = PV = \frac{INT}{(1+r)^1} + \dots + \frac{INT}{(1+r)^N} + \frac{M}{(1+r)^N}$$

We know  $n = 10$ ,  $PV = -887$ ,  $pmt = 90$ , and  $FV = 1000$ , so we have an equation with one unknown,  $r$ . We can solve for  $r$  by entering the known data into a financial calculator and then pressing the  $I = r$  button. The YTM is found to be 10.91%.

Alternatively, we could use present value interest factors:

$$\begin{aligned} \$887 &= \$90(PVIFA_{r,10}) + \$1,000(PVIF_{r,10}) \\ &= \$90 \left( \frac{1 - 1/(1+r)^{10}}{r} \right) + \$1,000 (1/(1+r)^{10}) \end{aligned}$$

We would substitute for various interest rates, in a trial-and-error manner, until we found the rate that produces the equality. This is tiresome, and the procedure will not give an exact answer unless the YTM is a whole number. Consequently, in the real world everyone uses financial calculators.

We can tell from the bond's price, even before we begin the calculations, that the YTM must be above the 9% coupon rate. We know this because the bond is selling at a discount, and discount bonds always have  $r >$  coupon rate.

If the bond were priced at \$1,134.20, then it would be selling at a premium. In that case, it must have a YTM that is below the 9 percent coupon rate, because all premium bonds must have coupons which exceed the going interest rate. Going through the same procedures as before--plugging the appropriate values into a financial calculator and then pressing the  $r = I$  button, we find that at a price of \$1,134.20,  $r = YTM = 7.08\%$ .

- f. 2. What are the total return, the current yield, and the capital gains yield for the discount bond? (Assume the bond is held to maturity and the company does not default on

the bond.)

**Answer:** The current yield is defined as follows:

$$\text{Current Yield} = \frac{\text{Annual coupon interest payment}}{\text{Current price of the bond}}$$

The capital gains yield is defined as follows:

$$\text{Capital gains yield} = \frac{\text{Expected Change in bond's price}}{\text{Beginning - of - year price}}$$

The total expected return is the sum of the current yield and the expected capital gains yield:

$$\text{Expected Total Return} = \text{Expected current yield} + \text{Expected capital gains yield}$$

The term yield to maturity, or YTM, is often used in discussing bonds. It is simply the expected total return (assuming no default risk), so  $\hat{r} = \text{expected total return} = \text{expected YTM}$ .

Recall also that securities have required returns,  $r$ , which depend on a number of factors:

$$\text{Required return} = r = r^* + \text{IP} + \text{LP} + \text{MRP} + \text{DRP}$$

We know that (1) security markets are normally in equilibrium, and (2) that for equilibrium to exist, the expected return,  $\hat{r} = \text{YTM}$ , as seen by the marginal investor, must be equal to the required return,  $r$ . If that equality does not hold, then buying and selling will occur until it does hold, and equilibrium is established. Therefore, for the marginal investor:

$$\hat{r} = \text{YTM} = r$$

For our 9% coupon, 10-year bond selling at a price of \$887 with a YTM of 10.91%, the current yield is:

$$\text{Current yield} = \frac{\$90}{\$887} = 0.1015 = 10.15\%$$

Knowing the current yield and the total return, we can find the capital gains yield:

$$\text{YTM} = \text{current yield} + \text{capital gains yield}$$

And

$$\text{Capital gains yield} = \text{YTM} - \text{current yield} = 10.91\% - 10.15\% = 0.76\%$$

The capital gains yield calculation can be checked by asking this question: "What is the expected value of the bond 1 year from now, assuming that interest rates remain at current levels?" This is the same as asking, "What is the value of a 9-year, 9 percent annual coupon

bond if its YTM (its required rate of return) is 10.91 percent?" The answer, using the bond valuation function of a calculator, is \$893.87. With this data, we can now calculate the bond's capital gains yield as follows:

$$\begin{aligned} \text{Capital Gains Yield} &= (V_{B_1} - V_{B_0}) / V_{B_0} \\ &= (\$893.87 - \$887) / \$887 = 0.0077 = 0.77\%, \end{aligned}$$

This agrees with our earlier calculation (except for rounding). When the bond is selling for \$1,134.20 and providing a total return of  $r = \text{YTM} = 7.08\%$ , we have this situation:

$$\text{Current Yield} = \$90 / \$1,134.20 = 7.94\%$$

and

$$\text{Capital Gains Yield} = 7.08\% - 7.94\% = -0.86\%.$$

The bond provides a current yield that exceeds the total return, but a purchaser would incur a small capital loss each year, and this loss would exactly offset the excess current yield and force the total return to equal the required rate.

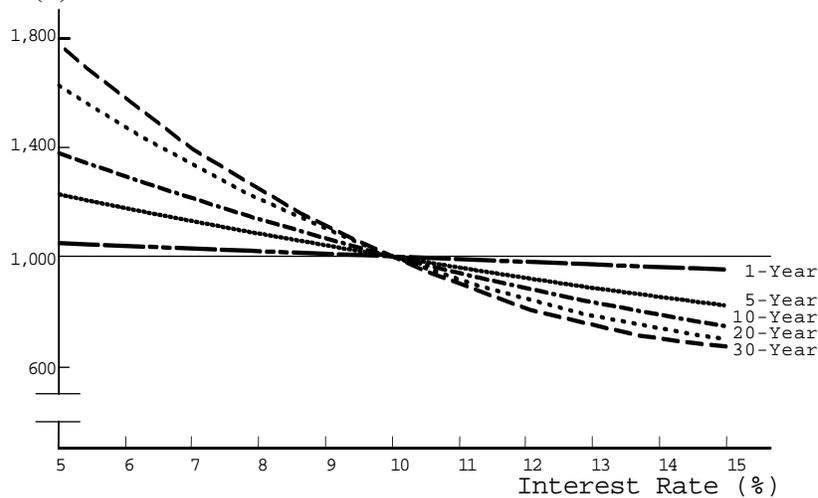
**g. What is *interest rate (or price) risk*? Which bond has more interest rate risk, an annual payment 1-year bond or a 10-year bond? Why?**

**Answer:** Interest rate risk, which is often just called price risk, is the risk that a bond will lose value as the result of an increase in interest rates. Earlier, we developed the following values for a 10 percent, annual coupon bond:

<u>10-Year</u>	<u>Change</u>	<u>r</u>	<u>Maturity</u>	<u>1-Year</u>	<u>Change</u>
	5%	\$1,048		\$1,386	38.6%
	10	1,000	4.8%	1,000	25.1%
	15	956	4.4%	749	

A 5 percentage point increase in  $r$  causes the value of the 1-year bond to decline by only 4.8 percent, but the 10-year bond declines in value by more than 38 percent. Thus, the 10-year bond has more interest rate price risk.

Bond Value Interest Rate Price Risk for 10 Percent Coupon Bonds with Different Maturities



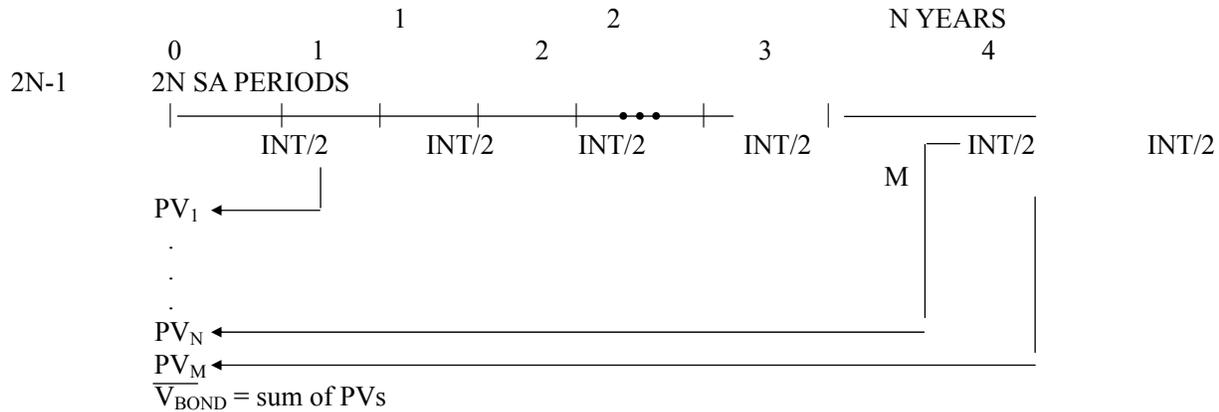
The graph above shows the relationship between bond values and interest rates for a 10 percent, annual coupon bond with different maturities. The longer the maturity, the greater the change in value for a given change in interest rates,  $r_d$ .

h. What is reinvestment rate risk? Which has more reinvestment rate risk, a 1-year bond or a 10-year bond?

**Answer:** Investment rate risk is defined as the risk that cash flows (interest plus principal repayments) will have to be reinvested in the future at rates lower than today's rate. To illustrate, suppose you just won the lottery and now have \$500,000. You plan to invest the money and then live on the income from your investments. Suppose you buy a 1-year bond with a YTM of 10 percent. Your income will be \$50,000 during the first year. Then, after 1 year, you will receive your \$500,000 when the bond matures, and you will then have to reinvest this amount. If rates have fallen to 3 percent, then your income will fall from \$50,000 to \$15,000. On the other hand, had you bought 30-year bonds that yielded 10%, your income would have remained constant at \$50,000 per year. Clearly, buying bonds that have short maturities carries reinvestment rate risk. Note that long maturity bonds also have reinvestment rate risk, but the risk applies only to the coupon payments, and not to the principal amount. Since the coupon payments are significantly less than the principal amount, the reinvestment rate risk on a long-term bond is significantly less than on a short-term bond.

**i. How does the equation for valuing a bond change if semiannual payments are made? Find the value of a 10-year, semiannual payment, 10 percent coupon bond if nominal  $r_d = 13\%$ .**

**Answer:** In reality, virtually all bonds issued in the U.S. have semiannual coupons and are valued using the setup shown below:



We would use this equation to find the bond's value:

$$V_B = \sum_{t=1}^{2N} \frac{\text{INT}/2}{(1 + r_d/2)^t} + \frac{M}{(1 + r_d/2)^{2N}}$$

The payment stream consists of an annuity of  $2n$  payments plus a lump sum equal to the maturity value.

To find the value of the 10-year, semiannual payment bond, semiannual interest = annual coupon/2 =  $\$100/2 = \$50$  and  $n = 2$  (years to maturity) =  $2(10) = 20$ . To find the value of the bond with a financial calculator, enter  $n = 20$ ,  $r_d/2 = I = 5$ ,  $\text{pmt} = 50$ ,  $\text{FV} = 1000$ , and then press PV to determine the value of the bond. Its value is  $\$1,000$ .

You could then change  $r = I$  to see what happens to the bond's value as  $r$  changes, and plot the values--the graph would look like the one we developed earlier.

For example, if  $r$  rose to 13%, we would input  $I = 6.5$  rather than 5%, and find the 10-year bond's value to be  $\$834.72$ . If  $r$  fell to 7%, then input  $I = 3.5$  and press PV to find the bond's new value,  $\$1,213.19$ .

We would find the values with a financial calculator, but they could also be found with formulas. Thus:

$$\begin{aligned} V_{10\text{-YEAR}} &= \$50(\text{PVIFA}_{5\%,20}) + \$1,000(\text{PVIF}_{5\%,20}) \\ &= \$50 \left( \frac{1 - 1/(1+0.05)^{20}}{0.065} \right) + \$1,000 (1/(1+0.05)^{20}) \\ &= \$50(12.4622) + \$1,000(0.37689) = \$623.11 + \$376.89 = \$1,000.00. \end{aligned}$$

At a 13 percent required return:

$$\begin{aligned} V_{10\text{-YEAR}} &= \$50(\text{PVIFA}_{6.5\%,20}) + \$1,000(\text{PVIF}_{6.5\%,20}) \\ &= \$50 \left( \frac{1 - 1/(1+0.065)^{20}}{0.065} \right) + \$1,000 (1/(1+0.065)^{20}) \\ &= \$834.72. \end{aligned}$$

At a 7 percent required return:

$$\begin{aligned}V_{10\text{-YEAR}} &= \$50(\text{PVIFA}_{3.5\%,20}) + \$1,000(\text{PVIF}_{3.5\%,20}) \\ &= \$50 \left( (1 - 1/(1+0.035)^{20}) / 0.035 \right) + \$1,000 (1/(1+0.035)^{20}) \\ &= \$1,213.19.\end{aligned}$$

- j. Suppose you could buy, for \$1,000, either a 10 percent, 10-year, annual payment bond or a 10 percent, 10-year, semiannual payment bond. They are equally risky. Which would you prefer? If \$1,000 is the proper price for the semiannual bond, what is the equilibrium price for the annual payment bond?

**Answer:** The semiannual payment bond would be better. Its EAR would be:

$$\text{EAR} = \left( 1 + \frac{r_{\text{Nom}}}{m} \right)^m - 1 = \left( 1 + \frac{0.10}{2} \right)^2 - 1 = 10.25\%.$$

An EAR of 10.25% is clearly better than one of 10.0%, which is what the annual payment bond offers. You, and everyone else, would prefer it.

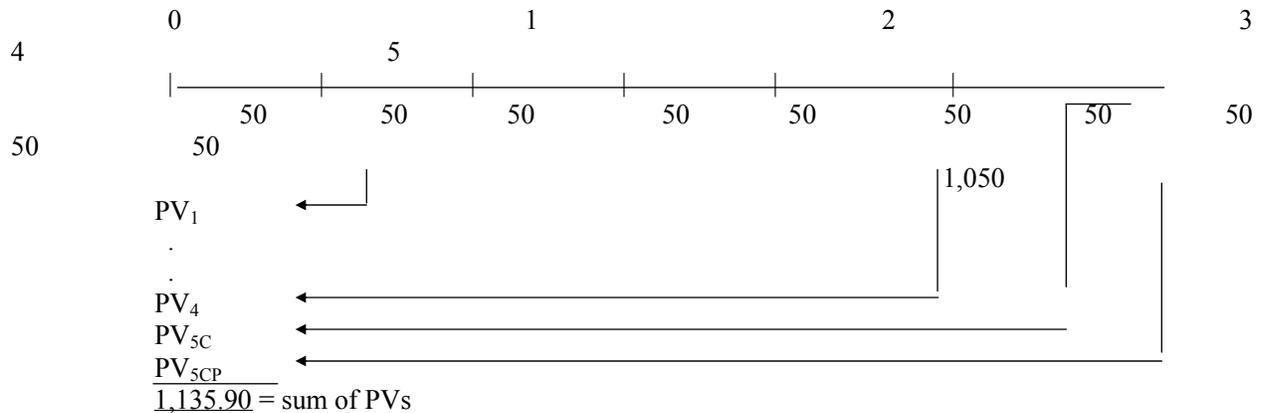
If the going rate of interest on semiannual bonds is  $r_{\text{Nom}} = 10\%$ , with an EAR of 10.25%, then it would not be appropriate to find the value of the annual payment bond using a 10% EAR. If the annual payment bond were traded in the market, its value would be found using 10.25%, because investors would insist on getting the same EAR on the two bonds, because their risk is the same. Therefore, you could find the value of the annual payment bond, using 10.25%, with your calculator. It would be \$984.80 versus \$1,000 for the semiannual payment bond.

Note that, if the annual payment bond were selling for \$984.80 in the market, its EAR would be 10.25%. This value can be found by entering  $n = 10$ ,  $PV = -984.80$ ,  $pmt = 100$ , and  $FV = 1000$  into a financial calculator and then pressing the  $r = I$  button to find the answer, 10.25%. With this rate, and the \$984.80 price, the annual and semiannual payment bonds would be in equilibrium--investors would get the same rate of return on either bond, so there would not be a tendency to sell one and buy the other (as there would be if they were both priced at \$1,000.)

k. Suppose a 10-year, 10 percent, semiannual coupon bond with a par value of \$1,000 is currently selling for \$1,135.90, producing a nominal yield to maturity of 8 percent. However, the bond can be called after 5 years for a price of \$1,050.

k. 1. What is the bond's *nominal yield to call (YTC)*?

**Answer:** If the bond were called, bondholders would receive \$1,050 at the end of year 5. Thus, the time line would look like this:



The easiest way to find the YTC on this bond is to input values into your calculator:  $n = 10$ ;  $PV = -1135.90$ ;  $pmt = 50$ ; and  $FV = 1050$ , which is the par value plus a call premium of \$50; and then press the  $r = I$  button to find  $I = 3.765\%$ . However, this is the 6-month rate, so we would find the nominal rate on the bond as follows:

$$r_{Nom} = 2(3.765\%) = 7.5301\% \approx 7.5\%.$$

This 7.5% is the rate brokers would quote if you asked about buying the bond.

You could also calculate the EAR on the bond:

$$EAR = (1.03765)^2 - 1 = 7.672\%.$$

Usually, people in the bond business just talk about nominal rates, which is OK so long as all the bonds being compared are on a semiannual payment basis. When you start making comparisons among investments with different payment patterns, though, it is important to convert to EARs.

k. 2. If you bought this bond, do you think you would be more likely to earn the YTM or the YTC? Why?

**Answer:** Since the coupon rate is 10% versus  $YTC = r_d = 7.53\%$ , it would pay the company to call the bond, get rid of the obligation to pay \$100 per year in interest, and sell replacement bonds whose interest would be only \$75.30 per year. Therefore, if interest rates remain at the current level until the call date, the bond will surely be called, so investors should expect to earn 7.53%. In general, investors should expect to earn the YTC on premium bonds, but to earn the YTM on par and discount bonds. (Bond brokers publish lists of the bonds they have for sale; they quote YTM or YTC depending on whether the bond sells at a premium or a discount.)

l. Boeing's bonds were issued with a yield to maturity of 7.5 percent. Does the yield to maturity represent the promised or expected return on the bond?

**Answer:** The yield to maturity is the rate of return earned on a bond if it is held to maturity. It can be viewed as the bond's promised rate of return, which is the return that investors will receive if all the promised payments are made. The yield to maturity equals the expected rate of return only if (1) the probability of default is zero and (2) the bond cannot be called. For bonds where there is some default risk, or where the bond may be called, there is some probability that the promised payments to maturity will not be received, in which case, the promised yield to maturity will differ from the expected return.

m. Boeing's bonds were rated AA- by S&P. Would you consider these bonds investment grade or junk bonds?

**Answer:** The Boeing bonds would be investment grade bonds. Triple-A double-A, single-A, and triple-B bonds are considered investment grade. Double-B and lower-rated bonds are considered speculative, or junk bonds, because they have a significant probability of going into default. Many financial institutions are prohibited from buying junk bonds.

**n. What factors determine a company's bond rating?**

**Answer:** Bond ratings are based on both qualitative and quantitative factors, some of which are listed below.

1. Financial performance--determined by ratios such as the debt, TIE, FCC, and current ratios.
2. Provisions in the bond contract:
  - A. Secured vs. Unsecured debt
  - B. Senior vs. Subordinated debt
  - C. Guarantee provisions
  - D. Sinking fund provisions
  - E. Debt maturity
3. Other factors:
  - A. Earnings stability
  - B. Regulatory environment
  - C. Potential product liability
  - D. Accounting policy

**o. If this firm were to default on the bonds, would the company be immediately liquidated? Would the bondholders be assured of receiving all of their promised payments?**

**Answer:** When a business becomes insolvent, it does not have enough cash to meet scheduled interest and principal payments. A decision must then be made whether to dissolve the firm through liquidation or to permit it to reorganize and thus stay alive.

The decision to force a firm to liquidate or to permit it to reorganize depends on whether the value of the reorganized firm is likely to be greater than the value of the firm's assets if they were sold off piecemeal. In a reorganization, a committee of unsecured creditors is appointed by the court to negotiate with management on the terms of a potential reorganization. The reorganization plan may call for a restructuring of the firm's debt, in which case the interest rate may be reduced, the term to maturity lengthened, or some of the debt may be exchanged for equity. The point of the restructuring is to reduce the financial charges to a level that the firm's cash flows can support.

If the firm is deemed to be too far gone to be saved, it will be liquidated and the priority of claims would be as follows:

1. Secured creditors.
2. Trustee's costs.
3. Expenses incurred after bankruptcy was filed.
4. Wages due workers, up to a limit of \$2,000 per worker.
5. Claims for unpaid contributions to employee benefit plans.
6. Unsecured claims for customer deposits up to \$900 per customer.
7. Federal, state, and local taxes.
8. Unfunded pension plan liabilities.
9. General unsecured creditors.
10. Preferred stockholders, up to the par value of their stock.
11. Common stockholders, if anything is left.

If the firm's assets are worth more "alive" than "dead," the company would be reorganized. Its bondholders, however, would expect to take a "hit." Thus, they would not expect to receive all their promised payments. If the firm is deemed to be too far gone to be saved, it would be liquidated.

# Chapter 7

## Stocks and Their Valuation

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 7-1
- a. A proxy is a document giving one person the authority to act for another, typically the power to vote shares of common stock. If earnings are poor and stockholders are dissatisfied, an outside group may solicit the proxies in an effort to overthrow management and take control of the business, known as a proxy fight. A takeover is an action whereby a person or group succeeds in ousting a firm's management and taking control of the company. The preemptive right gives the current shareholders the right to purchase any new shares issued in proportion to their current holdings. The preemptive right may or may not be required by state law. When granted, the preemptive right enables current owners to maintain their proportionate share of ownership and control of the business. It also prevents the sale of shares at low prices to new stockholders which would dilute the value of the previously issued shares. Classified stock is sometimes created by a firm to meet special needs and circumstances. Generally, when special classifications of stock are used, one type is designated "Class A", another as "Class B", and so on. Class A might be entitled to receive dividends before dividends can be paid on Class B stock. Class B might have the exclusive right to vote. Founders' shares are stock owned by the firm's founders that have sole voting rights but restricted dividends for a specified number of years.
  - b. Some companies are so small that their common stocks are not actively traded; they are owned by only a few people, usually the companies' managers. Such firms are said to be closely held corporations. In contrast, the stocks of most larger companies are owned by a large number of investors, most of whom are not active in management. Such companies are said to be publicly owned corporations.
  - c. The secondary market deals with trading in previously issued, or outstanding, shares of established, publicly owned companies. The company receives no new money when sales are made in the secondary market. The primary market handles additional shares sold by established, publicly owned companies. Companies can raise additional capital by selling in this market. Going public is the act of selling stock to the public at large by a closely held corporation or its principal stockholders, and this market is often termed the initial public offering (IPO) market.
  - d. Intrinsic value ( $\hat{P}_0$ ) is the present value of the expected future cash flows. The market price ( $P_0$ ) is the price at which an asset can be sold.
  - e. The required rate of return on common stock, denoted by  $r_s$ , is the minimum acceptable rate of return considering both its riskiness and the returns available on other investments. The expected rate of return, denoted by  $\hat{r}_s$ , is the rate of return expected on a stock given its current price and expected future cash flows. If the stock is in equilibrium, the required rate of return will equal the expected rate of return. The realized (actual) rate of return, denoted by  $\bar{r}_s$ , is the rate of return that was actually realized at the end of some holding period. Although expected

and required rates of return must always be positive, realized rates of return over some periods may be negative.

- f. The capital gains yield results from changing prices and is calculated as  $(P_1 - P_0)/P_0$ , where  $P_0$  is the beginning-of-period price and  $P_1$  is the end-of-period price. For a constant growth stock, the capital gains yield is  $g$ , the constant growth rate. The dividend yield on a stock can be defined as either the end-of-period dividend divided by the beginning-of-period price, or the ratio of the current dividend to the current price. Valuation formulas use the former definition. The expected total return, or expected rate of return, is the expected capital gains yield plus the expected dividend yield on a stock. The expected total return on a bond is the yield to maturity.
- g. Normal, or constant, growth occurs when a firm's earnings and dividends grow at some constant rate forever. One category of nonconstant growth stock is a "supernormal" growth stock which has one or more years of growth above that of the economy as a whole, but at some point the growth rate will fall to the "normal" rate. This occurs, generally, as part of a firm's normal life cycle. A zero growth stock has constant earnings and dividends; thus, the expected dividend payment is fixed, just as a bond's coupon payment. Since the company is presumed to continue operations indefinitely, the dividend stream is a perpetuity. A perpetuity is a security on which the principal never has to be repaid.
- h. Equilibrium is the condition under which the expected return on a security is just equal to its required return,  $\hat{r} = r$ , and the price is stable. The Efficient Markets Hypothesis (EMH) states (1) that stocks are always in equilibrium and (2) that it is impossible for an investor to consistently "beat the market." In essence, the theory holds that the price of a stock will adjust almost immediately in response to any new developments. In other words, the EMH assumes that all important information regarding a stock is reflected in the price of that stock. Financial theorists generally define three forms of market efficiency: weak-form, semistrong-form, and strong-form. Weak-form efficiency assumes that all information contained in past price movements is fully reflected in current market prices. Thus, information about recent trends in a stock's price is of no use in selecting a stock. Semistrong-form efficiency states that current market prices reflect all publicly available information. Therefore, the only way to gain abnormal returns on a stock is to possess inside information about the company's stock. Strong-form efficiency assumes that all information pertaining to a stock, whether public or inside information, is reflected in current market prices. Thus, no investors would be able to earn abnormal returns in the stock market.
- i. Preferred stock is a hybrid--it is similar to bonds in some respects and to common stock in other respects. Preferred dividends are similar to interest payments on bonds in that they are fixed in amount and generally must be paid before common stock dividends can be paid. If the preferred dividend is not earned, the directors can omit it without throwing the company into bankruptcy. So, although preferred stock has a fixed payment like bonds, a failure to make this payment will not lead to bankruptcy. Most preferred stocks entitle their owners to regular fixed dividend payments.

7-2 True. The value of a share of stock is the PV of its expected future dividends. If the two investors expect the same future dividend stream, and they agree on the stock's riskiness, then they should reach similar conclusions as to the stock's value.

7-3 A perpetual bond is similar to a no-growth stock and to a share of preferred stock in the following ways:

1. All three derive their values from a series of cash inflows--coupon payments from the perpetual bond, and dividends from both types of stock.
2. All three are assumed to have indefinite lives with no maturity value (M) for the perpetual bond and no capital gains yield for the stocks.

---

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

7-1  $D_0 = \$1.50$ ;  $g_{1-3} = 5\%$ ;  $g_n = 10\%$ ;  $D_1$  through  $D_5 = ?$

$$D_1 = D_0(1 + g_1) = \$1.50(1.05) = \$1.5750.$$

$$D_2 = D_0(1 + g_1)(1 + g_2) = \$1.50(1.05)^2 = \$1.6538.$$

$$D_3 = D_0(1 + g_1)(1 + g_2)(1 + g_3) = \$1.50(1.05)^3 = \$1.7364.$$

$$D_4 = D_0(1 + g_1)(1 + g_2)(1 + g_3)(1 + g_n) = \$1.50(1.05)^3(1.10) = \$1.9101.$$

$$D_5 = D_0(1 + g_1)(1 + g_2)(1 + g_3)(1 + g_n)^2 = \$1.50(1.05)^3(1.10)^2 = \$2.1011.$$

7-2  $D_1 = \$0.50$ ;  $g = 7\%$ ;  $r_s = 15\%$ ;  $\hat{P}_0 = ?$

$$\hat{P}_0 = \frac{D_1}{r_s - g} = \frac{\$0.50}{0.15 - 0.07} = \$6.25.$$

7-3  $P_0 = \$20$ ;  $D_0 = \$1.00$ ;  $g = 10\%$ ;  $\hat{P}_1 = ?$ ;  $\hat{r}_s = ?$

$$\hat{P}_1 = P_0(1 + g) = \$20(1.10) = \$22.$$

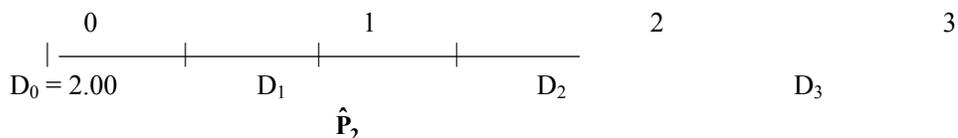
$$\hat{r}_s = \frac{D_1}{P_0} + g = \frac{\$1.00(1.10)}{\$20} + 0.10$$

$$= \frac{\$1.10}{\$20} + 0.10 = 15.50\%. \quad \hat{r}_s = 15.50\%.$$

7-4  $D_{ps} = \$5.00$ ;  $V_{ps} = \$60$ ;  $r_{ps} = ?$

$$r_{ps} = \frac{D_{ps}}{V_{ps}} = \frac{\$5.00}{\$60.00} = 8.33\%.$$

7-5



Step 1: Calculate the required rate of return on the stock:

$$r_s = r_{RF} + (r_M - r_{RF})b = 7.5\% + (4\%)1.2 = 12.3\%.$$

Step 2: Calculate the expected dividends:

$$\begin{aligned} D_0 &= \$2.00 \\ D_1 &= \$2.00(1.20) = \$2.40 \\ D_2 &= \$2.00(1.20)^2 = \$2.88 \\ D_3 &= \$2.88(1.07) = \$3.08 \end{aligned}$$

Step 3: Calculate the PV of the expected dividends:

$$PV_{Div} = \$2.40/(1.123) + \$2.88/(1.123)^2 = \$2.14 + \$2.28 = \$4.42.$$

Step 4: Calculate  $\hat{P}_2$ :

$$\hat{P}_2 = D_3/(r_s - g) = \$3.08/(0.123 - 0.07) = \$58.11.$$

Step 5: Calculate the PV of  $\hat{P}_2$ :

$$PV = \$58.11/(1.123)^2 = \$46.08.$$

Step 6: Sum the PVs to obtain the stock's price:

$$\hat{P}_0 = \$4.42 + \$46.08 = \$50.50.$$

Alternatively, using a financial calculator, input the following:

$CF_0 = 0$ ,  $CF_1 = 2.40$ , and  $CF_2 = 60.99$  ( $2.88 + 58.11$ ) and then enter  $I = 12.3$  to solve for  $NPV = \$50.50$ .

7-6

The problem asks you to determine the constant growth rate, given the following facts:  $P_0 = \$80$ ,  $D_1 = \$4$ , and  $r_s = 14\%$ . Use the constant growth rate formula to calculate  $g$ :

$$\hat{r}_s = \frac{D_1}{P_0} + g$$

$$0.14 = \frac{\$4}{\$80} + g$$

$$g = 0.09 = 9\%$$

7-7 The problem asks you to determine the value of  $\hat{P}_3$ , given the following facts:  $D_1 = \$2$ ,  $b = 0.9$ ,  $r_{RF} = 5.6\%$ ,  $RP_M = 6\%$ , and  $P_0 = \$25$ . Proceed as follows:

Step 1: Calculate the required rate of return:

$$r_s = r_{RF} + (r_M - r_{RF})b = 5.6\% + (6\%)0.9 = 11\%$$

Step 2: Use the constant growth rate formula to calculate  $g$ :

$$\hat{r}_s = \frac{D_1}{P_0} + g$$

$$0.11 = \frac{\$2}{\$25} + g$$

$$g = 0.03 = 3\%$$

Step 3: Calculate  $\hat{P}_3$ :

$$\hat{P}_3 = P_0(1 + g)^3 = \$25(1.03)^3 = \$27.3182 \approx \$27.32$$

Alternatively, you could calculate  $D_4$  and then use the constant growth rate formula to solve for  $\hat{P}_3$ :

$$D_4 = D_1(1 + g)^3 = \$2.00(1.03)^3 = \$2.1855$$

$$\hat{P}_3 = \$2.1855 / (0.11 - 0.03) = \$27.3188 \approx \$27.32$$

7-8  $V_{ps} = D_{ps} / r_{ps}$ ; therefore,  $r_{ps} = D_{ps} / V_{ps}$ .

a.  $r_{ps} = \$8 / \$60 = 13.3\%$ .

b.  $r_{ps} = \$8 / \$80 = 10\%$ .

c.  $r_{ps} = \$8 / \$100 = 8\%$ .



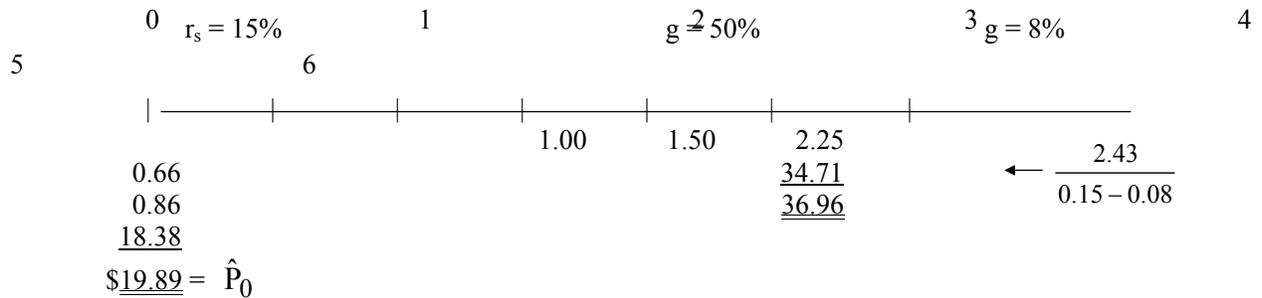
7-12 Calculate the dividend stream and place them on a time line. Also, calculate the price of the stock at the end of the supernormal growth period, and include it, along with the dividend to be paid at  $t = 5$ , as  $CF_5$ . Then, enter the cash flows as shown on the time line into the cash flow register, enter the required rate of return as  $I = 15$ , and then find the value of the stock using the NPV calculation. Be sure to enter  $CF_0 = 0$ , or else your answer will be incorrect.

$$D_0 = 0; D_1 = 0, D_2 = 0, D_3 = 1.00$$

$$D_4 = 1.00(1.5) = 1.5; D_5 = 1.00(1.5)^2 = 2.25; D_6 = 1.00(1.5)^2(1.08)$$

$$= \$2.43.$$

$$\hat{P}_0 = ?$$



$$\hat{P}_5 = D_6 / (r_s - g) = 2.43 / (0.15 - 0.08) = 34.71. \quad \text{This is the price of the stock at the end of Year 5.}$$

$$CF_0 = 0; CF_{1-2} = 0; CF_3 = 1.0; CF_4 = 1.5; CF_5 = 36.96; I = 15\%.$$

With these cash flows in the CFLO register, press NPV to get the value of the stock today: NPV = \$19.89.

7-13 a.  $V_{ps} = \frac{D_{ps}}{r_{ps}} = \frac{\$10}{0.08} = \$125.$

b.  $V_{ps} = \frac{\$10}{0.12} = \$83.33.$



7-16 a. 1.  $\hat{P}_0 = \frac{\$2(1-0.05)}{0.15+0.05} = \frac{\$1.90}{0.20} = \$9.50.$

2.  $\hat{P}_0 = \$2/0.15 = \$13.33.$

3.  $\hat{P}_0 = \frac{\$2(1.05)}{0.15-0.05} = \frac{\$2.10}{0.10} = \$21.00.$

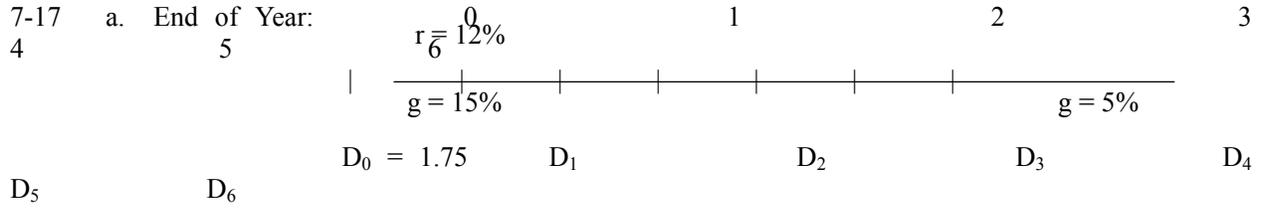
4.  $\hat{P}_0 = \frac{\$2(1.10)}{0.15-0.10} = \frac{\$2.20}{0.05} = \$44.00.$

b. 1.  $\hat{P}_0 = \$2.30/0 = \text{Undefined}.$

2.  $\hat{P}_0 = \$2.40/(-0.05) = -\$48,$  which is nonsense.

These results show that the formula does not make sense if the required rate of return is equal to or less than the expected growth rate.

c. No.



$$\begin{aligned}
 D_t &= D_0(1 + g)^t \\
 D_1 &= \$1.75(1.15)^1 = \$2.01. \\
 D_2 &= \$1.75(1.15)^2 = \$1.75(1.3225) = \$2.31. \\
 D_3 &= \$1.75(1.15)^3 = \$1.75(1.5209) = \$2.66. \\
 D_4 &= \$1.75(1.15)^4 = \$1.75(1.7490) = \$3.06. \\
 D_5 &= \$1.75(1.15)^5 = \$1.75(2.0114) = \$3.52.
 \end{aligned}$$

b. Step 1

$$\text{PV of dividends} = \sum_{t=1}^5 \frac{D_t}{(1 + r_s)^t}$$

$$\begin{aligned}
 \text{PV } D_1 &= \$2.01(\text{PVIF}_{12\%,1}) = \$2.01(0.8929) = \$1.79 \\
 \text{PV } D_2 &= \$2.31(\text{PVIF}_{12\%,2}) = \$2.31(0.7972) = \$1.84 \\
 \text{PV } D_3 &= \$2.66(\text{PVIF}_{12\%,3}) = \$2.66(0.7118) = \$1.89 \\
 \text{PV } D_4 &= \$3.06(\text{PVIF}_{12\%,4}) = \$3.06(0.6355) = \$1.94 \\
 \text{PV } D_5 &= \$3.52(\text{PVIF}_{12\%,5}) = \$3.52(0.5674) = \underline{\underline{\$2.00}} \\
 \text{PV of dividends} &= \underline{\underline{\$9.46}}
 \end{aligned}$$

Step 2

$$\hat{P}_5 = \frac{D_6}{r_s - g_n} = \frac{D_5(1 + g_n)}{r_s - g_n} = \frac{\$3.52(1.05)}{0.12 - 0.05} = \frac{\$3.70}{0.07} = \$52.80.$$

This is the price of the stock 5 years from now. The PV of this price, discounted back 5 years, is as follows:

$$\text{PV of } \hat{P}_5 = \$52.80(\text{PVIF}_{12\%,5}) = \$52.80(0.5674) = \$29.96.$$

Step 3

The price of the stock today is as follows:

$$\begin{aligned}
 \hat{P}_0 &= \text{PV dividends Years 1 through 5} + \text{PV of } \hat{P}_5 \\
 &= \$9.46 + \$29.96 = \$39.42.
 \end{aligned}$$

This problem could also be solved by substituting the proper values into the following equation:

$$\hat{P}_0 = \sum_{t=1}^5 \frac{D_0(1 + g_s)^t}{(1 + r_s)^t} + \left( \frac{D_6}{r_s - g_n} \right) \left( \frac{1}{1 + r_s} \right)^5$$

Calculator solution: Input 0, 2.01, 2.31, 2.66, 3.06, 56.32 (3.52 + 52.80) into the cash flow register, input I = 12, PV = ? PV = \$39.43.

c. First Year

$$\begin{aligned} D_1/P_0 = \$2.01/\$39.42 &= 5.10\% \\ \text{Capital gains yield} &= \underline{6.90\%} \\ \text{Expected total return} &= \underline{12.00\%} \end{aligned}$$

Sixth Year

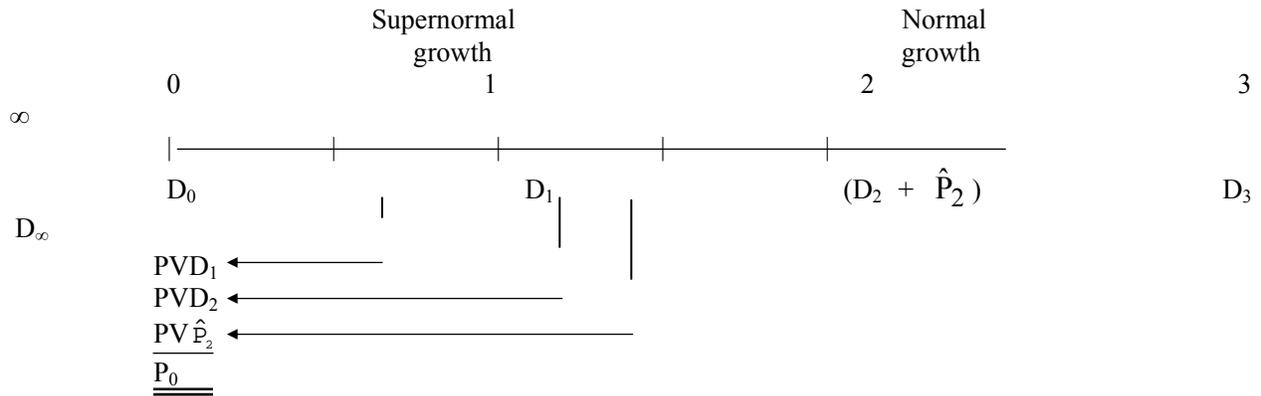
$$\begin{aligned} D_6/P_5 = \$3.70/\$52.80 &= 7.00\% \\ \text{Capital gains yield} &= \underline{5.00} \\ \text{Expected total return} &= \underline{12.00\%} \end{aligned}$$

\*We know that  $r$  is 12 percent, and the dividend yield is 5.10 percent; therefore, the capital gains yield must be 6.90 percent.

The main points to note here are as follows:

1. The total yield is always 12 percent (except for rounding errors).
2. The capital gains yield starts relatively high, then declines as the supernormal growth period approaches its end. The dividend yield rises.
3. After  $t=5$ , the stock will grow at a 5 percent rate. The dividend yield will equal 7 percent, the capital gains yield will equal 5 percent, and the total return will be 12 percent.

7-18 a. Part 1. Graphical representation of the problem:



$$D_1 = D_0(1 + g_s) = \$1.6(1.20) = \$1.92.$$

$$D_2 = D_0(1 + g_s)^2 = \$1.60(1.20)^2 = \$2.304.$$

$$\hat{P}_2 = \frac{D_3}{r_s - g_n} = \frac{D_2(1 + g_n)}{r_s - g_n} = \frac{\$2.304(1.06)}{0.10 - 0.06} = \$61.06.$$

$$\begin{aligned} \hat{P}_0 &= PV(D_1) + PV(D_2) + PV(\hat{P}_2) \\ &= \frac{D_1}{(1 + r_s)} + \frac{D_2}{(1 + r_s)^2} + \frac{\hat{P}_2}{(1 + r_s)^2} \\ &= \$1.92(0.9091) + \$2.304(0.8264) + \$61.06(0.8264) = \$54.11. \end{aligned}$$

Calculator solution: Input 0, 1.92, 63.364(2.304 + 61.06) into the cash flow register, input I = 10, PV = ? PV = \$54.11.

Part 2.

Expected dividend yield:  $D_1/P_0 = \$1.92/\$54.11 = 3.55\%$ .

Capital gains yield: First, find  $\hat{P}_1$  which equals the sum of the present values of  $D_2$  and  $\hat{P}_2$ , discounted for one year.

$$\hat{P}_1 = D_2(PVIF_{10\%, 1}) + \hat{P}_2(PVIF_{10\%, 1}) = \frac{\$2.304 + \$61.06}{(1.10)^1} = \$57.60.$$

Calculator solution: Input 0, 63.364(2.304 + 61.06) into the cash flow register, input I = 10, PV = ? PV = \$57.60.

Second, find the capital gains yield:

$$\frac{\hat{P}_1 - P_0}{P_0} = \frac{\$57.60 - \$54.11}{\$54.11} = 6.45\%.$$

$$\begin{aligned} \text{Dividend yield} &= 3.55\% \\ \text{Capital gains yield} &= \frac{6.45}{10.00}\% = r_s. \end{aligned}$$

- b. Due to the longer period of supernormal growth, the value of the stock will be higher for each year. Although the total return will remain the same,  $r_s = 10\%$ , the distribution between dividend yield and capital gains yield will differ: The dividend yield will start off lower and the capital gains yield will start off higher for the 5-year supernormal growth condition, relative to the 2-year supernormal growth state. The dividend yield will increase and the capital gains yield will decline over the 5-year period until dividend yield = 4% and capital gains yield = 6%.
- c. Throughout the supernormal growth period, the total yield will be 10 percent, but the dividend yield is relatively low during the early years of the supernormal growth period and the capital gains yield is relatively high. As we near the end of the supernormal growth period, the capital gains yield declines and the dividend yield rises. After the supernormal growth period has ended, the capital gains yield will equal  $g_n = 6\%$ . The total yield must equal  $r_s = 10\%$ , so the dividend yield must equal  $10\% - 6\% = 4\%$ .
- d. Some investors need cash dividends (retired people) while others would prefer growth. Also, investors must pay taxes each year on the dividends received during the year, while taxes on capital gains can be delayed until the gain is actually realized.

- 7-19 a.  $r_s = r_{RF} + (r_M - r_{RF})b = 11\% + (14\% - 11\%)1.5 = 15.5\%$ .  
 $\hat{P}_0 = D_1/(r_s - g) = \$2.25/(0.155 - 0.05) = \$21.43$ .
- b.  $r_s = 9\% + (12\% - 9\%)1.5 = 13.5\%$ .  $\hat{P}_0 = \$2.25/(0.135 - 0.05) = \$26.47$ .
- c.  $r_s = 9\% + (11\% - 9\%)1.5 = 12.0\%$ .  $\hat{P}_0 = \$2.25/(0.12 - 0.05) = \$32.14$ .
- d. New data given:  $r_{RF} = 9\%$ ;  $r_M = 11\%$ ;  $g = 6\%$ ,  $b = 1.3$ .  
 $r_s = r_{RF} + (r_M - r_{RF})b = 9\% + (11\% - 9\%)1.3 = 11.6\%$ .  
 $\hat{P}_0 = D_1/(r_s - g) = \$2.27/(0.116 - 0.06) = \$40.54$ .

## SOLUTION TO SPREADSHEET PROBLEM

---

- 7-20 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 07 P20 Build a Model.xls*) and on the instructor's side of the web site, [brigham.swcollege.com](http://brigham.swcollege.com).

## MINI CASE

---

Sam Strother and Shawna Tibbs are senior vice presidents of the Mutual of Seattle. They are co-directors of the company's pension fund management division, with Strother having responsibility for fixed income securities (primarily bonds) and Tibbs being responsible for equity investments. A major new client, the Northwestern Municipal League, has requested that Mutual of Seattle present an investment seminar to the mayors of the represented cities, and Strother and Tibbs, who will make the actual presentation, have asked you to help them.

**To illustrate the common stock valuation process, Strother and Tibbs have asked you to analyze the Temp Force Company, an employment agency that supplies word processor operators and computer programmers to businesses with temporarily heavy workloads. You are to answer the following questions.**

**a. Describe briefly the legal rights and privileges of common stockholders.**

**Answer:** The common stockholders are the owners of a corporation, and as such, they have certain rights and privileges as described below.

1. Ownership implies control. Thus, a firm's common stockholders have the right to elect its firm's directors, who in turn elect the officers who manage the business.
2. Common stockholders often have the right, called the preemptive right, to purchase any additional shares sold by the firm. In some states, the preemptive right is automatically included in every corporate charter; in others, it is necessary to insert it specifically into the charter.

**b. 1. Write out a formula that can be used to value any stock, regardless of its dividend pattern.**

**Answer:** The value of any stock is the present value of its expected dividend stream:

$$\hat{P}_0 = \frac{D_1}{(1+r_s)^1} + \frac{D_2}{(1+r_s)^2} + \frac{D_3}{(1+r_s)^3} + \Lambda + \frac{D_\infty}{(1+r_s)^\infty}.$$

**However, some stocks have dividend growth patterns which allow them to be valued using short-cut formulas.**

**b. 2. What is a constant growth stock? How are constant growth stocks valued?**

**Answer:** A constant growth stock is one whose dividends are expected to grow at a constant rate forever. “Constant growth” means that the best estimate of the future growth rate is some constant number, not that we really expect growth to be the same each and every year. Many companies have dividends which are expected to grow steadily into the foreseeable future, and such companies are valued as constant growth stocks.

For a constant growth stock:

$$D_1 = D_0(1 + g), D_2 = D_1(1 + g) = D_0(1 + g)^2, \text{ and so on.}$$

**With this regular dividend pattern, the general stock valuation model can be simplified to the following very important equation:**

$$\hat{P}_0 = \frac{D_1}{r_s - g} = \frac{D_0(1 + g)}{r_s - g}.$$

This is the well-known “Gordon,” or “constant-growth” model for valuing stocks. Here  $D_1$ , is the next expected dividend, which is assumed to be paid 1 year from now,  $r_s$  is the required rate of return on the stock, and  $g$  is the constant growth rate.

**b. 3. What happens if a company has a constant  $g$  which exceeds its  $r_s$ ? Will many stocks have expected  $g > r_s$  in the short run (i.e., for the next few years)? In the long run (i.e., forever)?**

**Answer:** The model is derived mathematically, and the derivation requires that  $r_s > g$ . If  $g$  is greater than  $r_s$ , the model gives a negative stock price, which is nonsensical. The model simply cannot be used unless (1)  $r_s > g$ , (2)  $g$  is expected to be constant, and (3)  $g$  can reasonably be expected to continue indefinitely.

Stocks may have periods of supernormal growth, where  $g_s > r_s$ ; however, this growth rate cannot be sustained indefinitely. In the long-run,  $g < r_s$ .

**c. Assume that temp force has a beta coefficient of 1.2, that the risk-free rate (the yield on T-bonds) is 7 percent, and that the market risk premium is 5 percent. What is the required rate of return on the firm’s stock?**

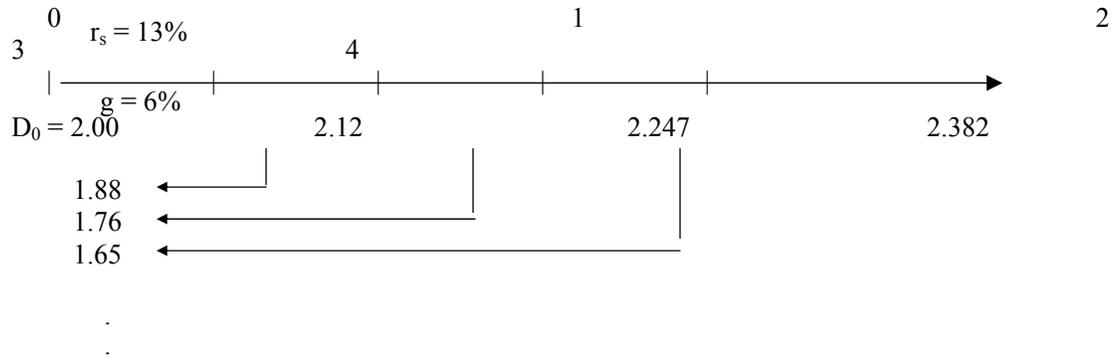
**Answer:** Here we use the SML to calculate temp force’s required rate of return:

$$\begin{aligned} r_s &= r_{RF} + (r_M - r_{RF})b_{\text{Temp Force}} = 7\% + (12\% - 7\%)(1.2) \\ &= 7\% + (5\%)(1.2) = 7\% + 6\% = 13\%. \end{aligned}$$

**d. Assume that Temp Force is a constant growth company whose last dividend ( $D_0$ , which was paid yesterday) was \$2.00, and whose dividend is expected to grow indefinitely at a 6 percent rate.**

**d. 1. What is the firm's expected dividend stream over the next 3 years?**

**Answer:** Temp Force is a constant growth stock, and its dividend is expected to grow at a constant rate of 6 percent per year. Expressed as a time line, we have the following setup. Just enter 2 in your calculator; then keep multiplying by  $1 + g = 1.06$  to get  $D_1$ ,  $D_2$ , and  $D_3$ :



**d. 2. What is the firm's current stock price?**

**Answer:** We could extend the time line on out forever, find the value of Temp Force's dividends for every year on out into the future, and then the PV of each dividend, discounted at  $r = 13\%$ . For example, the PV of  $D_1$  is \$1.76106; the PV of  $D_2$  is \$1.75973; and so forth. Note that the dividend payments increase with time, but as long as  $r_s > g$ , the present values decrease with time. If we extended the graph on out forever and then summed the PVs of the dividends, we would have the value of the stock. However, since the stock is growing at a constant rate, its value can be estimated using the constant growth model:

$$\hat{P}_0 = \frac{D_1}{r_s - g} = \frac{\$2.12}{0.13 - 0.06} = \frac{\$2.12}{0.07} = \$30.29.$$

**d. 3. What is the stock's expected value one year from now?**

**Answer:** After one year,  $D_1$  will have been paid, so the expected dividend stream will then be  $D_2$ ,  $D_3$ ,  $D_4$ , and so on. Thus, the expected value one year from now is \$32.10:

$$\hat{P}_1 = \frac{D_2}{(r_s - g)} = \frac{\$2.247}{(0.13 - 0.06)} = \frac{\$2.247}{0.07} = \$32.10.$$

d. 4. What are the expected dividend yield, the capital gains yield, and the total return during the first year?

**Answer:** The expected dividend yield in any year n is

$$\text{Dividend Yield} = \frac{D_n}{\hat{P}_{n-1}},$$

While the expected capital gains yield is

$$\text{Capital Gains Yield} = \frac{(\hat{P}_n - \hat{P}_{n-1})}{\hat{P}_{n-1}} = r - \frac{D_n}{\hat{P}_{n-1}}.$$

**Thus, the dividend yield in the first year is 10 percent, while the capital gains yield is 6 percent:**

Total return	= 13.0%
Dividend yield = \$2.12/\$30.29	= <u>7.0%</u>
Capital gains yield	= <u>6.0%</u>

e. **Now assume that the stock is currently selling at \$30.29. What is the expected rate of return on the stock?**

**Answer:** The constant growth model can be rearranged to this form:

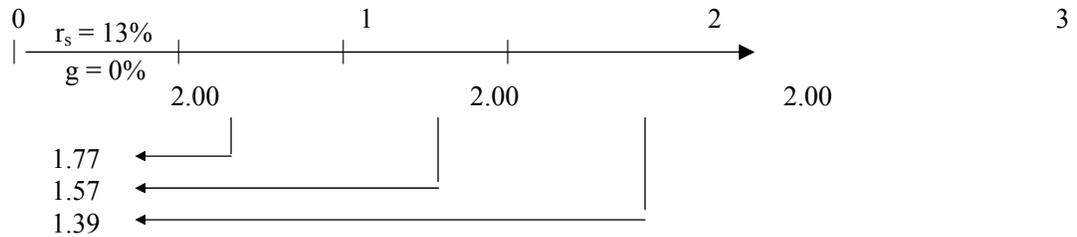
$$\hat{r}_s = \frac{D_1}{P_0} + g.$$

**Here the current price of the stock is known, and we solve for the expected return. For Temp Force:**

$$\hat{r}_s = \$2.12/\$30.29 + 0.060 = 0.070 + 0.060 = 13\%.$$

f. What would the stock price be if its dividends were expected to have zero growth?

Answer: **If Temp Force's dividends were not expected to grow at all, then its dividend stream would be a perpetuity. Perpetuities are valued as shown below:**



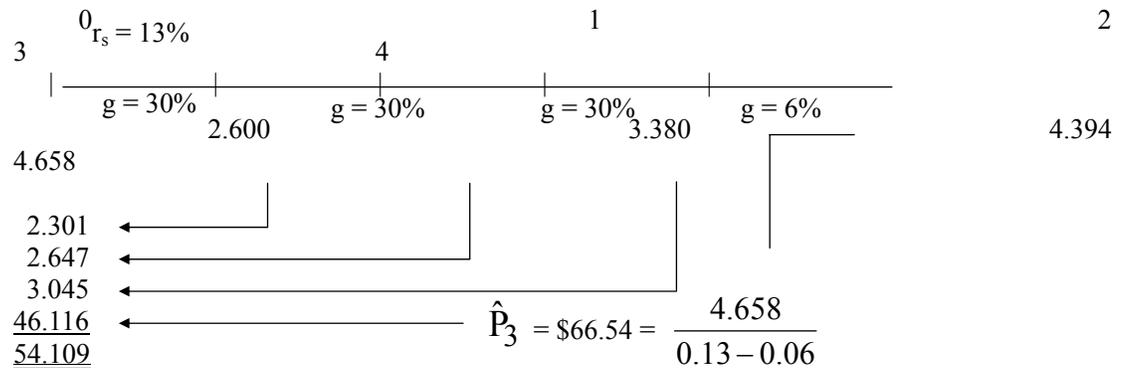
$$P_0 = \underline{15.38}$$

$$P_0 = \text{PMT}/r = \$2.00/0.13 = \$15.38.$$

**Note that if a preferred stock is a perpetuity, it may be valued with this formula.**

g. Now assume that Temp Force is expected to experience supernormal growth of 30 percent for the next 3 years, then to return to its long-run constant growth rate of 6 percent. What is the stock's value under these conditions? What is its expected dividend yield and capital gains yield in year 1? In year 4?

**Answer:** Temp Force is no longer a constant growth stock, so the constant growth model is not applicable. Note, however, that the stock is expected to become a constant growth stock in 3 years. Thus, it has a nonconstant growth period followed by constant growth. The easiest way to value such nonconstant growth stocks is to set the situation up on a time line as shown below:



Simply enter \$2 and multiply by (1.30) to get  $D_1 = \$2.60$ ; multiply that result by 1.3 to get  $D_2 = \$3.38$ , and so forth. Then recognize that after year 3, Temp Force becomes a constant growth stock, and at that point  $\hat{P}_3$  can be found using the constant growth model.  $\hat{P}_3$  is the present value as of  $t = 3$  of the dividends in year 4 and beyond.

With the cash flows for  $D_1$ ,  $D_2$ ,  $D_3$ , and  $\hat{P}_3$  shown on the time line, we discount each value back to year 0, and the sum of these four PVs is the value of the stock today,  $P_0 = \$54.109$ .

**The dividend yield in year 1 is 4.80 percent, and the capital gains yield is 8.2 percent:**

$$\text{Dividend yield} = \frac{\$2.600}{\$54.109} = 0.0480 = 4.8\%.$$

**Capital gains yield = 13.00% - 4.8% = 8.2%.**

During the nonconstant growth period, the dividend yields and capital gains yields are not constant, and the capital gains yield does not equal  $g$ . However, after year 3, the stock becomes a constant growth stock, with  $g = \text{capital gains yield} = 6.0\%$  and  $\text{dividend yield} = 13.0\% - 6.0\% = 7.0\%$ .

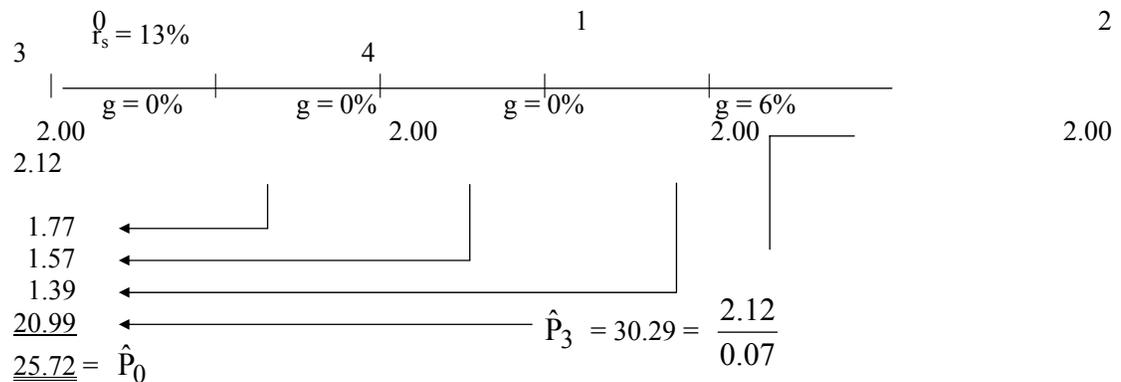
h. Is the stock price based more on long-term or short-term expectations? Answer this by finding the percentage of Temp Force current stock price based on dividends expected more than three years in the future.

**Answer:**  $\frac{\$46.116}{\$54.109} = 85.2\%$ .

**Stock price is based more on long-term expectations, as is evident by the fact that over 85 percent of temp force stock price is determined by dividends expected more than three years from now.**

i. Suppose Temp Force is expected to experience zero growth during the first 3 years and then to resume its steady-state growth of 6 percent in the fourth year. What is the stock's value now? What is its expected dividend yield and its capital gains yield in year 1? In year 4?

**Answer:** Now we have this situation:



**During year 1:**

$$\text{Dividend Yield} = \frac{\$2.00}{\$25.72} = 0.0778 = 7.78\%$$

$$\text{Capital Gains Yield} = 13.00\% - 7.78\% = 5.22\%$$

Again, in year 4 temp force becomes a constant growth stock; hence  $g = \text{capital gains yield} = 6.0\%$  and  $\text{dividend yield} = 7.0\%$ .

j. Finally, assume that Temp Force's earnings and dividends are expected to decline by a constant 6 percent per year, that is,  $g = -6\%$ . Why would anyone be willing to buy such a stock, and at what price should it sell? What would be the dividend yield and capital gains yield in each year?

**Answer:** The company is earning something and paying some dividends, so it clearly has a value greater than zero. That value can be found with the constant growth formula, but where  $g$  is negative:

$$P_0 = \frac{D_1}{r_S - g} = \frac{D_0(1+g)}{r_S - g} = \frac{\$2.00(0.94)}{0.13 - (-0.06)} = \frac{\$1.88}{0.19} = \$9.89.$$

Since it is a constant growth stock:

$$g = \text{Capital Gains Yield} = -6.0\%,$$

hence:

$$\text{Dividend Yield} = 13.0\% - (-6.0\%) = 19.0\%.$$

As a check:

$$\text{Dividend Yield} = \frac{\$1.88}{\$9.89} = 0.190 = 19.0\%.$$

**The dividend and capital gains yields are constant over time, but a high (19.0 percent) dividend yield is needed to offset the negative capital gains yield.**

k. What is market multiple analysis?

**Answer:** Analysts often use the P/E multiple (the price per share divided by the earnings per share) or the P/CF multiple (price per share divided by cash flow per share, which is the earnings per share plus the dividends per share) to value stocks. For example, estimate the average P/E ratio of comparable firms. This is the P/E multiple. Multiply this average P/E ratio by the expected earnings of the company to estimate its stock price. The entity value ( $V$ ) is the market value of equity (# shares of stock multiplied by the price per share) plus the value of debt. Pick a measure, such as EBITDA, sales, customers, eyeballs, etc. Calculate the average entity ratio for a sample of comparable firms. For example,  $V/\text{EBITDA}$ ,  $V/\text{customers}$ . Then find the entity value of the firm in question. For example, multiply the firm's sales by the  $V/\text{sales}$  multiple, or multiply the firm's # of customers by the  $V/\text{customers}$  ratio. The result is the total value of the firm. Subtract the firm's debt to get the total value of equity. Divide by the number of shares to get the price per share. There are problems with market multiple analysis. (1) It is often hard to find comparable firms. (2) The average ratio for the sample of comparable firms often has a wide range. For example, the average P/E ratio might be 20, but the range could be from 10 to 50. How do you know whether your firm should be compared to the low, average, or high performers?

l. Why do stock prices change? Suppose the expected  $D_1$  is \$2, the growth rate is 5

percent, and  $r_s$  is 10 percent. Using the constant growth model, what is the impact on stock price if  $g$  is 4 percent or 6 percent? If  $r_s$  is 9 percent or 11 percent?

**Answer:** Using the constant growth model, the price of a stock is  $P_0 = D_1 / (r_s - g)$ . If estimates of  $g$  change, then the price will change. If estimates of the required return on stock change, then the stock price will change. Notice that  $r_s = r_{RF} + (r_{PM})b_1$ , so  $r_s$  will change if there are changes in inflation expectations, risk aversion, or company risk. The following table shows the stock price for various levels of  $g$  and  $r_s$ .

$r_s$	$g$ 4%	$g$ 5%	$g$ 6%
9%	40.00	50.00	66.67
10%	33.33	40.00	50.00
11%	28.57	33.33	40.00

**m. What does market equilibrium mean?**

**Answer:** Equilibrium means stable, no tendency to change. Market equilibrium means that prices are stable--at its current price, there is no general tendency for people to want to buy or to sell a security that is in equilibrium. Also, when equilibrium exists, the expected rate of return will be equal to the required rate of return:

$$\hat{r} = D_1/P_0 + g = r = r_{RF} + (r_M - r_{RF})b.$$

**n. If equilibrium does not exist, how will it be established?**

**Answer:** Securities will be bought and sold until the equilibrium price is established.

**o. What is the efficient markets hypothesis, what are its three forms, and what are its implications?**

**Answer:** The EMH in general is the hypothesis that securities are normally in equilibrium, and are “priced fairly,” making it impossible to “beat the market.”

Weak-form efficiency says that investors cannot profit from looking at past movements in stock prices--the fact that stocks went down for the last few days is no reason to think that they will go up (or down) in the future. This form has been proven pretty well by empirical tests, even though people still employ “technical analysis.”

Semistrong-form efficiency says that all publicly available information is reflected in stock prices, hence that it won't do much good to pore over annual reports trying to find undervalued stocks. This one is (I think) largely true, but superior analysts can still obtain and process new information fast enough to gain a small advantage.

Strong-form efficiency says that all information, even inside information, is embedded in stock prices. This form does not hold--insiders know more, and could take advantage of that information to make abnormal profits in the markets. Trading on the basis of insider information is illegal.

**p. Temp Force recently issued preferred stock. It pays an annual dividend of \$5, and the issue price was \$50 per share. What is the expected return to an investor on this preferred stock?**

**Answer:**

$$\begin{aligned} \hat{r}_{ps} &= \frac{D_{ps}}{V_{ps}} \\ &= \frac{\$5}{\$50} \\ &= 10\%. \end{aligned}$$

## Chapter 8

### Financial Options and Their Valuation

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 8-1 a. An option is a contract which gives its holder the right to buy or sell an asset at some predetermined price within a specified period of time. A call option allows the holder to buy the asset, while a put option allows the holder to sell the asset.
- b. **A simple measure of an option's value is its exercise value. The exercise value is equal to the current price of the stock (underlying the option) less the striking price of the option. The strike price is the price stated in the option contract at which the security can be bought (or sold). For example, if the underlying stock sells for \$50 and the striking price is \$20, the exercise value of the option would be \$30.**
- c. The Black-Scholes Option Pricing Model is widely used by option traders to value options. It is derived from the concept of a riskless hedge. By buying shares of a stock and simultaneously selling call options on that stock, the investor will create a risk-free investment position. This riskless return must equal the risk-free rate or an arbitrage opportunity would exist. People would take advantage of this opportunity until the equilibrium level estimated by the Black-Scholes model was reached.
- 8-2 The market value of an option is typically higher than its exercise value due to the speculative nature of the investment. Options allow investors to gain a high degree of personal leverage when buying securities. The option allows the investor to limit his or her loss but amplify his or her return. The exact amount this protection is worth is the premium over the exercise value.
- 8-3 (1) An increase in stock price causes an increase in the value of a call option. (2) An increase in exercise price causes a decrease in the value of a call option. (3) An increase in the time to expiration causes an increase in the value of a call option. (4) An increase in the risk-free rate causes an increase in the value of a call option. (1) An increase in the variance of stock return causes an increase in the value of a call option.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

8-1  $P = \$15$ ;  $X = \$15$ ;  $t = 0.5$ ;  $r_{RF} = 0.06$ ;  $\sigma^2 = 0.12$ ;  $d_1 = 0.24495$ ;  
 $d_2 = 0.0000$ ;  $N(d_1) = 0.59675$ ;  $N(d_2) = 0.500000$ ;  $V = ?$

Using the Black-Scholes Option Pricing Model, you calculate the option's value as:

$$\begin{aligned} V &= P[N(d_1)] - Xe^{-r_{RF}t}[N(d_2)] \\ &= \$15(0.59675) - \$15e^{(-0.10)(0.5)}(0.50000) \\ &= \$8.95128 - \$15(0.9512)(0.50000) \\ &= \$1.6729 \approx \$1.67. \end{aligned}$$

8-2 Option's exercise price = \$15; Exercise value = \$22; Premium value = \$5;  
 $V = ?$   $P_0 = ?$

$$\begin{aligned} \text{Premium} &= \text{Market price of option} - \text{Exercise value} \\ \$5 &= V - \$22 \\ V &= \$27. \end{aligned}$$

$$\begin{aligned} \text{Exercise value} &= P_0 - \text{Exercise price} \\ \$22 &= P_0 - \$15 \\ P_0 &= \$37. \end{aligned}$$

8-3  $d_1 = \frac{\ln(P/X) + [r_{RF} + (\sigma^2/2)]t}{\sigma\sqrt{t}} = \frac{\ln(\$30/\$35) + [0.05 + (0.25/2)](0.333333)}{0.5\sqrt{0.333333}} = -0.3319.$

$$d_2 = d_1 - s(t)^{0.5} = -0.3319 - 0.5(0.33333)^{0.5} = -0.6206.$$

$$N(d_1) = 0.3700 \text{ (from Excel NORMSDIST function).}$$

$$N(d_2) = 0.2674 \text{ (from Excel NORMSDIST function).}$$

$$\begin{aligned} V &= P[N(d_1)] - Xe^{-r_{RF}t}[N(d_2)] \\ &= \$30(0.3700) - \$35e^{(-0.05)(0.33333)}(0.2674) \\ &= \$11.1000 - \$9.2043 \\ &= \$1.8957 \approx \$1.90. \end{aligned}$$

- 8-4 The stock's range of payoffs in one year is  $\$26 - \$16 = \$10$ . At expiration, the option will be worth  $\$26 - \$21 = \$5$  if the stock price is  $\$26$ , and zero if the stock price  $\$16$ . The range of payoffs for the stock option is  $\$5 - 0 = \$5$ .

Equalize the range to find the number of shares of stock:  $\text{Option range} / \text{Stock range} = \$5/\$10 = 0.5$ .

With 0.5 shares, the stock's payoff will be either  $\$13$  or  $\$8$ . The portfolio's payoff will be  $\$13 - \$5 = \$8$ , or  $\$8 - 0 = \$8$ .

The present value of  $\$8$  at the daily compounded risk-free rate is:  $\text{PV} = \$8 / (1 + (0.05/365))^{365} = \$7.610$ .

The option price is the current value of the stock in the portfolio minus the PV of the payoff:

$$V = 0.5(\$20) - \$7.610 = \$2.39.$$

- 8-5 The stock's range of payoffs in six months is  $\$18 - \$13 = \$5$ . At expiration, the option will be worth  $\$18 - \$14 = \$4$  if the stock price is  $\$18$ , and zero if the stock price  $\$13$ . The range of payoffs for the stock option is  $\$4 - 0 = \$5$ .

Equalize the range to find the number of shares of stock:  $\text{Option range} / \text{Stock range} = \$4/\$5 = 0.8$ .

With 0.8 shares, the stock's payoff will be either  $0.8(\$18) = \$14.40$  or  $0.8(\$13) = \$10.40$ . The portfolio's payoff will be  $\$14.4 - \$4 = \$10.40$ , or  $\$10.40 - 0 = \$10.40$ .

The present value of  $\$10.40$  at the daily compounded risk-free rate is:  $\text{PV} = \$10.40 / (1 + (0.06/365))^{365/2} = \$10.093$ .

The option price is the current value of the stock in the portfolio minus the PV of the payoff:

$$V = 0.8(\$15) - \$10.093 = \$1.907 \approx \$1.91.$$

- 8-6 
$$\begin{aligned} \text{Put} &= V - P + X \exp(-r_{\text{RF}} t) \\ &= \$6.56 - \$33 + \$32 e^{-0.06(1)} \\ &= \$6.56 - \$33 + \$30.136 = \$3.696 \approx \$3.70. \end{aligned}$$

## SOLUTION TO SPREADSHEET PROBLEMS

---

- 8-7 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM 11 Ch 08 P07 Build a Model.xls*) and on the instructor's side of the textbook's web site, <http://brigham.swcollege.com>.

## MINI CASE

---

Assume that you have just been hired as a financial analyst by Triple Trice Inc., a mid-sized California company that specializes in creating exotic clothing. Since no one at Triple Trice is familiar with the basics of financial options, you have been asked to prepare a brief report that the firm's executives could use to gain at least a cursory understanding of the topic.

To begin, you gathered some outside materials the subject and used these materials to draft a list of pertinent questions that need to be answered. In fact, one possible approach to the paper is to use a question-and-answer format. Now that the questions have been drafted, you have to develop the answers.

a. What is a financial option? What is the single most important characteristic of an option?

**Answer:** A financial option is a contract which gives its holder the right to buy (or sell) an asset at a predetermined price within a specified period of time. An option's most important characteristic is that it does not obligate its owner to take any action; it merely gives the owner the right to buy or sell an asset.

b. Options have a unique set of terminology. Define the following terms: (1) call option; (2) put option; (3) exercise price; (4) striking, or strike, price; (5) option price; (6) expiration date; (7) exercise value; (8) covered option; (9) naked option; (10) in-the-money call; (11) out-of-the-money call; and (12) LEAPS.

- Answer:**
1. A call option is an option to *buy* a specified number of shares of a security within some future period.
  2. A put option is an option to *sell* a specified number of shares of a security within some future period.
  3. Exercise price is another name for strike price, the price stated in the option contract at which the security can be bought (or sold).
  4. The strike price is the price stated in the option contract at which the security can be bought (or sold).
  5. The option price is the market price of the option contract.
  6. The expiration date is the date the option matures.
  7. The exercise value is the value of a call option if it were exercised today, and it is equal to the current stock price minus the strike price. Note: the exercise value is zero if the stock price is less than the strike price.
  8. A covered option is a call option written against stock held in an investor's portfolio.
  9. A naked option is an option sold without the stock to back it up.

10. An in-the-money call is a call option whose exercise price is less than the current price of the underlying stock.
11. An out-of-the-money call is a call option whose exercise price exceeds the current stock price.
12. LEAPS stands for long-term equity anticipation securities. They are similar to conventional options except they are long-term options with maturities of up to 2½ years.

c. Consider Triple Trice's call option with a \$25 strike price. The following table contains historical values for this option at different stock prices:

<u>Call Option Price</u>	<u>Stock Price</u>	
	\$25	\$ 3.00
	30	7.50
	35	12.00
	40	16.50
	45	21.00
	50	25.50

1. Create a table which shows (a) stock price, (b) strike price, (c) exercise value, (d) option price, and (e) the premium of option price over exercise value.

<b>Answer:</b>	Price Of Stock	Strike	Exercise Value Price	Market Price Of Option	Premium Of Option
	(D) - (C) = _____ (A)		_____ (B)	(A) - (B) = (C)	_____ (D)
(E) _____					
	\$25.00	\$25.00	\$ 0.00	\$ 3.00	\$3.00
2.50	30.00	25.00	5.00	7.50	
2.00	35.00	25.00	10.00	12.00	
1.50	40.00	25.00	15.00	16.50	
1.00	45.00	25.00	20.00	21.00	
0.50	50.00	25.00	25.00	25.50	

c. 2. What happens to the premium of option price over exercise value as the stock price rises? Why?

**Answer:** As the table shows, the premium of the option price over the exercise value declines as the stock price increases. This is due to the declining degree of leverage provided by options as the underlying stock prices increase, and to the greater loss potential of options at higher option prices.

d. In 1973, Fischer Black and Myron Scholes developed the Black-Scholes Option Pricing Model (OPM).

1. What assumptions underlie the OPM?

**Answer:** The assumptions which underlie the OPM are as follows:

- The stock underlying the call option provides no dividends during the life of the option.
- No transactions costs are involved with the sale or purchase of either the stock or the option.
- The short-term, risk-free interest rate is known and is constant during the life of the option.
- Security buyers may borrow any fraction of the purchase price at the short-term, risk-free rate.
- Short-term selling is permitted without penalty, and sellers receive immediately the full cash proceeds at today's price for securities sold short.
- The call option can be exercised only on its expiration date.
- Security trading takes place in continuous time, and stock prices move randomly in continuous time.

d. 2. Write out the three equations that constitute the model.

**Answer:** The OPM consists of the following three equations:

$$V = P[N(d_1) - Xe^{-r_{RF}t} N(d_2)].$$

$$d_1 = \frac{\ln(P/X) + [r_{RF} + (\sigma^2/2)]t}{\sigma\sqrt{t}}.$$

$$d_2 = d_1 - \sigma\sqrt{t}.$$

Here,

V = current value of a call option with time t until expiration.

P = current price of the underlying stock.

$N(d_i)$  = probability that a deviation less than  $d_i$  will occur in a standard normal distribution.

Thus,  $N(d_1)$  and  $N(d_2)$  represent areas under a standard normal distribution function.

X = exercise, or strike, price of the option.

$e \approx 2.7183$ .

$r_{RF}$  = risk-free interest rate.

t = time until the option expires (the option period).

$\ln(P/X)$  = natural logarithm of P/X.

$\sigma^2$  = variance of the rate of return on the stock.

d. 3. What is the value of the following call option according to the OPM?

**Stock Price = \$27.00.**  
**Exercise Price = \$25.00**  
**Time To Expiration = 6 Months.**  
**Risk-Free Rate = 6.0%.**  
**Stock Return Variance = 0.11.**

**Answer:** the input variables are:

$P = \$27.00$ ;  $X = \$25.00$ ;  $r_{RF} = 6.0\%$ ;  $t = 6 \text{ months} = 0.5 \text{ years}$ ; and  $\sigma^2 = 0.11$ .

Now, we proceed to use the OPM:

$$V = \$27[N(d_1)] - \$25e^{-(0.06)(0.5)}[N(d_2)].$$

$$\begin{aligned}d_1 &= \frac{\ln(\$27/\$25) + [(0.06 + 0.11/2)](0.5)}{(0.3317)(0.7071)} \\ &= \frac{0.0770 + 0.0575}{0.2345} = 0.5736.\end{aligned}$$

$$\begin{aligned}d_2 &= d_1 - (0.3317)(0.7071) = d_1 - 0.2345 \\ &= 0.5736 - 0.2345 = 0.3391.\end{aligned}$$

$$N(d_1) = N(0.5736) = 0.5000 + 0.2168 = 0.7168.$$

$$N(d_2) = N(0.3391) = 0.5000 + 0.1327 = 0.6327.$$

Therefore,

$$\begin{aligned}V &= \$27(0.7168) - \$25e^{-0.03}(0.6327) = \$19.3536 - \$25(0.97045)(0.6327) \\ &= \$19.3536 - \$15.3500 = \$4.0036 \approx \$4.00.\end{aligned}$$

Thus, under the OPM, the value of the call option is about \$4.00.

e. What impact does each of the following call option parameters have on the value of a call option?

1. Current Stock Price
2. Exercise Price
3. Option's Term To Maturity
4. Risk-Free Rate
5. Variability Of The Stock Price

- Answer:**
1. The value of a call option increases (decreases) as the current stock price increases (decreases).
  2. As the exercise price of the option increases (decreases), the value of the option decreases (increases).
  3. As the expiration date of the option is lengthened, the value of the option increases. This is because the value of the option depends on the chance of a stock price increase, and the longer the option period, the higher the stock price can climb.
  4. As the risk-free rate increases, the value of the option tends to increase as well. Since increases in the risk-free rate tend to decrease the present value of the option's exercise price, they also tend to increase the current value of the option.
  5. The greater the variance in the underlying stock price, the greater the possibility that the stock's price will exceed the exercise price of the option; thus, the more valuable the option will be.

f. What is put-call parity?

**Answer:** Put-call parity specifies the relationship between puts, calls, and the underlying stock price that must hold to prevent arbitrage:

$$\text{Put} + \text{Stock} = \text{Call} + \text{PV Of Exercise Price}$$

**Chapter 9**  
**The Cost of Capital**

---

**ANSWERS TO END-OF-CHAPTER QUESTIONS**

---

- 9-1
- a. The weighted average cost of capital, WACC, is the weighted average of the after-tax component costs of capital—debt, preferred stock, and common equity. Each weighting factor is the proportion of that type of capital in the optimal, or target, capital structure. The after-tax cost of debt,  $r_d(1 - T)$ , is the relevant cost to the firm of *new* debt financing. Since interest is deductible from taxable income, the after-tax cost of debt to the firm is less than the before-tax cost. Thus,  $r_d(1 - T)$  is the appropriate component cost of debt (in the weighted average cost of capital).
  - b. The cost of preferred stock,  $r_{ps}$ , is the cost to the firm of issuing new preferred stock. For perpetual preferred, it is the preferred dividend,  $D_{ps}$ , divided by the net issuing price,  $P_n$ . Note that no tax adjustments are made when calculating the component cost of preferred stock because, unlike interest payments on debt, dividend payments on preferred stock are not tax deductible. The cost of new common equity,  $r_e$ , is the cost to the firm of equity obtained by selling new common stock. It is, essentially, the cost of retained earnings adjusted for flotation costs. Flotation costs are the costs that the firm incurs when it issues new securities. The amount actually available to the firm for capital investment from the sale of new securities is the sales price of the securities less flotation costs. Note that flotation costs consist of (1) direct expenses such as printing costs and brokerage commissions, (2) any price reduction due to increasing the supply of stock, and (3) any drop in price due to informational asymmetries.
  - c. The target capital structure is the relative amount of debt, preferred stock, and common equity that the firm desires. The WACC should be based on these target weights.
  - d. There are considerable costs when a company issues a new security, including fees to an investment banker and legal fees. These costs are called flotation costs. The cost of new common equity is higher than that of common equity raised internally by reinvesting earnings. Project's financed with external equity must earn a higher rate of return, since they project must cover the flotation costs.
- 9-2
- The WACC is an average cost because it is a weighted average of the firm's component costs of capital. However, each component cost is a marginal cost; that is, the cost of new capital. Thus, the WACC is the weighted average *marginal* cost of capital.

9-3

WACC

	Probable Effect on		
	$r_d(1 - T)$	$r_s$	$r_e$
a. The corporate tax rate is lowered.	+	0	+
b. The Federal Reserve tightens credit.	+	+	+
c. The firm uses more debt; that is, it increases its debt/assets ratio.	+	+	0



**SOLUTIONS TO END-OF-CHAPTER PROBLEMS**

---

9-1 40% Debt; 60% Equity;  $r_d = 9\%$ ;  $T = 40\%$ ;  $WACC = 9.96\%$ ;  $r_s = ?$

$$\begin{aligned}WACC &= (w_d)(r_d)(1 - T) + (w_{ce})(r_s) \\9.96\% &= (0.4)(9\%)(1 - 0.4) + (0.6)r_s \\9.96\% &= 2.16\% + 0.6r_s \\7.8\% &= 0.6r_s \\r_s &= 13\%.\end{aligned}$$

9-2  $V_{ps} = \$50$ ;  $D_{ps} = \$3.80$ ;  $F = 5\%$ ;  $r_{ps} = ?$

$$\begin{aligned}r_{ps} &= \frac{D_{ps}}{V_{ps}(1 - F)} \\&= \frac{\$3.80}{\$50(1 - 0.05)} \\&= \frac{\$3.80}{\$47.50} = 8\%.\end{aligned}$$

9-3  $P_0 = \$30$ ;  $D_1 = \$3.00$ ;  $g = 5\%$ ;  $r_s = ?$

$$r_s = \frac{D_1}{P_0} + g = \frac{\$3.00}{\$30} + 0.05 = 15\%.$$

9-4 a.  $r_d(1 - T) = 13\%(1 - 0) = 13.00\%$ .

b.  $r_d(1 - T) = 13\%(0.80) = 10.40\%$ .

c.  $r_d(1 - T) = 13\%(0.65) = 8.45\%$ .

9-5  $r_d(1 - T) = 0.12(0.65) = 7.80\%$ .

9-6  $r_{ps} = \frac{\$100(0.11)}{\$97.00(1 - 0.05)} = \frac{\$11}{\$97.00(0.95)} = \frac{\$11}{\$92.15} = 11.94\%$ .

9-7 Enter these values:  $N = 60$ ,  $PV = -515.16$ ,  $PMT = 30$ , and  $FV = 1000$ , to get  $I = 6\%$  = periodic rate. The nominal rate is  $6\%(2) = 12\%$ , and the after-tax component cost of debt is  $12\%(0.6) = 7.2\%$ .

9-8 a.  $r_s = \frac{D_1}{P_0} + g = \frac{\$2.14}{\$23} + 7\% = 9.3\% + 7\% = 16.3\%$ .

b.  $r_s = r_{RF} + (r_M - r_{RF})b$   
 $= 9\% + (13\% - 9\%)1.6 = 9\% + (4\%)1.6 = 9\% + 6.4\% = 15.4\%$ .

c.  $r_s = \text{Bond rate} + \text{Risk premium} = 12\% + 4\% = 16\%$ .

d. The bond-yield-plus-risk-premium approach and the CAPM method both resulted in lower cost of equity values than the DCF method. The firm's cost of equity should be estimated to be about 15.9 percent, which is the average of the three methods.

9-9 a.  $\$6.50 = \$4.42(1+g)^5$   
 $(1+g)^5 = 6.50/4.42 = 1.471$   
 $(1+g) = 1.471^{(1/5)} = 1.080$   
 $g = 8\%$ .

Alternatively, with a financial calculator, input N = 5, PV = -4.42, PMT = 0, FV = 6.50, and then solve for I = 8.02%  $\approx$  8%.

b.  $D_1 = D_0(1 + g) = \$2.60(1.08) = \$2.81$ .

c.  $r_s = D_1/P_0 + g = \$2.81/\$36.00 + 8\% = 15.81\%$ .

9-10 a.  $r_s = \frac{D_1}{P_0} + g$   
 $0.09 = \frac{\$3.60}{\$60.00} + g$   
 $0.09 = 0.06 + g$   
 $g = 3\%$ .

b. Current EPS		\$5.400
Less: Dividends per share	<u>3.600</u>	
Retained earnings per share	\$1.800	
Rate of return	$\times 0.090$	
Increase in EPS	<u>\$0.162</u>	
Current EPS		<u>5.400</u>
Next year's EPS		<u>\$5.562</u>

Alternatively,  $EPS_1 = EPS_0(1 + g) = \$5.40(1.03) = \$5.562$ .

9-11 a. Common equity needed:

$$0.5(\$30,000,000) = \$15,000,000.$$

b. Cost using  $r_s$ :

	Percent	×	After-Tax Cost	=	Product	
Debt			0.50		4.8%*	
Common equity	0.50		12.0			2.4%
					<u>6.0</u>	WACC =
						<u>8.4%</u>

$$*8\%(1 - T) = 8\%(0.6) = 4.8\%.$$

c.  $r_s$  and the WACC will increase due to the flotation costs of new equity.

9-12 The book and market value of the current liabilities are both \$10,000,000.

The bonds have a value of

$$\begin{aligned} V &= \$60(PVIFA_{10\%,20}) + \$1,000(PVIF_{10\%,20}) \\ &= \$60([1/0.10] - [1/(0.1*(1+0.10)^{20})]) + \$1,000((1+0.10)^{-20}) \\ &= \$60(8.5136) + \$1,000(0.1486) \\ &= \$510.82 + \$148.60 = \$659.42. \end{aligned}$$

Alternatively, using a financial calculator, input  $N = 20$ ,  $I = 10$ ,  $PMT = 60$ , and  $FV = 1000$  to arrive at a  $PV = \$659.46$ .

The total market value of the long-term debt is  $30,000(\$659.46) = \$19,783,800$ .

There are 1 million shares of stock outstanding, and the stock sells for \$60 per share. Therefore, the market value of the equity is \$60,000,000.

The market value capital structure is thus:

Short-term debt	\$10,000,000	11.14%	
Long-term debt	19,783,800	22.03	
Common equity	60,000,000	<u>66.83</u>	
	<u>\$89,783,800</u>	<u>100.00%</u>	

9-13 Several steps are involved in the solution of this problem. Our solution follows:

Step 1.

Establish a set of market value capital structure weights. In this case, A/P and accruals, and also short-term debt, may be disregarded because the firm does not use these as a source of permanent financing.

Debt:

The long-term debt has a market value found as follows:

$$V_0 = \sum_{t=1}^{40} \frac{\$40}{(1.06)^t} + \frac{\$1,000}{(1.06)^{40}} = \$699,$$

or  $0.699(\$30,000,000) = \$20,970,000$  in total.

Preferred Stock:

The preferred has a value of

$$P_{ps} = \frac{\$2}{0.11/4} = \$72.73.$$

There are  $\$5,000,000/\$100 = 50,000$  shares of preferred outstanding, so the total market value of the preferred is

$$50,000(\$72.73) = \$3,636,500.$$

Common Stock:

The market value of the common stock is

$$4,000,000(\$20) = \$80,000,000.$$

Therefore, here is the firm's market value capital structure, which we assume to be optimal:

Long-term debt	\$ 20,970,000	20.05%
Preferred stock	3,636,500	3.48
Common equity	<u>80,000,000</u>	<u>76.47</u>
	<u>\$104,606,500</u>	<u>100.00%</u>

We would round these weights to 20 percent debt, 4 percent preferred, and 76 percent common equity.

Step 2.

Establish cost rates for the various capital structure components.

Debt cost:

$$r_d(1 - T) = 12\%(0.6) = 7.2\%.$$

Preferred cost:

Annual dividend on new preferred = 11%(\$100) = \$11. Therefore,

$$r_{ps} = \$11/\$100(1 - 0.05) = \$11/\$95 = 11.6\%.$$

Common equity cost:

There are three basic ways of estimating  $r_s$ : CAPM, DCF, and risk premium over own bonds. None of the methods is very exact.

CAPM:

We would use  $r_{RF}$  = T-bond rate = 10%. For  $RP_{M_s}$ , we would use 4.5% to 5.5%. For beta, we would use a beta in the 1.3 to 1.7 range. Combining these values, we obtain this range of values for  $r_s$ :

$$\begin{aligned} \text{Highest: } r_s &= 10\% + (5.5)(1.7) = 19.35\%. \\ \text{Lowest: } r_s &= 10\% + (4.5)(1.3) = 15.85\%. \\ \text{Midpoint: } r_s &= 10\% + (5.0)(1.5) = 17.50\%. \end{aligned}$$

DCE:

The company seems to be in a rapid, nonconstant growth situation, but we do not have the inputs necessary to develop a nonconstant  $r_s$ . Therefore, we will use the constant growth model but temper our growth rate; that is, think of it as a long-term average  $g$  that may well be higher in the immediate than in the more distant future.

Data exist that would permit us to calculate historic growth rates, but problems would clearly arise, because the growth rate has been variable and also because  $g_{EPS} \neq g_{DPS}$ . For the problem at hand, we would simply disregard historic growth rates, except for a discussion about calculating them as an exercise.

We could use as a growth estimator this method:

$$g = b(r) = 0.5(24\%) = 12\%.$$

It would not be appropriate to base  $g$  on the 30% ROE, because investors do not expect that rate.

Finally, we could use the analysts' forecasted  $g$  range, 10 to 15 percent. The dividend yield is  $D_1/P_0$ . Assuming  $g = 12\%$ ,

$$\frac{D_1}{P_0} = \frac{\$1(1.12)}{\$20} = 5.6\%.$$

One could look at a range of yields, based on  $P$  in the range of \$17 to \$23, but because we believe in efficient markets, we would use  $P_0 = \$20$ . Thus, the DCF model suggests a  $r_s$  in the range of 15.6 to 20.6 percent:

$$\begin{aligned} \text{Highest: } r_s &= 5.6\% + 15\% = 20.6\%. \\ \text{Lowest: } r_s &= 5.6\% + 10\% = 15.6\%. \\ \text{Midpoint: } r_s &= 5.6\% + 12.5\% = 18.1\%. \end{aligned}$$

Generalized risk premium.

Highest:  $r_s = 12\% + 6\% = 18\%$ .  
Lowest:  $r_s = 12\% + 4\% = 16\%$ .  
Midpoint:  $r_s = 12\% + 5\% = 17\%$ .

Based on the three midpoint estimates, we have  $r_s$  in this range:

CAPM	17.5%
DCF	18.1%
Risk Premium	17.0%

Step 3.

Calculate the WACC:

$$\begin{aligned} \text{WACC} &= (D/V)(r_{dAT}) + (P/V)(r_{ps}) + (S/V)(r_s \text{ or } r_e) \\ &= 0.20(r_{dAT}) + 0.04(r_{ps}) + 0.76(r_s \text{ or } r_e). \end{aligned}$$

It would be appropriate to calculate a range of WACCs based on the ranges of component costs, but to save time, we shall assume  $r_{dAT} = 7.2\%$ ,  $r_{ps} = 11.6\%$ , and  $r_s = 17.5\%$ . With these cost rates, here is the WACC calculation:

$$\text{WACC} = 0.2(7.2\%) + 0.04(11.6\%) + 0.76(17.5\%) = 15.2\%.$$

9-14  $P_0 = \$30$ ;  $D_1 = \$3.00$ ;  $g = 5\%$ ;  $F = 10\%$ ;  $r_s = ?$

$$r_s = [D_1 / (1-F) P_0] + g = [3 / (1-0.10)(30)] + 0.05 = 16.1\%.$$

9-15 Enter these values:  $N = 20$ ,  $PV = 1000(1-0.02) = 980$ ,  $PMT = -90(1-.4) = -54$ , and  $FV = -1000$ , to get  $I = 5.57\%$ , which is the after-tax component cost of debt.

### **SPREADSHEET PROBLEM**

- 9-16 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 09 P16 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

During the last few years, Harry Davis Industries has been too constrained by the high cost of capital to make many capital investments. Recently, though, capital costs have been declining, and the company has decided to look seriously at a major expansion program that had been proposed by the marketing department. Assume that you are an assistant to Leigh Jones, the financial vice-president. Your first task is to estimate Harry Davis' cost of capital. Jones has provided you with the following data, which she believes may be relevant to your task:

1. The firm's tax rate is 40 percent.
2. The current price of Harry Davis' 12 percent coupon, semiannual payment, noncallable bonds with 15 years remaining to maturity is \$1,153.72. Harry Davis does not use short-term interest-bearing debt on a permanent basis. New bonds would be privately placed with no flotation cost.
3. The current price of the firm's 10 percent, \$100 par value, quarterly dividend, perpetual preferred stock is \$113.10. Harry Davis would incur flotation costs of \$2.00 per share on a new issue.
4. Harry Davis' common stock is currently selling at \$50 per share. Its last dividend ( $d_0$ ) was \$4.19, and dividends are expected to grow at a constant rate of 5 percent in the foreseeable future. Harry Davis' beta is 1.2; the yield on t-bonds is 7 percent; and the market risk premium is estimated to be 6 percent. For the bond-yield-plus-risk-premium approach, the firm uses a 4 percentage point risk premium.
5. Harry Davis' target capital structure is 30 percent long-term debt, 10 percent preferred stock, and 60 percent common equity.

To structure the task somewhat, Jones has asked you to answer the following questions.

a. 1. What sources of capital should be included when you estimate Harry Davis' weighted average cost of capital (WACC)?

**Answer:** The WACC is used primarily for making long-term capital investment decisions, i.e., for capital budgeting. Thus, the WACC should include the types of capital used to pay for long-term assets, and this is typically long-term debt, preferred stock (if used), and common stock. Short-term sources of capital consist of (1) spontaneous, noninterest-bearing liabilities such as accounts payable and accruals and (2) short-term interest-bearing debt, such as notes payable. If the firm uses short-term interest-bearing debt to acquire fixed assets rather than just to finance working capital needs, then the WACC should include a short-term debt component. Noninterest-bearing debt is generally not included in the cost of capital estimate because these funds are netted out when determining investment needs, that is, net rather than gross working capital is included in capital expenditures.

a. 2. Should the component costs be figured on a before-tax or an after-tax basis?

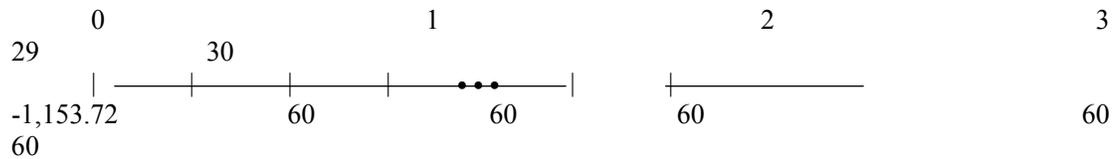
**Answer:** Stockholders are concerned primarily with those corporate cash flows that are available for their use, namely, those cash flows available to pay dividends or for reinvestment. Since dividends are paid from and reinvestment is made with after-tax dollars, all cash flow and rate of return calculations should be done on an after-tax basis.

a. 3. Should the costs be historical (embedded) costs or new (marginal) costs?

**Answer:** In financial management, the cost of capital is used primarily to make decisions which involve raising new capital. Thus, the relevant component costs are today's marginal costs rather than historical costs.

b. What is the market interest rate on Harry Davis' debt and its component cost of debt?

**Answer:** Harry Davis' 12 percent bond with 15 years to maturity is currently selling for \$1,153.72. Thus, its yield to maturity is 10 percent:



1,000

Enter  $n = 30$ ,  $PV = -1153.72$ ,  $pmt = 60$ , and  $FV = 1000$ , and then press the  $i$  button to find  $r_d/2 = i = 5.0\%$ . Since this is a semiannual rate, multiply by 2 to find the annual rate,  $r_d = 10\%$ , the pre-tax cost of debt.

Since interest is tax deductible, Uncle Sam, in effect, pays part of the cost, and Harry Davis' relevant component cost of debt is the after-tax cost:

$$r_d(1 - T) = 10.0\%(1 - 0.40) = 10.0\%(0.60) = 6.0\%.$$

### Optional Question

**Should flotation costs be included in the estimate?**

**Answer:** The actual component cost of new debt will be somewhat higher than 6 percent because the firm will incur flotation costs in selling the new issue. However, flotation costs are typically small on public debt issues, and, more important, most debt is placed directly with banks, insurance companies, and the like, and in this case flotation costs are almost nonexistent.

### Optional Question

**Should you use the nominal cost of debt or the effective annual cost?**

**Answer:** Our 10 percent pre-tax estimate is the nominal cost of debt. Since the firm's debt has semiannual coupons, its effective annual rate is 10.25 percent:

$$(1.05)^2 - 1.0 = 1.1025 - 1.0 = 0.1025 = 10.25\%.$$

However, nominal rates are generally used. The reason is that the cost of capital is used in capital budgeting, and capital budgeting cash flows are generally assumed to occur at year-end. Therefore, using nominal rates makes the treatment of the capital budgeting discount rate and cash flows consistent.

**c. 1. What is the firm's cost of preferred stock?**

**Answer:** Since the preferred issue is perpetual, its cost is estimated as follows:

$$r_{ps} = \frac{D_{ps}}{P_n} = \frac{0.1(\$100)}{\$133.10 - \$2.00} = \frac{\$10}{\$111.10} = 0.090 = 9.0\%$$

Note (1) that flotation costs for preferred are significant, so they are included here, (2) that since preferred dividends are not deductible to the issuer, there is no need for a tax adjustment, and (3) that we could have estimated the effective annual cost of the preferred, but as in the case of debt, the nominal cost is generally used.

**c. 2. Harry Davis' preferred stock is riskier to investors than its debt, yet the preferred's yield to investors is lower than the yield to maturity on the debt. Does this suggest that you have made a mistake? (Hint: think about taxes.)**

**Answer:** Corporate investors own most preferred stock, because 70 percent of preferred dividends received by corporations are nontaxable. Therefore, preferred often has a lower before-tax yield than the before-tax yield on debt issued by the same company. Note, though, that the after-tax yield to a corporate investor, and the after-tax cost to the issuer, are higher on preferred stock than on debt.

**d. 1. What are the two primary ways companies raise common equity?**

**Answer:** A firm can raise common equity in two ways: (1) by retaining earnings and (2) by issuing new common stock.

**d. 2. Why is there a cost associated with reinvested earnings?**

**Answer:** Management may either pay out earnings in the form of dividends or else retain earnings for reinvestment in the business. If part of the earnings is retained, an opportunity cost is incurred: stockholders could have received those earnings as dividends and then invested that money in stocks, bonds, real estate, and so on.

**d. 3. Harry Davis doesn't plan to issue new shares of common stock. Using the CAPM approach, what is Harry Davis' estimated cost of equity?**

**Answer:**  $r_s = 0.07 + (0.06)1.2 = 14.2\%$ .

**e. 1. What is the estimated cost of equity using the discounted cash flow (DCF) approach?**

**Answer:**  $\hat{r}_s = \frac{D_1}{P_0} = \frac{D_0(1+g)}{P_0} + g = \frac{\$4.19(1.05)}{\$50} + 0.05 = 13.8\%$ .

e. 2. Suppose the firm has historically earned 15 percent on equity (ROE) and retained 35 percent of earnings, and investors expect this situation to continue in the future. How could you use this information to estimate the future dividend growth rate, and what growth rate would you get? Is this consistent with the 5 percent growth rate given earlier?

**Answer:** Another method for estimating the growth rate is to use the retention growth model:

$$g = (1 - \text{Payout Ratio})\text{ROE}$$

In this case  $g = (0.35)0.15 = 5.25\%$ . This is consistent with the 5% rate given earlier.

e. 3. Could the DCF method be applied if the growth rate was not constant? How?

**Answer:** yes, you could use the DCF using nonconstant growth. You would find the PV of the dividends during the nonconstant growth period and add this value to the PV of the series of inflows when growth is assumed to become constant.

f. What is the cost of equity based on the bond-yield-plus-risk-premium method?

**Answer:**  $r_s = \text{company's own bond yield} + \text{risk premium}$ .

First find the YTM of the bond:

Enter  $n = 30$ ,  $PV = -1153.72$ ,  $pmt = 60$ , and  $FV = 1000$ , and then press the  $i$  button to find  $r/2 = i = 5\%$ . Since this is a semiannual rate, multiply by 2 to find the annual rate,  $r = 10\%$ .

The assumed risk premium is 4%, thus

$$r_s = 0.10 + 0.04 = 14\%.$$

g. What is your final estimate for the cost of equity,  $r_s$ ?

**Answer:** The final estimate for the cost of equity would simply be the average of the values found using the above three methods.

CAPM	14.2%
DCF	13.8
BOND YIELD + R.P.	<u>14.0</u>
AVERAGE	<u>14.0%</u>

h. What is Harry Davis' weighted average cost of capital (WACC)?

**Answer:**  $\text{WACC} = w_d r_d (1 - T) + w_{ps} r_{ps} + w_{ce} (r_s)$

$$= 0.3(0.10)(0.6) + 0.1(0.09) + 0.6(0.14)$$

$$= 0.111 = 11.1\%$$

**i. What factors influence Harry Davis' composite WACC?**

**Answer:** There are factors that the firm cannot control and those that they can control that influence WACC.

Factors The Firm Cannot Control:

Level Of Interest Rates  
Tax Rates

} Market Conditions

Factors The Firm Can Control:

Capital Structure Policy  
Dividend Policy  
Investment Policy

**j. Should the company use the composite WACC as the hurdle rate for each of its projects?**

**Answer:** No. The composite WACC reflects the risk of an average project undertaken by the firm. Therefore, the WACC only represents the "hurdle rate" for a typical project with average risk. Different projects have different risks. The project's WACC should be adjusted to reflect the project's risk.

**k. What procedures are used to determine the risk-adjusted cost of capital for a particular division? What approaches are used to measure a division's beta?**

**Answer:** The following procedures can be used to determine a division's risk-adjusted cost of capital:

- (1) Subjective adjustments to the firm's composite WACC.
- (2) Attempt to estimate what the cost of capital would be if the division were a stand-alone firm. This requires estimating the division's beta.

The following approaches can be used to measure a division's beta:

- (1) Pure play approach. Find several publicly traded companies exclusively in the project's business. Then, use the average of their betas as a proxy for the project's beta. (It's hard to find such companies.)
- (2) Accounting beta approach. Run a regression between the project's ROA and the S&P index ROA. Accounting betas are correlated (0.5 - 0.6) with market betas. However, you normally can't get data on new project ROAs before the capital budgeting decision has been made.

1. Harry Davis is interested in establishing a new division, which will focus primarily on developing new internet-based projects. In trying to determine the cost of capital for this new division, you discover that stand-alone firms involved in similar projects have on average the following characteristics:
- Their capital structure is 10 percent debt and 90 percent common equity.
  - Their cost of debt is typically 12 percent.
  - The beta is 1.7.
- given this information, what would your estimate be for the division's cost of capital?

**Answer:**

$$\begin{aligned} r_{s \text{ DIV.}} &= r_{RF} + (r_M - r_{RF})b_{\text{DIV.}} \\ &= 7\% + (6\%)1.7 = 17.2\%. \end{aligned}$$

$$\begin{aligned} \text{WACC}_{\text{DIV.}} &= W_d r_d (1 - T) + W_c r_s \\ &= 0.1(12\%)(0.6) + 0.9(17.2\%) \\ &= 16.2\%. \end{aligned}$$

The division's WACC = 16.2% vs. The corporate WACC = 11.1%. The division's market risk is greater than the firm's average projects. Typical projects within this division would be accepted if their returns are above 16.2 percent.

**m. What are three types of project risk? How is each type of risk used?**

**Answer:** The three types of project risk are:

Stand-Alone Risk  
Corporate Risk  
Market Risk

Market risk is theoretically best in most situations. However, creditors, customers, suppliers, and employees are more affected by corporate risk. Therefore, corporate risk is also relevant. Stand-alone risk is the easiest type of risk to measure.

Taking on a project with a high degree of either stand-alone or corporate risk will not necessarily affect the firm's market risk. However, if the project has highly uncertain returns, and if those returns are highly correlated with returns on the firm's other assets and with most other assets in the economy, the project will have a high degree of all types of risk.

**n. Explain in words why new common stock that is raised externally has a higher percentage cost than equity that is raised internally by reinvesting earnings.**

**Answer:** The company is raising money in order to make an investment. The money has a cost, and this cost is based primarily on the investors' required rate of return, considering risk and alternative investment opportunities. So, the new investment must provide a return at least equal to the investors' opportunity cost.

If the company raises capital by selling stock, the company doesn't get all of the money that investors put up. For example, if investors put up \$100,000, and if they expect a 15 percent return

on that \$100,000, then \$15,000 of profits must be generated. But if flotation costs are 20 percent (\$20,000), then the company will receive only \$80,000 of the \$100,000 investors put up. That \$80,000 must then produce a \$15,000 profit, or a  $15/80 = 18.75\%$  rate of return versus a 15 percent return on equity raised as retained earnings.

- o. 1. Harry Davis estimates that if it issues new common stock, the flotation cost will be 15 percent. Harry Davis incorporates the flotation costs into the DCF approach. What is the estimated cost of newly issued common stock, taking into account the flotation cost?**

**Answer:**

$$\begin{aligned} r_e &= \frac{D_0(1+g)}{P_0(1-F)} + g \\ &= \frac{\$4.19(1.05)}{\$50(1-0.15)} + 5.0\% \\ &= \frac{\$4.40}{\$42.50} + 5.0\% = 15.4\%. \end{aligned}$$

- o. 2. Suppose Harry Davis issues 30-year debt with a par value of \$1,000 and a coupon rate of 10%, paid annually. If flotation costs are 2 percent, what is the after-tax cost of debt for the new bond?**

**Answer:** Using a financial calculator,  $n = 30$ ,  $PV = (1-0.02)(1000) = 980$ ,  $pmt = -(1-0.40)(100) = -60$ ,  $FV = -1000$ . The resulting  $i$  is 6.15%, which is the after-tax cost of debt.

- p. What four common mistakes in estimating the WACC should Harry Davis avoid?**

- Answer:**
1. Don't use the coupon rate on a firm's existing debt as the pre-tax cost of debt. Use the current cost of debt.
  2. When estimating the risk premium for the CAPM approach, don't subtract the current long-term t-bond rate from the historical average return on stocks.  
For example, the historical average return on stocks has been about 12.7%. If inflation has driven the current risk-free rate up to 10%, it would be wrong to conclude that the current market risk premium is  $12.7\% - 10\% = 2.7\%$ . In all likelihood, inflation would also have driven up the expected return on the market. Therefore, the historical return on the market would not be a good estimate of the current expected return on the market.
  3. Don't use book weights to estimate the weights for the capital structure. Use the target capital structure to determine the weights for the WACC. If you don't have the target weights, then use market value rather than book value to obtain the weights. Use the book value of debt only as a last resort.
  4. Always remember that capital components are sources of funding that come from investors. If it's not a source of funding from an investor, then it's not a capital component.

# Chapter 10

## The Basics of Capital Budgeting

### Evaluating Cash Flows

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 10-1
- a. Capital budgeting is the whole process of analyzing projects and deciding whether they should be included in the capital budget. This process is of fundamental importance to the success or failure of the firm as the fixed asset investment decisions chart the course of a company for many years into the future. The payback, or payback period, is the number of years it takes a firm to recover its project investment. Payback may be calculated with either raw cash flows (regular payback) or discounted cash flows (discounted payback). In either case, payback does not capture a project's entire cash flow stream and is thus not the preferred evaluation method. Note, however, that the payback does measure a project's liquidity, and hence many firms use it as a risk measure.
  - b. Mutually exclusive projects cannot be performed at the same time. We can choose either Project 1 or Project 2, or we can reject both, but we cannot accept both projects. Independent projects can be accepted or rejected individually.
  - c. The net present value (NPV) and internal rate of return (IRR) techniques are discounted cash flow (DCF) evaluation techniques. These are called DCF methods because they explicitly recognize the time value of money. NPV is the present value of the project's expected future cash flows (both inflows and outflows), discounted at the appropriate cost of capital. NPV is a direct measure of the value of the project to shareholders. The internal rate of return (IRR) is the discount rate that equates the present value of the expected future cash inflows and outflows. IRR measures the rate of return on a project, but it assumes that all cash flows can be reinvested at the IRR rate.
  - d. The modified internal rate of return (MIRR) assumes that cash flows from all projects are reinvested at the cost of capital as opposed to the project's own IRR. This makes the modified internal rate of return a better indicator of a project's true profitability. The profitability index is found by dividing the project's PV of future cash flows by its initial cost. A profitability index greater than 1 is equivalent to a positive NPV project.
  - e. An NPV profile is the plot of a project's NPV versus its cost of capital. The crossover rate is the cost of capital at which the NPV profiles for two projects intersect.
  - f. Capital projects with nonnormal cash flows have a large cash outflow either sometime during or at the end of their lives. A common problem encountered when evaluating projects with nonnormal cash flows is multiple IRRs. A project has normal cash flows if one or more cash outflows (costs) are followed by a series of cash inflows.
- g. The hurdle rate is the project cost of capital, or discount rate. It is the rate used in discounting future cash flows in the NPV method, and it is the rate that is compared to the IRR. The mathematics of the NPV method imply that project cash flows are reinvested at the cost of capital while the IRR method assumes**

**reinvestment at the IRR. Since project cash flows can be replaced by new external capital which costs  $r$ , the proper reinvestment rate assumption is the cost of capital, and thus the best capital budget decision rule is NPV. The post-audit is the final aspect of the capital budgeting process. The post-audit is a feedback process in which the actual results are compared with those predicted in the original capital budgeting analysis. The post-audit has several purposes, the most important being to improve forecasts and improve operations.**

- h. A replacement chain is a method of comparing mutually exclusive projects that have unequal lives. Each project is replicated such that they will both terminate in a common year. If projects with lives of 3 years and 5 years are being evaluated, the 3-year project would be replicated 5 times and the 5-year project replicated 3 times; thus, both projects would terminate in 15 years. Not all projects maximize their NPV if operated over their engineering lives and therefore it may be best to terminate a project prior to its potential life. The economic life is the number of years a project should be operated to maximize its NPV, and is often less than the maximum potential life. Capital rationing occurs when management places a constraint on the size of the firm's capital budget during a particular period.
- 10-2 Project classification schemes can be used to indicate how much analysis is required to evaluate a given project, the level of the executive who must approve the project, and the cost of capital that should be used to calculate the project's NPV. Thus, classification schemes can increase the efficiency of the capital budgeting process.
- 10-3 The NPV is obtained by discounting future cash flows, and the discounting process actually compounds the interest rate over time. Thus, an increase in the discount rate has a much greater impact on a cash flow in Year 5 than on a cash flow in Year 1.
- 10-4 This question is related to Question 10-3 and the same rationale applies. With regard to the second part of the question, the answer is no; the IRR rankings are constant and independent of the firm's cost of capital.
- 10-5 The NPV and IRR methods both involve compound interest, and the mathematics of discounting requires an assumption about reinvestment rates. The NPV method assumes reinvestment at the cost of capital, while the IRR method assumes reinvestment at the IRR. MIRR is a modified version of IRR which assumes reinvestment at the cost of capital.
- 10-6 Generally, the failure to employ common life analysis in such situations will bias the NPV against the shorter project because it "gets no credit" for profits beyond its initial life, even though it could possibly be "renewed" and thus provide additional NPV.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

10-1 a.  $\$52,125/\$12,000 = 4.3438$ , so the payback is about 4 years.

b. Project K's discounted payback period is calculated as follows:

<u>Cumulative</u>	<u>Period</u>	Annual <u>Cash</u>	Discounted @12% <u>Flows</u>	<u>Cash</u>	<u>Flows</u>
	0	(\$52,125)	(\$52,125.00)	(\$52,125.00)	
	1	12,000	10,714.80	(41,410.20)	
	2	12,000	9,566.40	(31,843.80)	
	3	12,000	8,541.60	(23,302.20)	
	4	12,000	7,626.00	(15,676.20)	
	5	12,000	6,808.80	(8,867.40)	
	6	12,000	6,079.20	(2,788.20)	
2,639.40	7	12,000	5,427.60		
	8	12,000	4,846.80	7,486.20	

The discounted payback period is  $6 + \frac{\$2,788.20}{\$5,427.60}$  years, or 6.51 years.

Alternatively, since the annual cash flows are the same, one can divide \$12,000 by 1.12 (the discount rate = 12%) to arrive at  $CF_1$  and then continue to divide by 1.12 seven more times to obtain the discounted cash flows (Column 3 values). The remainder of the analysis would be the same.

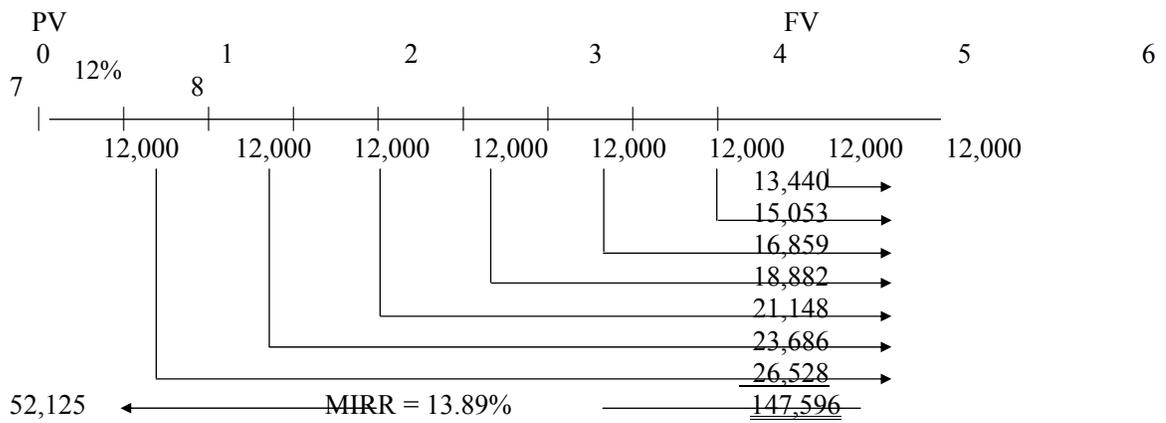
c. 
$$\begin{aligned} NPV &= -\$52,125 + \$12,000[(1/i)-(1/(i*(1+i)^n))] \\ &= -\$52,125 + \$12,000[(1/0.12)-(1/(0.12*(1+0.12)^8))] \\ &= -\$52,125 + \$12,000(4.9676) = \$7,486.20. \end{aligned}$$

Financial calculator: Input the appropriate cash flows into the cash flow register, input  $I = 12$ , and then solve for  $NPV = \$7,486.68$ .

d. **Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for  $IRR = 16\%$ .**

e. MIRR: PV Costs = \$52,125.

FV Inflows:



Financial calculator: Obtain the FVA by inputting  $N = 8$ ,  $I = 12$ ,  $PV = 0$ ,  $PMT = 12000$ , and then solve for  $FV = \$147,596$ . The MIRR can be obtained by inputting  $N = 8$ ,  $PV = -52125$ ,  $PMT = 0$ ,  $FV = 147596$ , and then solving for  $I = 13.89\%$ .

10-2 Project A:

Using a financial calculator, enter the following:

$$\begin{aligned}CF_0 &= -15000000 \\CF_1 &= 5000000 \\CF_2 &= 10000000 \\CF_3 &= 20000000\end{aligned}$$

$$I = 10; NPV = \$12,836,213.$$

$$\text{Change } I = 10 \text{ to } I = 5; NPV = \$16,108,952.$$

$$\text{Change } I = 5 \text{ to } I = 15; NPV = \$10,059,587.$$

Project B:

Using a financial calculator, enter the following:

$$\begin{aligned}CF_0 &= -15000000 \\CF_1 &= 20000000 \\CF_2 &= 10000000 \\CF_3 &= 6000000\end{aligned}$$

$$I = 10; NPV = \$15,954,170.$$

$$\text{Change } I = 10 \text{ to } I = 5; NPV = \$18,300,939.$$

$$\text{Change } I = 5 \text{ to } I = 15; NPV = \$13,897,838.$$

10-3 Truck:

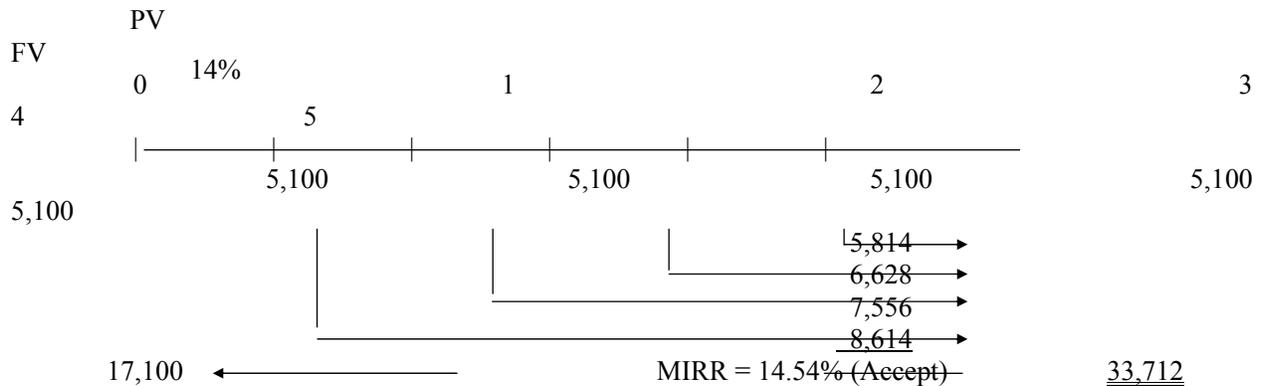
$$\begin{aligned}NPV &= -\$17,100 + \$5,100(PVIFA_{14\%,5}) \\&= -\$17,100 + \$5,100(3.4331) = -\$17,100 + \$17,509 \\&= \$409. \quad (\text{Accept})\end{aligned}$$

Financial calculator: Input the appropriate cash flows into the cash flow register, input I = 14, and then solve for NPV = \$409.

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for IRR = 14.99% ≈ 15%.

MIRR: PV Costs = \$17,100.

FV Inflows:



Financial calculator: Obtain the FVA by inputting N = 5, I = 14, PV = 0, PMT = 5100, and then solve for FV = \$33,712. The MIRR can be obtained by inputting N = 5, PV = -17100, PMT = 0, FV = 33712, and then solving for I = 14.54%.

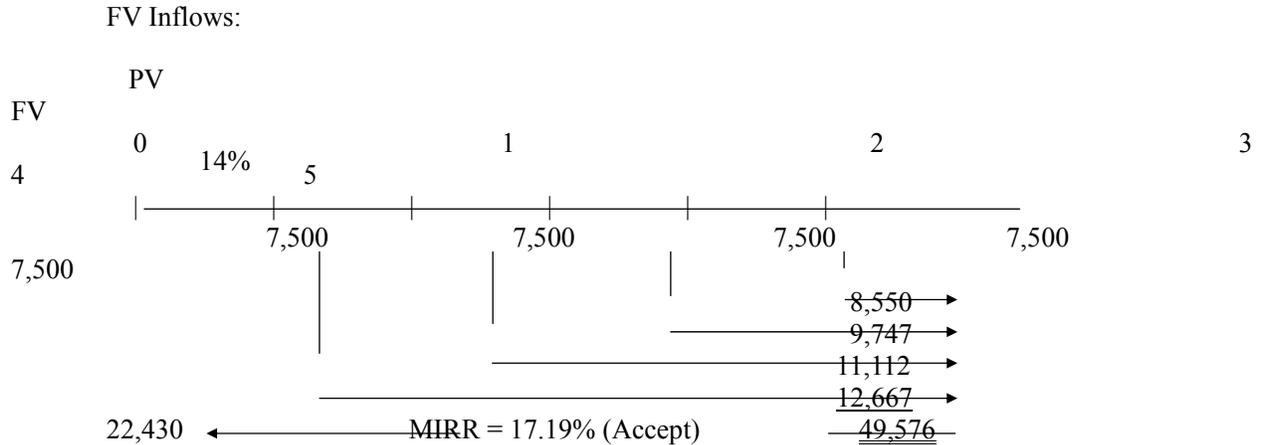
*Pulley:*

$$\begin{aligned} \text{NPV} &= -\$22,430 + \$7,500(3.4331) = -\$22,430 + \$25,748 \\ &= \$3,318. \quad (\text{Accept}) \end{aligned}$$

Financial calculator: Input the appropriate cash flows into the cash flow register, input I = 14, and then solve for NPV = \$3,318.

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for IRR = 20%.

MIRR: PV Costs = \$22,430.



Financial calculator: Obtain the FVA by inputting  $N = 5$ ,  $I = 14$ ,  $PV = 0$ ,  $PMT = 7500$ , and then solve for  $FV = \$49,576$ . The MIRR can be obtained by inputting  $N = 5$ ,  $PV = -22430$ ,  $PMT = 0$ ,  $FV = 49576$ , and then solving for  $I = 17.19\%$ .

10-4 *Electric-powered:*

$$\begin{aligned} NPV_E &= -\$22,000 + \$6,290 \left[ \frac{1}{i} - \frac{1}{i \cdot (1+i)^n} \right] \\ &= -\$22,000 + \$6,290 \left[ \frac{1}{0.12} - \frac{1}{0.12 \cdot (1+0.12)^6} \right] \\ &= -\$22,000 + \$6,290(4.1114) = -\$22,000 + \$25,861 = \$3,861. \end{aligned}$$

Financial calculator: Input the appropriate cash flows into the cash flow register, input  $I = 12$ , and then solve for  $NPV = \$3,861$ .

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for  $IRR = 18\%$ .

*Gas-powered:*

$$\begin{aligned} NPV_G &= -\$17,500 + \$5,000 \left[ \frac{1}{i} - \frac{1}{i \cdot (1+i)^n} \right] \\ &= -\$17,500 + \$5,000 \left[ \frac{1}{0.12} - \frac{1}{0.12 \cdot (1+0.12)^6} \right] \\ &= -\$17,500 + \$5,000(4.1114) = -\$17,500 + \$20,557 = \$3,057. \end{aligned}$$

Financial calculator: Input the appropriate cash flows into the cash flow register, input  $I = 12$ , and then solve for  $NPV = \$3,057$ .

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for  $IRR = 17.97\% \approx 18\%$ .

The firm should purchase the electric-powered forklift because it has a higher NPV than the gas-powered forklift. The company gets a high rate of return ( $18\% > r = 12\%$ ) on a larger investment.

10-5 Financial calculator solution, NPV:

**Project S**

Inputs	5	12		3000	0
	N	I	PV	PMT	FV
Output			= -10,814.33		

$NPV_S = \$10,814.33 - \$10,000 = \$814.33.$

**Project L**

Inputs	5	12		7400	0
	N	I	PV	PMT	FV
Output			= -26,675.34		

$NPV_L = \$26,675.34 - \$25,000 = \$1,675.34.$

Financial calculator solution, IRR:

Input  $CF_0 = -10000, CF_1 = 3000, N_j = 5, IRR_S = ?$   $IRR_S = 15.24\%.$

Input  $CF_0 = -25000, CF_1 = 7400, N_j = 5, IRR_L = ?$   $IRR_L = 14.67\%.$

Financial calculator solution, MIRR:

**Project S**

Inputs	5	12	0	3000	
	N	I	PV	PMT	FV
Output					= -19,058.54

$PV\ costs_S = \$10,000.$   
 $FV\ inflows_S = \$19,058.54.$

Inputs	5		-10000	0	19058.54
	N	I	PV	PMT	FV
Output		= 13.77			

$MIRR_S = 13.77\%.$

**Project L**

Inputs	5	12	0	7400	
	N	I	PV	PMT	FV

Output = -47,011.07

PV costs<sub>L</sub> = \$25,000.

FV inflows<sub>L</sub> = \$47,011.07.

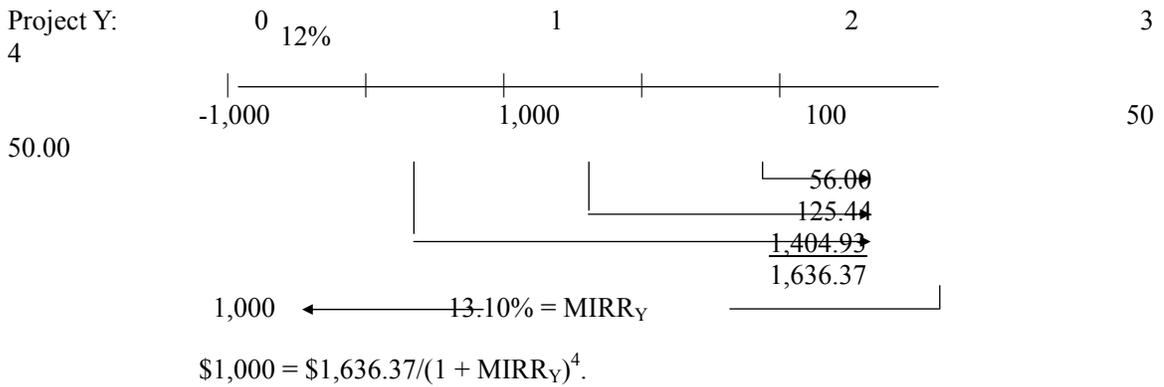
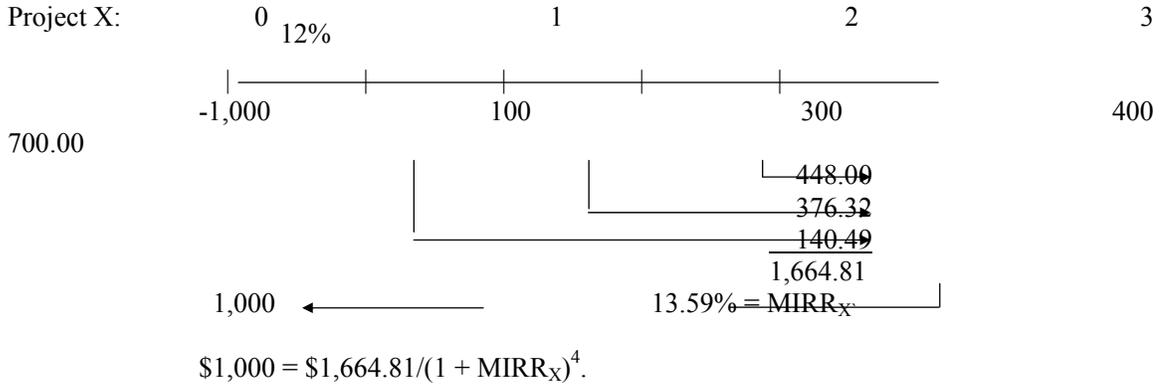
Inputs	5		-25000	0	47011.07
	<input type="text" value="N"/>	<input type="text" value="I"/>	<input type="text" value="PV"/>	<input type="text" value="PMT"/>	<input type="text" value="FV"/>
Output		= 13.46			

MIRR<sub>L</sub> = 13.46%.

$$PI_S = \frac{\$10,814.33}{\$10,000} = 1.081. \quad PI_L = \frac{\$26,675.34}{\$25,000} = 1.067.$$

Thus, NPV<sub>L</sub> > NPV<sub>S</sub>, IRR<sub>S</sub> > IRR<sub>L</sub>, MIRR<sub>S</sub> > MIRR<sub>L</sub>, and PI<sub>S</sub> > PI<sub>L</sub>. The scale difference between Projects S and L result in the IRR, MIRR, and PI favoring S over L. However, NPV favors Project L, and hence L should be chosen.

10-6  
4



Thus, since  $\text{MIRR}_X > \text{MIRR}_Y$ , Project X should be chosen.

Alternative step: You could calculate NPVs, see that Project X has the higher NPV, and just calculate  $\text{MIRR}_X$ .

$\text{NPV}_X = \$58.02$  and  $\text{NPV}_Y = \$39.94$ .

10-7

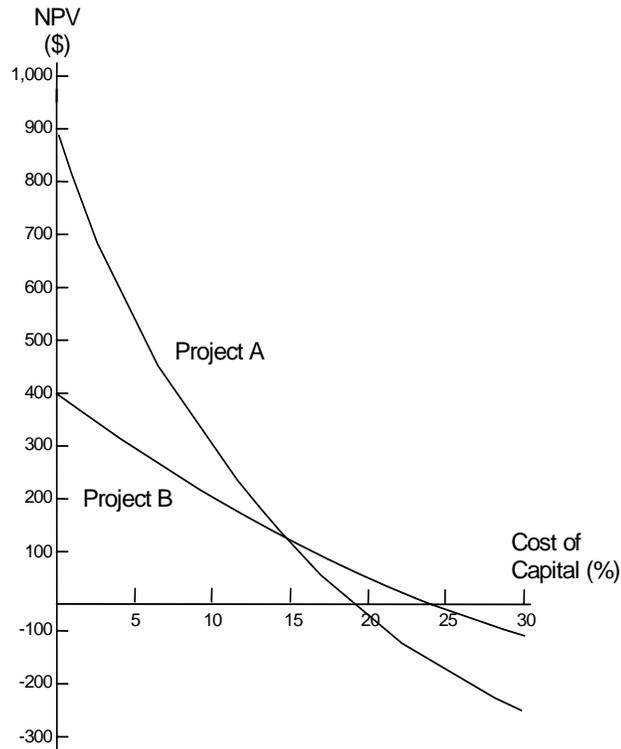
a.	Purchase price	\$ 900,000
	Installation	<u>165,000</u>
	Initial outlay	<u>\$1,065,000</u>

$\text{CF}_0 = -1,065,000$ ;  $\text{CF}_{1-5} = 350,000$ ;  $I = 14$ ;  $\text{NPV} = ?$   
 $\text{NPV} = \$136,578$ ;  $\text{IRR} = 19.22\%$ .

**b. Ignoring environmental concerns, the project should be undertaken because its NPV is positive and its IRR is greater than the firm's cost of capital.**

c. Environmental effects could be added by estimating penalties or any other cash outflows that might be imposed on the firm to help return the land to its previous state (if possible). These outflows could be so large as to cause the project to have a negative NPV--in which case the project should not be undertaken.

10-8 a.



r	NPV <sub>A</sub>	NPV <sub>B</sub>
0.0%	\$890	\$399
10.0	283	179
12.0	200	146
18.1	0	62
20.0	(49)	41
24.0	(138)	0
30.0	(238)	(51)

b.  $IRR_A = 18.1\%$ ;  $IRR_B = 24.0\%$ .

c. **At  $r = 10\%$ , Project A has the greater NPV, specifically \$283.34 as compared to Project B's NPV of \$178.60. Thus, Project A would be selected. At  $r = 17\%$ , Project B has an NPV of \$75.95 which is higher than Project A's NPV of \$31.05. Thus, choose Project B if  $r = 17\%$ .**

d. Here is the MIRR for Project A when  $r = 10\%$ :

$$\text{PV costs} = \$300 + \$387/(1.10)^1 + \$193/(1.10)^2 + \$100/(1.10)^3 + \$180/(1.10)^7 = \$978.82.$$

$$\text{TV inflows} = \$600(1.10)^3 + \$600(1.10)^2 + \$850(1.10)^1 = \$2,459.60.$$

Now, MIRR is that discount rate which forces the TV of \$2,459.60 in 7 years to equal \$978.82:

$$\$952.00 = \$2,547.60(1+\text{MIRR})^7.$$

$$\text{MIRR}_A = 14.07\%.$$

Similarly,  $\text{MIRR}_B = 15.89\%$ .

At  $r = 17\%$ ,

$$\text{MIRR}_A = 17.57\%.$$

$$\text{MIRR}_B = 19.91\%.$$

e. To find the crossover rate, construct a Project  $\Delta$  which is the difference in the two projects' cash flows:

Year	Project $\Delta =$ CF <sub>A</sub> - CF <sub>B</sub>	
0	\$105	
1	(521)	
2	(327)	
3	(234)	
4	466	
5		466
6	716	
7	(180)	

$$\text{IRR}_\Delta = \text{Crossover rate} = 14.53\%.$$

Projects A and B are mutually exclusive, thus, only one of the projects can be chosen. As long as the cost of capital is greater than the crossover rate, both the NPV and IRR methods will lead to the same project selection. However, if the cost of capital is less than the crossover rate the two methods lead to different project selections--a conflict exists. When a conflict exists the NPV method must be used.

Because of the sign changes and the size of the cash flows, Project  $\Delta$  has multiple IRRs. Thus, a calculator's IRR function will not work. One could use the trial and error method of entering different discount rates until  $\text{NPV} = \$0$ . However, an HP can be "tricked" into giving the roots. After you have keyed Project Delta's cash flows into the g register of an HP-10B, you will see an "Error-Soln" message. Now enter 10   and the 14.53% IRR is found. Then enter 100   to obtain  $\text{IRR} = 456.22\%$ . Similarly, Excel or Lotus 1-2-3 can also be used.

10-9 a.

<u>(B - A)</u>	<u>Year</u>	<u>Plan B</u>	<u>Incremental Cash</u> <u>Plan A</u>	<u>Flow</u>
	0	(\$10,000,000)	(\$10,000,000)	\$ 0
	1	1,750,000	12,000,000	(10,250,000)

1,750,000

2-20

1,750,000

0

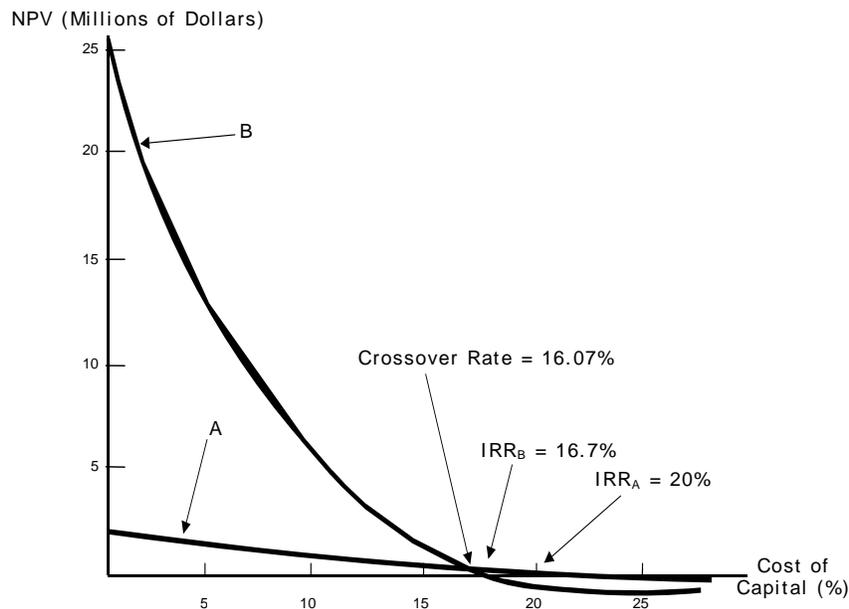
If the firm goes with Plan B, it will forgo \$10,250,000 in Year 1, but will receive \$1,750,000 per year in Years 2-20.

- b. If the firm could invest the incremental \$10,250,000 at a return of 16.07%, it would receive cash flows of \$1,750,000. If we set up an amortization schedule, we would find that payments of \$1,750,000 per year for 19 years would amortize a loan of \$10,250,000 at 16.0665%.

Financial calculator solution:

Inputs	19		-10250000	1750000	0
	<input type="text" value="N"/>	<input type="text" value="I"/>	<input type="text" value="PV"/>	<input type="text" value="PMT"/>	<input type="text" value="FV"/>
Output		= 16.0665			

- c. Yes, assuming (1) equal risk among projects, and (2) that the cost of capital is a constant and does not vary with the amount of capital raised.
- d. See graph. If the cost of capital is less than 16.07%, then Plan B should be accepted; if  $r > 16.07\%$ , then Plan A is preferred.



10-10 a. Financial calculator solution:

Plan A

Inputs	20	10		8000000	0
	<input type="text" value="N"/>	<input type="text" value="I"/>	<input type="text" value="PV"/>	<input type="text" value="PMT"/>	<input type="text" value="FV"/>
Output			= -68,108,510		

$$NPV_A = \$68,108,510 - \$50,000,000 = \$18,108,510.$$

Plan B

Inputs	20	10		3400000	0
	<input type="text" value="N"/>	<input type="text" value="I"/>	<input type="text" value="PV"/>	<input type="text" value="PMT"/>	<input type="text" value="FV"/>
Output			= -28,946,117		

$$NPV_B = \$28,946,117 - \$15,000,000 = \$13,946,117.$$

Plan A

Inputs	20		-50000000	8000000	0
	<input type="text" value="N"/>	<input type="text" value="I"/>	<input type="text" value="PV"/>	<input type="text" value="PMT"/>	<input type="text" value="FV"/>
Output		= 15.03			

$$IRR_A = 15.03\%.$$

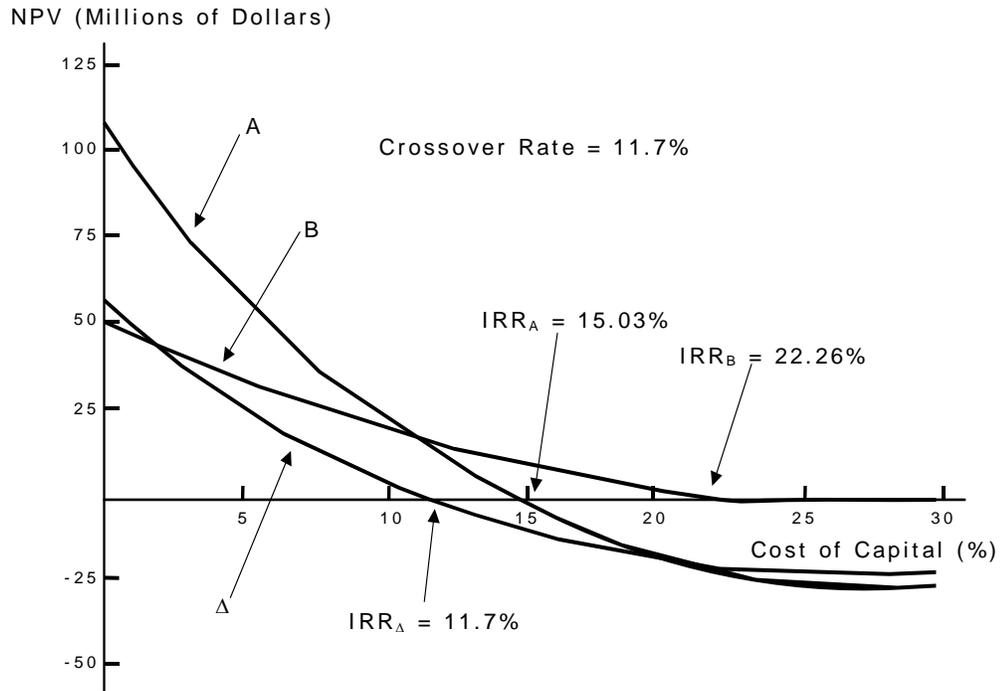
Plan B

Inputs	20		-15000000	3400000	0
	<input type="text" value="N"/>	<input type="text" value="I"/>	<input type="text" value="PV"/>	<input type="text" value="PMT"/>	<input type="text" value="FV"/>
Output		= 22.26			

$$IRR_B = 22.26\%.$$



c.



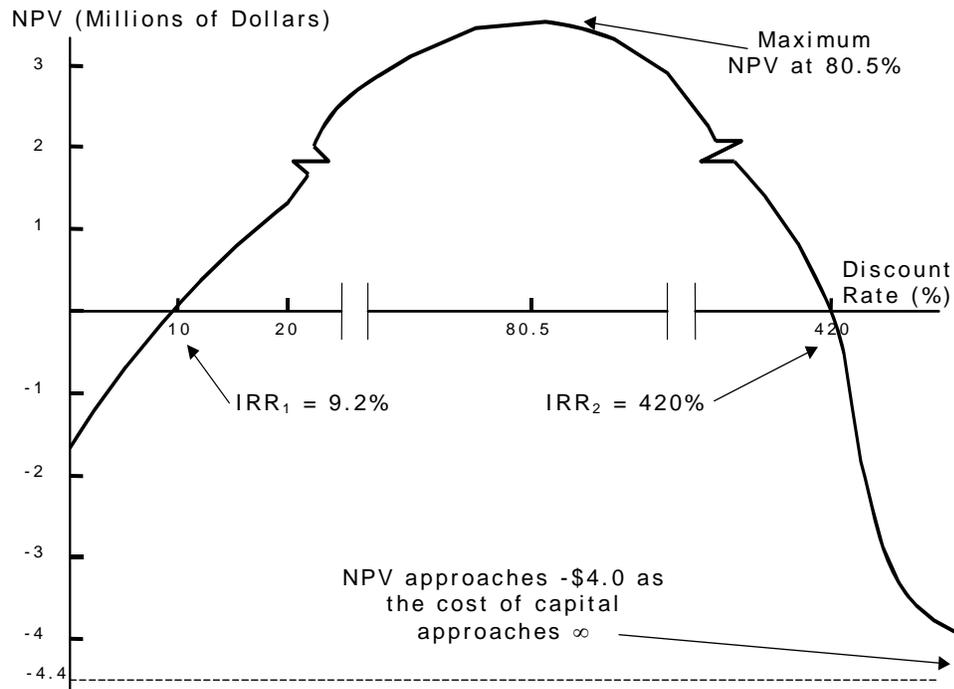
- d. The NPV method implicitly assumes that the opportunity exists to reinvest the cash flows generated by a project at the cost of capital, while use of the IRR method implies the opportunity to reinvest at the IRR. If the firm's cost of capital is constant at 10 percent, all projects with an  $NPV > 0$  will be accepted by the firm. As cash flows come in from these projects, the firm will either pay them out to investors, or use them as a substitute for outside capital which costs 10 percent. Thus, since these cash flows are expected to save the firm 10 percent, this is their opportunity cost reinvestment rate.

The IRR method assumes reinvestment at the internal rate of return itself, which is an incorrect assumption, given a constant expected future cost of capital, and ready access to capital markets.

- 10-11 a. The project's expected cash flows are as follows (in millions of dollars):

<u>Time</u>	<u>Net Cash Flow</u>
0	(\$ 4.4)
1	27.7
2	(25.0)

We can construct the following NPV profile:



<u>Discount Rate</u>	<u>NPV</u>
0%	(\$1,700,000)
9	(29,156)
10	120,661
50	2,955,556
100	3,200,000
200	2,055,556
300	962,500
400	140,000
410	70,204
420	2,367
430	(63,581)

The table above was constructed using a financial calculator with the following inputs:  $CF_0 = -4400000$ ,  $CF_1 = 27700000$ ,  $CF_2 = -25000000$ , and  $I =$  discount rate to solve for the NPV.

- If  $r = 8\%$ , reject the project since  $NPV < 0$ . But if  $r = 14\%$ , accept the project because  $NPV > 0$ .
- Other possible projects with multiple rates of return could be nuclear power plants where disposal of radioactive wastes is required at the end of the project's life, or leveraged leases where the borrowed funds are repaid at the end of the lease life. (See Chapter 20 for more information on leases.)
- Here is the MIRR for the project when  $r = 8\%$ :

$$PV \text{ costs} = \$4,400,000 + \$25,000,000 / (1.08)^2 = \$25,833,470.51.$$

$$\text{TV inflows} = \$27,700,000(1.08)^1 = \$29,916,000.00.$$

Now, MIRR is that discount rate which forces the PV of the TV of \$29,916,000 over 2 years to equal \$25,833,470.51:

$$\$25,833,470.51 = \$29,916,000(\text{PVIF}_{r,2}).$$

Inputs	2		-25833470.51	0	29916000
	N	I	PV	PMT	FV
Output		= 7.61			

$$\text{MIRR} = 7.61\%.$$

At  $r = 14\%$ ,

Inputs	2		-23636688.21	0	31578000
	N	I	PV	PMT	FV
Output		= 15.58			

$$\text{MIRR} = 15.58\%.$$

$$\text{PV costs} = \$4,400,000 + \$25,000,000/(1.14)^2 = \$23,636,688.21.$$

$$\text{TV inflows} = \$27,700,000(1.14)^1 = \$31,578,000.$$

Now, MIRR is that discount rate which forces the PV of the TV of \$31,578,000 over 2 years to equal \$23,636,688.21:

$$\$23,636,688.21 = \$31,578,000(\text{PVIF}_{r,2}).$$

Yes. The MIRR method leads to the same conclusion as the NPV method. Reject the project if  $r = 8\%$ , which is greater than the corresponding MIRR of 7.61%, and accept the project if  $r = 14\%$ , which is less than the corresponding MIRR of 15.58%.

- 10-12 a. The IRRs of the two alternatives are undefined. To calculate an IRR, the cash flow stream must include both cash inflows and outflows.
- b. The PV of costs for the conveyor system is (\$911,067), while the PV of costs for the forklift system is (\$838,834). Thus, the forklift system is expected to be (\$838,834) - (\$911,067) = \$72,233 less costly than the conveyor system, and hence the forklift trucks should be used.

Financial calculator solution:

$$\text{Input: } CF_0 = -500000, \quad CF_1 = -120000, \quad N_j = 4, \quad CF_2 = -20000, \quad I = 8, \quad \text{NPV}_C = ? \quad \text{NPV}_C = -911,067.$$

Input:  $CF_0 = -200000$ ,  $CF_1 = -160000$ ,  $N_1 = 5$ ,  $I = 8$ ,  $NPV_F = ?$   $NPV_F = -838,834$ .

10-13 a. Payback A (cash flows in thousands):

<u>Period</u>	<u>Annual Cash Flows</u>	<u>Cumulative</u>
0	(\$25,000)	(\$25,000)
1	5,000	(20,000)
2	10,000	(10,000)
3	15,000	5,000
4	20,000	25,000

$Payback_A = 2 + \$10,000/\$15,000 = 2.67$  years.

Payback B (cash flows in thousands):

<u>Period</u>	<u>Annual Cash Flows</u>	<u>Cumulative</u>
0	(\$25,000)	\$25,000)
1	20,000	(5,000)
2	10,000	5,000
3	8,000	13,000
4	6,000	19,000

$Payback_B = 1 + \$5,000/\$10,000 = 1.50$  years.

b. Discounted payback A (cash flows in thousands):

Period	Annual	Discounted @10%	
	Cash Flows	Cash Flows	Cumulative
0	(\$25,000)	(\$25,000.00)	(\$25,000.00)
1	5,000	4,545.45	( 20,454.55)
2	10,000	8,264.46	( 12,190.09)
3	15,000	11,269.72	( 920.37)
4	20,000	13,660.27	12,739.90

Discounted Payback<sub>A</sub> = 3 + \$920.37/\$13,660.27 = 3.07 years.

Discounted payback B (cash flows in thousands):

Period	Annual	Discounted @10%	
	Cash Flows	Cash Flows	Cumulative
0	(\$25,000)	(\$25,000.00)	(\$25,000.00)
1	20,000	18,181.82	( 6,818.18)
2	10,000	8,264.46	1,446.28
3	8,000	6,010.52	7,456.80
4	6,000	4,098.08	11,554.88

Discounted Payback<sub>B</sub> = 1 + \$6,818.18/\$8,264.46 = 1.825 years.

c. NPV<sub>A</sub> = \$12,739,908; IRR<sub>A</sub> = 27.27%.  
NPV<sub>B</sub> = \$11,554,880; IRR<sub>B</sub> = 36.15%.

Both projects have positive NPVs, so both projects should be undertaken.

d. At a discount rate of 5%, NPV<sub>A</sub> = \$18,243,813.  
At a discount rate of 5%, NPV<sub>B</sub> = \$14,964,829.

At a discount rate of 5%, Project A has the higher NPV; consequently, it should be accepted.

e. At a discount rate of 15%, NPV<sub>A</sub> = \$8,207,071.  
At a discount rate of 15%, NPV<sub>B</sub> = \$8,643,390.

At a discount rate of 15%, Project B has the higher NPV; consequently, it should be accepted.

f.

Year	Project Δ =		CF <sub>A</sub> - CF <sub>B</sub>
0	\$	0	
1		(15)	
2		0	
3		7	
4		4	14

IRR<sub>Δ</sub> = Crossover rate = 13.5254% ≈ 13.53%.

g. Use 3 steps to calculate MIRR<sub>A</sub> @ r = 10%:

Step 1: Calculate the NPV of the uneven cash flow stream, so its FV can then be calculated.  
With a financial calculator, enter the cash flow stream into the cash flow registers,  
then enter  $I = 10$ , and solve for  $NPV = \$37,739,908$ .

Step 2: Calculate the FV of the cash flow stream as follows:  
Enter  $N = 4$ ,  $I = 10$ ,  $PV = -37739908$ , and  $PMT = 0$  to solve for  $FV = \$55,255,000$ .

Step 3: Calculate  $MIRR_A$  as follows:  
Enter  $N = 4$ ,  $PV = -25000000$ ,  $PMT = 0$ , and  $FV = 55255000$  to solve for  $I = 21.93\%$ .

Use 3 steps to calculate  $MIRR_B @ r = 10\%$ :

Step 1: Calculate the NPV of the uneven cash flow stream, so its FV can then be calculated.  
With a financial calculator, enter the cash flow stream into the cash flow registers,  
then enter  $I = 10$ , and solve for  $NPV = \$36,554,880$ .

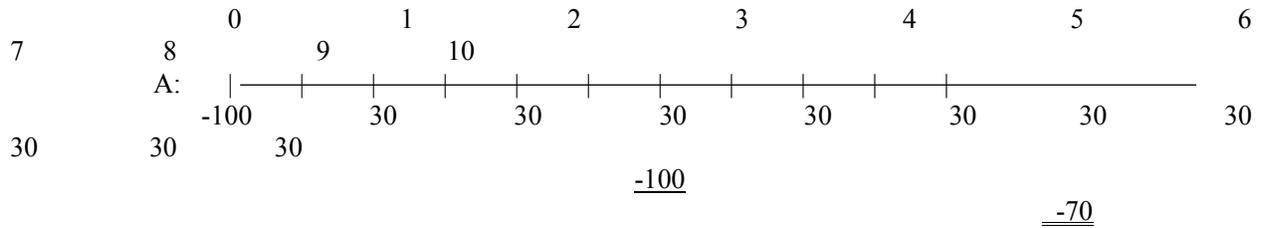
Step 2: Calculate the FV of the cash flow stream as follows:  
Enter  $N = 4$ ,  $I = 10$ ,  $PV = -36554880$ , and  $PMT = 0$  to solve for  $FV = \$53,520,000$ .

Step 3: Calculate  $MIRR_B$  as follows:  
Enter  $N = 4$ ,  $PV = -25000000$ ,  $PMT = 0$ , and  $FV = 53520000$  to solve for  $I = 20.96\%$ .

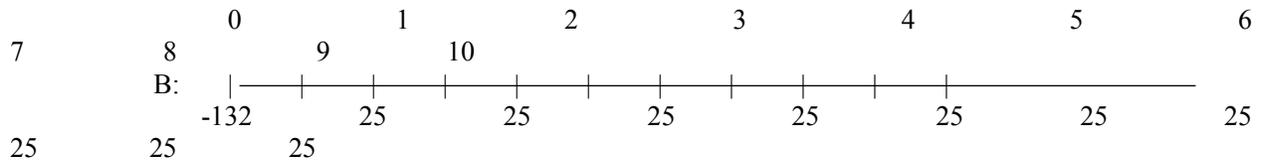
According to the MIRR approach, if the 2 projects were mutually exclusive, Project A would be chosen because it has the higher MIRR. This is consistent with the NPV approach.

10-14 Plane A: Expected life = 5 years; Cost = \$100 million; NCF = \$30 million; COC = 12%.

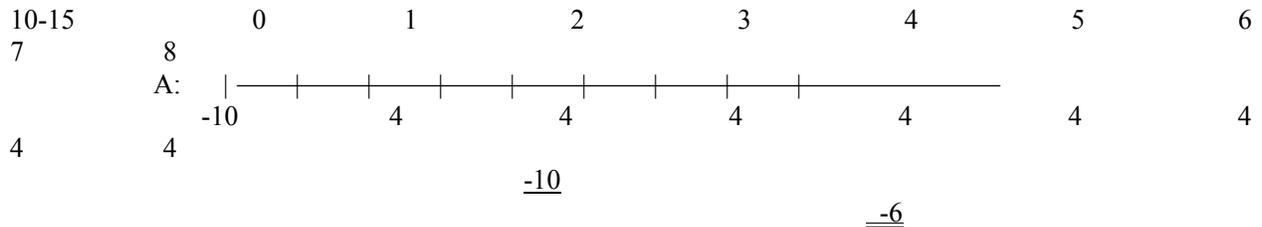
Plane B: Expected life = 10 years; Cost = \$132 million; NCF = \$25 million; COC = 12%.



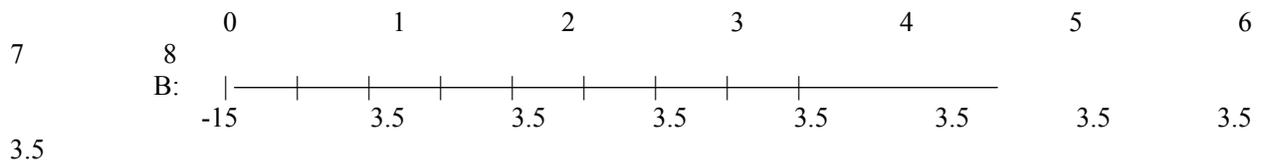
Enter these values into the cash flow register:  $CF_0 = -100$ ;  $CF_{1-4} = 30$ ;  $CF_5 = -70$ ;  $CF_{6-10} = 30$ . Then enter  $I = 12$ , and press the NPV key to get  $NPV_A = 12.764 \approx \$12.76$  million.



Enter these cash flows into the cash flow register, along with the interest rate, and press the NPV key to get  $NPV_B = 9.256 \approx \$9.26$  million. Project A is the better project and will increase the company's value by \$12.76 million.



Machine A's simple NPV is calculated as follows: Enter  $CF_0 = -10$  and  $CF_{1-4} = 4$ . Then enter  $I = 10$ , and press the NPV key to get  $NPV_A = \$2.679$  million. However, this does not consider the fact that the project can be repeated again. Enter these values into the cash flow register:  $CF_0 = -10$ ;  $CF_{1-3} = 4$ ;  $CF_4 = -6$ ;  $CF_{5-8} = 4$ . Then enter  $I = 10$ , and press the NPV key to get Extended  $NPV_A = \$4.5096 \approx \$4.51$  million.



Enter these cash flows into the cash flow register, along with the interest rate, and press the NPV key to get  $NPV_B = \$3.672 \approx \$3.67$  million. Machine A is the better project and will increase the company's value by \$4.51 million.

- 10-16 a. Using a financial calculator, input the following:  $CF_0 = -190000$ ,  $CF_1 = 87000$ ,  $N_j = 3$ , and  $I = 14$  to solve for  $NPV_{190-3} = \$11,981.99 \approx \$11,982$  (for 3 years).

$$\text{Adjusted } NPV_{190-3} = \$11,982 + \$11,982/(1.14)^3 = \$20,070.$$

Using a financial calculator, input the following:  $CF_0 = -360000$ ,  $CF_1 = 98300$ ,  $N_j = 6$ , and  $I = 14$  to solve for  $NPV_{360-6} = \$22,256.02 \approx \$22,256$  (for 6 years).

Both new machines have positive NPVs, hence the old machine should be replaced. Further, since its adjusted NPV is greater, choose Model 360-6.

- 10-17 a. NPV of termination after Year t:

$$NPV_0 = -\$22,500 + \$22,500 = 0.$$

Using a financial calculator, input the following:  $CF_0 = -22500$ ,  $CF_1 = 23750$ , and  $I = 10$  to solve for  $NPV_1 = -\$909.09 \approx -\$909$ .

Using a financial calculator, input the following:  $CF_0 = -22500$ ,  $CF_1 = 6250$ ,  $CF_2 = 20250$ , and  $I = 10$  to solve for  $NPV_2 = -\$82.64 \approx -\$83$ .

Using a financial calculator, input the following:  $CF_0 = -22500$ ,  $CF_1 = 6250$ ,  $N_j = 2$ ,  $CF_3 = 17250$ , and  $I = 10$  to solve for  $NPV_3 = \$1,307.29 \approx \$1,307$ .

Using a financial calculator, input the following:  $CF_0 = -22500$ ,  $CF_1 = 6250$ ,  $N_j = 3$ ,  $CF_4 = 11250$ , and  $I = 10$  to solve for  $NPV_4 = \$726.73 \approx \$727$ .

Using a financial calculator, input the following:  $CF_0 = -22500$ ,  $CF_1 = 6250$ ,  $N_j = 5$ , and  $I = 10$  to solve for  $NPV_5 = \$1,192.42 \approx \$1,192$ .

The firm should operate the truck for 3 years,  $NPV_3 = \$1,307$ .

- b. No. Salvage possibilities could only raise NPV and IRR. The value of the firm is maximized by terminating the project after Year 3.

## SOLUTION TO SPREADSHEET PROBLEM

---

- 10-18 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 10 P18 Build a Model.xls*) and on the instructor's side of the web site, [brigham.swcollege.com](http://brigham.swcollege.com).

## MINI CASE

---

You have just graduated from the MBA program of a large university, and one of your favorite courses was “Today’s Entrepreneurs.” In fact, you enjoyed it so much you have decided you want to “be your own boss.” While you were in the master’s program, your grandfather died and left you \$300,000 to do with as you please. You are not an inventor and you do not have a trade skill that you can market; however, you have decided that you would like to purchase at least one established franchise in the fast foods area, maybe two (if profitable). The problem is that you have never been one to stay with any project for too long, so you figure that your time frame is three years. After three years you will sell off your investment and go on to something else.

You have narrowed your selection down to two choices; (1) Franchise L: Lisa’s Soups, Salads, & Stuff and (2) Franchise S: Sam’s Wonderful Fried Chicken. The net cash flows shown below include the price you would receive for selling the franchise in year 3 and the forecast of how each franchise will do over the three-year period. Franchise L’s cash flows will start off slowly but will increase rather quickly as people become more health conscious, while Franchise S’s cash flows will start off high but will trail off as other chicken competitors enter the marketplace and as people become more health conscious and avoid fried foods. Franchise L serves breakfast and lunch, while franchise S serves only dinner, so it is possible for you to invest in both franchises. You see these franchises as perfect complements to one another: you could attract both the lunch and dinner crowds and the health conscious and not so health conscious crowds with the franchises directly competing against one another.

Here are the projects' net cash flows (in thousands of dollars):

<u>Year</u>	<u>Expected Net Cash Flow</u>	
	<u>Franchise L</u>	<u>Franchise S</u>
0	(\$100)	(\$100)
1	10	70
2	60	50
3	80	20

Depreciation, salvage values, net working capital requirements, and tax effects are all included in these cash flows.

You also have made subjective risk assessments of each franchise, and concluded that both franchises have risk characteristics that require a return of 10 percent. You must now determine whether one or both of the projects should be accepted.

**a. What is capital budgeting?**

**Answer:** Capital budgeting is the process of analyzing additions to fixed assets. Capital budgeting is important because, more than anything else, fixed asset investment decisions chart a company's course for the future. Conceptually, the capital budgeting process is identical to the decision process used by individuals making investment decisions. These steps are involved:

1. Estimate the cash flows--interest and maturity value or dividends in the case of bonds and stocks, operating cash flows in the case of capital projects.
2. Assess the riskiness of the cash flows.
3. Determine the appropriate discount rate, based on the riskiness of the cash flows and the general level of interest rates. This is called the project cost of capital in capital budgeting.
4. Evaluate the cash flows.

**b. What is the difference between independent and mutually exclusive projects?**

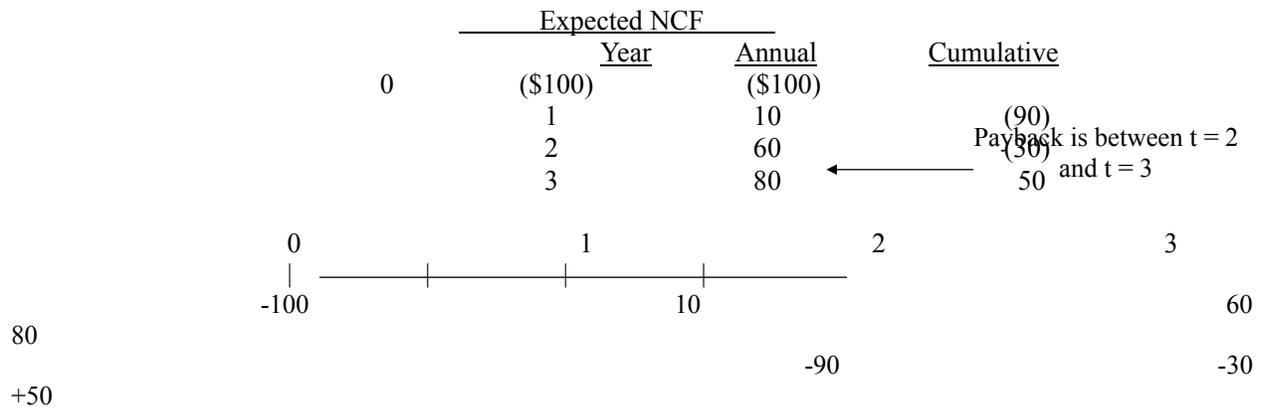
**Answer:** Projects are independent if the cash flows of one are not affected by the acceptance of the other. Conversely, two projects are mutually exclusive if acceptance of one impacts adversely the cash flows of the other; that is, at most one of two or more such projects may be accepted. Put another way, when projects are mutually exclusive it means that they do the same job. For example, a forklift truck versus a conveyor system to move materials, or a bridge versus a ferry boat.

Projects with normal cash flows have outflows, or costs, in the first year (or years) followed by a series of inflows. Projects with nonnormal cash flows have one or more outflows after the inflow stream has begun. Here are some examples:

	<u>Inflow (+) Or Outflow (-) In Year</u>						
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>_____</u>
Normal	-	+	+	+	+	+	+
		-	-	+	+	+	+
		-	-	-	+	+	+
Nonnormal	-	+	+	+	+	-	-
		-	+	+	-	+	-
	+	+	+	-	-	-	-

**c. 1. What is the payback period? Find the paybacks for franchises L and S.**

**Answer:** The payback period is the expected number of years required to recover a project's cost. We calculate the payback by developing the cumulative cash flows as shown below for project 1 (in thousands of dollars):



Franchise L's \$100 investment has not been recovered at the end of year 2, but it has been more than recovered by the end of year 3. Thus, the recovery period is between 2 and 3 years. If we assume that the cash flows occur evenly over the year, then the investment is recovered  $\$30/\$80 = 0.375 \approx 0.4$  into year 3. Therefore,  $\text{payback}_L = 2.4$  years. Similarly,  $\text{payback}_S = 1.6$  years.

**c. 2. What is the rationale for the payback method? According to the payback criterion, which franchise or franchises should be accepted if the firm's maximum acceptable payback is 2 years, and if franchises L and S are independent? If they are mutually exclusive?**

**Answer:** Payback represents a type of "breakeven" analysis: the payback period tells us when the project will break even in a cash flow sense. With a required payback of 2 years, franchise S is acceptable, but franchise L is not. Whether the two projects are independent or mutually exclusive makes no difference in this case.

**c. 3. What is the difference between the regular and discounted payback periods?**

**Answer:** Discounted payback is similar to payback except that discounted rather than raw cash flows are used.

Setup for franchise L's discounted payback, assuming a 10% cost of capital:

	Year	Expected Net Cash Flows		Cumulative
		Raw	Discounted	
	0		(\$100)	(\$100.00)
(\$100.00)	1		10	9.09
(90.91)	2		60	49.59
(41.32)	3		80	60.11
18.79				

$$\text{Discounted Payback}_L = 2 + (\$41.32/\$60.11) = 2.69 = 2.7 \text{ years.}$$

Versus 2.4 years for the regular payback.

**c. 4. What is the main disadvantage of discounted payback? Is the payback method of any real usefulness in capital budgeting decisions?**

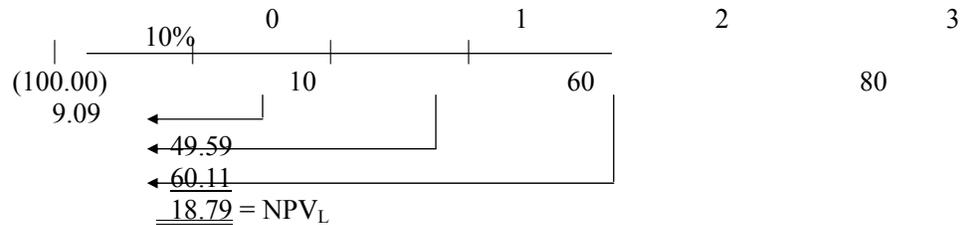
**Answer:** Regular payback has two critical deficiencies: (1) it ignores the time value of money, and (2) it ignores the cash flows that occur after the payback period. Discounted payback does consider the time value of money, but it still fails to consider cash flows after the payback period; hence it has a basic flaw. In spite of its deficiency, many firms today still calculate the discounted payback and give some weight to it when making capital budgeting decisions. However, payback is not generally used as the primary decision tool. Rather, it is used as a rough measure of a project's liquidity and riskiness.

**d. 1. Define the term *net present value (NPV)*. What is each franchise's NPV?**

**Answer:** The net present value (NPV) is simply the sum of the present values of a project's cash flows:

$$NPV = \sum_{t=0}^n \frac{CF_t}{(1+r)^t}$$

Franchise L's NPV is \$18.79:



NPVs are easy to determine using a calculator with an NPV function. Enter the cash flows sequentially, with outflows entered as negatives; enter the cost of capital; and then press the NPV button to obtain the project's NPV, \$18.78 (note the penny rounding difference). The NPV of franchise S is  $NPV_S = \$19.98$ .

**d. 2. What is the rationale behind the NPV method? According to NPV, which franchise or franchises should be accepted if they are independent? Mutually exclusive?**

**Answer:** The rationale behind the NPV method is straightforward: if a project has  $NPV = \$0$ , then the project generates exactly enough cash flows (1) to recover the cost of the investment and (2) to enable investors to earn their required rates of return (the opportunity cost of capital). If  $NPV = \$0$ , then in a financial (but not an accounting) sense, the project breaks even. If the NPV is positive, then more than enough cash flow is generated, and conversely if NPV is negative.

Consider franchise L's cash inflows, which total \$150. They are sufficient (1) to return the \$100 initial investment, (2) to provide investors with their 10 percent aggregate opportunity cost of capital, and (3) to still have \$18.79 left over on a present value basis. This \$18.79 excess PV belongs to the shareholders--the debtholders' claims are fixed, so the shareholders' wealth will be increased by \$18.79 if franchise L is accepted. Similarly, Axis's shareholders gain \$19.98 in value if franchise S is accepted.

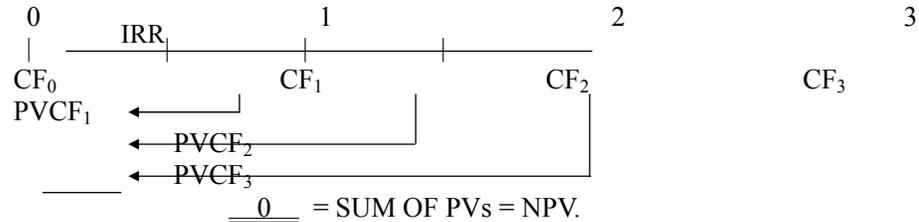
If franchises L and S are independent, then both should be accepted, because they both add to shareholders' wealth, hence to the stock price. If the franchises are mutually exclusive, then franchise S should be chosen over L, because s adds more to the value of the firm.

**d. 3. Would the NPVs change if the cost of capital changed?**

**Answer:** The NPV of a project is dependent on the cost of capital used. Thus, if the cost of capital changed, the NPV of each project would change. NPV declines as  $r$  increases, and NPV rises as  $r$  falls.

**e. 1. Define the term *Internal Rate Of Return (IRR)*. What is each franchise's IRR?**

**Answer:** The internal rate of return (IRR) is that discount rate which forces the NPV of a project to equal zero:

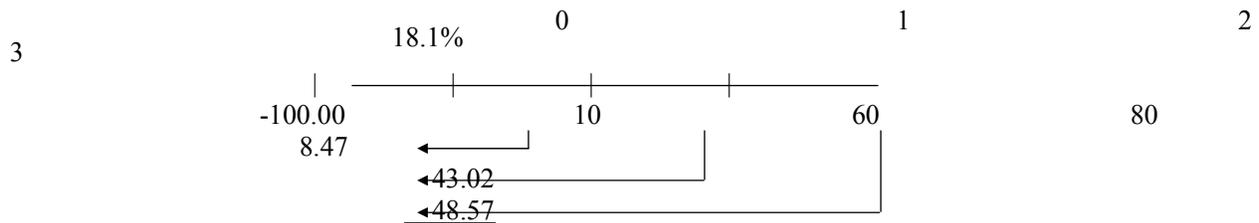


Expressed as an equation, we have:

$$\text{IRR: } \sum_{t=0}^n \frac{CF_t}{(1 + \text{IRR})^t} = \$0 = \text{NPV.}$$

Note that the IRR equation is the same as the NPV equation, except that to find the IRR the equation is solved for the particular discount rate, IRR, which forces the project's NPV to equal zero (the IRR) rather than using the cost of capital ( $r$ ) in the denominator and finding NPV. Thus, the two approaches differ in only one respect: in the NPV method, a discount rate is specified (the project's cost of capital) and the equation is solved for NPV, while in the IRR method, the NPV is specified to equal zero and the discount rate (IRR) which forces this equality is found.

Franchise L's IRR is 18.1 percent:



\$ 0.06  $\approx$  \$0 if  $\text{IRR}_L = 18.1\%$  is used as the discount rate.

therefore,  $\text{IRR}_L \approx 18.1\%$ .

A financial calculator is extremely helpful when calculating IRRs. The cash flows are entered sequentially, and then the IRR button is pressed. For franchise S,  $\text{IRR}_S \approx 23.6\%$ . Note that with many calculators, you can enter the cash flows into the cash flow register, also enter  $r = i$ , and then calculate both NPV and IRR by pressing the appropriate buttons.

**e. 2. How is the IRR on a project related to the YTM on a bond?**

**Answer:** The IRR is to a capital project what the YTM is to a bond. It is the expected rate of return on the project, just as the YTM is the promised rate of return on a bond.

**e. 3. What is the logic behind the IRR method? According to IRR, which franchises should be accepted if they are independent? Mutually exclusive?**

**Answer:** IRR measures a project's profitability in the rate of return sense: if a project's IRR equals its cost of capital, then its cash flows are just sufficient to provide investors with their required rates of return. An IRR greater than  $r$  implies an economic profit, which accrues to the firm's shareholders, while an IRR less than  $r$  indicates an economic loss, or a project that will not earn enough to cover its cost of capital.

Projects' IRRs are compared to their costs of capital, or hurdle rates. Since franchises L and S both have a hurdle rate of 10 percent, and since both have IRRs greater than that hurdle rate, both should be accepted if they are independent. However, if they are mutually exclusive, franchise S would be selected, because it has the higher IRR.

**e. 4. Would the franchises' IRRs change if the cost of capital changed?**

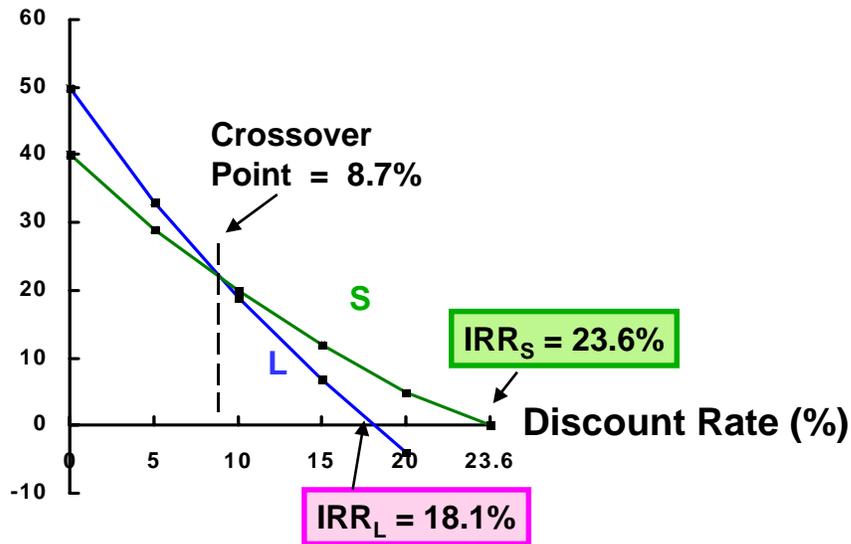
**Answer:** IRRs are independent of the cost of capital. Therefore, neither  $IRR_S$  nor  $IRR_L$  would change if  $r$  changed. However, the acceptability of the franchises could change--L would be rejected if  $r$  were above 18.1%, and S would also be rejected if  $r$  were above 23.6%.

**f. 1. Draw NPV profiles for franchises L and S. At what discount rate do the profiles cross?**

**Answer:** the NPV profiles are plotted in the figure below.

Note the following points:

1. The y-intercept is the project's NPV when  $r = 0\%$ . This is \$50 for L and \$40 for S.
2. The x-intercept is the project's IRR. This is 18.1 percent for L and 23.6 percent for S.
3. NPV profiles are curves rather than straight lines. To see this, note that these profiles approach  $\text{cost} = -\$100$  as  $r$  approaches infinity.
4. From the figure below, it appears that the crossover point is between 8 and 9 percent. The precise value is approximately 8.7 percent. One can calculate the crossover rate by (1) going back to the data on the problem, finding the cash flow differences for each year, (2) entering those differences into the cash flow register, and (3) pressing the IRR button to get the crossover rate,  $8.68\% \approx 8.7\%$ .



r	NPV <sub>L</sub>	NPV <sub>S</sub>		
0%	\$50	\$40		
5		5		33
10		10		19
15		15		7
20		20		(4)
5				

f. 2. Look at your NPV profile graph without referring to the actual NPVs and IRRs. Which franchise or franchises should be accepted if they are independent? Mutually exclusive? Explain. Are your answers correct at any cost of capital less than 23.6 percent?

**Answer:** The NPV profiles show that the IRR and NPV criteria lead to the same accept/reject decision for any independent project. Consider franchise L. It intersects the x-axis at its IRR, 18.1 percent. According to the IRR rule, L is acceptable if r is less than 18.1 percent. Also, at any r less than 18.1 percent, L's NPV profile will be above the x axis, so its NPV will be greater than \$0. Thus, for any independent project, NPV and IRR lead to the same accept/reject decision.

Now assume that L and S are mutually exclusive. In this case, a conflict might arise. First, note that  $IRR_S = 23.6\% > 18.1\%$  = therefore, regardless of the size of r, project S would be ranked higher by the IRR criterion. However, the NPV profiles show that  $NPV_L > NPV_S$  if r is less than 8.7 percent. Therefore, for any r below the 8.7% crossover rate, say r = 7 percent, the NPV rule says choose L, but the IRR rule says choose S. Thus, if r is less than the crossover rate, a ranking conflict occurs.

**g. 1. What is the underlying cause of ranking conflicts between NPV and IRR?**

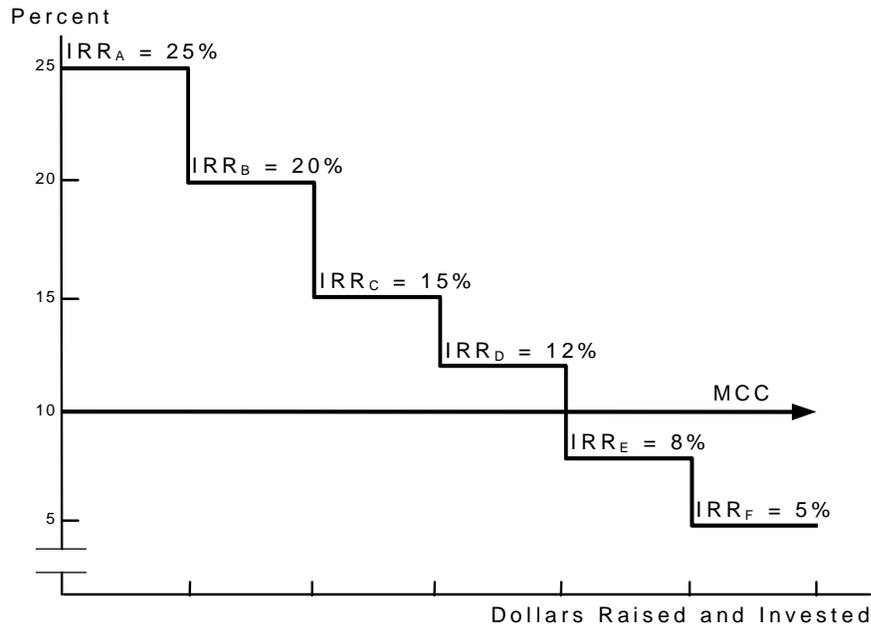
**Answer:** For normal projects' NPV profiles to cross, one project must have both a higher vertical axis intercept and a steeper slope than the other. A project's vertical axis intercept typically depends on (1) the size of the project and (2) the size and timing pattern of the cash flows--large projects, and ones with large distant cash flows, would generally be expected to have relatively high vertical axis intercepts. The slope of the NPV profile depends entirely on the timing pattern of the cash flows--long-term projects have steeper NPV profiles than short-term ones. Thus, we conclude that NPV profiles can cross in two situations: (1) when mutually exclusive projects differ in scale (or size) and (2) when the projects' cash flows differ in terms of the timing pattern of their cash flows (as for franchises L and S).

**g. 2. What is the "reinvestment rate assumption", and how does it affect the NPV versus IRR conflict?**

**Answer:** The underlying cause of ranking conflicts is the reinvestment rate assumption. All DCF methods implicitly assume that cash flows can be reinvested at some rate, regardless of what is actually done with the cash flows. Discounting is the reverse of compounding. Since compounding assumes reinvestment, so does discounting. NPV and IRR are both found by discounting, so they both implicitly assume some discount rate. Inherent in the NPV calculation is the assumption that cash flows can be reinvested at the project's cost of capital, while the IRR calculation assumes reinvestment at the IRR rate.

**g. 3. Which method is the best? Why?**

**Answer:** Whether NPV or IRR gives better rankings depends on which has the better reinvestment rate assumption. Normally, the NPV's assumption is better. The reason is as follows: a project's cash inflows are generally used as substitutes for outside capital, that is, projects' cash flows replace outside capital and, hence, save the firm the cost of outside capital. Therefore, in an opportunity cost sense, a project's cash flows are reinvested at the cost of capital. To see this graphically, think of the following situation: assume the firm's cost of capital is a constant 10% within the relevant range of financing considered, and it has projects available as shown in the graph below:



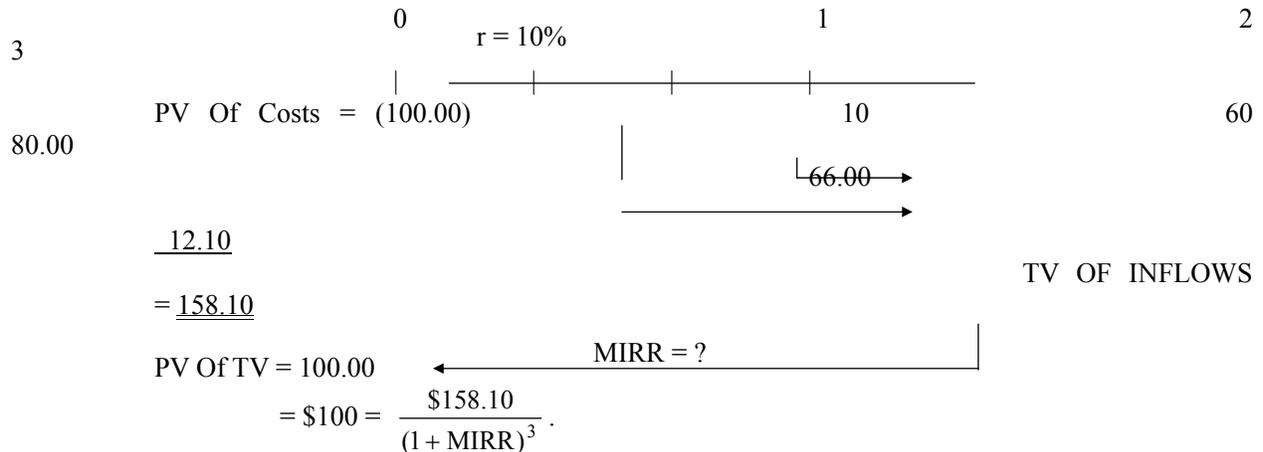
What projects will be accepted, by either NPV or IRR? Projects A, B, C, and D.

If the same situation exists year after year, at what rate of return will cash flows from earlier years' investments be reinvested? Capital budgeting decisions are made in this sequence: (1) the company would say, "we can take on A, B, C, and D and finance them with 10% money, so let's do it." (2) then, it would get cash flows from earlier years' projects. What would it do with those cash flows? It would use them in lieu of raising money that costs 10%, so it would save 10%. Therefore, 10% is the opportunity cost of the cash flows. In effect, cash flows are reinvested at the 10% cost of capital.

Note, however, that NPV and IRR always give the same accept/reject decisions for independent projects, so IRR can be used just as well as NPV when independent projects are being evaluated. The NPV versus IRR conflict arises only if mutually exclusive projects are involved.

**h. 1. Define the term Modified IRR (MIRR). Find the MIRRs for franchises L and S.**

**Answer:** MIRR is that discount rate which equates the present value of the terminal value of the inflows, compounded at the cost of capital, to the present value of the costs. Here is the setup for calculating franchise L's modified IRR:



$$PV\ costs = \frac{TV}{(1 + MIRR)^n} = \sum_{t=0}^n \frac{COF_t}{(1 + r)^t} = \frac{\sum_{t=1}^n CIF_t (1 + r)^{n-t}}{(1 + MIRR)^n}$$

After you calculate the TV, enter  $n = 3$ ,  $PV = -100$ ,  $pmt = 0$ ,  $fv = 158.1$ , and then press  $i$  to get the answer,  $MIRR_L = 16.5\%$ . We could calculate  $MIRR_S$  similarly:  $= 16.9\%$ . Thus, franchise S is ranked higher than L. This result is consistent with the NPV decision.

**h. 2. What are the MIRR's advantages and disadvantages vis-a-vis the regular IRR? What are the MIRR's advantages and disadvantages vis-a-vis the NPV?**

**Answer:** MIRR is a better rate of return measure than IRR for two reasons: (1) it correctly assumes reinvestment at the project's cost of capital rather than at its IRR. (2) MIRR avoids the problem of multiple IRRs--there can be only one MIRR for a given project.

MIRR does not always lead to the same decision as NPV when mutually exclusive projects are being considered. In particular, small projects often have a higher MIRR, but a lower NPV, than larger projects. Thus, MIRR is not a perfect substitute for NPV, and NPV remains the single best decision rule. However, MIRR is superior to the regular IRR, and if a rate of return measure is needed, MIRR should be used.

Business executives agree. As noted in the text, business executives prefer to compare projects' rates of return to comparing their NPVs. This is an empirical fact. As a result, financial managers are substituting MIRR for IRR in their discussions with other corporate executives. This fact was brought out in the October 1989 FMA meetings, where executives from Du Pont, Hershey, and Ameritech, among others, all reported a switch from IRR to MIRR.

- i. As a separate project (project P), you are considering sponsoring a pavilion at the upcoming world's fair. The pavilion would cost \$800,000, and it is expected to result in \$5 million of incremental cash inflows during its 1 year of operation. However, it would then take another year, and \$5 million of costs, to demolish the site and return it to its original condition. Thus, project P's expected net cash flows look like this (in millions of dollars):

Year	Net Cash Flows
0	(\$0.8)
1	5.0
2	(5.0)

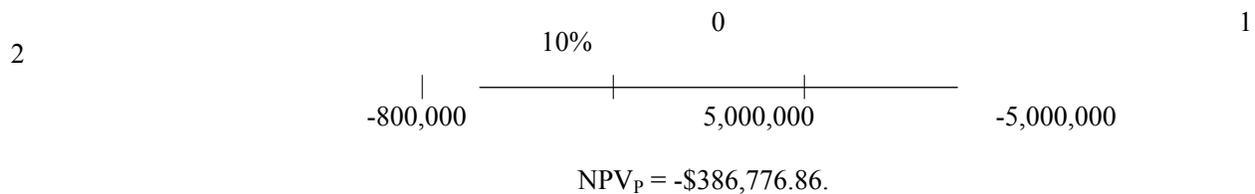
The project is estimated to be of average risk, so its cost of capital is 10 percent.

- i. 1. What are normal and nonnormal cash flows?

**Answer:** Normal cash flows begin with a negative cash flow (or a series of negative cash flows), switch to positive cash flows, and then remain positive. They have only one change in sign. (Note: normal cash flows can also start with positive cash flows, switch to negative cash flows, and then remain negative.) Nonnormal cash flows have more than one sign change. For example, they may start with negative cash flows, switch to positive, and then switch back to negative.

- i. 2. What is project P's NPV? What is its IRR? Its MIRR?

**Answer:** Here is the time line for the cash flows, and the NPV:



We can find the NPV by entering the cash flows into the cash flow register, entering  $i = 10$ , and then pressing the NPV button. However, calculating the IRR presents a problem. With the cash flows in the register, press the IRR button. An hp-10b financial calculator will give the message "error-soln." This means that project P has multiple IRRs. An HP-17B will ask for a guess. If you guess 10%, the calculator will produce IRR = 25%. If you guess a high number, such as 200%, it will produce the second IRR, 400%<sup>1</sup>. The MIRR of project P = 5.6%, and is found by computing the discount rate that equates the terminal value (\$5.5 million) to the present value of cost (\$4.93 million).

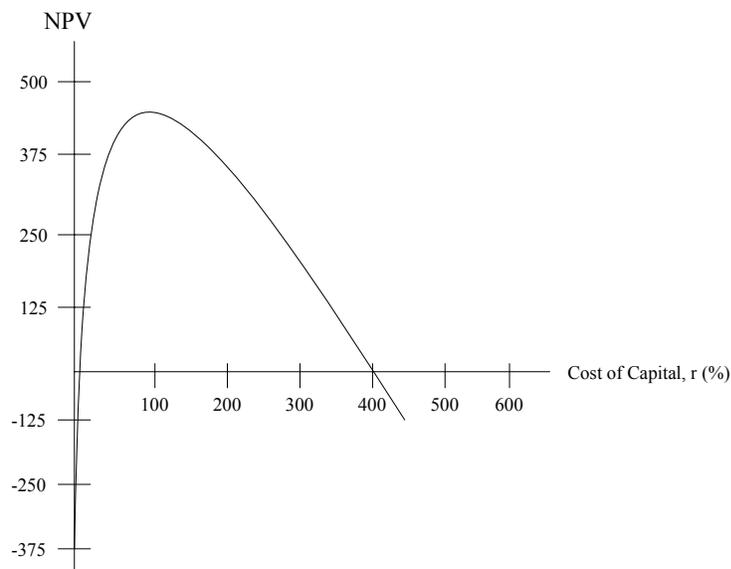
<sup>1</sup> Looking at the figure below, if you guess an IRR to the left of the peak NPV rate, the lower IRR will appear. If you guess IRR > peak NPV rate, the higher IRR will appear.

**i. 3. Draw project P's NPV profile. Does project P have normal or non-normal cash flows? Should this project be accepted?**

**Answer:** You could put the cash flows in your calculator and then enter a series of  $i$  values, get an NPV for each, and then plot the points to construct the NPV profile. We used a spreadsheet program to automate the process and then to draw the profile. Note that the profile crosses the  $x$ -axis twice, at 25% and at 400%, signifying two IRRs. Which IRR is correct? In one sense, they both are--both cause the project's NPV to equal zero. However, in another sense, both are wrong--neither has any economic or financial significance.

Project P has nonnormal cash flows; that is, it has more than one change of signs in the cash flows. Without this nonnormal cash flow pattern, we would not have the multiple IRRs.

Since project P's NPV is negative, the project should be rejected, even though both IRRs (25% and 400%) are greater than the project's 10 percent cost of capital. The MIRR of 5.6% also supports the decision that the project should be rejected.



j. In an unrelated analysis, you have the opportunity to choose between the following two mutually exclusive projects:

Year	Expected Net Cash Flows	
	Project S (\$100,000)	Project L (\$100,000)
0		
1	60,000	33,500
2	60,000	33,500
3	--	33,500
4	--	33,500

The projects provide a necessary service, so whichever one is selected is expected to be repeated into the foreseeable future. Both projects have a 10 percent cost of capital.

j. 1. What is each project's initial npv without replication?

**Answer:** The NPVs, found with a financial calculator, are calculated as follows:

Input the following:  $CF_0 = -100000$ ,  $CF_1 = 60000$ ,  $N_J = 2$ , AND  $I = 10$  to solve for  $NPV_S = \$4,132.23 \approx \$4,132$ .

Input the following:  $CF_0 = -100000$ ,  $CF_1 = 33500$ ,  $N_J = 4$ , AND  $I = 10$  to solve for  $NPV_L = \$6,190.49 \approx \$6,190$ .

However, if we make our decision based on the raw NPVs, we would be biasing the decision against the shorter project. Since the projects are expected to be replicated, if we initially choose project S, it would be repeated after 2 years. However, the raw NPVs do not reflect the replication cash flows.

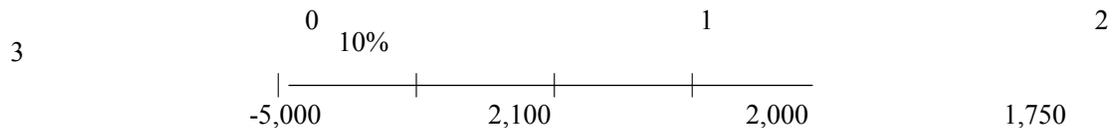


	Initial Investment	End-Of-Year
	<i>And Operating Net Salvage</i>	
Year	Cash Flows	Value
0	(\$5,000)	\$5,000
1	2,100	3,100
2	2,000	2,000
3	1,750	0

Using the 10 percent cost of capital, what is the project's NPV if it is operated for the full 3 years? Would the NPV change if the company planned to terminate the project at the end of year 2? At the end of year 1? What is the project's optimal (economic) life?

**Answer:** Here are the time lines for the 3 alternative lives:

No termination:

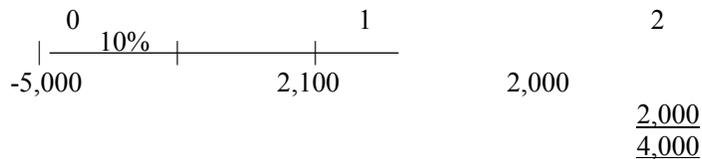


0

1,750

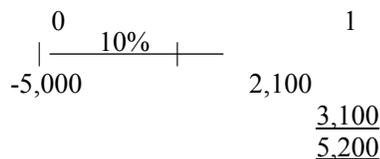
NPV = -\$123.

Terminate after 2 years:



NPV = \$215.

Terminate after 1 year:



NPV = -\$273.

We see (1) that the project is acceptable only if operated for 2 years, and (2) that a project's

engineering life does not always equal its economic life.

- 1. After examining all the potential projects, you discover that there are many more projects this year with positive NPVs than in a normal year. What two problems might this extra large capital budget cause?**

You only have a limited amount of capital to commit to projects. If you have to raise external capital to fund some of these other positive NPV projects, then you may be faced with an increasing cost of capital. This is called an increasing marginal cost of capital schedule, and it also happens to companies when they exhaust their internal sources of funds and have to go to external capital markets for their finding. This increased cost of capital may cause you to reject projects that you might otherwise accept because with your increased cost of capital, some projects may be negative NPV when they would otherwise be positive NPV in a normal year.

Another effect of this large capital budget is that you may choose to ration capital—i.e. not fund all of the projects. This is called capital rationing, and companies and investors do this when for whatever reason they put a cap on the funds they are willing to invest in new projects.

# Chapter 11

## Cash Flow Estimation and Risk Analysis

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 11-1
- a. Cash flow, which is the relevant financial variable, represents the actual flow of cash. Accounting income, on the other hand, reports accounting data as defined by Generally Accepted Accounting Principles (GAAP).
  - b. Incremental cash flows are those cash flows that arise solely from the asset that is being evaluated. For example, assume an existing machine generates revenues of \$1,000 per year and expenses of \$600 per year. A machine being considered as a replacement would generate revenues of \$1,000 per year and expenses of \$400 per year. On an incremental basis, the new machine would not increase revenues at all, but would decrease expenses by \$200 per year. Thus, the annual incremental cash flow is a before-tax savings of \$200. A sunk cost is one that has already occurred and is not affected by the capital project decision. Sunk costs are not relevant to capital budgeting decisions. Within the context of this chapter, an opportunity cost is a cash flow that a firm must forgo to accept a project. For example, if the project requires the use of a building that could otherwise be sold, the market value of the building is an opportunity cost of the project.
  - c. Net operating working capital changes are the increases in current operating assets resulting from accepting a project less the resulting increases in current operating liabilities, or accruals and accounts payable. A net operating working capital change must be financed just as a firm must finance its increases in fixed assets. Salvage value is the market value of an asset after its useful life. Salvage values and their tax effects must be included in project cash flow estimation.
  - d. The real rate of return ( $r_r$ ), or, for that matter the real cost of capital, contains no adjustment for expected inflation. If net cash flows from a project do not include inflation adjustments, then the cash flows should be discounted at the real cost of capital. In a similar manner, the IRR resulting from real net cash flows should be compared with the real cost of capital. Conversely, the nominal rate of return ( $r_n$ ) does include an inflation adjustment (premium). Thus if nominal rates of return are used in the capital budgeting process, the net cash flows must also be nominal.
  - e. Sensitivity analysis indicates exactly how much NPV will change in response to a given change in an input variable, other things held constant. Sensitivity analysis is sometimes called “what if” analysis because it answers this type of question. Scenario analysis is a shorter version of simulation analysis that uses only a few outcomes. Often the outcomes considered are optimistic, pessimistic and most likely. Monte Carlo simulation analysis is a risk analysis technique in which a computer is used to simulate probable future events and thus to estimate the profitability and risk of a project.
  - f. A risk-adjusted discount rate incorporates the riskiness of the project’s cash flows. The cost of capital to the firm reflects the average risk of the firm’s existing projects. Thus, new projects that are riskier than existing projects should have a higher risk-adjusted discount rate.

Conversely, projects with less risk should have a lower risk-adjusted discount rate. This adjustment process also applies to a firm's divisions. Risk differences are difficult to quantify, thus risk adjustments are often subjective in nature. A project's cost of capital is its risk-adjusted discount rate for that project.

- 11-2 Only cash can be spent or reinvested, and since accounting profits do not represent cash, they are of less fundamental importance than cash flows for investment analysis. Recall that in the stock valuation chapters we focused on dividends and free cash flows, which represent cash flows, rather than on earnings per share, which represent accounting profits.
- 11-3 Since the cost of capital includes a premium for expected inflation, failure to adjust cash flows means that the denominator, but not the numerator, rises with inflation, and this lowers the calculated NPV.
- 11-4 Capital budgeting analysis should only include those cash flows which will be affected by the decision. Sunk costs are unrecoverable and cannot be changed, so they have no bearing on the capital budgeting decision. Opportunity costs represent the cash flows the firm gives up by investing in this project rather than its next best alternative, and externalities are the cash flows (both positive and negative) to other projects that result from the firm taking on this project. These cash flows occur only because the firm took on the capital budgeting project; therefore, they must be included in the analysis.
- 11-5 When a firm takes on a new capital budgeting project, it typically must increase its investment in receivables and inventories, over and above the increase in payables and accruals, thus increasing its net operating working capital. Since this increase must be financed, it is included as an outflow in Year 0 of the analysis. At the end of the project's life, inventories are depleted and receivables are collected. Thus, there is a decrease in NOWC, which is treated as an inflow.
- 11-6 Simulation analysis involves working with continuous probability distributions, and the output of a simulation analysis is a distribution of net present values or rates of return. Scenario analysis involves picking several points on the various probability distributions and determining cash flows or rates of return for these points. Sensitivity analysis involves determining the extent to which cash flows change, given a change in one particular input variable. Simulation analysis is expensive. Therefore, it would more than likely be employed in the decision for the \$200 million investment in a satellite system than in the decision for the \$12,000 truck.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

11-1	Equipment	\$ 9,000,000
	NWC Investment	<u>3,000,000</u>
	Initial investment outlay	<u>\$12,000,000</u>
11-2	Operating Cash Flows: t = 1	
	Sales revenues	\$10,000,000
	Operating costs	7,000,000
	Depreciation	<u>2,000,000</u>
	Operating income before taxes	\$ 1,000,000
	Taxes (40%)	<u>400,000</u>
	Operating income after taxes	\$ 600,000
	Add back depreciation	<u>2,000,000</u>
	Operating cash flow	<u>\$ 2,600,000</u>
11-3	Equipment's original cost	\$20,000,000
	Depreciation (80%)	<u>16,000,000</u>
	Book value	<u>\$ 4,000,000</u>

Gain on sale = \$5,000,000 - \$4,000,000 = \$1,000,000.

Tax on gain = \$1,000,000(0.4) = \$400,000.

AT net salvage value = \$5,000,000 - \$400,000 = \$4,600,000.



50,702

85,628

With a financial calculator, input the appropriate cash flows into the cash flow register, input I = 12, and then solve for NPV = \$10,841.

- 11-5 a. The net cost is \$89,000:

Price	(\$70,000)	
Modification	(15,000)	
Change in NWC	<u>(4,000)</u>	
		<u>(\$89,000)</u>

- b. The operating cash flows follow:

		<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>
After-tax savings	\$15,000	\$15,000	\$15,000	
Depreciation shield	<u>11,220</u>	<u>15,300</u>	<u>5,100</u>	
Net cash flow		<u>\$26,220</u>	<u>\$30,300</u>	<u>\$20,100</u>

Notes:

1. The after-tax cost savings is  $\$25,000(1 - T) = \$25,000(0.6) = \$15,000$ .
  2. The depreciation expense in each year is the depreciable basis, \$85,000, times the MACRS allowance percentage of 0.33, 0.45, and 0.15 for Years 1, 2 and 3, respectively. Depreciation expense in Years 1, 2, and 3 is \$28,050, \$38,250, and \$12,750. The depreciation shield is calculated as the tax rate (40%) times the depreciation expense in each year.
- c. The additional end-of-project cash flow is \$24,380:

Salvage value	\$30,000	
Tax on SV*	(9,620)	
Return of NWC	<u>4,000</u>	
		<u>\$24,380</u>

\*Tax on SV =  $(\$30,000 - \$5,950)(0.4) = \$9,620$ .

Note that the remaining BV in Year 4 =  $\$85,000(0.07) = \$5,950$ .

- d. The project has an NPV of -\$6,705. Thus, it should not be accepted.

<u>Year</u>	<u>Net Cash Flow</u>	<u>PV @ 10%</u>
0	(\$89,000)	(\$89,000)
1	26,220	23,836
2	30,300	25,041
3	44,480	<u>33,418</u>
		NPV = <u>(\$ 6,705)</u>

Alternatively, with a financial calculator, input the following:  $CF_0 = -89000$ ,  $CF_1 = 26220$ ,  $CF_2 = 30300$ ,  $CF_3 = 44480$ , and  $I = 10$  to solve for  $NPV = -\$6,703.83$ .

11-6	a.	Sales = 1,000(\$138)	\$138,000
		Cost = 1,000(\$105)	<u>105,000</u>
		Net before tax	\$ 33,000
		Taxes (34%)	<u>11,220</u>
		Net after tax	<u>\$ 21,780</u>

Not considering inflation, NPV is  $-\$4,800$ . This value is calculated as

$$-\$150,000 + \frac{\$21,780}{0.15} = -\$4,800.$$

Considering inflation, the real cost of capital is calculated as follows:

$$\begin{aligned}(1 + r_r)(1 + i) &= 1.15 \\ (1 + r_r)(1.06) &= 1.15 \\ r_r &= 0.0849.\end{aligned}$$

Thus, the NPV considering inflation is calculated as

$$-\$150,000 + \frac{\$21,780}{0.0849} = \$106,537.$$

After adjusting for expected inflation, we see that the project has a positive NPV and should be accepted. This demonstrates the bias that inflation can induce into the capital budgeting process: Inflation is already reflected in the denominator (the cost of capital), so it must also be reflected in the numerator.

- b. If part of the costs were fixed, and hence did not rise with inflation, then sales revenues would rise faster than total costs. However, when the plant wears out and must be replaced, inflation will cause the replacement cost to jump, necessitating a sharp output price increase to cover the now higher depreciation charges.

$$\begin{aligned}11-7 \quad E(NPV) &= 0.05(-\$70) + 0.20(-\$25) + 0.50(\$12) + 0.20(\$20) + 0.05(\$30) \\ &= -\$3.5 + -\$5.0 + \$6.0 + \$4.0 + \$1.5 \\ &= \$3.0 \text{ million.}\end{aligned}$$

$$\begin{aligned}\sigma_{NPV} &= [0.05(-\$70 - \$3)^2 + 0.20(-\$25 - \$3)^2 + 0.50(\$12 - \$3)^2 \\ &\quad + 0.20(\$20 - \$3)^2 + 0.05(\$30 - \$3)^2]^{0.5} \\ &= \$23.622 \text{ million.}\end{aligned}$$

$$CV = \frac{\$23.622}{\$3.0} = 7.874.$$

11-8 a. Expected annual cash flows:

Project A:	<u>Probability</u>	×	<u>Cash Flow</u>	=	<u>Cash Flow</u>	Probable
	0.2		\$6,000			\$1,200
	0.6		6,750			4,050
	0.2		7,500			<u>1,500</u>
Expected annual cash flow = <u>\$6,750</u>						

Project B:	<u>Probability</u>	×	<u>Cash Flow</u>	=	<u>Cash Flow</u>	Probable
	0.2		\$ 0			\$ 0
	0.6		6,750			4,050
	0.2		18,000			<u>3,600</u>
Expected annual cash flow = <u>\$7,650</u>						

Coefficient of variation:

$$CV = \frac{\text{Standard deviation}}{\text{Expected value}} = \frac{\sigma_{NPV}}{\text{Expected NPV}}$$

Project A:

$$\sigma_A = \sqrt{(-\$750)^2(0.2) + (\$0)^2(0.6) + (\$750)^2(0.2)} = \$474.34.$$

Project B:

$$\begin{aligned} \sigma_B &= \sqrt{(-\$7,650)^2(0.2) + (-\$900)^2(0.6) + (\$10,350)^2(0.2)} \\ &= \$5,797.84. \end{aligned}$$

$$CV_A = \$474.34/\$6,750 = 0.0703.$$

$$CV_B = \$5,797.84/\$7,650 = 0.7579.$$

- b. Project B is the riskier project because it has the greater variability in its probable cash flows, whether measured by the standard deviation or the coefficient of variation. Hence, Project B is evaluated at the 12 percent cost of capital, while Project A requires only a 10 percent cost of capital.

Project A: With a financial calculator, input the appropriate cash flows into the cash flow register, input I = 10, and then solve for NPV = \$10,036.25.

Project B: With a financial calculator, input the appropriate cash flows into the cash flow register, input I = 12, and then solve for NPV = \$11,624.01.

Project B has the higher NPV; therefore, the firm should accept Project B.

- c. The portfolio effects from Project B would tend to make it less risky than otherwise. This would tend to reinforce the decision to accept Project B. Again, if Project B were negatively correlated with the GDP (Project B is profitable when the economy is down), then it is less risky and Project B's acceptance is reinforced.

- 11-9 a. First, note that with symmetric probability distributions, the middle value of each distribution is the expected value. Therefore,

	<u>Expected Values</u>
Sales (units)	200
Sales price	\$13,500
Sales in dollars	\$2,700,000
Costs (200 x \$6,000)	<u>1,200,000</u>
Earnings before taxes	\$1,500,000
Taxes (40%)	<u>600,000</u>
Net income	\$ 900,000 =Cash flow under the assumption used in the problem.

$$0 = \sum_{t=1}^8 \frac{\$900,000}{(1 + \text{IRR})^t} - \$4,000,000.$$

Using a financial calculator, input the following:  $CF_0 = -4000000$ ,  $CF_1 = 900000$ , and  $N_j = 8$ , to solve for  $\text{IRR} = 15.29\%$ .

$$\text{Expected IRR} = 15.29\% \approx 15.3\%.$$

Assuming complete independence between the distributions, and normality, it would be possible to derive  $\sigma_{\text{IRR}}$  statistically. Alternatively, we could employ simulation to develop a distribution of IRRs, hence  $\sigma_{\text{IRR}}$ . There is no easy way to get  $\sigma_{\text{IRR}}$ .

- b.  $\text{NPV} = \$900,000(\text{PVIFA}_{15\%,8}) - \$4,000,000.$

Using a financial calculator, input the following:  $CF_0 = -4000000$ ,  $CF_1 = 900000$ ,  $N_j = 8$ , and  $I = 15$  to solve for  $\text{NPV} = \$38,589.36$ . Again, there is no easy way to estimate  $\sigma_{\text{NPV}}$ .

- c. (1) a. Calculate developmental costs. The 44 random number value, coming between 30 and 70, indicates that the costs for this run should be taken to be \$4 million.
- b. Calculate the project life. The 17, being less than 20, indicates that a 3-year life should be used.
- (2) a. Estimate unit sales. The 16 indicates sales of 100 units.
- b. Estimate the sales price. The 58 indicates a sales price of \$13,500.
- c. Estimate the cost per unit. The 1 indicates a cost of \$5,000.
- d. Now estimate the after-tax cash flow for Year 1. It is

$$[100(\$13,500) - 100(\$5,000)](1 - 0.4) = \$510,000 = CF_1.$$

- (3) Repeat the process for Year 2. Sales will be 200 with a random number of 79; the price will be \$13,500 with a random number of 83; and the cost will be \$7,000 with a random

number of 86:

$$[200(\$13,500) - 200(\$7,000)](0.6) = \$780,000 = CF_2.$$

- (4) Repeat the process for Year 3. Sales will be 100 units with a random number of 19; the price will be \$13,500 with a random number of 62; and the cost will be \$5,000 with a random number of 6:

$$[100(\$13,500) - 100(\$5,000)](0.6) = \$510,000 = CF_3.$$

(5) a. 
$$0 = \frac{\$510,000}{(1 + \text{IRR})^1} + \frac{\$780,000}{(1 + \text{IRR})^2} + \frac{\$510,000}{(1 + \text{IRR})^3} - \$4,000,000$$
  
IRR = -31.55%.

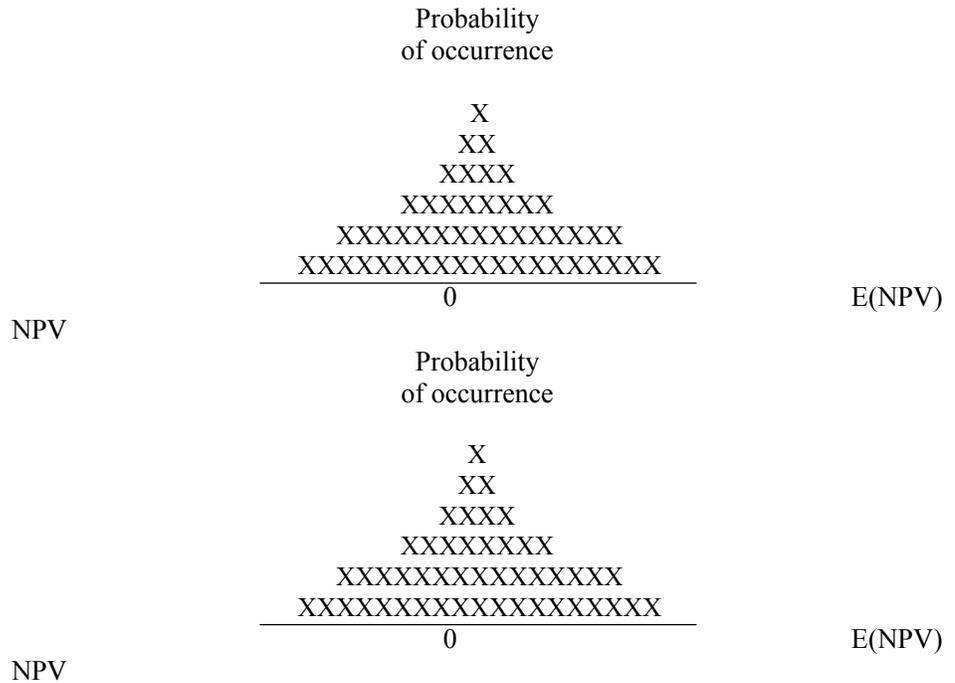
Alternatively, with a financial calculator, input the following:  $CF_0 = -4000000$ ,  $CF_1 = 510000$ ,  $CF_2 = 780000$ ,  $CF_3 = 510000$ , and solve for IRR = -31.55%.

b. 
$$\text{NPV} = \frac{\$510,000}{(1.15)^1} + \frac{\$780,000}{(1.15)^2} + \frac{\$510,000}{(1.15)^3} - \$4,000,000.$$

With a financial calculator, input the following:  $CF_0 = -4000000$ ,  $CF_1 = 510000$ ,  $CF_2 = 780000$ ,  $CF_3 = 510000$ , and  $I = 15$  to solve for NPV = -\$2,631,396.40.

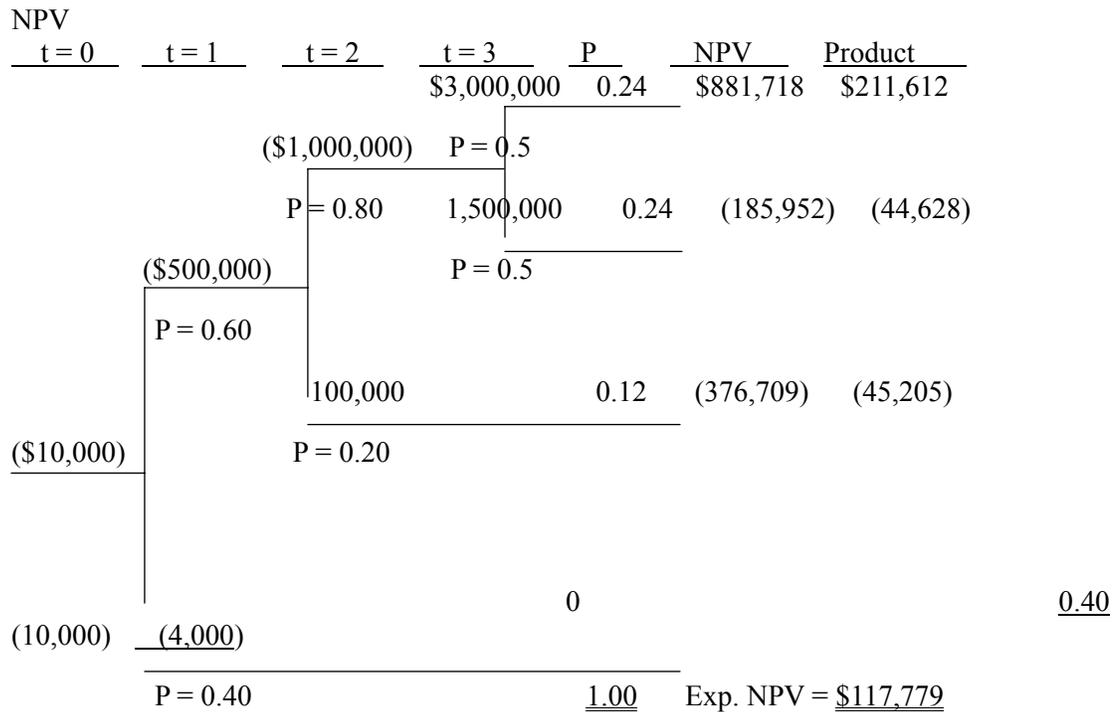
The results of this run are very bad because the project's life is so short. Had the life turned out (by chance) to be 13 years, the longest possible life, the IRR would have been about 25%, and the NPV would have been about \$1 million.

(6) & (7) The computer would store  $\sigma_{NPVs}$  and  $\sigma_{IRR_s}$  for the different trials, then display them as frequency distributions:



The distribution would be reasonably symmetrical because all the input data were from symmetrical distributions. One often finds, however, that the input and output distributions are badly skewed. The frequency values would also be used to calculate  $\sigma_{NPV}$  and  $\sigma_{IRR}$ ; these values would be printed out and available for analysis.

11-10 a. The resulting decision tree is:



The NPV of the top path is:

$$\frac{\$3,000,000}{(1.12)^3} - \frac{\$1,000,000}{(1.12)^2} - \frac{\$500,000}{(1.12)^1} - \$10,000 = \$881,718.$$

Using a financial calculator, input the following:  $CF_0 = -10000$ ,  $CF_1 = -500000$ ,  $CF_2 = -1000000$ ,  $CF_3 = 3000000$ , and  $I = 12$  to solve for  $NPV = \$881,718.29 \approx \$881,718$ .

**The other NPVs were determined in the same manner. If the project is of average risk, it should be accepted because the expected NPV of the total project is positive.**

$$\begin{aligned} \text{b. } \sigma_{NPV}^2 &= 0.24(\$881,718 - \$117,779)^2 + 0.24(-\$185,952 - \$117,779)^2 \\ &\quad + 0.12(-\$376,709 - \$117,779)^2 + 0.4(-\$10,000 - \$117,779)^2 \\ &= 198,078,470,853. \end{aligned}$$

$$\sigma_{NPV} = \$445,060.$$

$$CV_{NPV} = \frac{\$445,060}{\$117,779} = 3.78.$$

Since the CV is 3.78 for this project, while the firm's average project has a CV of 1.0 to 2.0, this project is of high risk.

## **SOLUTION TO SPREADSHEET PROBLEM**

- 11-11 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 11 P11 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

Shrieves Casting Company is considering adding a new line to its product mix, and the capital budgeting analysis is being conducted by Sidney Johnson, a recently graduated MBA. The production line would be set up in unused space in Shrieves' main plant. The machinery's invoice price would be approximately \$200,000; another \$10,000 in shipping charges would be required; and it would cost an additional \$30,000 to install the equipment. The machinery has an economic life of 4 years, and Shrieves has obtained a special tax ruling which places the equipment in the MACRS 3-year class. The machinery is expected to have a salvage value of \$25,000 after 4 years of use.

THE NEW LINE WOULD GENERATE INCREMENTAL SALES OF 1,250 UNITS PER YEAR FOR FOUR YEARS AT AN INCREMENTAL COST OF \$100 PER UNIT IN THE FIRST YEAR, EXCLUDING DEPRECIATION. EACH UNIT CAN BE SOLD FOR \$200 IN THE FIRST YEAR. THE SALES PRICE AND COST ARE EXPECTED TO INCREASE BY 3% PER YEAR DUE TO INFLATION. FURTHER, TO HANDLE THE NEW LINE, THE FIRM'S NET OPERATING WORKING CAPITAL WOULD HAVE TO INCREASE BY AN AMOUNT EQUAL TO 12% OF SALES REVENUES. THE FIRM'S TAX RATE IS 40 PERCENT, AND ITS OVERALL WEIGHTED AVERAGE COST OF CAPITAL IS 10 PERCENT.

a. Define "incremental cash flow."

**Answer:** This is the firm's cash flow with the project minus the firm's cash flow without the project.

a. 1. Should you subtract interest expense or dividends when calculating project cash flow?

**Answer:** The cash flow statement should not include interest expense or dividends. The return required by the investors furnishing the capital is already accounted for when we apply the 10 percent cost of capital discount rate, hence including financing flows would be "double counting." Put another way, if we deducted capital costs in the table, and thus reduced the bottom line cash flows, and then discounted those CFS by the cost of capital, we would, in effect, be subtracting capital costs twice.

a. 2. Suppose the firm had spent \$100,000 last year to rehabilitate the production line site. Should this cost be included in the analysis? Explain.

**Answer:** The \$100,000 cost to rehabilitate the production line site was incurred last year, and presumably also expensed for tax purposes. Since, it is a sunk cost, it should not be included in the analysis.

a. 3. Now assume that the plant space could be leased out to another firm at \$25,000 a year. Should this be included in the analysis? If so, how?

**Answer:** If the plant space could be leased out to another firm, then if Shrieves accepts this project, it would forgo the opportunity to receive \$25,000 in annual cash flows. This represents an

opportunity cost to the project, and it should be included in the analysis. Note that the opportunity cost cash flow must be net of taxes, so it would be a  $\$25,000(1 - t) = \$25,000(0.6) = \$15,000$  annual outflow.

**a. 4. Finally, assume that the new product line is expected to decrease sales of the firm's other lines by \$50,000 per year. Should this be considered in the analysis? If so, how?**

**Answer:** If a project affects the cash flows of another project, this is an "externality" which must be considered in the analysis. If the firm's sales would be reduced by \$50,000, then the net cash flow loss would be a cost to the project. Note that this annual loss would not be the full \$50,000, because Shrieves would save on cash operating costs if its sales dropped. Note also that externalities can be positive as well as negative.

**b. Disregard the assumptions in part a. What is Shrieves' depreciable basis?**

**Answer:** Get the depreciation rates from table 11-2 in the book. Note that because of the half-year convention, a 3-year project is depreciated over 4 calendar years:

<u>YEAR</u>	<u>RATE</u>	×	<u>BASIS</u>	=	<u>DEPRECIATION</u>
1	0.33		\$240		\$ 79
2	0.45		240		108
3	0.15		240		36
4	0.07		240		17
					<u>\$240</u>

**c. Calculate the annual sales revenues and costs (other than depreciation). Why is it important to include inflation when estimating cash flows?**

**Answer:** With an inflation rate of 3%, the annual revenues and costs are:

	Year 1	Year 2	Year 3	Year 4
Units	1250	1250	1250	1250
Unit Price	\$200.00	\$206.00	\$212.18	\$218.55
Unit Cost	\$100.00	\$103.00	\$106.09	\$109.27
Sales	\$250,000	\$257,500	\$265,225	\$273,188
Costs	\$125,000	\$128,750	\$132,613	\$136,588

The cost of capital is a nominal cost; i.e., it includes a premium for inflation. In other words, it is larger than the real cost of capital. Similarly, nominal cash flows (those that are inflated) are larger than real cash flows. If you discount the low, real cash flows with the high, nominal rate, then the resulting NPV is too low. Therefore, you should always discount nominal cash flows with a nominal rate, and real cash flows with a real rate. In theory, you could do either way and get the correct answer. However, there is no accurate way to convert a nominal cost of capital to a real cost. Therefore, you should inflate cash flows and then discount at the nominal rate.

**c. Calculate the annual sales revenues and costs (other than depreciation). Why is it important to include inflation when estimating cash flows?**

**Answer:** With an inflation rate of 3%, the annual revenues and costs are:

Here are the annual operating cash flows (in thousands of dollars):

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Net Revenues	\$125	\$125	\$125	\$125
Depreciation	<u>79</u>	<u>108</u>	<u>36</u>	<u>17</u>
Before-Tax Income	\$ 46	\$ 17	\$ 89	\$108
Taxes (40%)	<u>18</u>	<u>7</u>	<u>36</u>	<u>43</u>
Net Income	\$ 28	\$ 10	\$ 53	\$ 65
Plus Depreciation	<u>79</u>	<u>108</u>	<u>36</u>	<u>17</u>
Net Operating CF	<u>\$107</u>	<u>\$118</u>	<u>\$ 89</u>	<u>\$ 82</u>

**d. Construct annual incremental operating cash flow statements.**

**Answer:**

	Year 1	Year 2	Year 3	Year 4
Sales	\$250,000	\$257,500	\$265,225	\$273,188
Costs	\$125,000	\$128,750	\$132,613	\$136,588
Depreciation	<u>\$79,200</u>	<u>\$108,000</u>	<u>\$36,000</u>	<u>\$16,800</u>
Op. EBIT	\$45,800	\$20,750	\$96,612	\$119,800
Taxes (40%)	<u>\$18,320</u>	<u>\$8,300</u>	<u>\$38,645</u>	<u>\$47,920</u>
NOPAT	\$27,480	\$12,450	\$57,967	\$71,880
Depreciation	<u>\$79,200</u>	<u>\$108,000</u>	<u>\$36,000</u>	<u>\$16,800</u>
Net Operating CF	<u>\$106,680</u>	<u>\$120,450</u>	<u>\$93,967</u>	<u>\$88,680</u>

**e. Estimate the required net operating working capital for each year, and the cash flow due to investments in net operating working capital.**

**Answer:** The project requires a level of net operating working capital in the amount equal to 12% of the next year's sales. Any increase in NOWC is a negative cash flow, and any decrease is a positive cash flow.

	Year 0	Year 1	Year 2	Year 3	Year 4
Sales		\$250,000	\$257,500	\$265,225	\$273,188
NOWC (% of sales)	\$30,000	\$30,900	\$31,827	\$32,783	\$0
CF due to NOWC)	(\$30,000)	(\$900)	(\$927)	(\$956)	\$32,783

**f. Calculate the after-tax salvage cash flow.**

**Answer:** When the project is terminated at the end of year 4, the equipment can be sold for \$25,000. But, since it has been depreciated to a \$0 book value, taxes must be paid on the full salvage value. For this project, the after-tax salvage cash flow is:

Salvage Value	\$25,000
Tax On Salvage Value	<u>(10,000)</u>
Net After-Tax Salvage Cash Flow	<u>\$15,000</u>

**g. Calculate the net cash flows for each year? Based on these cash flows, what are the project's NPV, IRR, MIRR, and payback? Do these indicators suggest that the project should be undertaken?**

**Answer:** The net cash flows are:

	Year 0	Year 1	Year 2	Year 3	Year 4
Initial Outlay	(\$240,000)				
Operating Cash Flows		\$106,680	\$120,450	\$93,967	\$88,680
CF Due To NOWC	(\$30,000)	(\$900)	(\$927)	(\$956)	\$32,783
Salvage Cash Flows					\$15,000
Net Cash Flows	(\$270,000)	\$105,780	\$119,523	\$93,011	\$136,463

NPV =	\$88,030
IRR =	23.9%
MIRR =	18.0%
Payback =	2.5

**h. What does the term "risk" mean in the context of capital budgeting, to what extent can risk be quantified, and when risk is quantified, is the quantification based primarily on statistical analysis of historical data or on subjective, judgmental estimates?**

**Answer:** Risk throughout finance relates to uncertainty about future events, and in capital budgeting, this means the future profitability of a project. For certain types of projects, it is possible to look back at historical data and to statistically analyze the riskiness of the investment. This is often true when the investment involves an expansion decision; for example, if Sears were opening a new store, if Citibank were opening a new branch, or if GM were expanding its Chevrolet plant, then past experience could be a useful guide to future risk. Similarly, a company that is considering going into a new business might be able to look at historical data on existing firms in that industry to get an idea about the riskiness of its proposed investment. However, there are times when it is impossible to obtain historical data regarding proposed investments; for example, if GM were considering the development of an electric auto, not much relevant historical data for assessing the riskiness of the project would be available. Rather, GM would have to rely primarily on the judgment of its executives, and they, in turn would have to rely on their experience in developing, manufacturing, and marketing new products. We will try to quantify risk analysis, but you must

recognize at the outset that some of the data used in the analysis will necessarily be based on subjective judgments rather than on hard statistical observations.

- |  |
|--|
| <p><b>i. 1. What are the three types of risk that are relevant in capital budgeting?</b></p> <p><b>2. How is each of these risk types measured, and how do they relate to one another?</b></p> |
|--|

**Answer:** Here are the three types of project risk:

- Stand-alone risk is the project's total risk if it were operated independently. Stand-alone risk ignores both the firm's diversification among projects and investors' diversification among firms. Stand-alone risk is measured either by the project's standard deviation of NPV ( $\sigma_{NPV}$ ) or its coefficient of variation of NPV ( $CV_{NPV}$ ). Note that other profitability measures, such as IRR and MIRR, can also be used to obtain stand-alone risk estimates.
- Within-firm risk is the total riskiness of the project giving consideration to the firm's other projects, that is, to diversification within the firm. It is the contribution of the project to the firm's total risk, and it is a function of (a) the project's standard deviation of NPV and (b) the correlation of the projects' returns with those of the rest of the firm. Within-firm risk is often called corporate risk, and it is measured by the project's corporate beta, which is the slope of the regression line formed by plotting returns on the project versus returns on the firm.
- Market risk is the riskiness of the project to a well-diversified investor, hence it considers the diversification inherent in stockholders' portfolios. It is measured by the project's market beta, which is the slope of the regression line formed by plotting returns on the project versus returns on the market.

- |   |
|---|
| <p><b>i. 3. How is each type of risk used in the capital budgeting process?</b></p> |
|---|

**Answer:** Because management's primary goal is shareholder wealth maximization, the most relevant risk for capital projects is market risk. However, creditors, customers, suppliers, and employees are all affected by a firm's total risk. Since these parties influence the firm's profitability, a project's within-firm risk should not be completely ignored.

**Unfortunately, by far the easiest type of risk to measure is a project's stand-alone risk. Thus, firms often focus on this type of risk when making capital budgeting decisions. However, this focus does not necessarily lead to poor decisions, because most projects that a firm undertakes are in its core business. In this situation, a project's stand-alone risk is likely to be highly correlated with its within-firm risk, which in turn is likely to be highly correlated with its market risk.**

**j. 1. What is sensitivity analysis?**

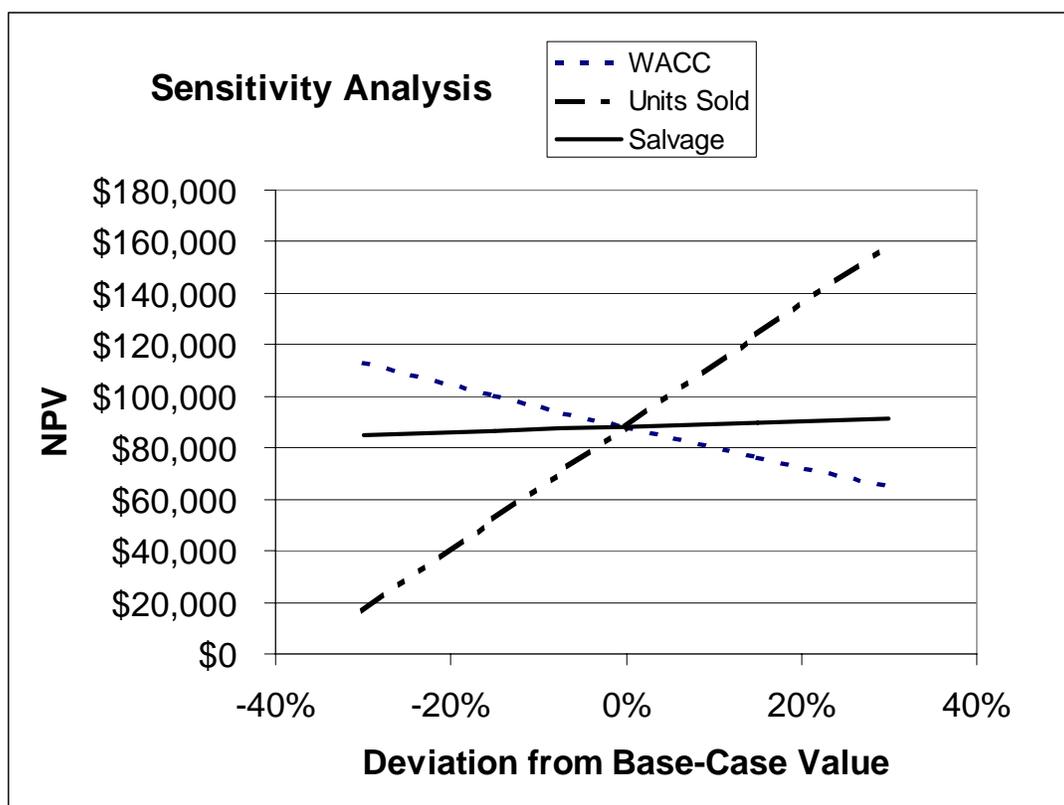
**Answer:** Sensitivity analysis measures the effect of changes in a particular variable, say revenues, on a project's NPV. To perform a sensitivity analysis, all variables are fixed at their expected values except one. This one variable is then changed, often by specified percentages, and the resulting effect on NPV is noted. (One could allow more than one variable to change, but this then merges sensitivity analysis into scenario analysis.)

**j. 2. Perform a sensitivity analysis on the unit sales, salvage value, and cost of capital for the project. Assume that each of these variables can vary from its base case, or expected, value by plus and minus 10, 20, and 30 percent. Include a sensitivity diagram, and discuss the results.**

**Answer:** The sensitivity data are given here in tabular form (in thousands of dollars):

Deviation From Base Case	NPV Deviation From Base Case		
	WACC	Units Sold	Salvage
-30%	\$113,288	\$16,668	\$84,956
-15%	\$100,310	\$52,348	\$86,493
0%	\$88,030	\$88,030	\$88,030
15%	\$76,398	\$123,711	\$89,567
30%	\$65,371	\$159,392	\$91,103
Range	47,916	176,060	6,147

We generated these data with a spreadsheet model in the file ch 11 mini case.xls.



- A. The sensitivity lines intersect at 0% change and the base case NPV, \$81,573. Since all other variables are set at their base case, or expected values, the zero change situation is the base case.
- B. The plots for unit sales and salvage value are upward sloping, indicating that higher variable values lead to higher NPVs. Conversely, the plot for cost of capital is downward sloping, because a higher cost of capital leads to a lower NPV.
- C. The plot of unit sales is much steeper than that for salvage value. This indicates that NPV is more sensitive to changes in unit sales than to changes in salvage value.
- D. Steeper sensitivity lines indicate greater risk. Thus, in comparing two projects, the one with the steeper lines is considered to be riskier.

**j. 3. What is the primary weakness of sensitivity analysis? What is its primary usefulness?**

**Answer:** The two primary disadvantages of sensitivity analysis are (1) that it does not reflect the effects of diversification and (2) that it does not incorporate any information about the possible magnitudes of the forecast errors. Thus, a sensitivity analysis might indicate that a project's NPV is highly sensitive to the sales forecast, hence that the project is quite risky, but if the project's sales, hence its revenues, are fixed by a long-term contract, then sales variations may actually contribute little to the project's risk. It also ignores any relationships between variables, such as unit sales and sales price.

**Therefore, in many situations, sensitivity analysis is not a particularly good indicator of risk. However, sensitivity analysis does identify those variables which potentially have the greatest impact on profitability, and this helps management focus its attention on those variables that are probably most important.**

**k. Assume that Sidney Johnson is confident of her estimates of all the variables that affect the project's cash flows except unit sales and sales price: if product acceptance is poor, unit sales would be only 900 units a year and the unit price would only be \$160; a strong consumer response would produce sales of 1,600 units and a unit price of \$240. Sidney believes that there is a 25 percent chance of poor acceptance, a 25 percent chance of excellent acceptance, and a 50 percent chance of average acceptance (the base case).**

**k. 1. What is scenario analysis?**

**Answer:** Scenario analysis examines several possible situations, usually worst case, most likely case, and best case. It provides a range of possible outcomes.

**k. 2. What is the worst-case NPV? The best-case NPV?**

**k. 3. Use the worst-, most likely, and best-case NPVs and probabilities of occurrence to find the project's expected NPV, standard deviation, and coefficient of variation.**

**Answer:** We used a spreadsheet model to develop the scenarios (in thousands of dollars), which are summarized below:

Scenario	Probability	Unit Sales	Unit Price	NPV
Best Case	25%	1600	\$240	\$278,965
Base Case	50%	1250	\$200	\$88,030
Worst Case	25%	900	\$160	(\$48,514)

Expected NPV = \$101,628

Standard Deviation = \$116,577

Coefficient Of Variation =  
Std Dev / Expected NPV = 1.15

**l. Are there problems with scenario analysis? Define simulation analysis, and discuss its principal advantages and disadvantages.**

**Answer:** Scenario analysis examines several possible scenarios, usually worst case, most likely case, and best case. Thus, it usually considers only 3 possible outcomes. Obviously the world is much more complex, and most projects have an almost infinite number of possible outcomes.

Simulation analysis is a type of scenario analysis which uses a relatively powerful financial planning software such as interactive financial planning system (IFPs) or @risk (a spreadsheet add-in). Simple simulations can also be conducted with other spreadsheet add-ins, such as Simtools. Here the uncertain cash flow variables (such as unit sales) are entered as continuous probability distribution parameters rather than as point values. Then, the computer uses a random number generator to select values for the uncertain variables on the basis of their designated distributions. Once all of the variable values have been selected, they are combined, and an NPV is calculated. The process is repeated many times, say 1,000, with new values selected from the distributions for each run. The end result is a probability distribution of NPV based on a sample of 1,000 values. The software can graph the distribution as well as print out summary statistics such as expected NPV and  $\sigma_{NPV}$ . Simulation provides the decision maker with a better idea of the profitability of a project than does scenario analysis because it incorporates many more possible outcomes.

**Although simulation analysis is technically refined, its usefulness is limited because managers are often unable to accurately specify the variables' probability distributions. Further, the correlations among the uncertain variables must be specified, along with the correlations over time. If managers are unable to do this with much confidence, then the results of simulation analyses are of limited value.**

**Recognize also that neither sensitivity, scenario, nor simulation analysis provides a decision rule--they may indicate that a project is relatively risky, but they do not indicate whether the project's expected return is sufficient to compensate for its risk.**

**Finally, remember that sensitivity, scenario, and simulation analyses all focus on stand-alone risk, which is not the most relevant risk in capital budgeting analysis.**

**m. 1. Assume that Shrieves' average project has a coefficient of variation in the range of 0.2 - 0.4. Would the new line be classified as high risk, average risk, or low risk? What type of risk is being measured here?**

**Answer:** The project has a CV of 0.57, which is above the average range of 0.2-0.4, so it falls into the high risk category. The CV measures a project's stand-alone risk-it is merely a measure of the variability of returns (as measured by NPV) about the expected return.

**m. 2. Shrieves typically adds or subtracts 3 percentage points to the overall cost of capital to adjust for risk. Should the new furniture line be accepted?**

**Answer:** Since the project is judged to have above-average risk, its differential risk-adjusted, or project, cost of capital would be 13 percent. At this discount rate, its NPV would be \$60,541, so it would still be acceptable. If it were a low risk project, its cost of capital would be 7 percent, its NPV would be \$104,975, and it would be an even more profitable project on a risk-adjusted basis.

<b>m. 3. Are there any subjective risk factors that should be considered before the final decision is made?</b>
---

**Answer:** A numerical analysis such as this one may not capture all of the risk factors inherent in the project. If the project has a potential for bringing on harmful lawsuits, then it might be riskier than first assessed. Also, if the project's assets can be redeployed within the firm or can be easily sold, then, as a result of "abandonment possibilities," the project may be less risky than the analysis indicates.

## Chapter 12

### Real Options

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

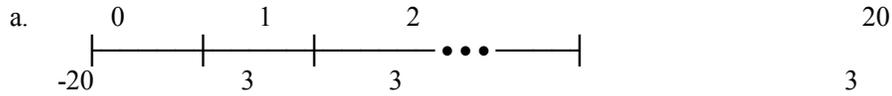
---

- 12-1 a. Real options occur when managers can influence the size and risk of a project's cash flows by taking different actions during the project's life. They are referred to as real options because they deal with real as opposed to financial assets. They are also called managerial options because they give opportunities to managers to respond to changing market conditions. Sometimes they are called strategic options because they often deal with strategic issues. Finally, they are also called embedded options because they are a part of another project.
- b. Investment timing options give companies the option to delay a project rather than implement it immediately. This option to wait allows a company to reduce the uncertainty of market conditions before it decides to implement the project. Capacity options allow a company to change the capacity of their output in response to changing market conditions. This includes the option to contract or expand production. Growth options allow a company to expand if market demand is higher than expected. This includes the opportunity to expand into different geographic markets and the opportunity to introduce complementary or second-generation products. It also includes the option to abandon a project if market conditions deteriorate too much.
- c. Decision trees are a form of scenario analysis in which different actions are taken in different scenarios.
- 12-2 Postponing the project means that cash flows come later rather than sooner; however, waiting may allow you to take advantage of changing conditions. It might make sense, however, to proceed today if there are important advantages to being the first competitor to enter a market.
- 12-3 Timing options make it less likely that a project will be accepted today. Often, if a firm can delay a decision, it can increase the expected NPV of a project.
- 12-4 Having the option to abandon a project makes it more likely that the project will be accepted today.

---

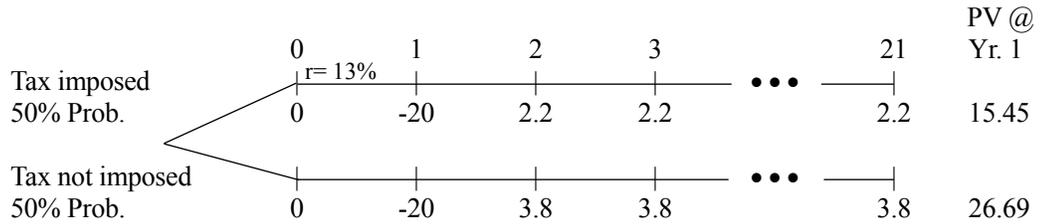
#### SOLUTIONS TO END-OF-CHAPTER PROBLEMS

12-1



NPV = \$1.074 million.

b. Wait 1 year:



Tax imposed: NPV @ Yr. 1 =  $(-20 + 15.45)/(1.13) = -4.027$

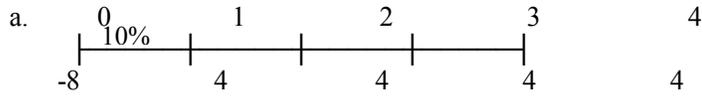
Tax not imposed: NPV @ Yr 1 =  $(-20 + 26.69)/(1.13) = 5.920$

Expected NPV =  $.5(-4.027) + .5(5.920) = 0.947$

Note though, that if the tax is imposed, the NPV of the project is negative and therefore would not be undertaken. The value of this option of waiting one year is evaluated as  $0.5(\$0) + (0.5)(\$ 5.920) = \$2.96$  million.

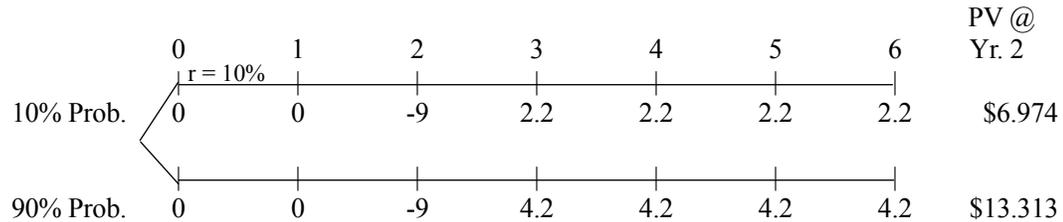
Since the NPV of waiting one year is greater than going ahead and proceeding with the project today, it makes sense to wait.

12-2



NPV = \$4.6795 million.

b. Wait 2 years:



**Low CF scenario:**  $NPV = (-9 + 6.974)/(1.1)^2 = -\$1.674$

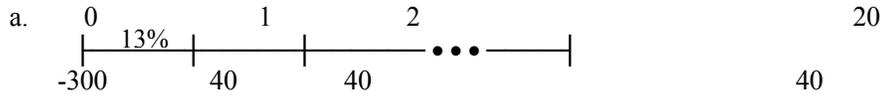
**High CF scenario:**  $NPV = (-9 + 13.313)/(1.1)^2 = \$3.564$

**Expected NPV** =  $.1(-1.674) + .9(3.564) = 3.040$

**If the cash flows are only \$2.2 million, the NPV of the project is negative and, thus, would not be undertaken. The value of the option of waiting two years is evaluated as  $0.10(\$0) + 0.90(\$3.564) = \$3.208$  million.**

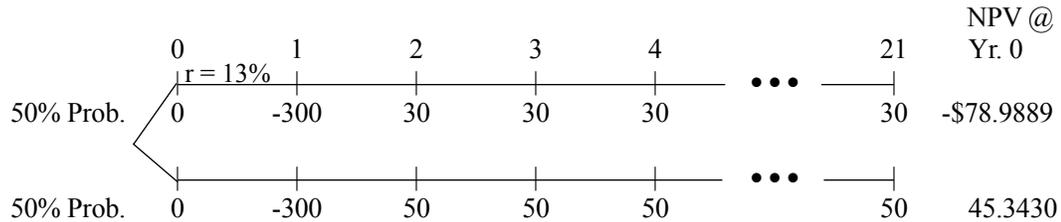
**Since the NPV of waiting two years is less than going ahead and proceeding with the project today, it makes sense to drill today.**

12-3

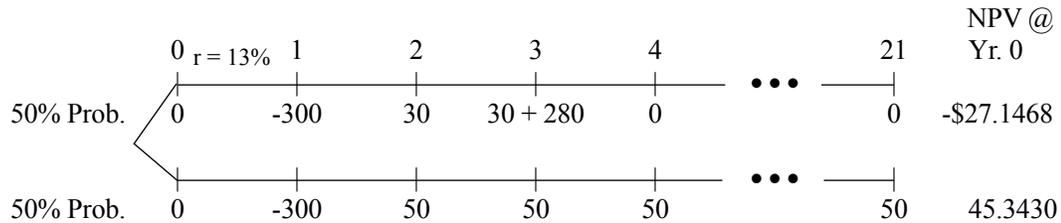


**NPV = -\$19.0099 million. Don't purchase.**

b. Wait 1 year:

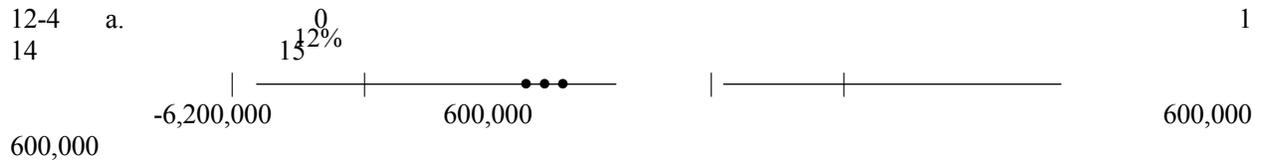


If the cash flows are only \$30 million per year, the NPV of the project is negative. However, we've not considered the fact that the company could then be sold for \$280 million. The decision tree would then look like this:

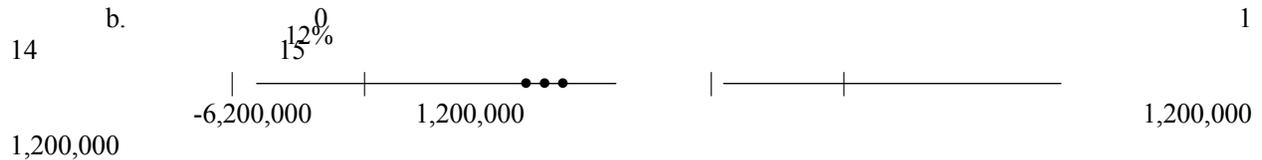


The expected NPV of waiting 1 year is  $0.5(-\$27.1468) + 0.5(\$45.3430) = \$9.0981$  million.

Given the option to sell, it makes sense to wait 1 year before deciding whether to make the acquisition.

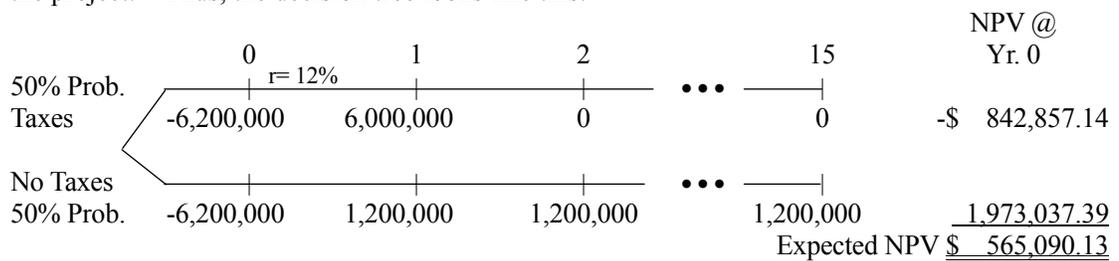


Using a financial calculator, input the following data:  $CF_0 = -6,200,000$ ;  $CF_{1-15} = 600,000$ ;  $I = 12$ ; and then solve for  $NPV = -\$2,113,481.31$ .

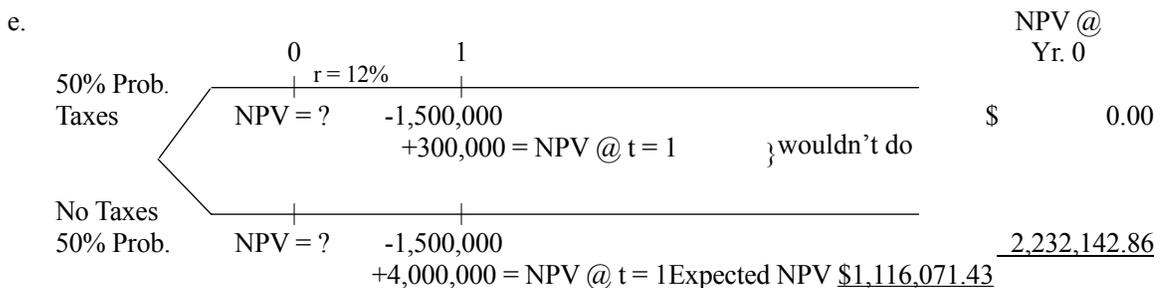


Using a financial calculator, input the following data:  $CF_0 = -6,200,000$ ;  $CF_{1-15} = 1,200,000$ ;  $I = 12$ ; and then solve for  $NPV = \$1,973,037.39$ .

- c. If they proceed with the project today, the project's expected  $NPV = (0.5 \times -\$2,113,481.31) + (0.5 \times \$1,973,037.39) = -\$70,221.96$ . So, Hart Enterprises would not do it.
- d. Since the project's  $NPV$  with the tax is negative, if the tax were imposed the firm would abandon the project. Thus, the decision tree looks like this:



Yes, the existence of the abandonment option changes the expected  $NPV$  of the project from negative to positive. Given this option the firm would take on the project because its expected  $NPV$  is  $\$565,090.13$ .



If the firm pays  $\$1,116,071.43$  for the option to purchase the land, then the  $NPV$  of the project is exactly equal to zero. So the firm would not pay any more than this for the option.

12-5 P = PV of all expected future cash flows if project is delayed. From Problem 15-3 we know that PV @ Year 1 of Tax Imposed scenario is \$15.45 and PV @ Year 1 of Tax Not Imposed Scenario is \$26.69. So the PV is:

$$P = [0.5(15.45) + 0.5(26.69)] / 1.13 = \$18.646.$$

$$X = \$20.$$

$$t = 1.$$

$$r_{RF} = 0.08.$$

$$\sigma^2 = 0.0687.$$

$$d_1 = \frac{\ln[18.646/20] + [0.08 + .5(0.0687)](1)}{(.0687)^{0.5} (1)^{0.5}} = 0.1688$$

$$d_2 = 0.1688 - (.0687)^{0.5} (1)^{0.5} = -0.0933$$

From Excel function NORMSDIST, or approximated from Table 13E-1 in Extension to Chapter 13:

$$N(d_1) = 0.5670$$

$$N(d_2) = 0.4628$$

Using the Black-Scholes Option Pricing Model, you calculate the option's value as:

$$\begin{aligned} V &= P[N(d_1)] - Xe^{-r_{RF}t} [N(d_2)] \\ &= \$18.646(0.5670) - \$20e^{(-0.08)(1)}(0.4628) \\ &= \$10.572 - \$8.544 \\ &= \$2.028 \text{ million.} \end{aligned}$$

- 12-6 P = PV of all expected future cash flows if project is delayed. From Problem 13-4 we know that PV @ Year 2 of Low CF Scenario is \$6.974 and PV @ Year 2 of High CF Scenario is \$13.313. So the PV is:

$$P = [0.1(6.974) + 0.9(13.313)] / 1.10^2 = \$10.479.$$

$$X = \$9.$$

$$t = 2.$$

$$r_{RF} = 0.06.$$

$$\sigma^2 = 0.0111.$$

$$d_1 = \frac{\ln[10.479/9] + [0.06 + .5(.0111)](2)}{(.0111)^{0.5} (2)^{0.5}} = 1.9010$$

$$d_2 = 1.9010 - (.0111)^{0.5} (2)^{0.5} = 1.7520$$

From Excel function NORMSDIST, or approximated from Table 12E-1 in Extension to Chapter 12:

$$N(d_1) = 0.9713$$

$$N(d_2) = 0.9601$$

Using the Black-Scholes Option Pricing Model, you calculate the option's value as:

$$\begin{aligned} V &= P[N(d_1)] - Xe^{-r_{RF}t} [N(d_2)] \\ &= \$10.479(0.9713) - \$9e^{(-0.06)(2)}(0.9601) \\ &= \$10.178 - \$7.664 \\ &= \$2.514 \text{ million.} \end{aligned}$$

## SOLUTION TO SPREADSHEET PROBLEMS

---

- 12-7 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 12 P7 Build a Model.xls*) and on the instructor's side of the textbook's web site, <http://brigham.swcollege.com>.

## MINI CASE

---

Assume that you have just been hired as a financial analyst by Tropical Sweets Inc., a mid-sized California company that specializes in creating exotic candies from tropical fruits such as mangoes, papayas, and dates. The firm's CEO, George Yamaguchi, recently returned from an industry corporate executive conference in San Francisco, and one of the sessions he attended was on real options. Since no one at Tropical Sweets is familiar with the basics of real options, Yamaguchi has asked you to prepare a brief report that the firm's executives could use to gain at least a cursory understanding of the topics.

To begin, you gathered some outside materials the subject and used these materials to draft a list of pertinent questions that need to be answered. In fact, one possible approach to the paper is to use a question-and-answer format. Now that the questions have been drafted, you have to develop the answers.

a. What are some types of real options?

- Answer:**
1. Investment timing options
  2. Growth options
    - a. Expansion of existing product line
    - b. New products
    - c. New geographic markets
  3. Abandonment options
    - a. Contraction
    - b. Temporary suspension
    - c. Complete abandonment
  4. Flexibility options.

b. What are five possible procedures for analyzing a real option?

- Answer:**
1. DCF analysis of expected cash flows, ignoring option.
  2. Qualitatively assess the value of the real option.
  3. Decision tree analysis.
  4. Use a model for a corresponding financial option, if possible.
  5. Use financial engineering techniques if a corresponding financial option is not available.

- c. Tropical Sweets is considering a project that will cost \$70 million and will generate expected cash flows of \$30 per year for three years. The cost of capital for this type of project is 10 percent and the risk-free rate is 6 percent. After discussions with the marketing department, you learn that there is a 30 percent chance of high demand, with future cash flows of \$45 million per year. There is a 40 percent chance of average demand, with cash flows of \$30 million per year. If demand is low (a 30 percent chance), cash flows will be only \$15 million per year. What is the expected NPV?

**Answer:** Initial Cost = \$70 Million  
 Expected Cash Flows = \$30 Million Per Year For Three Years  
 Cost Of Capital = 10%  
 PV Of Expected CFs = \$74.61 Million  
 Expected NPV = \$74.61 - \$70  
 = \$4.61 Million

Alternatively, one could calculate the NPV of each scenario:

<u>Demand</u>	<u>Probability</u>	<u>Annual Cash Flow</u>
High		30% \$45
Average	40%	\$30
Low		30% \$15

Find NPV of each scenario:

$$\text{PV High: } N=3 \quad I=10 \quad \text{PV=?} \quad \text{PMT}=-45 \text{ FV}=0$$

$$\text{PV} = 111.91$$

$$\text{NPV High} = \$111.91 - \$70 = \$41.91 \text{ Million.}$$

$$\text{PV Average: } N=3 \quad I=10 \quad \text{PV=?} \quad \text{PMT}=-30 \text{ FV}=0$$

$$\text{PV} = 74.61$$

$$\text{NPV Average} = \$74.61 - \$70 = \$4.71 \text{ Million.}$$

$$\text{PV Low: } N=3 \quad I=10 \quad \text{PV=?} \quad \text{PMT}=-15 \text{ FV}=0$$

$$\text{PV} = 37.30$$

$$\text{NPV Low} = \$37.30 - \$70 = -\$32.70 \text{ Million.}$$

Find Expected NPV:

$$E(\text{NPV}) = .3(\$41.91) + .4(\$4.61) + .3(-\$32.70)$$

$$E(\text{PV}) = \$4.61.$$

- d. Now suppose this project has an investment timing option, since it can be delayed for a year. The cost will still be \$70 million at the end of the year, and the cash flows for the scenarios will still last three years. However, Tropical Sweets will know the level of demand, and will implement the project only if it adds value to the company.

Perform a qualitative assessment of the investment timing option's value.

**Answer:** If we immediately proceed with the project, its expected NPV is \$4.61 million. However, the project is very risky. If demand is high, NPV will be \$41.91 million. If demand is average, NPV will be \$4.61 million. If demand is low, NPV will be -\$32.70 million. However, if we wait one year, we will find out additional information regarding demand. If demand is low, we won't implement project. If we wait, the up-front cost and cash flows will stay the same, except they will be shifted ahead by a year.

The value of any real option increases if the underlying project is very risky or if there is a long time before you must exercise the option.

This project is risky and has one year before we must decide, so the option to wait is probably valuable.

e. Use decision tree analysis to calculate the NPV of the project with the investment timing option.

**Answer:** The project will be implemented only if demand is average or high.

**Here is the time line:**

	0	1	2	3	4
<b>High</b>	\$0	-\$70	\$45	\$45	\$45
<b>Average</b>	\$0	-\$70	\$30	\$30	\$30
<b>Low</b>	\$0	\$0	\$0	\$0	\$0

**To find the NPVC, discount the cost at the risk-free rate of 6 percent since it is known for certain, and discount the other risky cash flows at the 10 percent cost of capital.**

**High: NPV =  $-\$70/1.06 + \$45/1.10^2 + \$45/1.10^3 + \$45/1.10^4 = \$35.70$**

**Average: NPV =  $-\$70/1.06 + \$30/1.10^2 + \$30/1.10^3 + \$30/1.10^4 = \$1.79$**

**Low: NPV = \$0.**

Expected NPV =  $0.3(\$35.70) + 0.4(\$1.79) + 0.3(\$0) = \$11.42$ .

Since this is much greater than the NPV of immediate implementation (which is \$4.61 million) we should wait. In other words, implementing immediately gives an expected NPV of \$4.61 million, but implementing immediately means we give up the option to wait, which is worth \$11.42 million.

f. Use a financial option pricing model to estimate the value of the investment timing option.

**Answer:** The option to wait resembles a financial call option-- we get to “buy” the project for \$70 million in one year if value of project in one year is greater than \$70 million. This is like a call option with an exercise price of \$70 million and an expiration date of one year.  
 $X = \text{Exercise Price} = \text{Cost Of Implement Project} = \$70 \text{ Million.}$   
 $R_{RF} = \text{Risk-Free Rate} = 6\%.$   
 $T = \text{Time To Maturity} = 1 \text{ year.}$   
 $P = \text{Current Price Of Stock} = \text{Current Value Of The Project's Future Cash Flows.}$   
 $\sigma^2 = \text{Variance Of Stock Return} = \text{Variance Of Project's Rate Of Return.}$

We explain how to calculate P and  $\sigma^2$  below.

Just as the price of a stock is the present value of all the stock's future cash flows, the “price” of the real option is the present value of all the project's cash flows that occur beyond the exercise date. Notice that the exercise cost of an option does not affect the stock price. Similarly, the cost to implement the real option does not affect the current value of the underlying asset (which is the PV of the project's cash flows). It will be helpful in later steps if we break the calculation into two parts. First, we find the value of all cash flows beyond the exercise date discounted back to the exercise date. Then we find the expected present value of those values.

Step 1: Find the value of all cash flows beyond the exercise date discounted back to the exercise date. Here is the time line. The exercise date is year 1, so we discount all future cash flows back to year 1.

	0	1	2	3	4
<b>High</b>			<b>\$45</b>	<b>\$45</b>	<b>\$45</b>
<b>Average</b>			<b>\$30</b>	<b>\$30</b>	<b>\$30</b>
<b>Low</b>			<b>\$15</b>	<b>\$15</b>	<b>\$15</b>

**High:**  $PV_1 = \$45/1.10 + \$45/1.10^2 + \$45/1.10^3 = \$111.91$

**Average:**  $PV_1 = \$30/1.10 + \$30/1.10^2 + \$30/1.10^3 = \$74.61$

**Low:**  $PV_1 = \$15/1.10 + \$15/1.10^2 + \$15/1.10^3 = \$37.30$

The current expected present value, P, is:

$$P = 0.3[\$111.91/1.1] + 0.4[\$74.61/1.1] + 0.3[\$37.30/1.1] = \$67.82.$$

For a stock option,  $\sigma^2$  is the variance of the stock return, not the variance of the stock price. Therefore, for a real option we need the variance of the project's rate of return. There are three ways to estimate this variance. First, we can use subjective judgment. Second, we can calculate the project's return in each scenario and then calculate the return's variance. This is the direct approach. Third, we know the projects value at each scenario at the expiration date, and we know the current value of the project. Thus, we can find a variance of project return that gives the range of project values that can occur at expiration. This is the indirect approach.

Following is an explanation of each approach.

Subjective estimate:

The typical stock has  $\sigma^2$  of about 12%. Most projects will be somewhat riskier than the firm, since the risk of the firm reflects the diversification that comes from having many projects. Subjectively scale the variance of the company's stock return up or down to reflect the risk of the

project. The company in our example has a stock with a variance of 10%, so we might expect the project to have a variance in the range of 12% to 19%.

Direct approach:

From our previous analysis, we know the current value of the project and the value for each scenario at the time the option expires (year 1). Here is the time line:

	<b>Current Value</b>	<b>Value At Expiration</b>
	<u><b>Year 0</b></u>	<u><b>Year 1</b></u>
<b>High</b>	<b>\$67.82</b>	<b>\$111.91</b>
<b>Average</b>	<b>\$67.82</b>	<b>\$74.61</b>
<b>Low</b>	<b>\$67.82</b>	<b>\$37.30</b>

The annual rate of return is:

High: Return =  $(\$111.91/\$67.82) - 1 = 65\%$ .

Average: Return =  $(\$74.61/\$67.82) - 1 = 10\%$ .

Low: Return =  $(\$37.30/\$67.82) - 1 = -45\%$ .

$$\begin{aligned} \text{Expected Return} &= 0.3(0.65) + 0.4(0.10) + 0.3(-0.45) \\ &= 10\%. \end{aligned}$$

$$\begin{aligned} \sigma^2 &= 0.3(0.65-0.10)^2 + 0.4(0.10-0.10)^2 + 0.3(-0.45-0.10)^2 \\ &= 0.182 = 18.2\%. \end{aligned}$$

The direct approach gives an estimate of 18.2% for the variance of the project's return.

The indirect approach:

Given a current stock price and an anticipated range of possible stock prices at some point in the future, we can use our knowledge of the distribution of stock returns (which is lognormal) to relate the variance of the stock's rate of return to the range of possible outcomes for stock price. To use this formula, we need the coefficient of variation of stock price at the time the option expires. To calculate the coefficient of variation, we need the expected stock price and the standard deviation of the stock price (both of these are measured at the time the option expires). For the real option, we need the expected value of the project's cash flows at the date the real option expires, and the standard deviation of the project's value at the date the real option expires. We previously calculated the value of the project at the time the option expires, and we can use this to calculate the expected value and the standard deviation.

### Value At Expiration

	<u>Year 1</u>
<b>High</b>	<b>\$111.91</b>
<b>Average</b>	<b>\$74.61</b>
<b>Low</b>	<b>\$37.30</b>

$$\begin{aligned} \text{Expected Value} &= .3(\$111.91) + .4(\$74.61) + .3(\$37.3) \\ &= \$74.61. \end{aligned}$$

$$\begin{aligned} \sigma_{\text{value}} &= [.3(\$111.91 - \$74.61)^2 + .4(\$74.61 - \$74.61)^2 \\ &\quad + .3(\$37.30 - \$74.61)^2]^{1/2} \\ &= \$28.90. \end{aligned}$$

$$\text{Coefficient Of Variation} = \text{CV} = \text{Expected Value} / \sigma_{\text{value}}$$

$$\text{CV} = \$74.61 / \$28.90 = 0.39.$$

Here is a formula for the variance of a stock's return, if you know the coefficient of variation of the expected stock price at some point in the future. The CV should be for the entire project, including all scenarios:

$$\sigma^2 = \text{LN}[\text{CV}^2 + 1]/T = \text{LN}[0.39^2 + 1]/1 = 14.2\%.$$

Now, we proceed to use the OPM:

$$V = \$67.83[N(d_1)] - \$70e^{-(0.06)(1)}[N(d_2)].$$

$$d_1 = \frac{\ln(\$67.83/\$70) + [(0.06 + 0.142/2)](15)}{(.142)^{0.5}(1)^{0.5}}$$

$$= 0.2641.$$

$$d_2 = d_1 - (0.142)^{0.5}(1)^{0.5} = 0.2641 - 0.3768$$

$$= -0.1127.$$

$$N(d_1) = N(0.2641) = 0.6041.$$

$$N(d_2) = N(-0.1127) = 0.4551.$$

therefore,

$$V = \$67.83(0.6041) - \$70e^{-0.06}(0.4551)$$

$$= \$10.98.$$

g. Now suppose the cost of the project is \$75 million and the project cannot be delayed. But if Tropical Sweets implements the project, then Tropical Sweets will have a growth option. It will have the opportunity to replicate the original project at the end of its life. What is the total expected NPV of the two projects if both are implemented?

**Answer:** Suppose the cost of the project is \$75 million instead of \$70 million, and there is no option to wait.

$$\text{NPV} = \text{PV of future cash flows} - \text{cost}$$

$$= \$74.61 - \$75 = -\$0.39 \text{ million.}$$

The project now looks like a loser. Using NPV analysis:

$$\text{NPV} = \text{NPV Of Original Project} + \text{NPV Of Replication Project}$$

$$= -\$0.39 + -\$0.39/(1+0.10)^3$$

$$= -\$0.39 + -\$0.30 = -\$0.69.$$

Still looks like a loser, but you will only implement project 2 if demand is high. We might have chosen to discount the cost of the replication project at the risk-free rate, and this would have made the NPV even lower.

h. Tropical Sweets will replicate the original project only if demand is high. Using decision tree analysis, estimate the value of the project with the growth option.

**Answer:** The future cash flows of the optimal decisions are shown below. The cash flow in year 3 for the high demand scenario is the cash flow from the original project and the cost of the replication project.

	0	1	2	3	4	5	6
<b>High</b>	<b>-\$75</b>	<b>\$45</b>	<b>\$45</b>	<b>\$45</b>	<b>-\$70</b>	<b>\$45</b>	<b>\$45</b>
<b>Average</b>	<b>-\$75</b>	<b>\$30</b>	<b>\$30</b>	<b>\$30</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Low</b>	<b>-\$75</b>	<b>\$15</b>	<b>\$15</b>	<b>\$15</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

To find the NPV, we discount the risky cash flows at the 10 percent cost of capital, and the non-risky cost to replicate (i.e., the \$75 million) at the risk-free rate.

$$\begin{aligned} \text{NPV high} &= -\$75 + \$45/1.10 + \$45/1.10^2 + \$45/1.10^3 + \$45/1.10^4 \\ &\quad + \$45/1.10^5 + \$45/1.10^6 - \$75/1.06^3 \\ &= \$58.02 \end{aligned}$$

$$\text{NPV average} = -\$75 + \$30/1.10 + \$30/1.10^2 + \$30/1.10^3 = -\$0.39$$

$$\text{NPV low} = -\$75 + \$15/1.10 + \$15/1.10^2 + \$15/1.10^3 = -\$37.70$$

$$\text{Expected NPV} = 0.3(\$58.02) + 0.4(-\$0.39) + 0.3(-\$37.70) = \$5.94.$$

Thus, the option to replicate adds enough value that the project now has a positive NPV.

i. Use a financial option model to estimate the value of the growth option.

**Answer:** X = Exercise Price = Cost Of Implement Project = \$75 million.  
 $R_{RF}$  = Risk-Free Rate = 6%.  
 T = Time To Maturity = 3 years.  
 P = Current Price Of Stock = Current Value Of The Project's Future Cash Flows.  
 $\sigma^2$  = Variance Of Stock Return = Variance Of Project's Rate Of Return.

We explain how to calculate P and  $\sigma^2$  below.

Step 1: Find the value of all cash flows beyond the exercise date discounted back to the exercise date. Here is the time line. The exercise date is year 1, so we discount all future cash flows back to year 3.

	0	1	2	3	4	5	6
<b>High</b>					<b>\$45</b>	<b>\$45</b>	<b>\$45</b>
<b>Average</b>					<b>\$30</b>	<b>\$30</b>	<b>\$30</b>
<b>Low</b>					<b>\$15</b>	<b>\$15</b>	<b>\$15</b>

$$\text{High: } PV_3 = \$45/1.10 + \$45/1.10^2 + \$45/1.10^3 = \$111.91$$

$$\text{Average: } PV_3 = \$30/1.10 + \$30/1.10^2 + \$30/1.10^3 = \$74.61$$

$$\text{Low: } PV_3 = \$15/1.10 + \$15/1.10^2 + \$15/1.10^3 = \$37.30$$

The current expected present value, P, is:  
 $P = 0.3[\$111.91/1.1^3] + 0.4[\$74.61/1.1^3] + 0.3[\$37.30/1.1^3] = \$56.05.$

Direct approach for estimating  $\sigma^2$ :

From our previous analysis, we know the current value of the project and the value for each scenario at the time the option expires (year 3). Here is the time line:

	<b>Current Value</b>	<b>Value At Expiration</b>
	<u>Year 0</u>	<u>Year 3</u>
<b>High</b>	<b>\$56.02</b>	<b>\$111.91</b>
<b>Average</b>	<b>\$56.02</b>	<b>\$74.61</b>
<b>Low</b>	<b>\$56.02</b>	<b>\$37.30</b>

The annual rate of return is:  
 High: Return =  $(\$111.91/\$56.02)^{(1/3)} - 1 = 25.9\%.$   
 High: Average =  $(\$74.61/\$56.02)^{(1/3)} - 1 = 10\%.$   
 High: Return =  $(\$37.30/\$56.02)^{(1/3)} - 1 = -12.7\%.$

Expected Return =  $0.3(0.259) + 0.4(0.10) + 0.3(-0.127)$   
 $= 8.0\%.$

$\sigma^2 = 0.3(0.259-0.08)^2 + 0.4(0.10-0.08)^2 + 0.3(-0.127-0.08)^2$   
 $= 0.182 = 2.3\%.$

This is lower than the variance found for the previous option because the dispersion of cash flows for the replication project is the same as for the original, even though the replication occurs much later. Therefore, the rate of return for the replication is less volatile. We do sensitivity analysis later.

The indirect approach:  
 First, find the coefficient of variation for the value of the project at the time the option expires (year 3).

We previously calculated the value of the project at the time the option expires, and we can use this to calculate the expected value and the standard deviation.

	<b>Value At Expiration</b>
	<u>Year 3</u>
<b>High</b>	<b>\$111.91</b>
<b>Average</b>	<b>\$74.61</b>
<b>Low</b>	<b>\$37.30</b>

$$\begin{aligned}\text{Expected Value} &= .3(\$111.91) + .4(\$74.61) + .3(\$37.3) \\ &= \$74.61.\end{aligned}$$

$$\begin{aligned}\sigma_{\text{value}} &= [.3(\$111.91 - \$74.61)^2 + .4(\$74.61 - \$74.61)^2 \\ &\quad + .3(\$37.30 - \$74.61)^2]^{1/2} \\ &= \$28.90.\end{aligned}$$

$$\begin{aligned}\text{Coefficient Of Variation} = \text{CV} &= \text{Expected Value} / \sigma_{\text{value}} \\ \text{CV} &= \$74.61 / \$28.90 = 0.39.\end{aligned}$$

To find the variance of the project's rate of return, we use the formula below:  
 $\sigma^2 = \text{LN}[\text{CV}^2 + 1]/T = \text{LN}[0.39^2 + 1]/3 = 4.7\%$ .

Now, we proceed to use the OPM:

$$V = \$56.06[N(d_1)] - \$75e^{-(0.06)(3)}[N(d_2)].$$

$$\begin{aligned}d_1 &= \frac{\ln(\$56.06/\$75) + [(0.06 + 0.047/2)](3)}{(0.047)^{0.5}(3)^{0.5}} \\ &= -0.1085.\end{aligned}$$

$$\begin{aligned}d_2 &= d_1 - (0.047)^{0.5}(3)^{0.5} = -.1085 - 0.3755 \\ &= -0.4840.\end{aligned}$$

$$N(d_1) = N(-0.1080) = 0.4568.$$

$$N(d_2) = N(-0.4835) = 0.3142.$$

Therefore,

$$\begin{aligned}V &= \$56.06(0.4568) - \$75e^{-(0.06)(3)}(0.3142) \\ &= \$5.92.\end{aligned}$$

$$\begin{aligned}\text{Total Value} &= \text{NPV Of Project 1} + \text{Value Of Growth Option} \\ &= -\$0.39 + \$5.92 \\ &= \$5.5 \text{ million}\end{aligned}$$

j. What happens to the value of the growth option if the variance of the project's return is 14.2 percent? What if it is 50 percent? How might this explain the high valuations of many dot.com companies?

**Answer:** If risk, defined by  $\sigma^2$ , goes up, then value of growth option goes up (see the file *ch 12 mini case.xls* for calculations):  
 $\sigma^2 = 4.7\%$ , option value = \$5.92  
 $\sigma^2 = 14.2\%$ , option value = \$12.10  
 $\sigma^2 = 50\%$ , option value = \$24.09

If the future profitability of dot.com companies is very volatile (i.e., there is the potential for very high profits), then a company with a real option on those profits might have a very high value for its growth option.

# Chapter 13

## Analysis of Financial Statements

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 13-1
- a. A liquidity ratio is a ratio that shows the relationship of a firm's cash and other current assets to its current liabilities. The current ratio is found by dividing current assets by current liabilities. It indicates the extent to which current liabilities are covered by those assets expected to be converted to cash in the near future. The quick, or acid test, ratio is found by taking current assets less inventories and then dividing by current liabilities.
  - b. Asset management ratios are a set of ratios that measure how effectively a firm is managing its assets. The inventory turnover ratio is sales divided by inventories. Days sales outstanding is used to appraise accounts receivable and indicates the length of time the firm must wait after making a sale before receiving cash. It is found by dividing receivables by average sales per day. The fixed assets turnover ratio measures how effectively the firm uses its plant and equipment. It is the ratio of sales to net fixed assets. Total assets turnover ratio measures the turnover of all the firm's assets; it is calculated by dividing sales by total assets.
  - c. Financial leverage ratios measure the use of debt financing. The debt ratio is the ratio of total debt to total assets, it measures the percentage of funds provided by creditors. The times-interest-earned ratio is determined by dividing earnings before interest and taxes by the interest charges. This ratio measures the extent to which operating income can decline before the firm is unable to meet its annual interest costs. The EBITDA coverage ratio is similar to the times-interest-earned ratio, but it recognizes that many firms lease assets and also must make sinking fund payments. It is found by adding EBITDA and lease payments then dividing this total by interest charges, lease payments, and sinking fund payments over one minus the tax rate.
  - d. Profitability ratios are a group of ratios, which show the combined effects of liquidity, asset management, and debt on operations. The profit margin on sales, calculated by dividing net income by sales, gives the profit per dollar of sales. Basic earning power is calculated by dividing EBIT by total assets. This ratio shows the raw earning power of the firm's assets, before the influence of taxes and leverage. Return on total assets is the ratio of net income to total assets. Return on common equity is found by dividing net income into common equity.
  - e. Market value ratios relate the firm's stock price to its earnings and book value per share. The price/earnings ratio is calculated by dividing price per share by earnings per share--this shows how much investors are willing to pay per dollar of reported profits. The price/cash flow is calculated by dividing price per share by cash flow per share. This shows how much investors are willing to pay per dollar of cash flow. Market-to-book ratio is simply the market price per share divided by the book value per share. Book value per share is common equity divided by the number of shares outstanding.
  - f. Trend analysis is an analysis of a firm's financial ratios over time. It is used to estimate the likelihood of improvement or deterioration in its financial situation. Comparative ratio analysis

is when a firm compares its ratios to other leading companies in the same industry. This technique is also known as benchmarking.

- g. The Du Pont chart is a chart designed to show the relationships among return on investment, asset turnover, the profit margin, and leverage. The Du Pont equation is a formula, which shows that the rate of return on assets can be found as the product of the profit margin times the total assets turnover.
  - h. Window dressing is a technique employed by firms to make their financial statements look better than they really are. Seasonal factors can distort ratio analysis. At certain times of the year a firm may have excessive inventories in preparation of a “season” of high demand. Therefore an inventory turnover ratio taken at this time as opposed to after the season will be radically distorted.
- 13-2 The emphasis of the various types of analysts is by no means uniform nor should it be. *Management* is interested in all types of ratios for two reasons. First, the ratios point out weaknesses that should be strengthened; second, management recognizes that the other parties are interested in all the ratios and that financial appearances must be kept up if the firm is to be regarded highly by creditors and equity investors. *Equity investors* are interested primarily in profitability, but they examine the other ratios to get information on the riskiness of equity commitments. *Long-term creditors* are more interested in the debt ratio, TIE, and fixed-charge coverage ratios, as well as the profitability ratios. *Short-term creditors* emphasize liquidity and look most carefully at the liquidity ratios.
- 13-3 Given that sales have not changed, a decrease in the total assets turnover means that the company’s assets have increased. Also, the fact that the fixed assets turnover ratio remained constant implies that the company increased its current assets. Since the company’s current ratio increased, and yet, its quick ratio is unchanged means that the company has increased its inventories.
- 13-4 Differences in the amounts of assets necessary to generate a dollar of sales cause asset turnover ratios to vary among industries. For example, a steel company needs a greater number of dollars in assets to produce a dollar in sales than does a grocery store chain. Also, profit margins and turnover ratios may vary due to differences in the amount of expenses incurred to produce sales. For example, one would expect a grocery store chain to spend more per dollar of sales than does a steel company. Often, a large turnover will be associated with a low profit margin, and vice versa.
- 13-5
- a. Cash, receivables, and inventories, as well as current liabilities, vary over the year for firms with seasonal sales patterns. Therefore, those ratios that examine balance sheet figures will vary unless averages (monthly ones are best) are used.
  - b. Common equity is determined at a point in time, say December 31, 2004. Profits are earned over time, say during 2004. If a firm is growing rapidly, year-end equity will be much larger than beginning-of-year equity, so the calculated rate of return on equity will be different depending on whether end-of-year, beginning-of-year, or average common equity is used as the denominator. Average common equity is conceptually the best figure to use. In public utility rate cases, people are reported to have deliberately used end-of-year or beginning-of-year equity to make returns on equity appear excessive or inadequate. Similar problems can arise when a firm is being evaluated.
- 13-6 Firms within the same industry may employ different accounting techniques, which make it difficult to compare financial ratios. More fundamentally, comparisons may be misleading if firms in the

same industry differ in their other investments. For example, comparing Pepsico and Coca-Cola may be misleading because apart from their soft drink business, Pepsi also owns other businesses such as Frito-Lay, Pizza Hut, Taco Bell, and KFC.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

13-1  $CA = \$3,000,000$ ;  $\frac{CA}{CL} = 1.5$ ;  $\frac{CA - I}{CL} = 1.0$ ;

$CL = ?$ ;  $I = ?$

$$\frac{CA}{CL} = 1.5$$

$$\frac{\$3,000,000}{CL} = 1.5$$

$$1.5CL = \$3,000,000$$

$$CL = \$2,000,000.$$

$$\frac{CA - I}{CL} = 1.0$$

$$\frac{\$3,000,000 - I}{\$2,000,000} = 1.0$$

$$\$3,000,000 - I = \$2,000,000$$

$$I = \$1,000,000.$$

13-2  $DSO = 40$  days;  $ADS = \$20,000$ ;  $AR = ?$

$$DSO = \frac{AR}{\frac{S}{365}}$$

$$40 = \frac{AR}{\$20,000}$$

$$AR = \$800,000.$$

13-3  $A/E = 2.4$ ;  $D/A = ?$

$$\frac{D}{A} = \left( 1 - \frac{1}{\frac{A}{E}} \right)$$

$$\frac{D}{A} = \left( 1 - \frac{1}{2.4} \right)$$

$$\frac{D}{A} = 0.5833 = 58.33\%.$$

- 13-4 ROA = 10%; PM = 2%; ROE = 15%; S/TA = ?; A/E = ?  
 ROA = NI/A; PM = NI/S; ROE = NI/E

$$\begin{aligned} \text{ROA} &= \text{PM} \times \text{S/TA} \\ \text{NI/A} &= \text{NI/S} \times \text{S/TA} \\ 10\% &= 2\% \times \text{S/TA} \\ \text{S/TA} &= 5. \end{aligned}$$

$$\begin{aligned} \text{ROE} &= \text{PM} \times \text{S/TA} \times \text{TA/E} \\ \text{NI/E} &= \text{NI/S} \times \text{S/TA} \times \text{TA/E} \\ 15\% &= 2\% \times 5 \times \text{TA/E} \\ 15\% &= 10\% \times \text{TA/E} \\ \text{TA/E} &= 1.5. \end{aligned}$$

- 13-5 We are given ROA = 3% and Sales/Total assets = 1.5×.

From Du Pont equation: ROA = Profit margin × Total assets turnover  
 3% = Profit margin (1.5)

$$\text{Profit margin} = 3\%/1.5 = 2\%.$$

We can also calculate the company's debt ratio in a similar manner, given the facts of the problem. We are given ROA(NI/A) and ROE(NI/E); if we use the reciprocal of ROE we have the following equation:

$$\frac{E}{A} = \frac{NI}{A} - \frac{E}{NI} \text{ and } \frac{D}{A} = 1 - \frac{E}{A}, \text{ so}$$

$$\frac{E}{A} = 3\% - \frac{1}{0.05}$$

$$\frac{E}{A} = 60\% .$$

$$\frac{D}{A} = 1 - 0.60 = 0.40 = 40\% .$$

Alternatively,

$$\begin{aligned} \text{ROE} &= \text{ROA} \times \text{EM} \\ 5\% &= 3\% \times \text{EM} \\ \text{EM} &= 5\%/3\% = 5/3 = \text{TA}/\text{E}. \end{aligned}$$

Take reciprocal:

$$\text{E}/\text{TA} = 3/5 = 60\%;$$

therefore,

$$\text{D}/\text{A} = 1 - 0.60 = 0.40 = 40\%.$$

Thus, the firm's profit margin = 2% and its debt ratio = 40%.

$$13-6 \quad \text{Present current ratio} = \frac{\$1,312,500}{\$525,000} = 2.5.$$

$$\text{Minimum current ratio} = \frac{\$1,312,500 + \Delta \text{NP}}{\$525,000 + \Delta \text{NP}} = 2.0.$$

$$\begin{aligned} \$1,312,500 + \Delta \text{NP} &= \$1,050,000 + 2\Delta \text{NP} \\ \Delta \text{NP} &= \$262,500. \end{aligned}$$

Short-term debt can increase by a maximum of \$262,500 without violating a 2 to 1 current ratio, assuming that the entire increase in notes payable is used to increase current assets. Since we assumed that the additional funds would be used to increase inventory, the inventory account will increase to \$637,500, and current assets will total \$1,575,000.

$$\text{Quick ratio} = (\$1,575,000 - \$637,500)/\$787,500 = \$937,500/\$787,500 = 1.19\times.$$

$$13-7 \quad 1. \quad \frac{\text{Current assets}}{\text{Current liabilities}} = 3.0\times \quad \frac{\$810,000}{\text{Current liabilities}} = 3.0\times$$

$$\text{Current liabilities} = \$270,000.$$

$$2. \quad \frac{\text{Current assets} - \text{Inventories}}{\text{Current liabilities}} = 1.4\times \quad \frac{\$810,000 - \text{Inventories}}{\$270,000} = 1.4\times$$

$$\text{Inventories} = \$432,000.$$

$$3. \quad \text{Current assets} = \text{Cash} + \text{Marketable Securities} + \text{Accounts receivable} + \text{Inventories}$$

$$\begin{aligned} \$810,000 &= \$120,000 + \text{Accounts receivable} + \$432,000 \\ \text{Accounts receivable} &= \$258,000. \end{aligned}$$

$$4. \quad \frac{\text{Sales}}{\text{Inventory}} = 6.0\times \quad \frac{\text{Sales}}{\$432,000} = 6.0\times$$

$$\text{Sales} = \$2,592,000.$$

$$5. \quad \text{DSO} = \frac{\text{Accounts receivable}}{\text{Sales}/365} = \frac{\$258,000}{\$2,592,000/365} = 36.33 \text{ days.}$$

13-8 TIE = EBIT/INT, so find EBIT and INT.

$$\text{Interest} = \$500,000 \times 0.1 = \$50,000.$$

$$\text{Net income} = \$2,000,000 \times 0.05 = \$100,000.$$

$$\text{Pre-tax income} = \$100,000/(1 - T) = \$100,000/0.7 = \$142,857.$$

$$\text{EBIT} = \$142,857 + \$50,000 = \$192,857.$$

$$\text{TIE} = \$192,857/\$50,000 = 3.86\times.$$

13-9 a. (Dollar amounts in thousands.)

Industry

<u>Firm</u>	<u>Average</u>				
		$\frac{\text{Current assets}}{\text{Current liabilities}}$	=	$\frac{\$655,000}{\$330,000}$	= 1.98x
2.0x					
		DSO = $\frac{\text{Accounts receivable}}{\text{Sales}/365}$	=	$\frac{\$336,000}{\$4,404.11}$	= 76 days 35
days					
		$\frac{\text{Sales}}{\text{Inventory}}$	=	$\frac{\$1,607,500}{\$241,500}$	= 6.66x
6.7x					
		$\frac{\text{Sales}}{\text{Fixed assets}}$	=	$\frac{\$1,607,500}{\$292,500}$	= 5.50x
12.1x					
		$\frac{\text{Sales}}{\text{Total assets}}$	=	$\frac{\$1,607,500}{\$947,500}$	=
1.70x	3.0x				
		$\frac{\text{Net income}}{\text{Sales}}$	=	$\frac{\$27,300}{\$1,607,500}$	=
1.7%	1.2%				
		$\frac{\text{Net income}}{\text{Total assets}}$	=	$\frac{\$27,300}{\$947,500}$	= 2.9%
3.6%					

<u>Firm</u>	<u>Average</u>				
					Industry
		$\frac{\text{Net income}}{\text{Common equity}}$	=	$\frac{\$27,300}{\$361,000}$	= 7.6%
9.0%					
		$\frac{\text{Total debt}}{\text{Total assets}}$	=	$\frac{\$586,500}{\$947,500}$	= 61.9% 60.0%

b. For the firm,

$$\text{ROE} = \text{PM} \times \text{T.A. turnover} \times \text{EM} = 1.7\% \times 1.7 \times \frac{\$947,500}{\$361,000} = 7.6\%.$$

For the industry,  $\text{ROE} = 1.2\% \times 3 \times 2.5 = 9\%$ .

*Note:* To find the industry ratio of assets to common equity, recognize that  $1 - (\text{total debt}/\text{total assets}) = \text{common equity}/\text{total assets}$ . So,  $\text{common equity}/\text{total assets} = 40\%$ , and  $1/0.40 = 2.5 = \text{total assets}/\text{common equity}$ .

- c. The firm's days sales outstanding is more than twice as long as the industry average, indicating that the firm should tighten credit or enforce a more stringent collection policy. The total assets turnover ratio is well below the industry average so sales should be increased, assets decreased, or both. While the company's profit margin is higher than the industry average, its other profitability ratios are low compared to the industry--net income should be higher given the amount of equity and assets. However, the company seems to be in an average liquidity position and financial leverage is similar to others in the industry.
- d. If 2004 represents a period of supernormal growth for the firm, ratios based on this year will be distorted and a comparison between them and industry averages will have little meaning. Potential investors who look only at 2003 ratios will be misled, and a return to normal conditions in 2005 could hurt the firm's stock price.

- 13-10
1. Debt = (0.50)(Total assets) = (0.50)(\$300,000) = \$150,000.
  2. Accounts payable = Debt – Long-term debt = \$150,000 - \$60,000 = \$90,000
  3. Common stock =  $\frac{\text{Total liabilities and equity}}{\text{and equity}} - \text{Debt} - \text{Retained earnings}$   
= \$300,000 - \$150,000 - \$97,500 = \$52,500.
  4. Sales = (1.5)(Total assets) = (1.5)(\$300,000) = \$450,000.
  5. Inventory = Sales/5 = \$450,000/5 = \$90,000.
  6. Accounts receivable = (Sales/365)(DSO) = (\$450,000/365)(36.5) = \$45,000.
  7. Cash + Accounts receivable = (0.80)(Accounts payable)  
Cash + \$45,000 = (0.80)(\$90,000)  
Cash = \$72,000 - \$45,000 = \$27,000.
  8. Fixed assets = Total assets - (Cash + Accts rec. + Inventories)  
= \$300,000 - (\$27,000 + \$45,000 + \$90,000) = \$138,000.
  9. Cost of goods sold = (Sales)(1 - 0.25) = (\$450,000)(0.75) = \$337,500.

13-11 a. Here are the firm's base case ratios and other data as compared to the industry:

<u>Industry</u>	<u>Comment</u>		<u>Firm</u>
	Quick	0.8×	1.0×
Weak			
	Current	2.3	2.7
Weak			
	Inventory turnover	4.8	7.0
	Days sales outstanding	37 days	32 days
Poor			Poor
	Fixed assets turnover	10.0×	13.0×
Poor			
	Total assets turnover	2.3	2.6
Poor			
	Return on assets	5.9%	9.1%
Bad			
	Return on equity	13.1	18.2
Bad			
	Debt ratio	54.8	50.0
High			
	Profit margin on sales	2.5	3.5
Bad			
	EPS		\$4.71
n.a.	--		
	Stock Price	\$23.57	n.a.
--			
	P/E ratio		5.0×
6.0×	Poor		
	P/CF ratio		2.0×
3.5×	Poor		
	M/B ratio	0.65	n.a.
--			

The firm appears to be badly managed--all of its ratios are worse than the industry averages, and the result is low earnings, a low P/E, P/CF ratio, a low stock price, and a low M/B ratio. The company needs to do something to improve.

- b. A decrease in the inventory level would improve the inventory turnover, total assets turnover, and ROA, all of which are too low. It would have some impact on the current ratio, but it is difficult to say precisely how that ratio would be affected. If the lower inventory level allowed the company to reduce its current liabilities, then the current ratio would improve. The lower cost of goods sold would improve all of the profitability ratios and, if dividends were not increased, would lower the debt ratio through increased retained earnings. All of this should lead to a higher market/book ratio and a higher stock price.

## **SOLUTION TO SPREADSHEET PROBLEM**

---

13-12 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 13 P12 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

The first part of the case, presented in chapter 3, discussed the situation that Computron Industries was in after an expansion program. Thus far, sales have not been up to the forecasted level, costs have been higher than were projected, and a large loss occurred in 2004, rather than the expected profit. As a result, its managers, directors, and investors are concerned about the firm's survival.

Donna Jamison was brought in as assistant to Fred Campo, Computron's chairman, who had the task of getting the company back into a sound financial position. Computron's 2003 and 2004 balance sheets and income statements, together with projections for 2005, are shown in the following tables. Also, the tables show the 2003 and 2004 financial ratios, along with industry average data. The 2005 projected financial statement data represent Jamison's and Campo's best guess for 2005 results, assuming that some new financing is arranged to get the company "over the hump."

Jamison examined monthly data for 2004 (not given in the case), and she detected an improving pattern during the year. Monthly sales were rising, costs were falling, and large losses in the early months had turned to a small profit by December. Thus, the annual data looked somewhat worse than final monthly data. Also, it appears to be taking longer for the advertising program to get the message across, for the new sales offices to generate sales, and for the new manufacturing facilities to operate efficiently. In other words, the lags between spending money and deriving benefits were longer than Computron's managers had anticipated. For these reasons, Jamison and Campo see hope for the company--provided it can survive in the short run.

Jamison must prepare an analysis of where the company is now, what it must do to regain its financial health, and what actions should be taken. Your assignment is to help her answer the following questions. Provide clear explanations, not yes or no answers.

## Balance Sheets

<u>Assets</u>	2003	2004	2005e
Cash	\$ 9,000	\$ 7,282	\$ 14,000
Short-Term Investments	48,600	20,000	71,632
Accounts Receivable	351,200	632,160	878,000
Inventories	715,200	1,287,360	1,716,480
Total Current Assets	\$ 1,124,000	\$ 1,946,802	\$ 2,680,112
Gross Fixed Assets	491,000	1,202,950	1,220,000
Less: Accumulated Depreciation	146,200	263,160	383,160
Net Fixed Assets	\$ 344,800	\$ 939,790	\$ 836,840
Total Assets	\$ 1,468,800	\$ 2,886,592	\$ 3,516,952

<u>Liabilities And Equity</u>	2003	2004	2005e
Accounts Payable	\$ 145,600	\$ 324,000	\$ 359,800
Notes Payable	200,000	720,000	300,000
Accruals	136,000	284,960	380,000
Total Current Liabilities	\$ 481,600	\$ 1,328,960	\$ 1,039,800
Long-Term Debt	323,432	1,000,000	500,000
Common Stock (100,000 Shares)	460,000	460,000	1,680,936
Retained Earnings	203,768	97,632	296,216
Total Equity	\$ 663,768	\$ 557,632	\$ 1,977,152
Total Liabilities And Equity	\$ 1,468,800	\$ 2,886,592	\$ 3,516,952

## Income Statements

	2003	2004	2005e
Sales	\$ 3,432,000	\$ 5,834,400	\$ 7,035,600
Cost Of Goods Sold	2,864,000	4,980,000	5,800,000
Other Expenses	340,000	720,000	612,960
Depreciation	18,900	116,960	120,000
Total Operating Costs	\$ 3,222,900	\$ 5,816,960	\$ 6,532,960
EBIT	\$ 209,100	\$ 17,440	\$ 502,640
Interest Expense	62,500	176,000	80,000
EBT	\$ 146,600	\$ (158,560)	\$ 422,640
Taxes (40%)	58,640	(63,424)	169,056
Net Income	\$ 87,960	\$ (95,136)	\$ 253,584

<u>Other Data</u>	2003	2004	2005e
Stock Price	\$ 8.50	\$ 6.00	\$ 12.17
Shares Outstanding	100,000	100,000	250,000
EPS	\$ 0.880	\$ (0.951)	\$ 1.014
DPS	\$ 0.220	\$ 0.110	\$ 0.220
Tax Rate	40%	40%	40%
Book Value Per Share	\$ 6.638	\$ 5.576	\$ 7.909
Lease Payments	\$ 40,000	\$ 40,000	\$ 40,000

Ratio Analysis	2003	2004	2005e	Industry Average
Current	2.3	1.5	2.58	2.7
Quick	0.8	0.5	0.93	1.0
Inventory Turnover	4.8	4.5	4.10	6.1
Days Sales Outstanding	37.4	39.5	45.5	32.0
Fixed Assets Turnover	10.0			
		6.2	8.41	7.0
Total Assets Turnover				
	2.3	2.0	2.00	2.5
Debt Ratio	54.8%	80.7%	43.8%	50.0%
TIE	3.3	0.1	6.3	6.2
EBITDA Coverage	2.6	0.8	5.5	8.0
Profit Margin	2.6%	-1.6%	3.6%	3.6%
Basic Earning Power	14.2%	0.6%	14.3%	17.8%
ROA	6.0%	-3.3%	7.2%	9.0%
ROE	13.3%	-17.1%	12.8%	17.9%
Price/Earnings (P/E)	9.7	-6.3	12.0	16.2
Price/Cash Flow	8.0	27.5	8.1	7.6
Market/Book	1.3	1.1	1.5	2.9

**a. Why are ratios useful? What are the five major categories of ratios?**

**Answer:** Ratios are used by managers to help improve the firm's performance, by lenders to help evaluate the firm's likelihood of repaying debts, and by stockholders to help forecast future earnings and dividends. The five major categories of ratios are: liquidity, asset management, debt management, profitability, and market value.

**b. Calculate the 2005 current and quick ratios based on the projected balance sheet and income statement data. What can you say about the company's liquidity position in 2003, 2004, and as projected for 2005? We often think of ratios as being useful (1) to managers to help run the business, (2) to bankers for credit analysis, and (3) to stockholders for stock valuation. Would these different types of analysts have an equal interest in the liquidity ratios?**

**Answer:**  $\text{Current Ratio}_{05} = \text{Current Assets}/\text{Current Liabilities}$   
 $= \$2,680,112/\$1,039,800 = 2.58\times$ .

$\text{Quick Ratio}_{05} = (\text{Current Assets} - \text{Inventory})/\text{Current Liabilities}$   
 $= (\$2,680,112 - \$1,716,480)/\$1,039,800 = 0.93\times$ .

The company's current and quick ratios are higher relative to its 2003 current and quick ratios; they have improved from their 2004 levels. Both ratios are below the industry average, however.

**c. Calculate the 2005 inventory turnover, days sales outstanding (DSO), fixed assets turnover, and total assets turnover. How does Computron's utilization of assets stack up against other firms in its industry?**

**Answer:**  $\text{Inventory Turnover}_{05} = \text{Sales}/\text{Inventory}$   
 $= \$7,035,600/\$1,716,480 = 4.10\times$ .

$\text{DSO}_{05} = \text{Receivables}/(\text{Sales}/365)$   
 $= \$878,000/(\$7,035,600/365) = 45.5 \text{ Days}$ .

$\text{Fixed Assets Turnover}_{05} = \text{Sales}/\text{Net Fixed Assets}$   
 $= \$7,035,600/\$836,840 = 8.41\times$ .

$\text{Total Assets Turnover}_{05} = \text{Sales}/\text{Total Assets}$   
 $= \$7,035,600/\$3,516,952 = 2.0\times$ .

The firm's inventory turnover ratio has been steadily declining, while its days sales outstanding has been steadily increasing. While the firm's fixed assets turnover ratio is below its 2003 level, it is above the 2004 level. The firm's total assets turnover ratio is below its 2003 level and equal to its 2004 level.

The firm's inventory turnover and total assets turnover are below the industry average. The firm's days sales outstanding is above the industry average (which is bad); however, the firm's fixed assets turnover is above the industry average. (This might be due to the fact that Computron is an older firm than most other firms in the industry, in which case, its fixed assets are older and thus have been depreciated more, or that Computron's cost of fixed assets were lower than most firms in the industry.)

**d. Calculate the 2005 debt, times-interest-earned, and EBITDA coverage ratios. How does Computron compare with the industry with respect to financial leverage? What can you conclude from these ratios?**

**Answer:** Debt Ratio<sub>05</sub> = Total Liabilities/Total Assets  
 $= (\$1,039,800 + \$500,000)/\$3,516,952 = 43.8\%$ .  
 Tie<sub>05</sub> = EBIT/Interest =  $\$502,640/\$80,000 = 6.3\times$ .

$$\text{EBITDA Coverage}_{05} = \left( \text{EBITDA} + \frac{\text{Lease}}{\text{Payments}} \right) / \left( \text{Interest} + \frac{\text{Loan}}{\text{Repayments}} + \frac{\text{Lease}}{\text{Payments}} \right)$$

$$= (\$502,640 + \$120,000 + \$40,000)/(\$80,000 + \$40,000) = 5.5\times.$$

The firm's debt ratio is much improved from 2004, and is still lower than its 2002 level and the industry average. The firm's TIE and EBITDA coverage ratios are much improved from their 2003 and 2004 levels. The firm's TIE is better than the industry average, but the EBITDA coverage is lower, reflecting the firm's higher lease obligations.

**e. Calculate the 2005 profit margin, basic earning power (BEP), return on assets (ROA), and return on equity (ROE). What can you say about these ratios?**

**Answer:** Profit Margin<sub>05</sub> = Net Income/Sales =  $\$253,584/\$7,035,600 = 3.6\%$ .

Basic Earning Power<sub>05</sub> = EBIT/Total Assets =  $\$502,640/\$3,516,952 = 14.3\%$ .

ROA<sub>05</sub> = Net Income/Total Assets =  $\$253,584/\$3,516,952 = 7.2\%$ .

ROE<sub>05</sub> = Net Income/Common Equity =  $\$253,584/\$1,977,152 = 12.8\%$ .

The firm's profit margin is above 2003 and 2004 levels and is at the industry average. The basic earning power, ROA, and ROE ratios are above both 2003 and 2004 levels, but below the industry average due to poor asset utilization.

**f. Calculate the 2005 price/earnings ratio, price/cash flow ratios, and market/book ratio. Do these ratios indicate that investors are expected to have a high or low opinion of the company?**

**Answer:**  $EPS = \text{Net Income}/\text{Shares Outstanding} = \$253,584/250,000 = \$1.0143.$

$$\begin{aligned}\text{Price/Earnings}_{05} &= \text{Price Per Share/Earnings Per Share} \\ &= \$12.17/\$1.0143 = 12.0\times.\end{aligned}$$

Check:  $\text{Price} = EPS \times P/E = \$1.0143(12) = \$12.17.$

$$\begin{aligned}\text{Cash Flow/Share}_{05} &= (\text{NI} + \text{DEP})/\text{Shares} \\ &= (\$253,584 + \$120,000)/250,000 \\ &= \$1.49.\end{aligned}$$

$$\text{Price/Cash Flow} = \$12.17/\$1.49 = 8.2\times.$$

$$\begin{aligned}\text{BVPS} &= \text{Common Equity}/\text{Shares Outstanding} \\ &= \$1,977,152/250,000 = \$7.91.\end{aligned}$$

$$\begin{aligned}\text{Market/Book} &= \text{Market Price Per Share}/\text{Book Value Per Share} \\ &= \$12.17/\$7.91 = 1.54\times.\end{aligned}$$

Both the P/E ratio and BVPS are above the 2003 and 2004 levels but below the industry average.

**g. Perform a common size analysis and percent change analysis. What do these analyses tell you about Computron?**

**Answer:** For the common size balance sheets, divide all items in a year by the total assets for that year. For the common size income statements, divide all items in a year by the sales in that year.

### Common Size Balance Sheets

#### Assets

	2003	2004	2005e	Ind.
Cash	0.6%	0.3%	0.4%	0.3%
Short Term Investments	3.3%	0.7%	2.0%	0.3%
Accounts Receivable	23.9%	21.9%	25.0%	22.4%
Inventories	48.7%	44.6%	48.8%	41.2%
Total Current Assets	76.5%	67.4%	76.2%	64.1%
Gross Fixed Assets	33.4%	41.7%	34.7%	53.9%
Less Accumulated Depreciation	10.0%	9.1%	10.9%	18.0%
Net Fixed Assets	23.5%	32.6%	23.8%	35.9%
Total Assets	100.0%	100.0%	100.0%	100.0%

#### Liabilities And Equity

	2003	2004	2005e	Ind.
Accounts Payable	9.9%	11.2%	10.2%	11.9%
Notes Payable	13.6%	24.9%	8.5%	2.4%
Accruals	9.3%	9.9%	10.8%	9.5%
Total Current Liabilities	32.8%	46.0%	29.6%	23.7%
Long-Term Debt	22.0%	34.6%	14.2%	26.3%
Common Stock (100,000 Shares)	31.3%	15.9%	47.8%	20.0%
Retained Earnings	13.9%	3.4%	8.4%	30.0%
Total Equity	45.2%	19.3%	56.2%	50.0%
Total Liabilities And Equity	100.0%	100.0%	100.0%	100.0%

Common Size Income Statement	2003	2004	2005e	Ind.
Sales	100.0%	100.0%	100.0%	100.0%
Cost Of Goods Sold	83.4%	85.4%	82.4%	84.5%
Other Expenses	9.9%	12.3%	8.7%	4.4%
Depreciation	0.6%	2.0%	1.7%	4.0%
Total Operating Costs	93.9%	99.7%	92.9%	92.9%
EBIT	6.1%	0.3%	7.1%	7.1%
Interest Expense	1.8%	3.0%	1.1%	1.1%
EBT	4.3%	-2.7%	6.0%	5.9%
Taxes (40%)	1.7%	-1.1%	2.4%	2.4%
Net Income	2.6%	-1.6%	3.6%	3.6%

Computron has higher proportion of inventory and current assets than industry. Computron has slightly more equity (which means less debt) than industry. Computron has more short-term debt than industry, but less long-term debt than industry. Computron has lower COGS than industry, but higher other expenses. Result is that Computron has similar EBIT as industry.

For the percent change analysis, divide all items in a row by the value in the first year of the analysis.

**Percent Change Balance Sheets**

*Assets*

	2003	2004	2005e
Cash	0.0%	-19.1%	55.6%
Short Term Investments	0.0%	-58.8%	47.4%
Accounts Receivable	0.0%	80.0%	150.0%
Inventories	0.0%	80.0%	140.0%
Total Current Assets	0.0%	73.2%	138.4%
Gross Fixed Assets	0.0%	145.0%	148.5%
Less Accumulated Depreciation	0.0%	80.0%	162.1%
Net Fixed Assets	0.0%	172.6%	142.7%
Total Assets	0.0%	96.5%	139.4%

*Liabilities And Equity*

	2003	2004	2005e
Accounts Payable	0.0%	122.5%	147.1%
Notes Payable	0.0%	260.0%	50.0%
Accruals	0.0%	109.5%	179.4%
Total Current Liabilities	0.0%	175.9%	115.9%
Long-Term Debt	0.0%	209.2%	54.6%
Common Stock (100,000 Shares)	0.0%	0.0%	265.4%
Retained Earnings	0.0%	-52.1%	45.4%
Total Equity	0.0%	-16.0%	197.9%
Total Liabilities And Equity	0.0%	96.5%	139.4%

**Percent Change Income Statement**

	2003	2004	2005e
Sales	0.0%	70.0%	105.0%
Cost Of Goods Sold	0.0%	73.9%	102.5%
Other Expenses	0.0%	111.8%	80.3%
Depreciation	0.0%	518.8%	534.9%
Total Operating Costs	0.0%	80.5%	102.7%
EBIT	0.0%	-91.7%	140.4%
Interest Expense	0.0%	181.6%	28.0%
EBT	0.0%	-208.2%	188.3%
Taxes (40%)	0.0%	-208.2%	188.3%
Net Income	0.0%	-208.2%	188.3%

We see that 2005 sales grew 105% from 2002, and that NI grew 188% from 2003. So Computron has become more profitable. We see that total assets grew at a rate of 139%, while sales grew at a rate of only 105%. So asset utilization remains a problem.

**h. Use the extended Du Pont equation to provide a summary and overview of Computron's financial condition as projected for 2005. What are the firm's major strengths and weaknesses?**

**Answer:** Du Pont Equation =  $\frac{\text{Profit}}{\text{Margin}} \times \frac{\text{Total Assets}}{\text{Turnover}} \times \frac{\text{Equity}}{\text{Multiplier}}$   
 $= 3.6\% \times 2.0 \times (\$3,516,952/\$1,977,152)$   
 $= 3.6\% \times 2.0 \times 1.8 = 13.0\%$

**Strengths:** The firm's fixed assets turnover was above the industry average. However, if the firm's assets were older than other firms in its industry this could possibly account for the higher ratio. (Computron's fixed assets would have a lower historical cost and would have been depreciated for longer periods of time.) The firm's profit margin is slightly above the industry average, despite its higher debt ratio. This would indicate that the firm has kept costs down, but, again, this could be related to lower depreciation costs.

**Weaknesses:** The firm's liquidity ratios are low; most of its asset management ratios are poor (except fixed assets turnover); its debt management ratios are poor, most of its profitability ratios are low (except profit margin); and its market value ratios are low.

**i. What are some potential problems and limitations of financial ratio analysis?**

**Answer:** Some potential problems are listed below:

1. Comparison with industry averages is difficult if the firm operates many different divisions.
2. Different operating and accounting practices distort comparisons.
3. Sometimes hard to tell if a ratio is "good" or "bad."
4. Difficult to tell whether company is, on balance, in a strong or weak position.
5. "Average" performance is not necessarily good.
6. Seasonal factors can distort ratios.
7. "Window dressing" techniques can make statements and ratios look better.

**j. What are some qualitative factors analysts should consider when evaluating a company's likely future financial performance?**

**Answer:** Top analysts recognize that certain qualitative factors must be considered when evaluating a company. These factors, as summarized by the American Association Of Individual Investors (AAII), are as follows:

1. Are the company's revenues tied to one key customer?
2. To what extent are the company's revenues tied to one key product?
3. To what extent does the company rely on a single supplier?
4. What percentage of the company's business is generated overseas?
5. Competition
6. Future prospects
7. Legal and regulatory environment

# Chapter 14

## Financial Planning and Forecasting Pro Forma Financial Statements

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 14-1
- a. The operating plan provides detailed implementation guidance designed to accomplish corporate objectives. It details who is responsible for what particular function, and when specific tasks are to be accomplished. The financial plan details the financial aspects of the corporation's operating plan. In addition to an analysis of the firm's current financial condition, the financial plan normally includes a sales forecast, the capital budget, the cash budget, pro forma financial statements, and the external financing plan. A sales forecast is merely the forecast of unit and dollar sales for some future period. Of course, a lot of work is required to produce a good sales forecast. Generally, sales forecasts are based on the recent trend in sales plus forecasts of the economic prospects for the nation, industry, region, and so forth. The sales forecast is critical to good financial planning.
  - b. A pro forma financial statement shows how an actual statement would look if certain assumptions are realized. With the percent of sales forecasting method, many items on the income statement and balance sheets are assumed to increase proportionally with sales. As sales increase, these items that are tied to sales also increase, and the values of these items for a particular year are estimated as percentages of the forecasted sales for that year.
  - c. Funds are spontaneously generated if a liability account increases spontaneously (automatically) as sales increase. An increase in a liability account is a source of funds, thus funds have been generated. Two examples of spontaneous liability accounts are accounts payable and accrued wages. Note that notes payable, although a current liability account, is not a spontaneous source of funds since an increase in notes payable requires a specific action between the firm and a creditor.

- d. Additional funds needed (AFN) are those funds required from external sources to increase the firm's assets to support a sales increase. A sales increase will normally require an increase in assets. However, some of this increase is usually offset by a spontaneous increase in liabilities as well as by earnings retained in the firm. Those funds that are required but not generated internally must be obtained from external sources. Although most firms' forecasts of capital requirements are made by constructing pro forma income statements and balance sheets, the AFN formula is sometimes used to forecast financial requirements. It is written as follows:

Additional Required Spontaneous Increase in  
funds = increase – increase in – retained  
needed in assets liabilities earnings

$$\text{AFN} = \left( \frac{A^*}{S} \right) \Delta S - \left( \frac{L^*}{S} \right) \Delta S - \text{MS}_1 (1 - d).$$

**Capital intensity is the dollar amount of assets required to produce a dollar of sales. The capital intensity ratio is the reciprocal of the total assets turnover ratio.**

- e. "Lumpy" assets are those assets that cannot be acquired smoothly, but require large, discrete additions. For example, an electric utility that is operating at full capacity cannot add a small amount of generating capacity, at least not economically.
- 14-2 Accounts payable, accrued wages, and accrued taxes increase spontaneously and proportionately with sales. Retained earnings increase, but not proportionately.
- 14-3 The equation gives good forecasts of financial requirements if the ratios  $A^*/S$  and  $L^*/S$ , as well as  $M$  and  $d$ , are stable. Otherwise, another forecasting technique should be used.
- 14-5
- a. +.
  - b. +. It reduces spontaneous funds; however, it may eventually increase retained earnings.
  - c. +.
  - d. +.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

$$\begin{aligned} 14-1 \quad \text{AFN} &= (A^*/S_0)\Delta S - (L^*/S_0)\Delta S - MS_1(1 - d) \\ &= \left(\frac{\$3,000,000}{\$5,000,000}\right)\$1,000,000 - \left(\frac{\$500,000}{\$5,000,000}\right)\$1,000,000 - 0.05(\$6,000,000)(1 - 0.7) \\ &= (0.6)(\$1,000,000) - (0.1)(\$1,000,000) - (\$300,000)(0.3) \\ &= \$600,000 - \$100,000 - \$90,000 \\ &= \$410,000. \end{aligned}$$

$$\begin{aligned} 14-2 \quad \text{AFN} &= \left(\frac{\$4,000,000}{\$5,000,000}\right)\$1,000,000 - (0.1)(\$1,000,000) - (\$300,000)(0.3) \\ &= (0.8)(\$1,000,000) - \$100,000 - \$90,000 \\ &= \$800,000 - \$190,000 \\ &= \$610,000. \end{aligned}$$

The capital intensity ratio is measured as  $A^*/S_0$ . This firm's capital intensity ratio is higher than that of the firm in Problem 14-1; therefore, this firm is more capital intensive--it would require a large increase in total assets to support the increase in sales.

$$\begin{aligned} 14-3 \quad \text{AFN} &= (0.6)(\$1,000,000) - (0.1)(\$1,000,000) - 0.05(\$6,000,000)(1 - 0) \\ &= \$600,000 - \$100,000 - \$300,000 \\ &= \$200,000. \end{aligned}$$

Under this scenario the company would have a higher level of retained earnings which would reduce the amount of additional funds needed.

- 14-4  $S_{2004} = \$2,000,000$ ;  $A_{2004} = \$1,500,000$ ;  $CL_{2004} = \$500,000$ ;  
 $NP_{2004} = \$200,000$ ;  $A/P_{2004} = \$200,000$ ;  $Accruals_{2004} = \$100,000$ ;  
 $PM = 5\%$ ;  $d = 60\%$ ;  $A^*/S_0 = 0.75$ .

$$\begin{aligned} AFN &= (A^*/S_0)\Delta S - (L^*/S_0)\Delta S - MS_1(1 - d) \\ &= (0.75)\Delta S - \left( \frac{\$300,000}{\$2,000,000} \right) \Delta S - (0.05)(S_1)(1 - 0.6) \\ &= (0.75)\Delta S - (0.15)\Delta S - (0.02)S_1 \\ &= (0.6)\Delta S - (0.02)S_1 \\ &= 0.6(S_1 - S_0) - (0.02)S_1 \\ &= 0.6(S_1 - \$2,000,000) - (0.02)S_1 \\ &= 0.6S_1 - \$1,200,000 - 0.02S_1 \end{aligned}$$

$$\$1,200,000 = 0.58S_1$$

$$\$2,068,965.52 = S_1.$$

Sales can increase by  $\$2,068,965.52 - \$2,000,000 = \$68,965.52$  without additional funds being needed.

- 14-5 a.  $AFN = (A^*/S)(\Delta S) - (L^*/S)(\Delta S) - MS_1(1 - d)$   
 $= \frac{\$122.5}{\$350}(\$70) - \frac{\$17.5}{\$350}(\$70) - \frac{\$10.5}{\$350}(\$420)(0.6) = \$13.44$  million.

b.

**Upton Computers**  
**Pro Forma Balance Sheet**  
**December 31, 2005**  
**(Millions of Dollars)**

Pro Forma after	Forecast		Basis %			
<u>Financing</u>	<u>2004</u>	<u>2005</u>	<u>Sales</u>	<u>Additions</u>	<u>Pro Forma</u>	<u>Financing</u>
Cash	\$ 3.5	0.0100		\$ 4.20		\$ 4.20
Receivables	26.0	0.7430		31.20		31.20
Inventories	<u>58.0</u>	0.1660		<u>69.60</u>		<u>69.60</u>
Total current assets	\$ 87.5			\$105.00		\$105.00
Net fixed assets	<u>35.0</u>	0.100		<u>42.00</u>		<u>42.00</u>
Total assets	<u>\$122.5</u>			<u>\$147.00</u>		<u>\$147.00</u>
Accounts payable	\$ 9.0	0.0257		\$ 10.80		\$ 10.80
Notes payable	18.0			18.00	+13.44	31.44
Accruals	<u>8.5</u>	0.0243		<u>10.20</u>		<u>10.20</u>
Total current liabilities	\$ 35.5			\$ 39.00		\$ 52.44
Mortgage loan	6.0			6.00		6.00
Common stock	15.0			15.00		15.00
Retained earnings	<u>66.0</u>		7.56*	<u>73.56</u>		<u>73.56</u>
Total liab. and equity	<u>\$122.5</u>			<u>\$133.56</u>		<u>\$147.00</u>
AFN =				<u>\$ 13.44</u>		

\*PM = \$10.5/\$350 = 3%.

Payout = \$4.2/\$10.5 = 40%.

NI = \$350 × 1.2 × 0.03 = \$12.6.

Addition to RE = NI - DIV = \$12.6 - 0.4(\$12.6) = 0.6(\$12.6) = \$7.56.

14-6 a.

**Stevens Textiles**  
**Pro Forma Income Statement**  
**December 31, 2005**  
**(Thousands of Dollars)**

	Forecast	2004	Pro Forma	Basis
<u>2005</u>				
Sales	\$36,000	$1.15 \times \text{Sales}_{04}$	\$41,400	
Operating costs	<u>\$32,440</u>	$0.9011 \times \text{Sales}_{05}$	<u>37,306</u>	
EBIT	\$ 3,560		\$ 4,094	
Interest	<u>460</u>	$0.10 \times \text{Debt}_{04}$	<u>560</u>	
EBT	\$ 3,100		\$ 3,534	
Taxes (40%)	<u>1,240</u>		<u>1,414</u>	
Net income	<u>\$ 1,860</u>		<u>\$ 2,120</u>	
Dividends (45%)	\$ 837			\$ 954
Addition to RE	\$ 1,023		\$ 1,166	

**Stevens Textiles**  
**Pro Forma Balance Sheet**  
**December 31, 2005**  
**(Thousands of Dollars)**

	Forecast		%
	Basis	2005 Sales	Additions
Pro Forma	<u>2004</u>	<u>2005 Sales</u>	<u>Pro Forma</u>
after			<u>Financing</u>
<u>Financing</u>			
Cash	\$ 1,0800	0.0300	\$ 1,242
Accts receivable	6,480	0.1883	7,452
Inventories	<u>9,000</u>	0.2005	<u>10,350</u>
Total curr. assets	\$16,560		\$19,044
Fixed assets	<u>12,600</u>	0.3500	<u>14,490</u>
Total assets	<u>\$29,160</u>		<u>\$33,534</u>
Accounts payable	\$ 4,320	0.1200	\$ 4,968
Accruals	2,880	0.0800	3,312
Notes payable	<u>2,100</u>		<u>2,100</u>
Total current liabilities	\$ 9,300		\$10,380
Long-term debt	<u>3,500</u>		<u>3,500</u>
Total debt	\$12,800		\$13,880
Common stock	3,500		3,500
Retained earnings	<u>12,860</u>	1,166*	<u>14,026</u>
Total liabilities and equity	<u>\$29,160</u>		<u>\$31,406</u>

AFN = \$ 2,128  
 \*From income statement.

14-7 a. & b.

**Garlington Technologies Inc.  
 Pro Forma Income Statement  
 December 31, 2005**

Basis	Forecast		2004
	Additions	2005	
Sales	\$3,600,000	$1.10 \times \text{Sales}_{04}$	\$3,960,000
Operating costs	<u>3,279,720</u>	$0.911 \times \text{Sales}_{05}$	<u>3,607,692</u>
EBIT	\$ 320,280		\$
352,308			
Interest	<u>18,280</u>	$0.13 \times \text{Debt}_{04}$	<u>20,280</u>
EBT	\$ 302,000		\$ 332,028
Taxes (40%)	<u>120,800</u>		<u>132,811</u>
Net income	<u>\$ 181,200</u>		<u>\$ 199,217</u>
Dividends:	\$ 108,000	Set by management	\$ 112,000
Addition to RE:	\$ 73,200		\$ 87,217

**Garlington Technologies Inc.**  
**Pro Forma Balance Statement**  
**December 31, 2005**

AFN	Forecast Basis	%
With AFN		
2004	2005 Sales	2005
Effects	Additions	
Cash	0.05	
Receivables	0.10	
Inventories	0.20	
Total current assets		
Fixed assets	0.40	
Total assets		
Accounts payable	0.10	
Notes payable		
Accruals	0.05	
Total current liabilities		
Common stock		
Retained earnings	87,217*	
Total liab. and equity		
AFN =		
Cumulative AFN =		

\*See income statement.

14-8 a. 
$$\text{Total liabilities and equity} = \text{Accounts Payable} + \text{Long-term debt} + \text{Common stock} + \text{Retained earnings}$$

$$\begin{aligned} \$1,200,000 &= \$375,000 + \text{Long-term debt} + \$425,000 + \$295,000 \\ \text{Long-term debt} &= \$105,000. \end{aligned}$$

$$\begin{aligned} \text{Total debt} &= \text{Accounts payable} + \text{Long-term debt} \\ &= \$375,000 + \$105,000 = \$480,000. \end{aligned}$$

Alternatively,

$$\begin{aligned} &\text{Total} \\ \text{Total debt} &= \text{liabilities and equity} - \text{Common stock} - \text{Retained earnings} \\ &= \$1,200,000 - \$425,000 - \$295,000 = \$480,000. \end{aligned}$$

b. 
$$\begin{aligned} \text{Assets/Sales (A*/S)} &= \$1,200,000/\$2,500,000 = 48\%. \\ \text{L*/Sales} &= \$375,000/\$2,500,000 = 15\%. \\ \text{2002 Sales} &= (1.25)(\$2,500,000) = \$3,125,000. \end{aligned}$$

$$\begin{aligned} \text{AFN} &= (\text{A*/S})(\Delta S) - (\text{L*/S})(\Delta S) - \text{MS}_1(1 - d) - \text{New common stock} \\ &= (0.48)(\$625,000) - (0.15)(\$625,000) - (0.06)(\$3,125,000)(0.6) - \$75,000 \\ &= \$300,000 - \$93,750 - \$112,500 - \$75,000 = \$18,750. \end{aligned}$$

Alternatively, using the percentage of sales method:

<u>Financing, R/E)</u>	<u>Pro Forma</u>	Forecast Basis %	Additions (New	
			<u>2004</u>	<u>2005 Sales</u>
Total assets	<u>\$1,200,000</u>	0.48		<u>\$1,500,000</u>
Current liabilities	\$ 375,000	0.15		\$ 468,750
Long-term debt	<u>105,000</u>			<u>105,000</u>
Total debt	<u>\$ 480,000</u>			<u>\$ 573,750</u>
Common stock	425,000		75,000*	500,000
Retained earnings	<u>295,000</u>		112,500**	<u>407,500</u>
Total common equity	<u>\$ 720,000</u>			<u>\$ 907,500</u>
Total liabilities and equity	<u>\$1,200,000</u>			<u>\$1,481,250</u>
AFN = Long-term debt =				<u>\$ 18,750</u>

\*Given in problem that firm will sell new common stock = \$75,000.

\*\*PM = 6%; Payout = 40%;  $\text{NI}_{2005} = \$2,500,000 \times 1.25 \times 0.06 = \$187,500$ .

Addition to RE =  $\text{NI} \times (1 - \text{Payout}) = \$187,500 \times 0.6 = \$112,500$ .

14-9	Cash	\$ 100.00	× 2	=	\$ 200.00
	Accounts receivable	200.00	× 2	=	400.00
	Inventories	200.00	× 2	=	400.00
	Net fixed assets	<u>500.00</u>	+ 0.0	=	<u>500.00</u>
	Total assets	<u>\$1,000.00</u>			<u>\$1,500.00</u>
	Accounts payable	\$ 50.00	× 2	=	\$ 100.00
	Notes payable	150.00	150.00 + 360.00	=	510.00
	Accruals	50.00	× 2 =		1 00.00
	Long-term debt	400.00			
	400.00				
	Common stock	100.00			
	100.00				
	Retained earnings	<u>250.00</u>	+ 40	=	<u>290.00</u>
	Total liabilities				
	and equity				
	<u>\$1,140.00</u>				<u>\$1,000.00</u>
	AFN				
	<u>\$ 360.00</u>				

Capacity sales = Sales/0.5 = \$1,000/0.5 = \$2,000.

Target FA/S ratio = \$500/\$2,000 = 0.25.

Target FA = 0.25(\$2,000) = \$500 = Required FA. Since the firm currently has \$500 of fixed assets, no new fixed assets will be required.

Addition to RE =  $M(S_1)(1 - \text{Payout ratio}) = 0.05(\$2,000)(0.4) = \$40$ .

## SOLUTION TO SPREADSHEET PROBLEM

---

- 14-10 The detailed solution for the spreadsheet problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 14 -10 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

Betty Simmons, the new financial manager of Southeast Chemicals (SEC), a Georgia producer of specialized chemicals for use in fruit orchards, must prepare a financial forecast for 2005. SEC's 2004 sales were \$2 billion, and the marketing department is forecasting a 25 percent increase for 2005. Simmons thinks the company was operating at full capacity in 2004, but she is not sure about this. The 2004 financial statements, plus some other data, are shown below.

Assume that you were recently hired as Simmons' assistant, and your first major task is to help her develop the forecast. She asked you to begin by answering the following set of questions.

### Financial Statements And Other Data On SEC (Millions Of Dollars)

A. 2004 Balance Sheet	%	of
% of		
<u>sales</u>	<u>sales</u>	
Cash & Securities	\$ 20	1%
Accounts Receivable	240	12
Inventory	<u>240</u>	12
Total Current Assets	\$ 500	
Net Fixed Assets	<u>500</u>	25
Total Assets	<u>\$1,000</u>	
Accounts Payable And Accruals	\$ 100	5%
Notes Payable	<u>100</u>	
Total Current Liabilities	\$ 200	
Long-Term Debt	100	
Common Stock	500	
Retained Earnings	<u>200</u>	
Total Liabilities And Equity	<u>\$1,000</u>	

B. 2004 Income Statement	%	of
	<u>sales</u>	
Sales	\$2,000.00	
Cost Of Goods Sold (COGS)	1,200.00	60%
Sales, General, And Administrative Costs	<u>700.00</u>	35
Earnings Before Interest And Taxes	\$ 100.00	
Interest		<u>10.00</u>
Earnings Before Taxes	\$ 90.00	
Taxes (40%)	<u>36.00</u>	
Net Income	\$ 54.00	
Dividends (40%)	<u>\$ 21.60</u>	
Addition To Retained Earnings	<u>\$ 32.40</u>	

C. Key Ratios

Sec

Industry

Profit Margin	2.70	4.00
Return On Equity	7.71	15.60
Days Sales Outstanding (365 Days)	43.80 Days	32.00 Days
Inventory Turnover	8.33×	11.00×
Fixed Assets Turnover	4.00	5.00
Debt/Assets	30.00%	36.00%
Times Interest Earned	10.00×	9.40×
Current Ratio	2.50	3.00
Return On Invested Capital (NOPAT/Operating Capital)	6.67%	14.00%

**a. Describe three ways that pro forma statements are used in financial planning.**

**Answer:** Three important uses: (1) forecast the amount of external financing that will be required, (2) evaluate the impact that changes in the operating plan have on the value of the firm, (3) set appropriate targets for compensation plans

**b. Explain the steps in financial forecasting.**

**Answer:** (1) forecast sales, (2) project the assets needed to support sales, (3) project internally generated funds, (4) project outside funds needed, (5) decide how to raise funds, and (6) see effects of plan on ratios and stock price.

**c. Assume (1) that SEC was operating at full capacity in 2004 with respect to all assets, (2) that all assets must grow proportionally with sales, (3) that accounts payable and accruals will also grow in proportion to sales, and (4) that the 2004 profit margin and dividend payout will be maintained. Under these conditions, what will the company's financial requirements be for the coming year? Use the AFN equation to answer this question.**

**Answer:** SEC will need \$184.5 million. Here is the AFN equation:

$$\begin{aligned}
 \text{AFN} &= (A^*/S_0)\Delta S - (L^*/S_0)\Delta S - M(S_1)(RR) \\
 &= (A^*/S_0)(g)(S_0) - (L^*/S_0)(g)(S_0) - M(S_0)(1 + g)(1 - \text{payout}) \\
 &= (\$1,000/\$2,000)(0.25)(\$2,000) - (\$100/\$2,000)(0.25)(\$2,000) \\
 &\quad - 0.0270(\$2,000)(1.25)(0.6) \\
 &= \$250 - \$25 - \$40.5 = \$184.5 \text{ million.}
 \end{aligned}$$

**d. How would changes in these items affect the AFN? (1) sales increase, (2) the dividend payout ratio increases, (3) the profit margin increases, (4) the capital intensity ratio increases, and (5) SEC begins paying its suppliers sooner. (Consider each item separately and hold all other things constant.)**

**Answer:** 1. If sales increase, more assets are required, which increases the AFN.

2. If the payout ratio were reduced, then more earnings would be retained, and this would reduce the need for external financing, or AFN. Note that if the firm is profitable and has any payout ratio less than 100 percent, it will have some retained earnings, so if the growth rate were zero, AFN would be negative, i.e., the firm would have surplus funds. As the growth rate rose above zero, these surplus funds would be used to finance growth. At some point, i.e., at some growth rate, the surplus AFN would be exactly used up. This growth rate where  $AFN = \$0$  is called the “sustainable growth rate,” and it is the maximum growth rate which can be financed without outside funds, holding the debt ratio and other ratios constant.
3. If the profit margin goes up, then both total and retained earnings will increase, and this will reduce the amount of AFN.
4. The capital intensity ratio is defined as the ratio of required assets to total sales, or  $a^*/s_0$ . Put another way, it represents the dollars of assets required per dollar of sales. The higher the capital intensity ratio, the more new money will be required to support an additional dollar of sales. Thus, the higher the capital intensity ratio, the greater the AFN, other things held constant.
5. If SEC begins paying sooner, this reduces spontaneous liabilities, leading to a higher AFN.

**e. Briefly explain how to forecast financial statements using the percent of sales approach. Be sure to explain how to forecast interest expenses.**

**Answer:** Project sales based on forecasted growth rate in sales. Forecast some items as a percent of the forecasted sales, such as costs, cash, accounts receivable, inventories, net fixed assets, accounts payable, and accruals. Choose other items according to the company’s financial policy: debt, dividend policy (which determines retained earnings), common stock. Given the previous assumptions and choices, we can estimate the required assets to support sales and the specified sources of financing. The additional funds needed (AFN) is: required assets minus specified sources of financing. If AFN is positive, then you must secure additional financing. If AFN is negative, then you have more financing than is needed and you can pay off debt, buy back stock, or buy short-term investments.

Interest expense is actually based on the daily balance of debt during the year. There are three ways to approximate interest expense. You can base it on: (1) debt at end of year, (2) debt at beginning of year, or (3) average of beginning and ending debt.

Basing interest expense on debt at end of year will over-estimate interest expense if debt is added throughout the year instead of all on January 1. It also causes circularity called financial feedback: more debt causes more interest, which reduces net income, which reduces retained earnings, which causes more debt, etc.

Basing interest expense on debt at beginning of year will under-estimate interest expense if debt is added throughout the year instead of all on December 31. But it doesn’t cause problem of circularity.

Basing interest expense on average of beginning and ending debt will accurately estimate the interest payments if debt is added smoothly throughout the year. But it has the problem of circularity.

A solution that balances accuracy and complexity is to base interest expense on beginning debt, but use a slightly higher interest rate. This is easy to implement and is reasonably accurate. See *FMII Ch 14 Mini Case Feedback.xls* for an example basing interest expense on average debt.

**f.** Now estimate the 2005 financial requirements using the percent of sales approach. Assume (1) that each type of asset, as well as payables, accruals, and fixed and variable costs, will be the same percent of sales in 2005 as in 2004; (2) that the payout ratio is held constant at 40 percent; (3) that external funds needed are financed 50 percent by notes payable and 50 percent by long-term debt (no new common stock will be issued); (4) that all debt carries an interest rate of 10 percent; and (5) interest expenses should be based on the balance of debt at the beginning of the year.

**Answer:** See the completed worksheet. The problem is not difficult to do “by hand,” but we used a spreadsheet model for the flexibility such a model provides.

Income Statement

(In Millions Of Dollars)

	Actual	Forecast Basis		Forecast
	2004			2005
Sales	\$ 2,000.0	Growth	1.25	\$ 2,500.0
COGS	\$ 1,200.0	% Of Sales	60.00%	\$ 1,500.0
SGA Expenses	\$ 700.0	% Of Sales	35.00%	\$ 875.0
EBIT	\$ 100.0			\$ 125.0
Less Interest	\$ 10.0	Interest Rate X Debt <sub>04</sub>		\$ 20.0
EBT	\$ 90.0			\$ 105.0
Taxes (40%)	\$ 36.0			\$ 42.0
Net Income	\$ 54.0			\$ 63.0
Dividends	\$ 21.6			\$ 25.2
Add. To Retained Earnings	\$ 32.4			\$ 37.8

Balance Sheet (In Millions Of Dollars)	2004	Forecast Basis		2005 Forecast	
				Without AFN	With AFN
Assets					0
Cash	\$ 20.0	% Of Sales	1.00%	\$ 25.0	\$ 25.0
Accounts Receivable	\$240.0	% Of Sales	12.00%	\$300.0	\$300.0
Inventories	\$240.0	% Of Sales	12.00%	\$300.0	\$300.0
Total Current Assets	\$500.0			\$625.0	\$625.0
Net Plant And Equipment	\$500.0	% Of Sales	25.00%	\$625.0	\$625.0
Total Assets	\$1,000.0			\$1,250.0	\$1,250.0
Liabilities And Equity					
Accounts Payable & Accruals	\$100.0	% Of Sales	5.00%	\$125.0	\$125.0
Notes Payable	\$100.0	Carry-Over		\$100.0	\$93.6
Total Current Liabilities	\$200.0			\$225.0	\$318.6
Long-Term Bonds	\$100.0	Carry-Over		\$100.0	\$93.6
Total Liabilities	\$300.0			\$325.0	\$512.2
Common Stock	\$500.0	Carry-Over		\$500.0	\$500.0
Retained Earnings	\$200.0	RE <sub>04</sub> + ΔRE <sub>04</sub>		\$237.8	\$237.8
Total Common Equity	\$700.0			\$737.8	\$737.8
Total Liabilities And Equity	\$1,000.0			\$1,062.8	\$1,250.0
Required Assets =				\$1,250.0	
Specified Sources Of Financing =				\$1,062.8	
Additional Funds Needed (AFN)				\$187.20	

**g. Why does the percent of sales approach produce a somewhat different AFN than the equation approach? Which method provides the more accurate forecast?**

**Answer:** The difference occurs because the AFN equation method assumes that the profit margin remains constant, while the forecasted balance sheet method permits the profit margin to vary. The balance sheet method is somewhat more accurate, but in this case the difference is not very large. The real advantage of the balance sheet method is that it can be used when everything does not increase proportionately with sales. In addition, forecasters generally want to see the resulting ratios, and the balance sheet method is necessary to develop the ratios.

In practice, the only time we have ever seen the AFN equation used is to provide (1) a “quick and dirty” forecast prior to developing the balance sheet forecast and (2) a rough check on the balance sheet forecast.

**h. Calculate SEC's forecasted ratios, and compare them with the company's 2004 ratios and with the industry averages. Calculate SEC's forecasted free cash flow and return on invested capital (ROIC).**

**Answer:**

Key Ratios	Actual	Forecast	Industry
	2004	2005	
Profit Margin	2.70%	2.52%	4.00%
ROE	7.71%	8.54%	15.60%
DSO	43.80	43.80	32.00
Inventory Turnover	8.33	8.33	11.00
Fixed Asset Turnover	4.00	4.00	5.00
Debt/Assets	30.00%	40.98%	36.00%
TIE	10.00	6.25	9.40
Current Ratio	2.50	1.96	3.00

$$\begin{aligned}
 \text{Free Cash Flow} &= \text{Operating Cash Flow} - \text{Gross Investment in Operating Capital} \\
 &= \text{NOPAT} - \text{Net Investment In Operating Capital} \\
 \text{FCF} &= \text{NOPAT} - (\text{Operating Capital}_{2005} - \text{Operating Capital}_{2004}) \\
 &= \$125(1 - 0.4) + [(\$625 - \$125 + \$625) - (\$500 - \$100 + \$500)] \\
 &= \$75 - (\$1,125 - \$900) = \$75 - \$225 = -\$150.
 \end{aligned}$$

Note: Operating Capital = Net Operating Working Capital + Net Fixed Assets.

$$\text{ROIC} = \text{NOPAT} / \text{Capital} = \$75 / \$1,125 = 0.067 = 6.67\%.$$

**i. Based on comparisons between SEC's days sales outstanding (DSO) and inventory turnover ratios with the industry average figures, does it appear that SEC is operating efficiently with respect to its inventory and accounts receivable? Suppose SEC was able to bring these ratios into line with the industry averages and reduce its SGA/sales ratio to 33%. What effect would this have on its AFN and its financial ratios? What effect would this have on free cash flow and ROIC?**

**Answer:** The DSO and inventory turnover ratio indicate that SEC has excessive inventories and receivables. The effect of improvements here would reduce asset requirements and AFN. See the results below based on the spreadsheet *FMII Ch 14 Mini Case.xls*.

<u>Inputs</u>	<u>Before</u>	<u>After</u>
DSO	43.20	32.01
Accounts Receivable/Sales	12.0%	8.77%
Inventory Turnover	8.33	11.00
Inventory/Sales	12.0%	9.09%
SGA/Sales	35.0%	33.0%
<u>Outputs</u>		
AFN	\$187.2	\$15.7
FCF	-\$150.0	\$33.5
ROIC	6.7%	10.8%
ROE	8.5%	12.3%

**j. Suppose you now learn that SEC's 2004 receivables and inventories were in line with required levels, given the firm's credit and inventory policies, but that excess capacity existed with regard to fixed assets. Specifically, fixed assets were operated at only 75 percent of capacity.**

**j. 1. What level of sales could have existed in 2004 with the available fixed assets?**

**Answer:** Full Capacity Sales =  $\frac{\text{Actual sales}}{\% \text{ of capacity at which fixed assets were operated}} = \frac{\$2,000}{0.75} = \$2,667.$

Since the firm started with excess fixed asset capacity, it will not have to add as much fixed assets during 2005 as was originally forecasted:

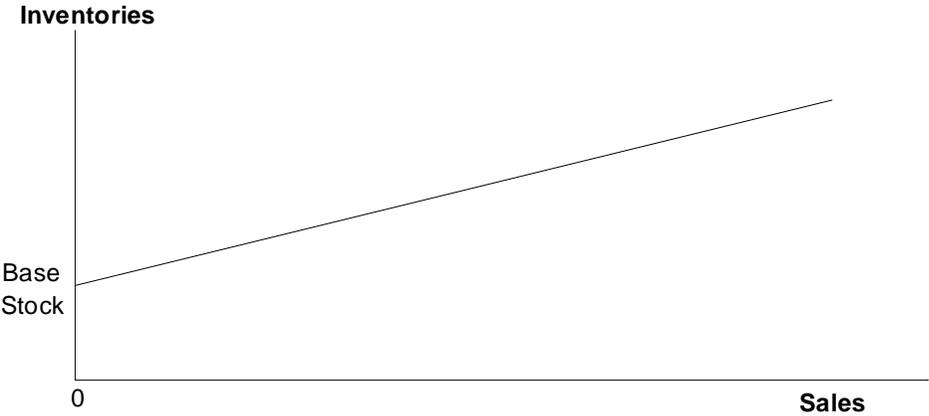
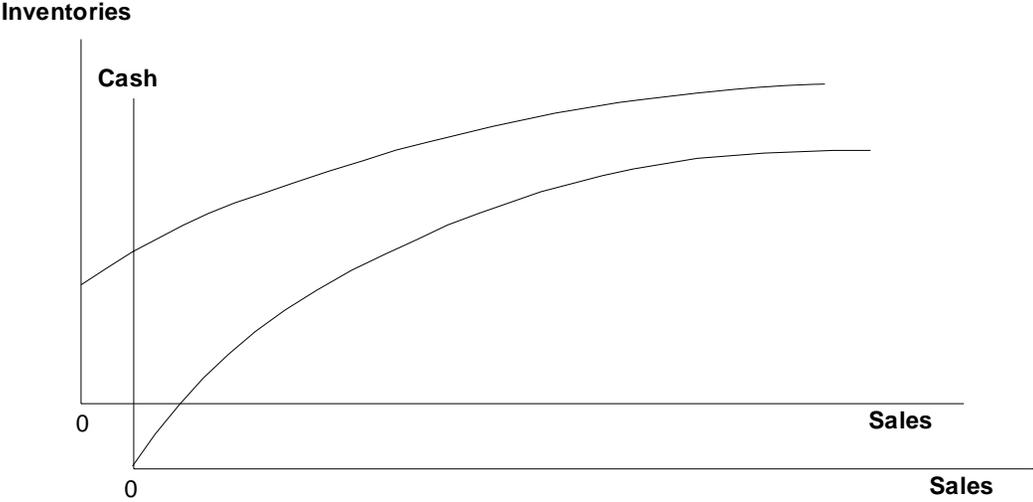
**j. 2. How would the existence of excess capacity in fixed assets affect the additional funds needed during 2005?**

**Answer:** We had previously found an AFN of \$184.5 using the balance sheet method. The fixed assets increase was  $0.25(\$500) = \$125.$  Therefore, the funds needed will decline by \$125.

**k. The relationship between sales and the various types of assets is important in financial forecasting. The percent of sales approach, under the assumption that each asset item**

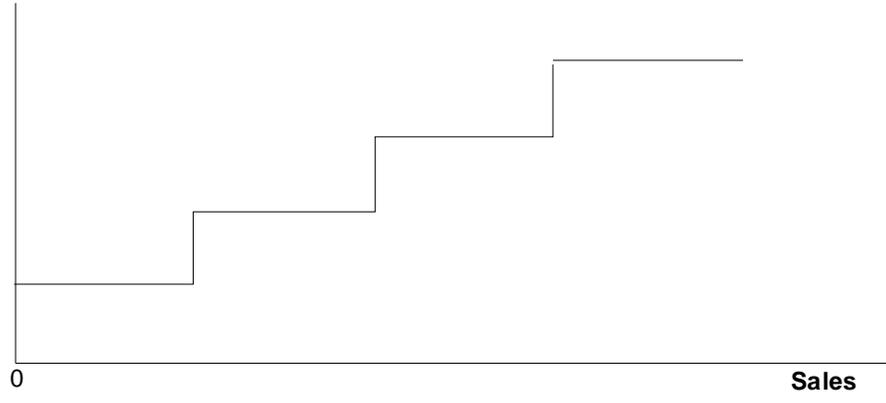
grows at the same rate as sales, leads to an AFN forecast that is reasonably close to the forecast using the AFN equation. Explain how each of the following factors would affect the accuracy of financial forecasts based on the AFN equation: (1) economies of scale in the use of assets, and (2) lumpy assets.

**Answer:** 1. Economies of scale in the use of assets mean that the asset item in question must increase less than proportionately with sales; hence it will grow less rapidly than sales. Cash and inventory are common examples, with possible relationship to sales as shown below:



2. Lumpy assets would cause the relationship between assets and sales to look as shown below. This situation is common with fixed assets.

**Fixed assets**



# Chapter 15

## Corporate Valuation, Value-Based Management, and Corporate Governance

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 15-1 a. Assets-in-place, also known as operating assets, include the land, buildings, machines, and inventory that the firm uses in its operations to produce its products and services. Growth options are not tangible. They include items such as R&D and customer relationships. Financial, or nonoperating, assets include investments in marketable securities and non-controlling interests in the stock of other companies.
- b. **Operating current assets are the current assets used to support operations, such as cash, accounts receivable, and inventory. It does not include short-term investments. Operating current liabilities are the current liabilities that are a natural consequence of the firm's operations, such as accounts payable and accruals. It does not include notes payable or any other short-term debt that charges interest. Net operating working capital is operating current assets minus operating current liabilities. Operating capital is sum of net operating working capital and operating long-term assets, such as net plant and equipment. Operating capital also is equal to the net amount of capital raised from investors. This is the amount of interest-bearing debt plus preferred stock plus common equity minus short-term investments. NOPAT is the amount of net income a company would generate if it had no debt and held no financial assets. NOPAT is a better measure of the performance of a company's operations because debt lowers income. In order to get a true reflection of a company's operating performance, one would want to take out debt to get a clearer picture of the situation. Free cash flow is the cash flow actually available for distribution to investors after the company has made all the investments in fixed assets and working capital necessary to sustain ongoing operations. It is the most important measure of cash flows because it shows the exact amount available to all investors.**
- c. **The value of operations is the present value of all the future free cash flows that are expected from current assets-in-place and the expected growth of assets-in-place when discounted at the weighted average cost of capital:**

$$V_{\text{op(at time 0)}} = \sum_{t=1}^{\infty} \frac{FCF_t}{(1 + WACC)^t}.$$

The terminal, or horizon value, is the value of operations at the end of the explicit forecast period. It is equal to the present value of all free cash flows beyond the forecast period, discounted back to the end of the forecast period at the weighted average cost of capital:

$$V_{\text{op(at time N)}} = \frac{FCF_{N+1}}{WACC - g} = \frac{FCF_N (1 + g)}{WACC - g}.$$

The corporate valuation model defines the total value of a company as the value of operations plus the value of nonoperating assets plus the value of growth options.

- d. **Value-based management is the systematic application of the corporate value model to a company's decisions. The four value drivers are the growth rate in sales (g), operating profitability (OP=NOPAT/Sales), capital requirements (CR=Capital/Sales), and the weighted average cost of capital (WACC). Return on Invested Capital (ROIC) is NOPAT divided by the amount of capital that is available at the beginning of the year.**
- e. **Managerial entrenchment occurs when a company has such a weak board of directors and has such strong anti-takeover provisions in its corporate charter that senior managers feel there is very little chance that they will be removed. Non-pecuniary benefits are perks that are not actual cash payments, such as lavish offices, memberships at country clubs, corporate jets, and excessively large staffs.**
- f. **Targeted share repurchases, also known as greenmail, occur when a company buys back stock from a potential acquiror at a higher than fair-market price. In return, the potential acquiror agrees not to attempt to take over the company. Shareholder rights provisions, also known as poison pills, allow existing shareholders in a company to purchase additional shares of stock at a lower than market value if a potential acquiror purchases a controlling stake in the company. A restricted voting rights provision automatically deprives a shareholder of voting rights if the shareholder owns more than a specified amount of stock.**
- g. **A stock option allows its owner to purchase a share of stock at a fixed price, called the exercise price, no matter what the actual price of the stock is. Stock options always have an expiration date, after which they cannot be exercised. A restricted stock grant allows an employee to buy shares of stock at a large discount from the current stock price, but the employee is restricted from selling the stock for a specified number of years. An Employee Stock Ownership Plan, often called an ESOP, is a type of retirement plan in which employees own stock in the company.**

- 15-2 The first step is to find the value of operations by discounting all expected future free cash flows at the weighted average cost of capital. The second step is to find the total corporate value by summing the value of operations, the value of nonoperating assets, and the value of growth options. The third step is to find the value of equity by subtracting the value of debt and preferred stock from the total value of the corporation. The last step is to divide the value of equity by the number of shares of common stock.
- 15-3 A company can be profitable and yet have an ROIC that is less than the WACC if the company has large capital requirements. If ROIC is less than the WACC, then the company is not earning enough on its capital to satisfy its investors. Growth adds even more capital that is not satisfying investors, hence, growth decreases value.
- 15-4 Entrenched managers consume too many perquisites, such as lavish offices, excessive staffs, country club memberships, and corporate jets. They also invest in projects or acquisitions that make the firm larger, even if they don't make the firm more valuable.

- 15-5 Stock options in compensation plans usually are issued with an exercise price equal to the current stock price. As long as the stock price increases, the option will become valuable, even if the stock price doesn't increase as much as investors expect.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

15-1 
$$\begin{aligned} \text{NOPAT} &= \text{EBIT}(1 - T) \\ &= 100(1 - 0.4) = \$60. \end{aligned}$$

$$\begin{aligned} \text{Net operating WC}_{04} &= (\$27 + \$80 + \$106) - (\$52 + \$28) \\ &= \$213 - \$80 = \$133. \end{aligned}$$

$$\text{Operating capital}_{04} = \$133 + \$265 = \$398.$$

$$\begin{aligned} \text{Net operating WC}_{05} &= (\$28 + \$84 + \$112) - (\$56 + \$28) \\ &= \$224 - \$84 = \$140. \end{aligned}$$

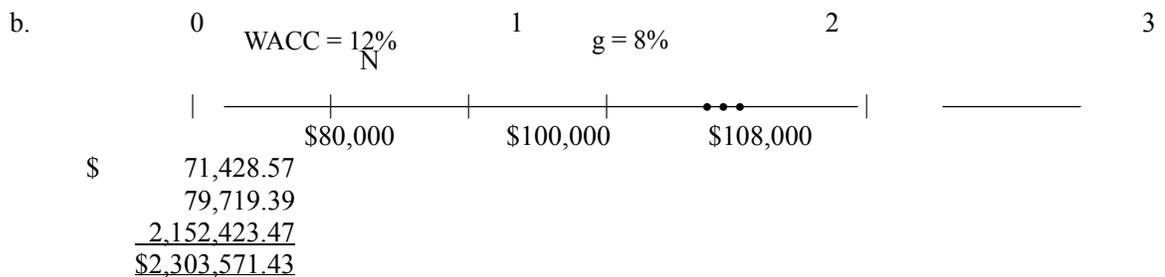
$$\text{Operating capital}_{05} = \$140 + \$281 = \$421.$$

$$\begin{aligned} \text{FCF} &= \text{NOPAT} - \text{Net investment in operating capital} \\ &= \$100(0.6) - (\$421 - \$398) \\ &= \$37.0. \end{aligned}$$

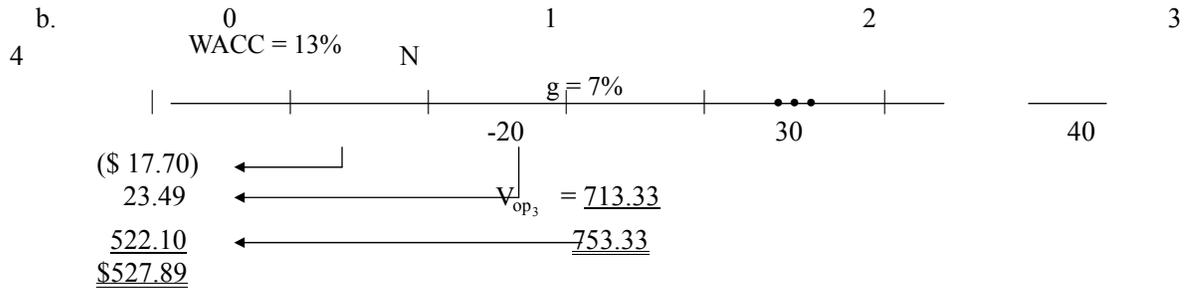
- 15-2 Value of operations =  $V_{op}$  = PV of expected future free cash flow

$$V_{op} = \frac{\text{FCF}(1 + g)}{\text{WACC} - g} = \frac{\$400,000(1.05)}{0.12 - 0.05} = \$6,000,000.$$

15-3 a. 
$$V_{op2} = \frac{\$108,000}{0.12 - 0.08} = \$2,700,000.$$



15-4 a.  $V_{op_3} = \frac{\$40(1.07)}{0.13 - 0.07} = \$713.33.$



c. Total value<sub>t=0</sub> = \$527.89 + \$10.0 = \$537.89.  
 Value of common equity = \$537.89 - \$100 = \$437.89.  
 Price per share =  $\frac{\$437.89}{10.0} = \$43.79.$

15-5 The growth rate in FCF from 2006 to 2007 is  $g = (\$750.00 - \$707.55) / \$707.50 = 0.06.$

$V_{Op \text{ at } 2006} = \frac{\$707.55(1.06)}{0.11 - 0.06} = \$15,000.$

15-6  $V_{Op} = \$200,000,000 + \left[ \frac{\$200,000,000}{0.098 - 0.05} \right] [0.09 - 0.10]$   
 $= \$200,000,000 + (-\$40,000,000) = \$160,000,000.$   
 MVA = \$160,000,000 - \$200,000,000 = -40,000,000.

15-7 Capital<sub>2008</sub> = Sales<sub>2008</sub> (0.43) = \$129,000,000.

$V_{Op \text{ at } 2008} = \$129,000,000 + \left[ \frac{\$300,000,000(1 + 0.05)}{0.098 - 0.05} \right] \left[ 0.06 - (0.098) \left( \frac{0.43}{1 + 0.05} \right) \right]$   
 $= \$129,000,000 + [\$6,562,500,000][0.020]$   
 $= \$129,000,000 + \$130,375,000 = \$259,375,000.$

15-8 Total corporate value = Value of operations + marketable securities  
 $= \$756 + \$77 = \$833 \text{ million.}$   
 Value of equity = Total corporate value - debt - Preferred stock  
 $= \$833 - (\$151 + \$190) - \$76 = \$416 \text{ million.}$

15-9 Total corporate value = Value of operations + marketable securities  
 $= \$651 + \$47 = \$698 \text{ million.}$   
 Value of equity = Total corporate value - debt - Preferred stock  
 $= \$698 - (\$65 + \$131) - \$33 = \$469 \text{ million.}$   
 Price per share = \$469 / 10 = \$46.90.

- 15-10 a.  $\text{NOPAT}_{2005} = \$108.6(1-0.4) = \$65.16$
- $\text{NOWC}_{2005} = (\$5.6 + \$56.2 + \$112.4) - (\$11.2 + \$28.1) = \$134.9$  million.
- $\text{Capital}_{2005} = \$134.9 + \$397.5 = \$532.4$  million.
- $\text{FCF}_{2005} = \text{NOPAT} - \text{Investment in Capital} = \$65.16 - (\$532.4 - \$502.2)$   
 $= \$65.16 - \$30.2 = \$34.96$  million.
- b.  $\text{HV}_{2005} = [\$34.96(1.06)]/(0.11-0.06) = \$741.152$  million.
- c.  $V_{\text{Op at 12/31/2004}} = [\$34.96 + \$741.152]/(1+0.11) = \$699.20$  million.
- d. Total corporate value =  $\$699.20 + \$49.9 = \$749.10$  million.
- e. Value of equity =  $\$749.10 - (\$69.9 + \$140.8) - \$35.0 = \$503.4$  million.  
Price per share =  $\$503.4 / 10 = \$50.34$ .

SOLUTION TO SPREADSHEET PROBLEM

- 15-11 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file "*Solution for FM11 Ch 15-11 Build a Model.xls*") and on the instructor's side of the web site, **<http://brigham.swcollege.com>**.

## MINI CASE

---

**You have been hired as a consultant to Kulpa Fishing Supplies (KFS), a company that is seeking to increase its value. KFS has asked you to estimate the value of two privately held companies that KFS is considering acquiring. But first, the senior management of KFS would like for you to explain how to value companies that don't pay any dividends. You have structured your presentation around the following questions.**

a. List the three types of assets that companies own.

**Answer:** Assets-in-place, growth options, and nonoperating, or financial, assets.

b. What are assets-in-place? How can their value be estimated?

**Answer:** Assets-in-place are tangible, such as buildings, machines, inventory. Usually they are expected to grow. They generate free cash flows. The PV of their expected future free cash flows, discounted at the WACC, is the value of operations.

c. What are growth options? How can their value be estimated?

**Answer:** Growth options are not tangible. They include R&D, such as at drug companies and genetic engineering companies, and building customer relationships, such as at amazon.com. Growth options are valued using option pricing techniques in Chapter 17.

d. What are nonoperating assets? How can their value be estimated?

**Answer:** Nonoperating assets are marketable securities and ownership of non-controlling interest in another company. The value of nonoperating assets usually is very close to figure that is reported on balance sheets.

e. What is the total value of a corporation? Who has claims on this value?

**Answer:** Total corporate value is sum of value of operations, value of nonoperating assets, and value of growth options. (No examples in this chapter have a growth option-- this is deferred until chapter 17). Debt holders have first claim. Preferred stockholders have the next claim. Any remaining value belongs to stockholders.

f. 1. The first acquisition target is a privately held company in a mature industry. The company currently has free cash flow of \$20 million. Its WACC is 10% and it is expected to grow at a constant rate of 5%. The company has marketable securities of \$100 million. It is financed with \$200 million of debt, \$50 million of preferred stock, and \$210 million of book equity. What is its value of operations?

**Answer:**

$$V_{Op} = \frac{FCF_0 (1 + g)}{(WACC - g)}$$

$$V_{Op} = \frac{20(1 + 0.05)}{(0.10 - 0.05)} = 420$$

f. 2. What is its total corporate value? What is its value of equity?

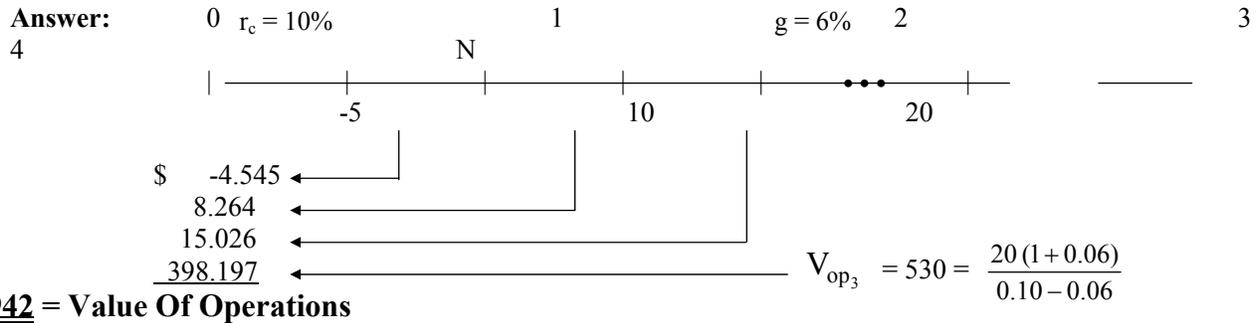
**Answer:** Total Corporate Value = VOP + MKT. SEC.  
 $= \$420 + \$100$   
 $= \$520 \text{ million}$

Value Of Equity = Total - Debt - Pref.  
 $= \$520 - \$200 - \$50$   
 $= \$270 \text{ million}$

f. 3. What is its MVA (MVA = total corporate value – total book value)?

**Answer:** MVA = total corporate value of firm minus total book value of firm  
total book value of firm = book value of equity + book value of debt  
+ book value of preferred stock  
MVA = \$520 - (\$210 + \$200 + \$50)  
 $= \$60 \text{ million}$

g. 1. The second acquisition target is a privately held company in a growing industry. The target has recently borrowed \$40 million to finance its expansion; it has no other debt or preferred stock. It pays no dividends and currently has no marketable securities. KFS expects the company to produce free cash flows of -\$5 million in one year, \$10 million in two years, and \$20 million in three years. After three years, free cash flow will grow at a rate of 6%. Its WACC is 10% and it currently has 10 million shares of stock. What is its horizon value (i.e., its value of operations at year three)? What is its current value of operations (i.e., at time zero)?



g. 2. What is its value of equity on a price per share basis?

**Answer:**

**Value of equity = value of operations - debt**  
**= \$416.94 - \$40 = \$376.94 million.**

price per share = \$376.94/10 = \$37.69.

h. KFS is also interested in applying value-based management to its own divisions. Explain what value-based management is.

**Answer:** VBM is the systematic application of the corporate valuation model to all corporate decisions and strategic initiatives. The objective of VBM is to increase market value added (MVA).

i. What are the four value drivers? How does each of them affect value?

**Answer:** MVA is determined by four drivers: sales growth, operating profitability (OP=NOPAT/sales), capital requirements (CR=operating capital / sales), and the weighted average cost of capital. MVA will improve if WACC is reduced, operating profitability (OP) increases, or the capital requirement (CR) decreases. See the next question for an explanation of the impact of growth.

j. What is return on invested capital (ROIC)? Why is the spread between ROIC and WACC so important?

Answer: **ROIC is the return on the capital that is in place at the beginning of the period:**

$$\text{ROIC}_{t+1} = \frac{\text{NOPAT}_{t+1}}{\text{Capital}_t}$$

**If the spread between the expected return,  $\text{ROIC}_{t+1}$ , and the required return, WACC, is positive, then MVA is positive and growth makes MVA larger. The opposite is true if the spread is negative.**

k. KFS has two divisions. Both have current sales of \$1,000, current expected growth of 5%, and a WACC of 10%. Division A has high profitability (OP=6%) but high capital requirements (CR=78%). Division B has low profitability (OP=4%) but low capital requirements (CR=27%). What is the MVA of each division, based on the current growth of 5%? What is the MVA of each division if growth is 6%?

Answer:

$$\text{MVA}_t = \left[ \frac{\text{Sales}_t (1+g)}{\text{WACC} - g} \right] \left[ \text{OP} - \text{WACC} \left( \frac{\text{CR}}{(1+g)} \right) \right]$$

		<u>Division A</u>		<u>Division B</u>	
OP	6%	6%	4%	4%	
CR	78%	78%	27%	27%	
Growth	5%	6%	5%	6%	
MVA	(300.0)	(360.0)	300.0	385.0	

l. What is the ROIC of each division for 5% growth and for 6% growth? How is this related to MVA?

Answer:

		<u>Division A</u>		<u>Division B</u>	
Capital <sub>0</sub>	\$780	\$780	\$270	\$270	
Growth	5%	6%	5%	6%	
Sales <sub>1</sub>	\$1,050	\$1,060	\$1,050	\$1,060	
Nopat <sub>1</sub>	\$63	\$63.6	\$42	\$42.4	
Roic <sub>1</sub>	8.1%	8.2%	15.6%	15.7%	
Mva	(300.0)	(360.0)	300.0	385.0	

The expected ROIC of division A is less than the WACC, so the division should postpone growth efforts until it improves ROIC by reducing capital requirements (e.g., reducing inventory) and/or improving profitability.

The expected ROIC of division b is greater than the WACC, so the division should continue with its growth plans.

m. The managers at KFS have heard that corporate governance can affect shareholder value. List for them the three mechanisms of corporate governance.

**Answer:** The three mechanisms are provisions in the charter that affect takeovers, composition of the board of directors, and compensation plans.

n. Why is entrenched management potentially harmful to shareholders?

**Answer:** Entrenchment occurs when there is little chance that poorly performing managers will be replaced. There are two causes: anti-takeover provisions in the charter and a weak board of directors.

**Management consumes perks: lavish offices, corporate jets, excessively large staffs, memberships at country clubs**

**Management accepts projects (or acquisitions) to make firm larger, even if MVA goes down. This is because salary and prestige are highly correlated with size.**

o. List three provisions in the corporate charter that affect takeovers.

**Answer:** These include targeted share repurchases (i.e., greenmail), shareholder rights provisions (i.e., poison pills), and restricted voting rights plans.

p. Explain the difference between insiders and outsiders on the board of directors. What are interlocking boards?

**Answer:** Weak boards have many insiders (i.e., those who also have another position in the company) compared with outsiders. Interlocking boards are weaker (CEO of company A sits on board of company B, CEO of B sits on board of A).

q. What is a stock option in a compensation plan?

**Answer:** Gives owner of option the right to buy a share of the company's stock at a specified price (called the exercise price) even if the actual stock price is higher. Usually can't exercise the option for several years (called the vesting period). Can't exercise the option after a certain number of years (called the expiration, or maturity, date).

# Chapter 16

## Capital Structure Decisions: The Basics

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 16-1 a. Capital structure is the manner in which a firm's assets are financed; that is, the right-hand side of the balance sheet. Capital structure is normally expressed as the percentage of each type of capital used by the firm--debt, preferred stock, and common equity. Business risk is the risk inherent in the operations of the firm, prior to the financing decision. Thus, business risk is the uncertainty inherent in a total risk sense, future operating income, or earnings before interest and taxes (EBIT). Business risk is caused by many factors. Two of the most important are sales variability and operating leverage. Financial risk is the risk added by the use of debt financing. Debt financing increases the variability of earnings before taxes (but after interest); thus, along with business risk, it contributes to the uncertainty of net income and earnings per share. Business risk plus financial risk equals total corporate risk.
- b. Operating leverage is the extent to which fixed costs are used in a firm's operations. If a high percentage of a firm's total costs are fixed costs, then the firm is said to have a high degree of operating leverage. Operating leverage is a measure of one element of business risk, but does not include the second major element, sales variability. Financial leverage is the extent to which fixed-income securities (debt and preferred stock) are used in a firm's capital structure. If a high percentage of a firm's capital structure is in the form of debt and preferred stock, then the firm is said to have a high degree of financial leverage. The breakeven point is that level of unit sales at which costs equal revenues. Breakeven analysis may be performed with or without the inclusion of financial costs. If financial costs are not included, breakeven occurs when EBIT equals zero. If financial costs are included, breakeven occurs when EBT equals zero.
- c. Reserve borrowing capacity exists when a firm uses less debt under "normal" conditions than called for by the tradeoff theory. This allows the firm some flexibility to use debt in the future when additional capital is needed.
- 16-2 Business risk refers to the uncertainty inherent in projections of future  $ROE_U$ .
- 16-3 Firms with relatively high nonfinancial fixed costs are said to have a high degree of operating leverage.
- 16-4 Operating leverage affects EBIT and, through EBIT, EPS. Financial leverage has no effect on EBIT--it only affects EPS, given EBIT.
- 16-5 If sales tend to fluctuate widely, then cash flows and the ability to service fixed charges will also vary. Such a firm is said to have high business risk. Consequently, there is a relatively large risk that the firm will be unable to meet its fixed charges, and interest payments are fixed charges. As a result, firms in unstable industries tend to use less debt than those whose sales are subject to only moderate fluctuations.
- 16-6 Public utilities place greater emphasis on long-term debt because they have more stable sales and profits as well as more fixed assets. Also, utilities have fixed assets which can be pledged as collateral. Further, trade firms use retained earnings to a greater extent, probably because these firms

are generally smaller and, hence, have less access to capital markets. Public utilities have lower retained earnings because they have high dividend payout ratios and a set of stockholders who want dividends.

- 16-7 EBIT depends on sales and operating costs. Interest is deducted from EBIT. At high debt levels, firms lose business, employees worry, and operations are not continuous because of financing difficulties. Thus, financial leverage can influence sales and costs, and hence EBIT, if excessive leverage is used.
- 16-8 The tax benefits from debt increase linearly, which causes a continuous increase in the firm's value and stock price. However, financial distress costs get higher and higher as more and more debt is employed, and these costs eventually offset and begin to outweigh the benefits of debt.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

16-1 a. Here are the steps involved:

- (1) Determine the variable cost per unit at present, V:

$$\begin{aligned}\text{Profit} &= P(Q) - FC - V(Q) \\ \$500,000 &= (\$100,000)(50) - \$2,000,000 - V(50) \\ 50(V) &= \$2,500,000 \\ V &= \$50,000.\end{aligned}$$

- (2) Determine the new profit level if the change is made:

$$\begin{aligned}\text{New profit} &= P_2(Q_2) - FC_2 - V_2(Q_2) \\ &= \$95,000(70) - \$2,500,000 - (\$50,000 - \$10,000)(70) \\ &= \$1,350,000.\end{aligned}$$

- (3) Determine the incremental profit:

$$\text{Profit} = \$1,350,000 - \$500,000 = \$850,000.$$

- (4) Estimate the approximate rate of return on new investment:

$$\text{ROI} = \text{Profit}/\text{Investment} = \$850,000/\$4,000,000 = 21.25\%.$$

Since the ROI exceeds the 15 percent cost of capital, this analysis suggests that the firm should go ahead with the change.

- b. If we measure operating leverage by the ratio of fixed costs to total costs at the expected output, then the change would increase operating leverage:

$$\text{Old: } \frac{FC}{FC + V(Q)} = \frac{\$2,000,000}{\$2,000,000 + \$2,500,000} = 44.44\%.$$

$$\text{New: } \frac{FC_2}{FC_2 + V_2(Q_2)} = \frac{\$2,500,000}{\$2,500,000 + \$2,800,000} = 47.17\%.$$

The change would also increase the breakeven point:

$$\text{Old: } Q_{BE} = \frac{F}{P - V} = \frac{\$2,000,000}{\$100,000 - \$50,000} = 40 \text{ units.}$$

$$\text{New: } Q_{BE} = \frac{\$2,500,000}{\$95,000 - \$40,000} = 45.45 \text{ units.}$$

However, one could measure operating leverage in other ways, say by degree of operating leverage:

$$\text{Old: } DOL = \frac{Q(P - V)}{Q(P - V) - F} = \frac{50(\$50,000)}{50(\$50,000) - \$2,000,000} = 5.0.$$

New: The new DOL, at the expected sales level of 70, is

$$\frac{70(\$95,000 - \$40,000)}{70(\$55,000) - \$2,500,000} = 2.85.$$

The problem here is that we have changed both output and sales price, so the DOLs are not really comparable.

- c. It is impossible to state unequivocally whether the new situation would have more or less business risk than the old one. We would need information on both the sales probability distribution and the uncertainty about variable input cost in order to make this determination. However, since a higher breakeven point, other things held constant, is more risky, the change in breakeven points--and also the higher percentage of fixed costs--suggests that the new situation is more risky.

- 16-2 a. Expected ROE for Firm C:

$$\begin{aligned} \text{ROE}_C &= (0.1)(-5.0\%) + (0.2)(5.0\%) + (0.4)(15.0\%) \\ &\quad + (0.2)(25.0\%) + (0.1)(35.0\%) = 15.0\%. \end{aligned}$$

Note: The distribution of  $\text{ROE}_C$  is symmetrical. Thus, the answer to this problem could have been obtained by simple inspection.

Standard deviation of ROE for Firm C:

$$\begin{aligned} \sigma_C &= \sqrt{0.1(-5.0 - 15.0)^2 + 0.2(5.0 - 15.0)^2 + 0.4(15.0 - 15.0)^2 +} \\ &\quad \sqrt{0.2(25.0 - 15.0)^2 + 0.1(35.0 - 15.0)^2} \\ &= \sqrt{0.1(-20)^2 + 0.2(-10)^2 + 0.4(0)^2 + 0.2(10)^2 + 0.1(20)^2} \\ &= \sqrt{40 + 20 + 0 + 20 + 40} = \sqrt{120} = 11.0\%. \end{aligned}$$

- b. According to the standard deviations of ROE, Firm A is the least risky, while C is the most risky. However, this analysis does not take into account portfolio effects--if C's ROE goes up when most other companies' ROEs decline (that is, its beta is negative), its apparent riskiness would be reduced.
- c. Firm A's  $\sigma_{\text{ROE}} = \sigma_{\text{BEP}} = 5.5\%$ . Therefore, Firm A uses no financial leverage and has no financial risk. Firm B and Firm C have  $\sigma_{\text{ROE}} > \sigma_{\text{BEP}}$ , and hence both use leverage. Firm C uses the most leverage because it has the highest  $\sigma_{\text{ROE}} - \sigma_{\text{BEP}}$  = measure of financial risk. However, Firm C's stockholders also have the highest expected ROE.

- 16-3 a. Original value of the firm ( $D = \$0$ ):

$$V = D + S = 0 + (\$15)(200,000) = \$3,000,000.$$

Original cost of capital:

$$\begin{aligned} \text{WACC} &= w_d r_d(1-T) + w_e r_s \\ &= 0 + (1.0)(10\%) = 10\%. \end{aligned}$$

With financial leverage ( $w_d=30\%$ ):

$$\begin{aligned} \text{WACC} &= w_d r_d(1-T) + w_e r_s \\ &= (0.3)(7\%)(1-0.40) + (0.7)(11\%) = 8.96\%. \end{aligned}$$

Because growth is zero, the value of the company is:

$$V = \frac{\text{FCF}}{\text{WACC}} = \frac{(\text{EBIT})(1-T)}{\text{WACC}} = \frac{(\$500,000)(1-0.40)}{0.0896} = \$3,348,214.286..$$

Increasing the financial leverage by adding \$900,000 of debt results in an increase in the firm's value from \$3,000,000 to \$3,348,214.286.

- b. Using its target capital structure of 30% debt, the company must have debt of:

$$D = w_d V = 0.30(\$3,348,214.286) = \$1,004,464.286.$$

Therefore, its debt value of equity is:

$$S = V - D = \$2,343,750.$$

$$\text{Alternatively, } S = (1 - w_d)V = 0.7(\$3,348,214.286) = \$2,343,750.$$

The new price per share, P, is:

$$P = [S + (D - D_0)]/n_0 = [\$2,343,750 + (\$1,004,464.286 - 0)]/200,000 = \$16.741.$$

- c. The number of shares repurchased, X, is:

$$X = (D - D_0)/P = \$1,004,464.286 / \$16.741 = 60,000.256 \approx 60,000.$$

The number of remaining shares, n, is:

$$n = 200,000 - 60,000 = 140,000.$$

Initial position:

$$\text{EPS} = [(\$500,000 - 0)(1 - 0.40)] / 200,000 = \$1.50.$$

With financial leverage:

$$\begin{aligned} \text{EPS} &= [(\$500,000 - 0.07(\$1,004,464.286))(1 - 0.40)] / 140,000 \\ &= [(\$500,000 - \$70,312.5)(1 - 0.40)] / 140,000 \\ &= \$257,812.5 / 140,000 = \$1.842. \end{aligned}$$

Thus, by adding debt, the firm increased its EPS by \$0.342.

d. 30% debt: 
$$\text{TIE} = \frac{\text{EBIT}}{I} = \frac{\text{EBIT}}{\$70,312.5}$$

<u>Probability</u>	<u>TIE</u>
0.10	( 1.42)
0.20	2.84
0.40	7.11
0.20	11.38
0.10	15.64

The interest payment is not covered when TIE < 1.0. The probability of this occurring is 0.10, or 10 percent.

16-4 a. Present situation (50% debt):

$$\begin{aligned} \text{WACC} &= w_d r_d(1-T) + w_e r_s \\ &= (0.5)(10\%)(1-0.15) + (0.5)(14\%) = 11.25\%. \end{aligned}$$

$$V = \frac{\text{FCF}}{\text{WACC}} = \frac{(\text{EBIT})(1-T)}{\text{WACC}} = \frac{(\$13.24)(1-0.15)}{0.1125} = \$100 \text{ million.}$$

70 percent debt:

$$\begin{aligned} \text{WACC} &= w_d r_d(1-T) + w_e r_s \\ &= (0.7)(12\%)(1-0.15) + (0.3)(16\%) = 11.94\%. \end{aligned}$$

$$V = \frac{\text{FCF}}{\text{WACC}} = \frac{(\text{EBIT})(1-T)}{\text{WACC}} = \frac{(\$13.24)(1-0.15)}{0.1194} = \$94.255 \text{ million.}$$

30 percent debt:

$$\begin{aligned} \text{WACC} &= w_d r_d(1-T) + w_e r_s \\ &= (0.3)(8\%)(1-0.15) + (0.7)(13\%) = 11.14\%. \end{aligned}$$

$$V = \frac{\text{FCF}}{\text{WACC}} = \frac{(\text{EBIT})(1-T)}{\text{WACC}} = \frac{(\$13.24)(1-0.15)}{0.1114} = \$101.023 \text{ million.}$$

16-5 a. BEA's unlevered beta is  $b_U = b_L / (1 + (1-T)(D/S)) = 1.0 / (1 + (1-0.40)(20/80)) = 0.870$ .

b.  $b_L = b_U (1 + (1-T)(D/S))$ .

$$\begin{aligned} \text{At 40 percent debt: } b_L &= 0.87 (1 + 0.6(40\%/60\%)) = 1.218. \\ r_s &= 6 + 1.218(4) = 10.872\% \end{aligned}$$

c.  $\text{WACC} = w_d r_d(1-T) + w_e r_s$   
 $= (0.4)(9\%)(1-0.4) + (0.6)(10.872\%) = 8.683\%$ .

$$V = \frac{\text{FCF}}{\text{WACC}} = \frac{(\text{EBIT})(1-T)}{\text{WACC}} = \frac{(\$14.933)(1-0.4)}{0.08683} = \$103.188 \text{ million.}$$

- 16-6 Tax rate = 40%       $r_{RF} = 5.0\%$   
 $b_U = 1.2$                $r_M - r_{RF} = 6.0\%$

From data given in the problem and table we can develop the following table:

	D/A	E/A	D/E	$r_d$	$r_d(1 - T)$	Leveraged beta <sup>a</sup>	$r_s$ <sup>b</sup>	WACC <sup>c</sup>
0.00	1.00	0.0000	7.00%	4.20%	1.20	12.20%	12.20%	
0.20	0.80	0.2500	8.00	4.80	1.38	13.28	11.58	
0.40	0.60	0.6667	10.00	6.00	1.68	15.08	11.45	
0.60	0.40	1.5000	12.00	7.20	2.28	18.68	11.79	
0.80	0.20	4.0000	15.00	9.00	4.08	29.48	13.10	

Notes:

<sup>a</sup> These beta estimates were calculated using the Hamada equation,

$b = b_U[1 + (1 - T)(D/E)]$ .

<sup>b</sup> These  $r_s$  estimates were calculated using the CAPM,  $r_s = r_{RF} + (r_M - r_{RF})b$ .

<sup>c</sup> These WACC estimates were calculated with the following equation:

$WACC = w_d(r_d)(1 - T) + (w_e)(r_s)$ .

The firm's optimal capital structure is that capital structure which minimizes the firm's WACC. Elliott's WACC is minimized at a capital structure consisting of 40% debt and 60% equity. At that capital structure, the firm's WACC is 11.45%.

## SOLUTION TO SPREADSHEET PROBLEM

---

- 16-7 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 16 P7 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

Assume you have just been hired as business manager of PizzaPalace, a pizza restaurant located adjacent to campus. The company's EBIT was \$500,000 last year, and since the university's enrollment is capped, EBIT is expected to remain constant (in real terms) over time. Since no expansion capital will be required, PizzaPalace plans to pay out all earnings as dividends. The management group owns about 50 percent of the stock, and the stock is traded in the over-the-counter market.

The firm is currently financed with all equity; it has 100,000 shares outstanding; and  $P_0 = \$25$  per share. When you took your MBA Corporate Finance course, your instructor stated that most firms' owners would be financially better off if the firms used some debt. When you suggested this to your new boss, he encouraged you to pursue the idea. As a first step, assume that you obtained from the firm's investment banker the following estimated costs of debt for the firm at different capital structures:

<u>% Financed With Debt</u>	<u><math>R_d</math></u>
0%	---
20	8.0%
30	8.5
40	10.0
50	12.0

If the company were to recapitalize, debt would be issued, and the funds received would be used to repurchase stock. PizzaPalace is in the 40 percent state-plus-federal corporate tax bracket, its beta is 1.0, the risk-free rate is 6 percent, and the market risk premium is 6 percent.

- a. Provide a brief overview of capital structure effects. Be sure to identify the ways in which capital structure can affect the weighted average cost of capital and free cash flows.

**Answer:** The basic definitions are:

- (1)  $V$  = Value Of Firm
- (2) FCF = Free Cash Flow
- (3) WACC = Weighted Average Cost Of Capital
- (4)  $R_s$  And  $R_d$  are costs of stock and debt
- (5)  $W_e$  And  $W_d$  are percentages of the firm that are financed with stock and debt.

The impact of capital structure on value depends upon the effect of debt on: WACC and/or FCF.

Debt holders have a prior claim on cash flows relative to stockholders. Debt holders' "fixed" claim increases risk of stockholders' "residual" claim, so the cost of stock,  $r_s$ , goes up.

Firm's can deduct interest expenses. This reduces the taxes paid, frees up more cash for payments to investors, and reduces after-tax cost of debt

Debt increases the risk of bankruptcy, causing pre-tax cost of debt,  $r_d$ , to increase.

Adding debt increase the percent of firm financed with low-cost debt ( $w_d$ ) and decreases the percent financed with high-cost equity ( $w_e$ ).

The net effect on WACC is uncertain, since some of these effects tend to increase WACC and some tend to decrease WACC.

Additional debt can affect FCF. The additional debt increases the probability of bankruptcy. The direct costs of financial distress are legal fees, “fire” sales, etc. The indirect costs are lost customers, reductions in productivity of managers and line workers, reductions in credit (i.e., accounts payable) offered by suppliers. Indirect costs cause NOPAT to go down due to lost customers and drop in productivity and causes the investment in capital to go up due to increases in net operating working capital (accounts payable goes up as suppliers tighten credit).

Additional debt can affect the behavior of managers. It can cause reductions in agency costs, because debt “pre-commits,” or “bonds,” free cash flow for use in making interest payments. Thus, managers are less likely to waste FCF on perquisites or non-value adding acquisitions.

But it can cause increases in other agency costs. Debt can make managers too risk-averse, causing “underinvestment” in risky but positive NPV projects.

There are also effects due to asymmetric information and signaling. Managers know the firm’s future prospects better than investors. Thus, managers would not issue additional equity if they thought the current stock price was less than the true value of the stock (given their inside information). Hence, investors often perceive an additional issuance of stock as a negative signal, and the stock price falls.

**b. (1) What is business risk? What factors influence a firm's business risk?**

**Answer:** Business risk is uncertainty about EBIT. Factors that influence business risk include: uncertainty about demand (unit sales); uncertainty about output prices; uncertainty about input costs; product and other types of liability; degree of operating leverage (DOL).

**b. (2) what is operating leverage, and how does it affect a firm's business risk? Show the operating break even point if a company has fixed costs of \$200, a sales price of \$15, and variables costs of \$10.**

**Answer:** Operating leverage is the change in EBIT caused by a change in quantity sold. The higher the proportion of fixed costs within a firm’s overall cost structure, the greater the operating leverage. Higher operating leverage leads to more business risk, because a small sales decline causes a larger EBIT decline.

Q is quantity sold, F is fixed cost, V is variable cost, TC is total cost, and P is price per unit.

Operating Breakeven =  $Q_{BE}$

$Q_{BE} = F / (P - V)$

Example:  $F = \$200$ ,  $P = \$15$ , AND  $V = \$10$ :

$$Q_{BE} = \$200 / (\$15 - \$10) = 40.$$

c. Now, to develop an example which can be presented to PizzaPalace's management to illustrate the effects of financial leverage, consider two hypothetical firms: firm U, which uses no debt financing, and firm L, which uses \$10,000 of 12 percent debt. Both firms have \$20,000 in assets, a 40 percent tax rate, and an expected EBIT of \$3,000.

**1. Construct partial income statements, which start with EBIT, for the two firms.**

**Answer:** Here are the fully completed statements:

	Firm U	Firm L
Assets	\$20,000	\$20,000
Equity	\$20,000	\$10,000
EBIT	\$ 3,000	\$ 3,000
INT (12%)	_____0	_____1,200
EBT	\$ 3,000	\$ 1,800
Taxes (40%)	_____1,200	_____720
NI	\$ 1,800	\$ 1,080

c. **2. Now calculate roe for both firms.**

**Answer:**

	Firm U	Firm L
BEP	15.0%	15.0%
ROI	9.0%	11.4%
ROE	9.0%	10.8%
TIE	∞	2.5×

c. **3. What does this example illustrate about the impact of financial leverage on ROE?**

**Answer:** Conclusions from the analysis:

- The firm's basic earning power,  $BEP = EBIT/\text{total assets}$ , is unaffected by financial leverage.
- Firm L has the higher expected ROI because of the tax savings effect:
  - $ROI_U = 9.0\%$ .
  - $ROI_L = 11.4\%$ .

- Firm L has the higher expected roe:
  - $ROE_U = 9.0\%$ .
  - $ROE_L = 10.8\%$ .

**Therefore, the use of financial leverage has increased the expected profitability to shareholders. The higher roe results in part from the tax savings and also because the stock is riskier if the firm uses debt.**

- At the expected level of EBIT,  $ROE_L > ROE_U$ .
- The use of debt will increase roe only if ROA exceeds the after-tax cost of debt. Here  $ROA = \text{unleveraged roe} = 9.0\% > r_d(1 - t) = 12\%(0.6) = 7.2\%$ , so the use of debt raises roe.
- Finally, note that the TIE ratio is huge (undefined, or infinitely large) if no debt is used, but it is relatively low if 50 percent debt is used. The expected tie would be larger than  $2.5\times$  if less debt were used, but smaller if leverage were increased.

**d. Explain the difference between financial risk and business risk.**

**Answer:** Business risk increases the uncertainty in future EBIT. It depends on business factors such as competition, operating leverage, etc. Financial risk is the additional business risk concentrated on common stockholders when financial leverage is used. It depends on the amount of debt and preferred stock financing.

**e. Now consider the fact that EBIT is not known with certainty, but rather has the following probability distribution:**

Economic State	Probability	EBIT
Bad	0.25	\$2,000
Average	0.50	3,000
Good	0.25	4,000

**Redo the part A analysis for firms U and L, but add basic earning power (BEP), return on investment (ROI), [defined as (net income + interest)/(debt + equity)], and the times-interest-earned (TIE) ratio to the outcome measures. Find the values for each firm in each state of the economy, and then calculate the expected values. Finally, calculate the standard deviation and coefficient of variation of ROE. What does this example illustrate about the impact of debt financing on risk and return?**

**Answer:** Here are the pro forma income statements:

	Firm U			Firm L		
	Bad	Avg.	Good	Bad	Avg.	Good
Prob.	0.25	0.50	0.25	0.25	0.50	0.25
EBIT	\$2,000	\$3,000	\$4,000	\$2,000	\$3,000	\$4,000
Interest	0	0	0	1,200	1,200	1,200
EBT	\$2,000	\$3,000	\$4,000	\$ 800	\$1,800	\$2,800
Taxes (40%)	800	1,200	1,600	320	720	1,120
NI	<u>\$1,200</u>	<u>\$1,800</u>	<u>\$2,400</u>	<u>\$ 480</u>	<u>\$1,080</u>	<u>\$1,680</u>
BEP	10.0%	15.0%	20.0%	10.0%	15.0%	20.0%
ROIC	6.0%	9.0%	12.0%	6.0%	9.0%	12.0%
ROE	6.0%	9.0%	12.0%	4.8%	10.8%	16.8%
TIE $\infty$	$\infty$	$\infty$	1.7 $\times$	2.5 $\times$	3.3 $\times$	
E(BEP)		15.0%			15.0%	
E(ROIC)		9.0%			9.0%	
E(ROE)		9.0%			10.8%	
$\sigma_{ROIC}$		2.12%			2.12%	
$\sigma_{ROE}$		2.12%			4.24%	

**This example illustrates that financial leverage can increase the expected return to stockholders. But, at the same time, it increases their risk.**

- Firm L has a wider range of ROEs and a higher standard deviation of ROE, indicating that its higher expected return is accompanied by higher risk. To be precise:

$$\sigma_{ROE} (\text{Unleveraged}) = 2.12\%, \text{ and } \sigma_{ROE} (\text{Leveraged}) = 4.24\%.$$

Thus, in a stand-alone risk sense, firm L is twice as risky as firm U--its business risk is 2.12 percent, but its stand-alone risk is 4.24 percent, so its financial risk is 4.24% - 2.12% = 2.12%.

**f. What does capital structure theory attempt to do? What lessons can be learned from capital structure theory? Be sure to address the MM models.**

**Answer:** MM theory begins with the assumption of zero taxes. MM prove, under a very restrictive set of assumptions, that a firm's value is unaffected by its financing mix:

$$V_L = V_U.$$

Therefore, capital structure is irrelevant. Any increase in roe resulting from financial leverage is exactly offset by the increase in risk (i.e.,  $r_s$ ), so WACC is constant.

MM theory later includes corporate taxes. Corporate tax laws favor debt financing over equity financing. With corporate taxes, the benefits of financial leverage exceed the risks because more EBIT goes to investors and less to taxes when leverage is used. MM show that:

$$V_L = V_U + TD.$$

If  $T=40\%$ , then every dollar of debt adds 40 cents of extra value to firm.

Miller later included personal taxes. Personal taxes lessen the advantage of corporate debt.

Corporate taxes favor debt financing since corporations can deduct interest expenses, but personal taxes favor equity financing, since no gain is reported until stock is sold, and long-term gains are taxed at a lower rate. Miller's conclusions with personal taxes are that the use of debt financing remains advantageous, but benefits are less than under only corporate taxes. Firms should still use 100% debt. Note: however, Miller argued that in equilibrium, the tax rates of marginal investors would adjust until there was no advantage to debt.

MM theory ignores bankruptcy (financial distress) costs, which increase as more leverage is used. At low leverage levels, tax benefits outweigh bankruptcy costs. At high levels, bankruptcy costs outweigh tax benefits. An optimal capital structure exists that balances these costs and benefits. This is the trade-off theory.

MM assumed that investors and managers have the same information. But managers often have better information. Thus, they would sell stock if stock is overvalued, and sell bonds if stock is undervalued. Investors understand this, so view new stock sales as a negative signal. This is signaling theory.

One agency problem is that managers can use corporate funds for non-value maximizing purposes. The use of financial leverage bonds "free cash flow," and forces discipline on managers to avoid perks and non-value adding acquisitions.

A second agency problem is the potential for "underinvestment". Debt increases risk of financial distress. Therefore, managers may avoid risky projects even if they have positive NPVs.

**g. With the above points in mind, now consider the optimal capital structure for PizzaPalace.**

**g. (1) For each capital structure under consideration, calculate the levered beta, the cost of equity, and the WACC.**

**Answer:** MM theory implies that beta changes with leverage.  $B_U$  is the beta of a firm when it has no debt (the unlevered beta.) Hamada's equation provides the beta of a levered firm:  $B_L = B_U [1 + (1 - T)(D/S)]$ . For example, to find the cost of equity for  $w_d = 20\%$ , we first use Hamada's equation to find beta:

$$\begin{aligned} B_L &= B_U [1 + (1 - T)(D/S)] \\ &= 1.0 [1 + (1-0.4) (20\% / 80\%)] \\ &= 1.15 \end{aligned}$$

Then use CAPM to find the cost of equity:

$$\begin{aligned} R_S &= R_{RF} + B_L (RP_M) \\ &= 6\% + 1.15 (6\%) = 12.9\% \end{aligned}$$

We can repeat this for the capital structures under consideration.

	$W_D$	$D/S$	$B_L$	$R_S$
0%	0.00	1.000	12.00%	
20%	0.25	1.150	12.90%	
30%	0.43	1.257	13.54%	
40%	0.67	1.400	14.40%	

50% 1.00 1.600 15.60%

Next, find the WACC. For example, the WACC for  $w_d = 20\%$  is:

$$\begin{aligned} \text{WACC} &= w_d (1-T) r_d + w_e r_s \\ \text{WACC} &= 0.2 (1 - 0.4) (8\%) + 0.8 (12.9\%) \\ \text{WACC} &= 11.28\% \end{aligned}$$

Then repeat this for all capital structures under consideration.

	$w_d$	$r_d$	$r_s$	WACC
0%	0.0%	12.00%	12.00%	
20%	8.0%	12.90%	11.28%	
30%	8.5%	13.54%	11.01%	
40%	10.0%	14.40%	11.04%	
50%	12.0%	15.60%	11.40%	

**g. (2) Now calculate the corporate value, the value of the debt that will be issued, and the resulting market value of equity.**

**Answer:** For example the corporate value for  $w_d = 20\%$  is:

$$V = \text{FCF} / (\text{WACC} - G)$$

$G=0$ , so investment in capital is zero; so  $\text{FCF} = \text{NOPAT} = \text{EBIT} (1-T)$ . In this example,  $\text{NOPAT} = (\$500,000)(1-0.40) = \$300,000$ .

Using these values,  $V = \$300,000 / 0.1128 = \$2,659,574$ .

Repeating this for all capital structures gives the following table:

	$w_d$	WACC	Corp. Value
0%	12.00%	\$2,500,000	
20%	11.28%	\$2,659,574	
30%	11.01%	\$2,724,796	
40%	11.04%	\$2,717,391	
50%	11.40%	\$2,631,579	

**As this shows, value is maximized at a capital structure with 30% debt.**

**g. (3) Calculate the resulting price per share, the number of shares repurchased, and the remaining shares.**

**Answer:** First, find the dollar value of debt and equity. For example, for  $w_d = 20\%$ , the dollar value of debt is:

$$d = w_d V = 0.2 (\$2,659,574) = \$531,915.$$

We can then find the dollar value of equity:

$$S = V - D$$

$$S = \$2,659,574 - \$531,915 = \$2,127,659.$$

We repeat this process for all the capital structures.

	$w_d$	Debt, D	Stock Value, S
	0%	\$0	\$2,500,000
	20%	\$531,915	\$2,127,660
	30%	\$817,439	\$1,907,357
	40%	\$1,086,957	\$1,630,435
	50%	\$1,315,789	\$1,315,789

Note: these are rounded; see FM11 Ch 16 mini case.xls for full calculations.

Notice that the value of the equity declines as more debt is issued, because debt is used to repurchase stock. But the total wealth of shareholders is the value of stock after the recap plus the cash received in repurchase, and this total goes up (it is equal to corporate value on earlier slide).

The firm issues debt, which changes its WACC, which changes value. The firm then uses debt proceeds to repurchase stock. The stock price changes after debt is issued, but does not change during actual repurchase (or arbitrage is possible). The stock price after debt is issued but before stock is repurchased reflects shareholder wealth, which is the sum of the stock and the cash paid in repurchase.

For example, to find the stock price for  $w_d = 20\%$ , let  $D_0$  and  $N_0$  denote debt and outstanding shares before the recap.  $D - D_0$  is equal to cash that will be used to repurchase stock.  $S + (D - D_0)$  is the wealth of shareholders' after the debt is issued but immediately before the repurchase. We can express the stock price per share prior to the repurchase,  $P$ , for  $w_d = 20\%$ , as:

$$P = [S + (D - D_0)] / N_0.$$

$$P = [\$2,127,660 + (\$531,915 - 0)] / 100,000$$

$$P = \$26.596 \text{ per share.}$$

The number of shares repurchased is:

$$\# \text{ repurchased} = (D - D_0) / P$$

$$\# \text{ rep.} = (\$531,915 - 0) / \$26.596$$

$$= 20,000.$$

The number of remaining shares after the repurchase is:

$$\# \text{ remaining} = N = S / P$$

$$N = \$2,127,660 / \$26.596 = 80,000.$$

We can apply this same procedure to all the capital structures under consideration.

	$W_d$	$P$	# Shares	# Shares	
				Repurch.	Remaining
	0%	\$25.00	0	100,000	
	20%	\$26.60	20,000	80,000	
	30%	\$27.25	30,000	70,000	
	40%	\$27.17	40,000	60,000	
	50%	\$26.32	50,000	50,000	

**h. Considering only the capital structures under analysis, what is PizzaPalace's optimal capital structure?**

**Answer:** The optimal capital structure is for  $w_d = 30\%$ . This gives the highest corporate value, the lowest WACC, and the highest stock price per share. But notice that  $w_d = 40\%$  is very similar to the optimal solution; in other words, the optimal range is pretty flat.

**i. What other factors should managers consider when setting the target capital structure?**

**Answer:** Managers should also consider the debt ratios of other firms in the industry, pro forma coverage ratios at different capital structures under different economic scenarios, lender and rating agency attitudes (i.e., the impact on bond ratings), reserve borrowing capacity, the effects on control (i.e., does the capital structure make it easier or harder for an outsider to take over the firm), the firm's types of assets (i.e., are they tangible, and hence suitable as collateral?), and the firm's projected tax rates.

# Chapter 17

## Capital Structure Decisions: Extensions

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 17-1
- a. MM Proposition I states the relationship between leverage and firm value. Proposition I without taxes is  $V = EBIT/r_{sU}$ . Since both EBIT and  $r_{sU}$  are constant, firm value is also constant and capital structure is irrelevant. With corporate taxes, Proposition I becomes  $V = V_u + TD$ . Thus, firm value increases with leverage and the optimal capital structure is virtually all debt.
  - b. MM Proposition II states the relationship between leverage and cost of equity. Without taxes, Proposition II is  $r_{sL} = r_{sU} + (r_{sU} - r_d)(D/S)$ . Thus,  $r_s$  increases in a precise way as leverage increases. In fact, this increase is just sufficient to offset the increased use of lower cost debt. When corporate taxes are added, Proposition II becomes  $r_{sL} = r_{sU} + (r_{sU} - r_d)(1 - T)(D/S)$ . Here the increase in equity costs is less than the zero-tax case, and the increasing use of lower cost debt causes the firm's cost of capital to decrease, and again, the optimal capital structure is virtually all debt.
  - c. The Miller model introduces personal taxes. The effect of personal taxes is, essentially, to reduce the advantage of corporate debt financing.
  - d. Financial distress costs are incurred when a leveraged firm facing a decline in earnings is forced to take actions to avoid bankruptcy. These costs may be the result of delays in the liquidation of assets, legal fees, the effects on product quality from cutting costs, and evasive actions by suppliers and customers.
  - e. Agency costs arise from lost efficiency and the expense of monitoring management to ensure that debtholders' rights are protected.
  - f. The addition of financial distress and agency costs to either the MM tax model or the Miller model results in a trade-off model of capital structure. In this model, the optimal capital structure can be visualized as a trade-off between the benefit of debt (the interest tax shelter) and the costs of debt (financial distress and agency costs).
  - g. The value of the debt tax shield is the present value of the tax savings from the interest payments. In the MM model with taxes, this is just interest x tax rate / discount rate =  $iDT/r$ , and since  $i = r$  in the MM model, this is just  $TD$ . If a firm grows and the discount rate isn't  $r$ , then the value of this growing tax shield is  $r_d TDg/(1+r_{TS})$  where  $r_d$  is the interest rate on the debt and  $r_{TS}$  is the discount rate for the tax shield.

- h. When a firm has debt outstanding it can choose to default if the firm is not worth more than the face value of the debt. This decision to default when the value of the firm is low is like the decision not to exercise a call option when the stock price is low. If management (and hence the stockholders) make the debt payment, they get to keep the company. This makes equity like an option on the underlying value of the entire firm, with a strike price equal to the face value of the debt. If  $D$  is the face value of debt maturing in one year and  $S$  is the value of the entire firm (the firm's debt plus equity) then the payoff to the stockholder when the debt matures is:  $\text{Payoff} = \max(S - D, 0)$ . This is the same payoff as a call option on  $S$  with a strike, or exercise, price of  $D$ .

17-2 Modigliani and Miller show that the value of a leveraged firm must be equal to the value of an unleveraged firm. If this is not the case, investors in the leveraged firm will sell their shares (assume they owned 10%). They will then borrow an amount equal to 10% of the debt of the leveraged firm. Using these proceeds, they will purchase 10% of the stock of the unleveraged firm (which provides the same return as the leveraged firm) with a surplus left to be invested elsewhere. This arbitrage process will drive the price of the stock of the leveraged firm down and drive up the price of the stock of the unleveraged firm. This will continue until the value of both stocks are equal.

The assumptions of the MM model are:

- Firms must be in a homogeneous business risk class. If the firms have varying degrees of risk, the market will value the firms at different rates. The earnings of the firms will be capitalized at different costs of capital.
- Investors have homogeneous expectations about expected future EBIT. If investors have different expectations about future EBIT then individual investors will assign different values to the firms. Therefore, the arbitrage process will not be effective.
- Stocks and bonds are traded in perfect capital markets. Therefore, (a) there are no brokerage costs and (b) individuals can borrow at the same rate as corporations. Brokerage fees and varying interest rates will, in effect, lower the surplus available for alternative investment.
- Investors are rational. If by chance, investors were irrational, then they would not go through the entire arbitrage process in order to achieve a higher return. They would be satisfied with the return provided by the leveraged firm.
- There are no corporate taxes. With the existence of corporate taxes the value of the leveraged firm ( $V_L$ ) must be equal to the value of the unleveraged firm ( $V_U$ ) plus the tax shield provided by debt ( $TD$ ).

17-3 MM without taxes would support AT&T, although if AT&T really believed MM, they should not object to Gordon's 50 percent debt ratio. MM with taxes would lead ultimately to 100 percent debt, which neither Gordon nor AT&T accepted. In effect, Gordon and AT&T seemed to be taking a "traditional" or perhaps a "compromise" view, but with different conclusions about the optimal debt ratio. We might note, in a postscript, that AT&T did raise its debt ratio, but not to the extent that Gordon recommended.

- 17-4 The value of a growing tax shield is greater than the value of a constant tax shield. This means that for a given initial level of debt a growing firm will have more value from the debt tax shield than a non-growing firm. Thus for a given face value of debt,  $D$ , and unlevered value of equity,  $U$ , a growing firm will have a smaller  $w_D$ , a larger levered cost of equity,  $r_{eL}$ , and a larger WACC. So the MM model will underestimate the value of the levered firm and its cost of equity and WACC.
- 17-5 If equity is viewed as an option on the total value of the firm with a strike price equal to the face value of debt then the equity value should be affected by risk in the same way that an option is affected by risk. An option is worth more if the underlying asset is more risky, so a manager wanting to maximize the option value of the firm might want to switch investment decisions to make the firm more risky. Of course bondholders will not like this, since the increase in equity value comes at their expense. They will write covenants in to the bonds specifying how the proceeds can be used, and if management still manages to engage in this “bait and switch” tactic, the firm will find it difficult to raise capital through bond issues in the future.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

17-1 a.  $b_L = b_U[1 + (1 - T)(D/S)]$ .

$$b_U = \frac{b_L}{1 + (1 - T)(D/S)} = \frac{1.8}{1 + (1 - 0.4)(0.5/0.5)} = \frac{1.8}{1.6} = 1.125.$$

b.  $r_{sU} = r_{RF} + (r_M - r_{RF})b_U = 10\% + (5\%)1.125 = 10\% + 5.625\% = 15.625\%$ .

c. \$2 Million Debt:  $V_L = V_U + TD = \$10 + 0.25(\$2) = \$10.5$  million.

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_{RF})b_U(1 - T)(D/S) \\ &= 15.625\% + (15.625\% - 10\%)(0.75)(\$2/\$8.5) \\ &= 15.625 + 5.625\% (0.75)(\$2/\$8.5) = 16.62\%. \end{aligned}$$

\$4 Million Debt:  $V_L = \$10 + 0.25(\$4) = \$11.0$  million.

$$r_{sL} = 15.625\% + 5.625\%(0.75)(\$4/\$7) = 18.04\%.$$

\$6 Million Debt:  $V_L = \$10 + 0.25(\$6) = \$11.5$  million.

$$r_{sL} = 15.625\% + 5.625\% (0.75)(\$6/\$5.5) = 20.23\%.$$

d. \$6 Million Debt:  $V_L = \$8.0 + 0.40(\$6) = \$10.4$  million.

$$r_{sL} = 15.625\% + 5.625\%(0.60)(\$6/\$4.4) = 20.23\%.$$

The mathematics of MM result in the required return, and, thus, the same financial risk premium. However, the market value debt ratio has increased from  $\$6/\$11.5 = 52\%$  to  $\$6/\$10.4 = 58\%$  at the higher tax rate. Hence, a higher tax rate reduces the financial risk premium at a *given* market value debt/equity ratio. This is because a higher tax rate increases the relative benefits of debt financing.

17-2 a.  $V_U = \frac{\text{EBIT}}{r_{sU}} = \frac{\$2 \text{ million}}{0.10} = \$20 \text{ million.}$

b.  $r_{sU} = 10.0\%$ . (Given)

$$r_{sL} = r_{sU} + (r_{sU} - r_d)(D/S) = 10\% + (10\% - 5\%)(\$10/\$10) = 15.0\%.$$

c.  $S_L = \frac{\text{EBIT} - r_d D}{r_{sL}} = \frac{\$2 - 0.05(\$10)}{0.15} = \$10 \text{ million.}$

$$S_L + D = V_L = V_U + TD.$$

$$\$10 + \$10 = \$20 = V_L = \$20 + (0)\$10 = \$20 \text{ million.}$$

d.  $\text{WACC}_U = r_{sU} = 10\%$ .

For Firm L, we know that WACC must equal  $r_{sU} = 10\%$  according to Proposition I. But, we can demonstrate this as follows:

$$\begin{aligned} \text{WACC}_L &= (D/V)r_d + (S/V)r_s = (\$10/\$20)5\% + (\$10/\$20)15\% \\ &= 2.5\% + 7.5\% = 10.0\%. \end{aligned}$$

e.  $V_L = \$22$  million is not an equilibrium value according to MM. Here's why. Suppose you owned 10 percent of Firm L's equity, worth  $0.10(\$22 \text{ million} - \$10 \text{ million}) = \$1.2$  million. You could (1) sell your stock, (2) borrow an amount (at 5%) equal to 10 percent of Firm L's debt, or  $0.10(\$10 \text{ million}) = \$1$  million, and (3) end up with  $\$1.2 \text{ million} + \$1 \text{ million} = \$2.2$  million. You could spend  $\$2$  million to buy 10% of Firm U's stock, and invest  $\$200,000$  in risk-free debt. Your cash stream would now be 10 percent of Firm U's flow, or  $0.10(\text{EBIT}_U) = 0.10(\$2 \text{ million}) = \$200,000$ , plus the return on the  $\$200,000$  of risk-free debt, minus the  $0.05(\$1 \text{ million}) = \$50,000$  interest expense for  $\$150,000$  plus the return on the extra  $\$200,000$ . Before the arbitrage, your return was 10 percent of the  $\$2 \text{ million} - 0.05(\$10 \text{ million}) = \$1.5$  million, or  $\$150,000$ . Investors would do this arbitrage until  $V_L = V_U = \$20$  million.

17-3 a.  $V_U = \frac{\text{EBIT}(1 - T)}{r_{sU}} = \frac{\$2(1 - 0.4)}{0.10} = \$12 \text{ million.}$

$$V_L = V_U + TD = \$12 + (0.4)\$10 = \$16 \text{ million.}$$

b.  $r_{sU} = 0.10 = 10.0\%$ .

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_d)(1 - T)(D/S) \\ &= 10\% + (10\% - 5\%)(0.6)(\$10/\$6) = 10\% + 5\% = 15.0\%. \end{aligned}$$

$$c. S_L = \frac{(EBIT - r_d D)(1 - T)}{r_{sL}} = \frac{[\$2 - 0.05(\$10)]0.6}{0.15} = \$6 \text{ million.}$$

$$V_L = S_L + D = \$6 + \$10 = \$16 \text{ million.}$$

$$d. WACC_U = r_{sU} = 10.00\%.$$

$$WACC_L = (D/V)r_d(1 - T) + (S/V)r_s = (\$10/\$16)5\%(0.6) + (\$6/\$16)15\% = 7.50\%.$$

$$17-4 \quad a. V_U = \frac{EBIT(1 - T_C)(1 - T_s)}{r_{sU}(1 - T_s)} = \frac{EBIT(1 - T_C)}{r_{sU}} = \frac{\$2(0.6)}{0.10} = \$12 \text{ million.}$$

$$b. V_L = V_U + \left[ 1 - \frac{(1 - T_C)(1 - T_s)}{(1 - T_d)} \right] D = \$12 + \left[ 1 - \frac{(0.6)(0.8)}{(0.72)} \right] \$10 = \$12 + [1 - 0.67]\$10 = \$12 + 0.33(\$10) = \$15.33 \text{ million.}$$

$$V_L = \$15.93 \text{ million. Gain from leverage} = \$3.33 \text{ million.}$$

c. The gain from leverage under Miller is  $0.33(\$10) = \$3.33$  million. The gain from leverage in Problem 17-3 is  $0.4(\$10) = \$4$  million. Thus, the addition of personal tax rates reduced the value of the debt financing.

d.  $V_U = V_L = \$20$  million. Gain from leverage = \$0.00.

e.  $V_U = \$12$  million.  $V_L = \$16$  million. Gain from leverage = \$4 million.

f.  $V_U = \$12$  million.  $V_L = \$16$  million.

Gain from leverage = \$4.0 million. Note that the gain from leverage is the same as in Part (e) and will be the same value, as long as  $T_d = T_s$ .

17-5 a.  $V_U = \$500,000 / (r_{sU} - g) = \$500,000 / (0.13 - 0.09) = 12,500,000.$

b.  $V_L = \$12.5 \text{ million} + \left( \frac{0.07 \times 0.40 \times 5 \text{ million}}{0.13 - 0.09} \right) = \$16.0 \text{ million.}$  So since

$D = 5, S = 16 - 5 = \$11.0 \text{ million.}$

$r_{sL} = 0.13 + (0.13 - 0.07) \frac{5}{11} = 15.7\%$

c. Under MM,  $V_L = V_U + TD = \$12.5 \text{ million} + (0.40)(5 \text{ million})$

$= \$14.5 \text{ million. } S = \$14.5 - 5 = \$9.5 \text{ million. } r_{sL} = 0.13 + (0.13 - 0.07)(5/9.5) = 14.9\%$

d.  $V_L$  is greater under the extension that incorporates growth than under MM because MM assumes 0 growth. A positive growth rate gives a larger value to the tax shield. In this case the value of the tax shield under MM is 2.0 million and is \$3.5 million if growth is included. The cost of capital when growth is included is higher because the relative weight of equity is higher and the relative weight of debt is lower than when growth is ignored.

17-6 a.  $V_U = S_U = \frac{\text{EBIT}}{r_{sU}} = \frac{\$1,600,000}{0.11} = \$14,545,455.$

$$V_L = V_U = \$14,545,455.$$

b. At D = \$0:

$$r_s = 11.0\%; \text{ WACC} = 11.0\%$$

At D = \$6 million:

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_d)(D/S) \\ &= 11\% + (11\% - 6\%) \left( \frac{\$6,000,000}{\$8,545,455} \right) = 11\% + 3.51\% = 14.51\%. \end{aligned}$$

$$\begin{aligned} \text{WACC} &= (D/V)r_d + (S/V)r_s \\ &= \left( \frac{\$6,000,000}{\$14,545,455} \right) 6\% + \left( \frac{\$8,545,455}{\$14,545,455} \right) 14.51\% \\ &= 11.0\%. \end{aligned}$$

At D = \$10 million:

$$r_{sL} = 11\% + 5\% \left( \frac{\$10,000,000}{\$4,545,455} \right) = 22.00\%.$$

$$\begin{aligned} \text{WACC} &= \left( \frac{\$10,000,000}{\$14,545,455} \right) 6\% + \left( \frac{\$4,545,455}{\$14,545,455} \right) 22\% \\ &= 11.0\%. \end{aligned}$$

Leverage has no effect on firm value, which is a constant \$14,545,455 since WACC is a constant 11%. This is because the cost of equity is increasing with leverage, and this increase exactly offsets the advantage of using lower cost debt financing.

c.  $V_U = [(EBIT - I)(1 - T)]/r_{sU} = [(\$1,600,000 - 0)(0.6)]/0.11 = \$8,727,273.$

$$V_L = V_U + TD = \$8,727,273 + 0.4(\$6,000,000) = \$11,127,273$$

d. At D = \$0:

$$r_s = 11.0\%. \quad \text{WACC} = 11.0\%.$$

At D = \$6 million:

$$V_L = V_U + TD = \$8,727,273 + 0.4(\$6,000,000) = \$11,127,273.$$

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_d)(1 - T)(D/S) \\ &= 11\% + (11\% - 6\%)(0.6)(\$6,000,000/\$11,127,273) = 14.51\%. \end{aligned}$$

$$\begin{aligned} \text{WACC} &= (D/V)r_d(1 - T) + (S/V)r_s \\ &= (\$6,000,000/\$11,127,273)(6\%)(0.6) + (\$5,127,273/\$11,127,273)(14.51\%) \\ &= 8.63\%. \end{aligned}$$

At D = \$10 million:

$$V_L = \$8,727,273 + 0.4(\$10,000,000) = \$12,727,273.$$

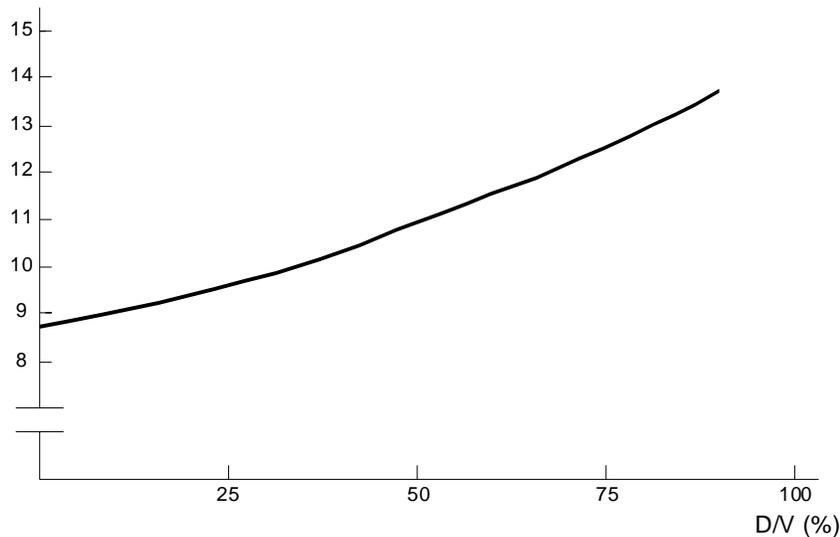
$$r_{sL} = 11\% + 5\%(0.6)(\$10,000,000/\$12,727,273) = 22.00\%.$$

$$\begin{aligned} \text{WACC} &= (\$10,000,000/\$12,727,273)(6\%)(0.6) + (\$2,727,273/\$12,727,273)(22\%) \\ &= 7.54\%. \end{aligned}$$

Summary: (in millions)

D	V	D/V	$r_s$	WACC
\$ 0	\$ 8.73	0%	11.0%	11.0%
6	11.13	53.9	14.5	8.6
10	12.73	78.6	22.0	7.5

Value (Millions of Dollars)

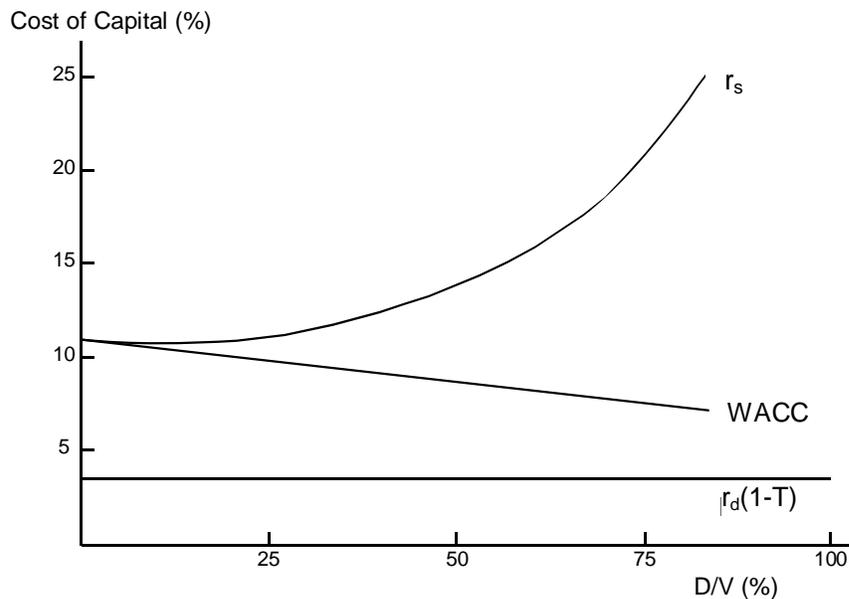


- e. **The maximum amount of debt financing is 100 percent. At this level  $D = V$ , and hence**

$$\begin{aligned}
 V_L &= V_U + TD = D \\
 \$8,727,273 + 0.4D &= D \\
 D - 0.4D &= \$8,727,273 \\
 0.6D &= \$8,727,273 \\
 D &= \$8,727,273 / 0.6 = \$14,545,455 = V.
 \end{aligned}$$

Since the bondholders are bearing the same risk as the equity holders of the unlevered firm,  $r_d$  is now 11 percent. Now, the total interest payment is  $\$14,545,455(0.11) = \$1.6$  million, and the entire  $\$1.6$  million of EBIT would be paid out as interest. Thus, the investors (bondholders) would get  $\$1.6$  million per year, and it would be capitalized at 11 percent:

$$V_L = \frac{\$1,600,000}{0.11} = \$14,545,455.$$



- f. (1) Rising interest rates would cause  $r_d$  and hence  $r_d(1 - T)$  to increase, pulling up WACC. These changes would cause  $V$  to rise less steeply, or even to decline.
- (2) Increased riskiness causes  $r_s$  to rise faster than predicted by MM. Thus, WACC would increase and  $V$  would decrease.

**17-7 a.** The inputs to the Black and Scholes option pricing model are  $P = 5$ ,  $X = 2$ ,  $r_{RF} = 6\%$ ,  $\sigma = 50\%$ , and  $t = 2$  years. Given these inputs, the value of a call option is calculated as:

$$d_1 = \frac{\ln(P/X) + [r_{RF} + \sigma^2/2]t}{\sigma\sqrt{t}} = \frac{\ln(5/2) + [0.06 + 0.5^2/2]2}{0.5\sqrt{2}} = 1.819$$

$$d_2 = d_1 - \sigma\sqrt{t} = 1.819 - 0.5\sqrt{2} = 1.112$$

Using Excel's Normsdist function  $N(d_1) = 0.9656$ , and  $N(d_2) = 0.8669$ . This gives a value of the call option equal to:

$$V = P[N(d_1)] - Xe^{-r_{RF}t}[N(d_2)] = 5[1.819] - 2e^{-0.06(2)}[1.112] = 3.29.$$

- b.** The debt must therefore be worth  $5 - 3.29 = \$1.71$  million. Its yield is  $\sqrt{2.0/1.71} - 1 = 0.81 = 8.1\%$ .
- c.** At a volatility of 30%  $d_1 = 2.566$  and  $N(d_1) = 0.996$ .  $d_2 = 2.230$  and  $N(d_2) = 0.987$ . This gives an option value of \$3.32 million. The debt value is then  $5.0 - 3.23 = \$1.77$  million. Its yield is 6.8%. The value of the stock goes down and the value of the debt goes up because with lower risk, Fethe has less of a chance of a "home run."

## SOLUTION TO SPREADSHEET PROBLEM

---

- 17-8 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 17 P8 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**David Lyons, CEO of Lyons Solar Technologies, is concerned about his firm's level of debt financing. The company uses short-term debt to finance its temporary working capital needs, but it does not use any permanent (long-term) debt. Other solar technology companies average about 30 percent debt, and Mr. Lyons wonders why they use so much more debt, and what its effects are on stock prices. To gain some insights into the matter, he poses the following questions to you, his recently hired assistant:**

a. *Business Week* recently ran an article on companies' debt policies, and the names Modigliani and Miller (MM) were mentioned several times as leading researchers on the theory of capital structure. Briefly, who are MM, and what assumptions are embedded in the MM and Miller models?

**Answer:** Modigliani and Miller (MM) published their first paper on capital structure (which assumed zero taxes) in 1958, and they added corporate taxes in their 1963 paper. Modigliani won the Nobel Prize in economics in part because of this work, and most subsequent work on capital structure theory stems from MM. Here are their assumptions:

- Firms' business risk can be measured by  $\sigma_{\text{EBIT}}$ , and firms with the same degree of risk can be grouped into homogeneous business risk classes.
- All investors have identical (homogeneous) expectations about all firms' future earnings.
- There are no transactions (brokerage) costs, either to individuals or to firms.
- All debt is riskless, and both individuals and corporations can borrow unlimited amounts of money at the same risk-free rate.
- All cash flows are perpetuities. This implies that firms and individuals issue perpetual debt, and also that firms pay out all earnings as dividends, hence have zero growth. Additionally, this implies that expected EBIT is constant over time, although realized EBIT may turn out to be higher or lower than was expected.
- In their first paper (1958), MM also assumed that there are no corporate or personal taxes.

These assumptions--all of them--were necessary in order for MM to use the arbitrage argument to develop and prove their equations. If the assumptions are unrealistic, then the results of the model are not guaranteed to hold in the real world.

**b. Assume that firms U and L are in the same risk class, and that both have EBIT = \$500,000. Firm U uses no debt financing, and its cost of equity is  $r_{sU} = 14\%$ . Firm L has \$1 million of debt outstanding at a cost of  $r_d = 8\%$ . There are no taxes. Assume that the MM assumptions hold, and then:**

**1. Find  $v$ ,  $s$ ,  $r_s$ , and WACC for firms U and L.**

**Answer:** First, we find  $V_U$  and  $V_L$ :

$$V_U = \frac{\text{EBIT}}{r_{sU}} = \frac{\$500,000}{0.14} = \$3,571,429.$$

$$V_L = V_U = \$3,571,429.$$

To find  $r_{sL}$ , it is necessary first to find the market values of firm L's debt and equity. The value of its debt is stated to be \$1,000,000. Therefore, we can find  $s$  as follows:

$$D + S_L = V_L$$

$$S_L = V_L - D = \$3,571,429 - \$1,000,000 = \$2,571,429.$$

Now we can find L's cost of equity,  $r_{sL}$ :

$$\begin{aligned}r_{sL} &= r_{sU} + (r_{sU} - r_d)(D/S) \\ &= 14.0\% + (14.0\% - 8.0\%)(\$1,000,000/\$2,571,429) \\ &= 14.0\% + 2.33\% = 16.33\%.\end{aligned}$$

We know from Proposition I that the WACC must be  $WACC = r_{sU} = 14.0\%$  for all firms in this risk class, regardless of leverage, but this can be verified using the WACC formula:

$$\begin{aligned}WACC &= w_d r_d + w_{ce} r_s = (D/V)r_d + (S/V)r_s \\ &= (\$1,000/\$3,571)(8.0\%) + (\$2,571/\$3,571)(16.33\%) \\ &= 2.24\% + 11.76\% = 14.0\%.\end{aligned}$$

- b. 2. Graph (a) the relationships between capital costs and leverage as measured by  $D/V$ , and (b) the relationship between value and  $D$ .

**Answer:** Figure 1 plots capital costs against leverage as measured by the debt/value ratio. Note that, under the MM no-tax assumption,  $r_d$  is a constant 8 percent, but  $r_s$  increases with leverage. Further, the increase in  $r_s$  is exactly sufficient to keep the WACC constant--the more debt the firm adds to its capital structure, the riskier the equity and thus the higher its cost. Figure 2 plots the firm's value against leverage (debt). With zero taxes, MM argue that value is unaffected by leverage, and thus the plot is a horizontal line. (Note that we should not really extend the graphs to  $D/V = 100\%$  or  $D = \$2.5$  million, because at this amount of leverage the debtholders become the firm's owners, and thus a discontinuity exists.)

Figure 1

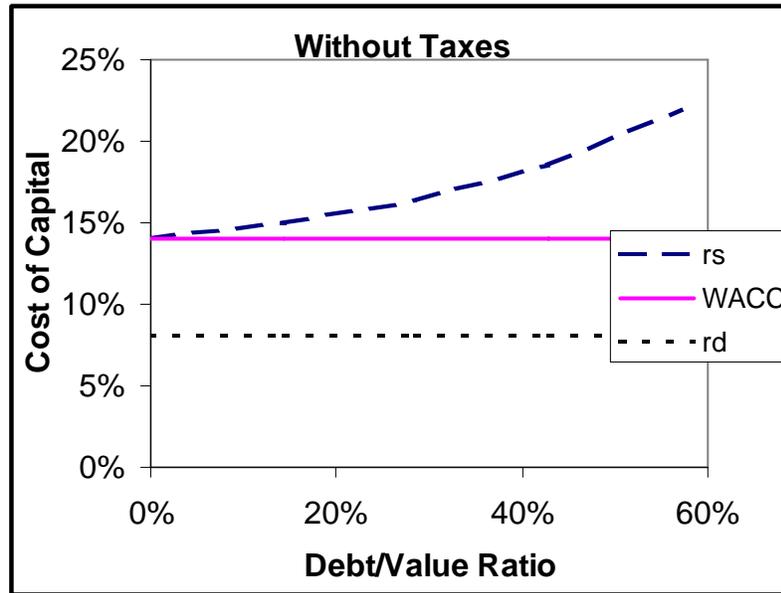
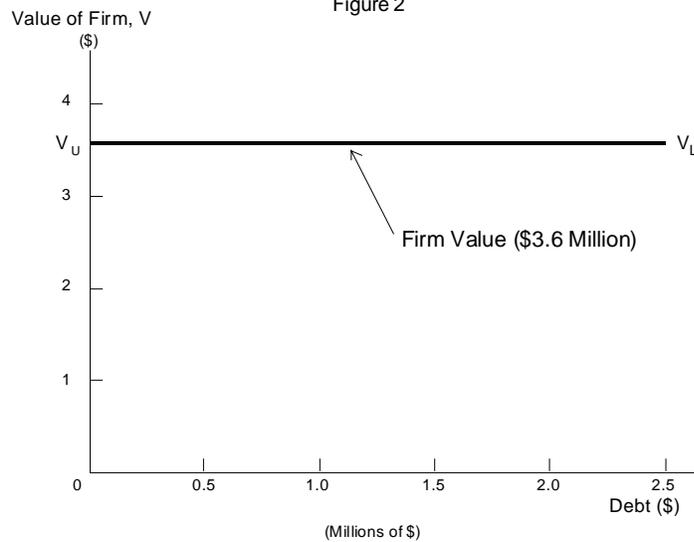


Figure 2



c. Using the data given in part B, but now assuming that firms L and U are both subject to a 40 percent corporate tax rate, repeat the analysis called for in B(1) and B(2) under the MM with-tax model.

**Answer:** With corporate taxes added, the MM propositions become:

Proposition I:  $V_L = V_U + TD$ .

Proposition II:  $r_{sL} = r_{sU} + (r_{sU} - r_d)(1 - T)(D/S)$ .

There are two very important differences between these propositions and the zero-tax propositions: (1) when corporate taxes are added,  $V_L$  does not equal  $V_U$ ; rather,  $V_L$  increases as debt is added to the capital structure, and the greater the debt usage, the higher the value of the firm. (2)  $r_{sL}$  increases less rapidly when corporate taxes are considered. This is seen by noting that the Proposition II slope coefficient changes from  $(r_{sU} - r_d)$  to  $(r_{sU} - r_d)(1 - t)$ , so at any positive  $T$ , the slope coefficient is smaller.

Note also that with corporate taxes considered,  $V_U$  changes to

$$V_U = \frac{EBIT(1 - T)}{r_{sU}} = \frac{\$500,000(0.6)}{0.14} = \$2,142,857 \text{ versus } \$3,571,429.$$

This represents a 40% decline in value, and it is logical, because the 40% tax rate takes away 40% of the income and hence 40% of the firm's value.

Looking at  $V_L$ , we see that:

$$V_L = V_U + TD = \$2,142,857 + 0.4(\$1,000,000)$$

$$V_L = \$2,142,857 + \$400,000 = \$2,542,857 \text{ versus } \$2,142,857 \text{ for } V_U.$$

Thus, the use of \$1,000,000 of debt financing increases firm value by  $T(D) = \$400,000$  over its leverage-free value.

To find  $r_{sL}$ , it is first necessary to find the market value of the equity:

$$D + S_L = V_L$$

$$\$1,000,000 + S_L = \$2,542,857$$

$$S_L = \$1,542,857.$$

now,

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_d)(1 - T)(D/S) \\ &= 14.0\% + (14.0\% - 8.0\%)(0.6)(\$1,000/\$1,543) \\ &= 14.0\% + 2.33\% = 16.33\%. \end{aligned}$$

Firm L's WACC is 11.8 percent:

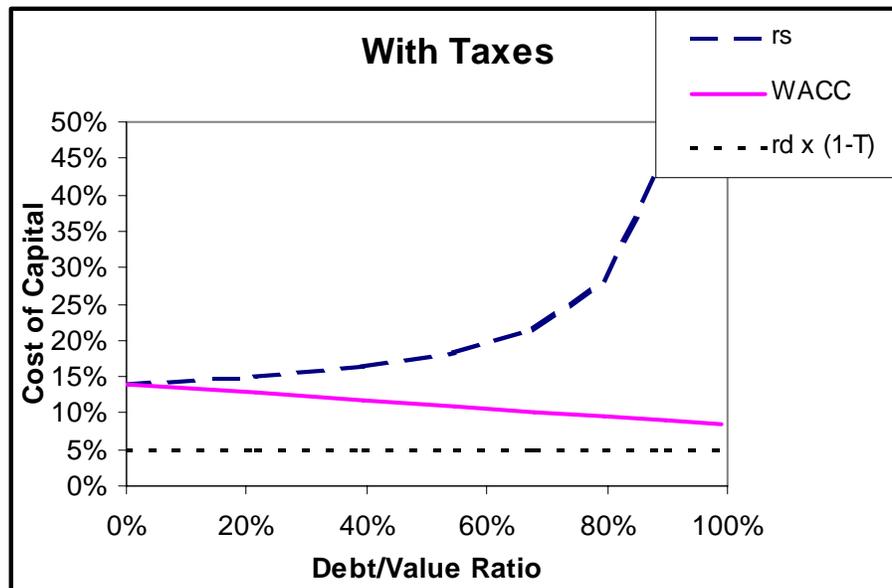
$$\begin{aligned} \text{WACC}_L &= (D/V)r_d(1 - T) + (S/V)r_s \\ &= (\$1,000/\$2,543)(8\%)(0.6) + (1,543/\$2,543)(16.33\%) \\ &= 1.89\% + 9.91\% = 11.8\%. \end{aligned}$$

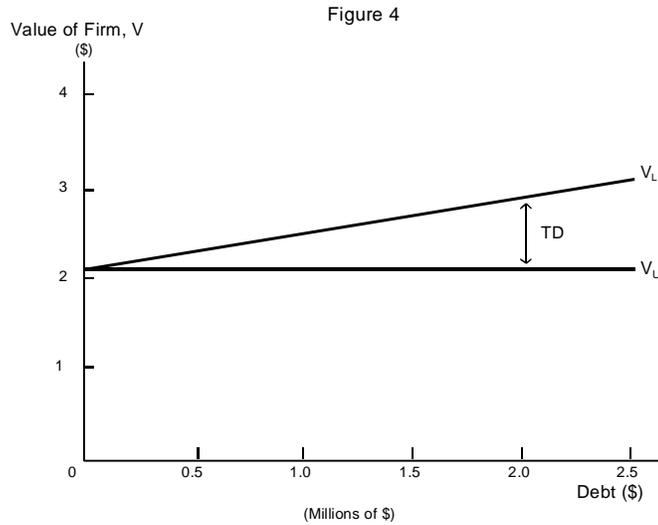
The WACC is lower for the leveraged firm than for the unleveraged firm when corporate taxes are considered.

Figure 3 below plots capital costs at different D/V ratios under the MM model with corporate taxes. Here the WACC declines continuously as the firm uses more and more debt, whereas the WACC was constant in the without-tax model. This result occurs because of the tax deductibility of debt financing (interest payments), which impacts the graph in two ways: (1) the cost of debt is lowered by  $(1 - T)$ , and (2) the cost of equity increases at a slower rate when corporate taxes are considered because of the  $(1 - T)$  term in Proposition II. The combined effect produces the downward-sloping WACC curve.

Figure 4 shows that, when corporate taxes are considered, the firm's value increases continuously as more and more debt is used.

Figure 3





**d. Now suppose investors are subject to the following tax rates:**

$$T_D = 30\% \text{ and } T_S = 12\%.$$

**1. What is the gain from leverage according to the miller model?**

**Answer:** To begin, note that Miller's Proposition I is stated as follows:

$$V_L = V_U + \left[ 1 - \frac{(1 - T_C)(1 - T_S)}{(1 - T_D)} \right] D.$$

Here the bracketed term replaces  $T$  in the earlier MM tax model, and  $T_c$  = corporate tax rate,  $T_d$  = personal tax rate on debt income, and  $T_s$  = personal tax rate on stock income.

If there are no personal or corporate taxes, then  $T_c = T_s = T_d = 0$ , and Miller's model simplifies to

$$V_L = V_U,$$

Which is the same as in MM's 1958 model, which assumed zero taxes.

If there are corporate taxes, but no personal taxes, then  $T_s = T_d = 0$ , and Miller's model simplifies to

$$V_L = V_U + T_C D,$$

Which is the same as MM obtained in their 1963 article, which considered only corporate taxes.

We can now analyze the firm's value numerically, using Miller's model: if  $T_c = 40\%$ ,  $T_d = 30\%$ , and  $T_s = 12\%$ , then Miller's model becomes

$$\begin{aligned} V_L &= V_U + \left[ 1 - \frac{(1 - T_C)(1 - T_S)}{(1 - T_D)} \right] D \\ &= V_U + \left[ 1 - \frac{(1 - 0.40)(1 - 0.12)}{(1 - 0.30)} \right] D = V_U + (1 - 0.75)D = V_U + 0.25D. \end{aligned}$$

d. 2. How does this gain compare to the gain in the MM model with corporate taxes?

**Answer:** If only corporate taxes were considered, then

$$V_L = V_U + T_C D = V_U + 0.40D.$$

The net effect depends on the relative effective tax rates on income from stocks and bonds, and on corporate tax rates. The tax rate on stock income is reduced vis-à-vis the tax rate on debt income if the company retains more of its income and thus provides more capital gains. If  $T_s$  declines, while  $T_c$  and  $T_d$  remain constant, the slope coefficient, which shows the benefit of debt in a graph like figure 4, is increased. Thus, a company with a low payout ratio gets greater benefits under the Miller model than a company with a high payout.

Note that the effects of leverage as computed by Miller's model were much more important before 1987, because in earlier years capital gains were taxed at only 40 percent of the rate imposed on dividends ( $T_s \sim 20\%$  and  $T_d \sim 50\%$ ). Now the advantages of capital gains are (1) the fact that taxes on them are deferred, and (2) individuals in the higher tax brackets obtain an advantage because the tax rate imposed on long-term capital gains is 20 percent.

d. 3. What does the Miller model imply about the effect of corporate debt on the value of the firm, that is, how do personal taxes affect the situation?

**Answer:** The addition of personal taxes lowers the value of debt financing to the firm. The underlying rationale can be explained as follows: the U.S. *corporate tax laws favor debt financing over equity financing*, because interest expense is tax deductible while dividends are not. This provides an incentive for firms to use debt financing, and this was the message of the mm 1963 paper. At the same time, though, the U.S. *personal tax laws favor investment in equity securities over debt securities*, because equity income is effectively taxed at a lower rate. Thus, investors require higher risk-adjusted before-tax returns on debt to be induced to buy debt rather than equity, and this reduces the advantage to issuing debt.

The bottom line conclusion we reach from an analysis of the Miller model is that personal taxes lower, but do not eliminate, the value of debt financing.

e. What capital structure policy recommendations do the three theories (MM without taxes, MM with corporate taxes, and Miller) suggest to financial managers? Empirically, do firms appear to follow any one of these guidelines?

**Answer:** In a zero tax world, MM theory says that capital structure is irrelevant--it has no impact on firm value. Thus, one capital structure is as good as another. With corporate but not personal taxes considered, the MM model states that firm value increases continuously with financial leverage, and hence firms should use (almost) 100 percent debt financing. Miller added personal taxes to the analysis, and the value of debt financing is seen to be reduced but not eliminated, so again firms should use (almost) 100 percent debt financing.

The Miller model is the most realistic of the three, but if it were really correct, we would expect to see firms using almost all debt financing. However, on average, firms use only about 40 percent debt. Note, though, that debt ratios increased all during the 1980s, so companies were moving toward the miller position. However, in the 1990s we see firms reducing their debt.

f. How is the analysis in part C different if firms U and L are growing? Assume that both firms are growing at a rate of 7 percent and that the investment in net operating assets required to support this growth is 10 percent of EBIT.

**Answer:** If a firm is growing, the assumptions that MM made are violated. The extension to the MM model shows how growth affects the value of the debt tax shield and the cost of capital. The first difference in this situation is that the appropriate discount rate for the debt tax shield is the unlevered cost of equity, not the cost of debt. The second difference is that a growing debt tax shield is more valuable than a constant debt tax shield.

First, calculate expected free cash flow:

$$\begin{aligned} \text{NOPAT} &= \text{EBIT} \times (1-T) = 500,000 \times (1 - 0.40) = \$300,000 \\ \text{Investment In Net Operating Assets} &= 0.10 \times \text{EBIT} = \$50,000 \\ \text{Free Cash Flow} &= \text{NOPAT} - \text{Investment In Net Operating Assets} \\ &= \$300,000 - \$50,000 = \$250,000 \end{aligned}$$

(Note that this is an expected value for the coming year since EBIT is an expected value for the coming year.)

Next, note that WACC = unlevered cost of equity if there is no debt so  
 $\text{WACC} = r_{sU} = 14\%$

$$\begin{aligned} \text{The Value Of U} &= \text{Expected FCF}/(\text{WACC} - g) \\ &= 250,000/(0.14 - 0.07) = \$3,571,429 \end{aligned}$$

Which is greater than in part C because the firm is growing.

If there is \$1,000,000 in debt then:

$$\begin{aligned} \text{The value of } l &= \text{the value of U} + \text{value of debt tax shield} \\ \text{The value of the (growing) debt tax shield} &= r_d \text{TD}/(r_{sU} - g) \\ &= 0.08(0.40)(1,000,000)/(0.14 - 0.07) \\ &= \$457,143 \end{aligned}$$

Therefore, the value of the firm = \$3,571,429 + \$457,143 = \$4,028,571.

The value of the equity is the value of the firm less the value of the debt = \$4,028,571 - \$1,000,000 = \$3,028,571.

In this case the increase in the firm's value due to the debt tax shield as a percent of its zero debt value is \$457,143/\$3,571,429 = 12.80%

This is less than the increase in the non-growing firm's value as calculated using the MM model: \$400,000/\$2,142,857 = 18.7%.

To calculate the new levered cost of equity:

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_d)(D/S) \\ &= 14\% + (14\% - 8\%)(1,000,000/3,028,571) \\ &= 15.98\% \end{aligned}$$

And the new levered WACC:

$$\begin{aligned} \text{WACC}_L &= (D/V)r_d(1 - T) + (S/V)r_s \\ &= (1,000,000/4,028,571)8\%(1-.40) \\ &\quad + (3,028,571/4,028,571)15.98\% \\ &= 13.2\%. \end{aligned}$$

**g. What if L's debt is risky? For the purpose of this example, assume that the value of L's operations is \$4 million—which is the value of its debt plus equity. Assume also that its debt consists of 1-year zero coupon bonds with a face value of \$2 million. Finally, assume that L's volatility is 0.60 ( $\sigma = 0.60$ ) and that the risk free rate is 6 percent.**

**Answer:** L's equity can be considered as a call option on the total value of l with an exercise price of \$2 million, and an expiration date in one year. If the value of L's operations is less than \$2 million in a year, then L's management will not be able to make its required payment on the debt, and the firm will be bankrupt. The debtholders will take over the firm and the equity holders will receive nothing. If L's value is greater than \$2 million in one year, then management will repay the debt and the stockholders will keep the company.

This option can be valued with the Black-Scholes Option Pricing Model:

$$V = PN(D_1) - Xe^{-RT}N(D_2)$$

where

$$D_1 = [\ln(P/X) + (r + 0.5\sigma^2)T]/[\sigma T^{0.5}]$$

$$D_2 = D_1 - \sigma T^{0.5}$$

And  $n()$  is the cumulative normal distribution function, from either appendix a in the back of the text, or the NORMSDIST() function in excel.

in this case,       $P = \$4$   
                          $X = \$2$   
                          $\sigma = 0.60$   
                          $T = 1.0$   
                          $R = 0.06$

and calculating,

$D_1 = 1.552$   
 $D_2 = 0.9552$   
 $N(D_1) = 0.9491$   
 $N(D_2) = 0.8303$

and  $V = \$2.1964$  million.

This leaves debt value of \$4 million - \$2.1964 million = \$1.8036 million.

The yield on this debt is calculated as

$$\text{Price} = (\text{Face Value}) / (1 + \text{Yield})^N$$

so that

$$\begin{aligned} \text{Yield} &= [\text{Face Value} / \text{Price}]^{1/N} - 1.0 \\ &= [2.0 / 1.8036] - 1.0 \\ &= 10.89\% \end{aligned}$$

In this case, the value of the debt must be \$1.8036 million, and it is yielding 10.89%. The value of the equity is \$2.1964 million.

h. What is the value of L's stock for volatilities between 0.20 and 0.95? What incentives might the manager of L have if she understands this relationship? What might debtholders do in response?

**Answer:** The mini case model shows the calculations for the table below.

Value of Stock and Debt for Different Volatilities		
Volatility	Equity	Debt
0.20	2.12	1.88
0.25	2.12	1.88
0.30	2.12	1.88
0.35	2.12	1.88
0.40	2.13	1.87
0.45	2.14	1.86
0.50	2.16	1.84
0.55	2.17	1.83
0.60	2.20	1.80
0.65	2.22	1.78
0.70	2.25	1.75
0.75	2.28	1.72
0.80	2.31	1.69
0.85	2.34	1.66
0.90	2.38	1.62
0.95	2.41	1.59

The value of the equity increases as the volatility increases—and the value of the debt decreases as well. A manager who knows this may choose to invest the proceeds from borrowing in assets that are riskier than usual. This is called “bait and switch.” This action decreases the value of the debt, because now its claim is riskier. It increases the value of equity because the worse the stockholders can do is default on the bonds, but the best they can do is potentially unlimited.

Bondholders who face this possibility will write covenants into their bond contracts limiting management’s ability to invest in assets other than originally planned. If this isn’t possible, then bondholders will demand a higher rate of return in order to compensate them for the possibility that management will switch investments.

# Chapter 18

## Distributions to Shareholders: Dividends and Repurchases

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 18-1
- The optimal distribution policy is one that strikes a balance between dividend yield and capital gains so that the firm's stock price is maximized.
  - The dividend irrelevance theory holds that dividend policy has no effect on either the price of a firm's stock or its cost of capital. The principal proponents of this view are Merton Miller and Franco Modigliani (MM). They prove their position in a theoretical sense, but only under strict assumptions, some of which are clearly not true in the real world. The "bird-in-the-hand" theory assumes that investors value a dollar of dividends more highly than a dollar of expected capital gains because the dividend yield component,  $D1/P0$ , is less risky than the  $g$  component in the total expected return equation  $r_S = D1/P0 + g$ . The tax preference theory proposes that investors prefer capital gains over dividends, because capital gains taxes can be deferred into the future, but taxes on dividends must be paid as the dividends are received.
  - The information content of dividends is a theory which holds that investors regard dividend changes as "signals" of management forecasts.

**Thus, when dividends are raised, this is viewed by investors as recognition by management of future earnings increases. Therefore, if a firm's stock price increases with a dividend increase, the reason may not be investor preference for dividends, but expectations of higher future earnings. Conversely, a dividend reduction may signal that management is forecasting poor earnings in the future. The clientele effect is the attraction of companies with specific dividend policies to those investors whose needs are best served by those policies. Thus, companies with high dividends will have a clientele of investors with low marginal tax rates and strong desires for current income. Similarly, companies with low dividends will attract a clientele with little need for current income, and who often have high marginal tax rates.**

- The residual distribution model states that firms should make distributions only when more earnings are available than needed to support the optimal capital budget. An extra dividend is a dividend paid, in addition to the regular dividend, when earnings permit. Firms with volatile earnings may have a low regular dividend that can be maintained even in low-profit (or high capital investment) years, and then supplement it with an extra dividend when excess funds are available.

- e. The declaration date is the date on which a firm's directors issue a statement declaring a dividend. If a company lists the stockholder as an owner on the holder-of-record date, then the stockholder receives the dividend. The ex-dividend date is the date when the right to the dividend leaves the stock. This date was established by stockbrokers to avoid confusion and is 2 business days prior to the holder of record date. If the stock sale is made prior to the ex-dividend date, the dividend is paid to the buyer.

If the stock is bought on or after the ex-dividend date, the dividend is paid to the seller. The date on which a firm actually mails dividend checks is known as the payment date.

- f. Dividend reinvestment plans allow stockholders to automatically purchase shares of common stock of the paying corporation in lieu of receiving cash dividends. There are two types of plans--one involves only stock that is already outstanding, while the other involves newly issued stock. In the first type, the dividends of all participants are pooled and the stock is purchased on the open market. Participants benefit from lower transaction costs. In the second type, the company issues new shares to the participants. Thus, the company issues stock in lieu of the cash dividend.
- g. In a stock split, current shareholders are given some number (or fraction) of shares for each stock owned. Thus, in a 3-for-1 split, each shareholder would receive 3 new shares in exchange for each old share, thereby tripling the number of shares outstanding. Stock splits usually occur when the stock price is outside of the optimal trading range. Stock dividends also increase the number of shares outstanding, but at a slower rate than splits. In a stock dividend, current shareholders receive additional shares on some proportional basis. Thus, a holder of 100 shares would receive 5 additional shares at no cost if a 5 percent stock dividend were declared. Stock repurchases occur when a firm repurchases its own stock. These shares of stock are then referred to as treasury stock. The higher EPS on the now decreased number of shares outstanding will cause the price of the stock to rise and thus capital gains are substituted for cash dividends.

- 18-2
- a. From the stockholders' point of view, an increase in the personal income tax rate would make it more desirable for a firm to retain and reinvest earnings. Consequently, an increase in personal tax rates should *lower* the aggregate payout ratio.
  - b. If the depreciation allowances were raised, cash flows would increase. With higher cash flows, payout ratios would tend to increase. On the other hand, the change in tax-allowed depreciation charges would increase rates of return on investment, other things being equal, and this might stimulate investment, and consequently reduce payout ratios. On balance, it is likely that aggregate payout ratios would rise, and this has in fact been the case.
  - c. If interest rates were to increase, the increase would make retained earnings a relatively attractive way of financing new investment. Consequently, the payout ratio might be expected to decline. On the other hand, higher interest rates would cause  $r_d$ ,  $r_s$ , and firm's MCCs to rise--that would mean that fewer projects would qualify for capital budgeting and the residual would increase (other things constant), hence the payout ratio might *increase*.
  - d. A permanent increase in profits would probably lead to an increase in dividends, but not necessarily to an increase in the payout ratio. If the aggregate profit increase were a cyclical increase that could be expected to be followed by a decline, then the payout ratio might fall, because firms do not generally raise dividends in response to a short-run profit increase.
  - e. If investment opportunities for firms declined while cash inflows remained relatively constant, an increase would be expected in the payout ratio.
  - f. Dividends are currently paid out of after-tax dollars, and interest charges from before-tax dollars. Permission for firms to deduct dividends as they do interest charges would make dividends less costly to pay than before and would thus tend to increase the payout ratio.
  - g. This change would make capital gains less attractive and would lead to an increase in the payout ratio.
- 18-3
- The difference is largely one of accounting. In the case of a *split*, the firm simply increases the number of shares and simultaneously reduces the par or stated value per share. In the case of a *stock dividend*, there must be a transfer from retained earnings to capital stock. For most firms, a 100 percent stock dividend and a 2-for-1 split accomplish exactly the same thing; hence, investors may choose either one.
- 18-4
- a. The residual distribution policy is based on the premise that, since new common stock is more costly than retained earnings, a firm should use all the retained earnings it can to satisfy its common equity requirement. Thus, the distribution under this policy is a function of the firm's investment opportunities.
  - b. Yes. A more shallow plot implies that changes from the optimal capital structure have little effect on the firm's cost of capital, hence value. In this situation, dividend policy is less critical than if the plot were V-shaped.

- 18-5 a. True. When investors sell their stock they are subject to capital gains taxes.
- b. True. If a company's stock splits 2 for 1, and you own 100 shares, then after the split you will own 200 shares.**
- c. True. Dividend reinvestment plans that involve newly issued stock will increase the amount of equity capital available to the firm.
- d. False. The tax code, through the tax deductibility of interest, encourages firms to use debt and thus pay interest to investors rather than dividends, which are not tax deductible. In addition, due to a lower capital gains tax rate than the highest personal tax rate, the tax code encourages investors in high tax brackets to prefer firms who retain earnings rather than those that pay large dividends.
- e. True. If a company's clientele prefers large dividends, the firm is unlikely to adopt a residual dividend policy. A residual dividend policy could mean low or zero dividends in some years which would upset the company's developed clientele.
- f. False. If a firm follows a residual dividend policy, all else constant, its dividend payout will tend to decline whenever the firm's investment opportunities improve.

---

### SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

- 18-1 70% Debt; 30% Equity; Capital Budget = \$3,000,000; NI = \$2,000,000;  
PO = ?

Equity retained =  $0.3(\$3,000,000) = \$900,000$ .

NI	\$2,000,000	
-Additions		900,000
Earnings Remaining	\$1,100,000	

$$\text{Payout} = \frac{\$1,100,000}{\$2,000,000} = 55\%.$$

- 18-2  $P_0 = \$90$ ; Split = 3 for 2; New  $P_0 = ?$

$$P_{0\text{New}} = \frac{\$90}{3/2} = \$60.$$

- 18-3 Retained earnings = Net income (1 - Payout ratio)

$$= \$5,000,000(0.55) = \$2,750,000.$$

External equity needed:

$$\begin{aligned} \text{Total equity required} &= (\text{New investment})(1 - \text{Debt ratio}) \\ &= \$10,000,000(0.60) = \$6,000,000. \end{aligned}$$

$$\text{New external equity needed} = \$6,000,000 - \$2,750,000 = \$3,250,000.$$

18-4 The company requires  $0.40(\$1,200,000) = \$480,000$  of equity financing. If the company follows a residual dividend policy it will retain \$480,000 for its capital budget and pay out the \$120,000 “residual” to its shareholders as a dividend. The payout ratio would therefore be  $\$120,000/\$600,000 = 0.20 = 20\%$ .

18-5 Equity financing =  $\$12,000,000(0.60) = \$7,200,000$ .

$$\begin{aligned} \text{Dividends} &= \text{Net income} - \text{Equity financing} \\ &= \$15,000,000 - \$7,200,000 = \$7,800,000. \end{aligned}$$

$$\begin{aligned} \text{Dividend payout ratio} &= \text{Dividends}/\text{Net income} \\ &= \$7,800,000/\$15,000,000 = 52\%. \end{aligned}$$

18-6 DPS after split = \$0.75.

$$\text{Equivalent pre-split dividend} = \$0.75(5) = \$3.75.$$

$$\begin{aligned} \text{New equivalent dividend} &= \text{Last year's dividend}(1.09) \\ \$3.75 &= \text{Last year's dividend}(1.09) \\ \text{Last year's dividend} &= \$3.75/1.09 = \$3.44. \end{aligned}$$

18-7 Capital budget should be \$10 million. We know that 50% of the \$10 million should be equity. Therefore, the company should pay dividends of:

$$\begin{aligned} \text{Dividends} &= \text{Net income} - \text{needed equity} \\ &= \$7,287,500 - \$5,000,000 = \$2,287,500. \\ \text{Payout ratio} &= \$2,287,500/\$7,287,500 = 0.3139 = 31.39\%. \end{aligned}$$

- 18-8 a. 1. 2005 Dividends =  $(1.10)(2004 \text{ Dividends})$   
 $= (1.10)(\$3,600,000) = \$3,960,000.$
2. 2004 Payout =  $\$3,600,000/\$10,800,000 = 0.33 = 33\%.$
- 2005 Dividends =  $(0.33)(2005 \text{ Net income})$   
 $= (0.33)(\$14,400,000) = \$4,800,000.$
- (Note: If the payout ratio is rounded off to 33%, 2005 dividends are then calculated as \$4,752,000.)
3. Equity financing =  $\$8,400,000(0.60) = \$5,040,000.$
- 2005 Dividends = Net income - Equity financing  
 $= \$14,400,000 - \$5,040,000 = \$9,360,000.$
- All of the equity financing is done with retained earnings as long as they are available.
4. The regular dividends would be 10% above the 2004 dividends:
- Regular dividends =  $(1.10)(\$3,600,000) = \$3,960,000.$
- The residual policy calls for dividends of \$9,360,000. Therefore, the extra dividend, which would be stated as such, would be
- Extra dividend =  $\$9,360,000 - \$3,960,000 = \$5,400,000.$
- An even better use of the surplus funds might be a stock repurchase.
- b. Policy 4, based on the regular dividend with an extra, seems most logical. Implemented properly, it would lead to the correct capital budget and the correct financing of that budget, and it would give correct signals to investors.
- 18-9 a. Capital Budget = \$10,000,000; Capital structure = 60% equity, 40% debt.
- Retained Earnings Needed =  $\$10,000,000 (0.6) = \$6,000,000.$
- b. According to the residual dividend model, only \$2 million is available for dividends.
- NI - Retained earnings needed for cap. projects = Residual dividend.  
 $\$8,000,000 - \$6,000,000 = \$2,000,000.$   
DPS =  $\$2,000,000/1,000,000 = \$2.00.$   
Payout ratio =  $\$2,000,000/\$8,000,000 = 25\%.$
- c. Retained Earnings Available =  $\$8,000,000 - \$3.00 (1,000,000)$   
Retained Earnings Available =  $\$8,000,000 - \$3,000,000$   
Retained Earnings Available =  $\$5,000,000.$
- d. No. If the company maintains its \$3.00 DPS, only \$5 million of retained earnings will be available for capital projects. However, if the firm is to maintain its current capital structure, \$6 million of equity is required. This would necessitate the company having to issue \$1 million of

new common stock.

- e. Capital Budget = \$10 million; Dividends = \$3 million; NI = \$8 million.  
Capital Structure = ?

$$\begin{aligned} \text{RE Available} &= \$8,000,000 - \$3,000,000 \\ &= \$5,000,000. \end{aligned}$$

$$\text{Percentage of Cap. Budget Financed with RE} = \frac{\$5,000,000}{\$10,000,000} = 50\%.$$

$$\text{Percentage of Cap. Budget Financed with Debt} = \frac{\$5,000,000}{\$10,000,000} = 50\%.$$

- f. Dividends = \$3 million; Capital Budget = \$10 million; 60% equity, 40% debt; NI = \$8 million.

$$\text{Equity Needed} = \$10,000,000(0.6) = \$6,000,000.$$

$$\begin{aligned} \text{RE Available} &= \$8,000,000 - \$3.00(1,000,000) \\ &= \$8,000,000 - \$3,000,000 \\ &= \$5,000,000. \end{aligned}$$

$$\begin{aligned} \text{External (New) Equity Needed} &= \$6,000,000 - \$5,000,000 \\ &= \$1,000,000. \end{aligned}$$

- g. Dividends = \$3 million; NI = \$8 million; Capital structure = 60% equity, 40% debt.

$$\begin{aligned} \text{RE Available} &= \$8,000,000 - \$3,000,000 \\ &= \$5,000,000. \end{aligned}$$

We're forcing the RE Available = Required Equity to find the new capital budget.

$$\begin{aligned} \text{Required Equity} &= \text{Capital Budget (Target Equity Ratio)} \\ \$5,000,000 &= \text{Capital Budget}(0.6) \\ \text{Capital Budget} &= \$8,333,333. \end{aligned}$$

Therefore, if Buena Terra cuts its capital budget from \$10 million to \$8.33 million, it can maintain its \$3.00 DPS, its current capital structure, and still follow the residual dividend policy.

- h. The firm can do one of four things:

- (1) Cut dividends.
- (2) Change capital structure, that is, use more debt.
- (3) Cut its capital budget.
- (4) Issue new common stock.

Realize that each of these actions is not without consequences to the company's cost of capital, stock price, or both.



## SPREADSHEET PROBLEM

---

- 18-10 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 18 P10 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

Southeastern Steel Company (SSC) was formed 5 years ago to exploit a new continuous-casting process. SSC's founders, Donald Brown and Margo Valencia, had been employed in the research department of a major integrated-steel company, but when that company decided against using the new process (which Brown and Valencia had developed), they decided to strike out on their own. One advantage of the new process was that it required relatively little capital in comparison with the typical steel company, so Brown and Valencia have been able to avoid issuing new stock, and thus they own all of the shares. However, SSC has now reached the stage where outside equity capital is necessary if the firm is to achieve its growth targets yet still maintain its target capital structure of 60 percent equity and 40 percent debt. Therefore, Brown and Valencia have decided to take the company public. Until now, Brown and Valencia have paid themselves reasonable salaries but routinely reinvested all after-tax earnings in the firm, so dividend policy has not been an issue. However, before talking with potential outside investors, they must decide on a dividend policy.

Assume that you were recently hired by Arthur Adamson & Company (AA), a national consulting firm, which has been asked to help SSC prepare for its public offering. Martha Millon, the senior AA consultant in your group, has asked you to make a presentation to Brown and Valencia in which you review the theory of dividend policy and discuss the following questions.

a. 1. What is meant by the term "distribution policy"?

**Answer:** Distribution policy is defined as the firm's policy with regard to (1) the level of distributions, (2) the form of distributions (dividends or stock repurchases), and (3) the stability of distributions.

a. 2. The terms "irrelevance," "bird-in-the-hand," and "tax preference" have been used to describe three major theories regarding the way dividend payouts affect a firm's value. Explain what these terms mean, and briefly describe each theory.

**Answer:** Dividend irrelevance refers to the theory that investors are indifferent between dividends and

capital gains, making dividend policy irrelevant with regard to its effect on the value of the firm. “Bird-in-the-hand” refers to the theory that a dollar of dividends in the hand is preferred by investors to a dollar retained in the business, in which case dividend policy would affect a firm’s value.

The dividend irrelevance theory was proposed by MM, but they had to make some very restrictive assumptions to “prove” it (zero taxes, no flotation or transactions costs). MM argued that paying out a dollar per share of dividends reduces the growth rate in earnings and dividends, because new stock will have to be sold to replace the capital paid out as dividends. Under their assumptions, a dollar of dividends will reduce the stock price by exactly \$1. Therefore, according to MM, stockholders should be indifferent between dividends and capital gains.

The “bird-in-the-hand” theory is identified with Myron Gordon and John Lintner, who argued that investors perceive a dollar of dividends in the hand to be less risky than a dollar of potential future capital gains in the bush; hence, stockholders prefer a dollar of actual dividends to a dollar of retained earnings. If the bird-in-the-hand theory is true, then investors would regard a firm with a high payout ratio as being less risky than one with a low payout ratio, all other things equal; hence, firms with high payout ratios would have higher values than those with low payout ratios.

MM opposed the Gordon-Lintner theory, arguing that a firm’s risk is dependent only on the riskiness of its cash flows from assets and its capital structure, not by how its earnings are distributed to investors.

The tax preference theory recognizes that there are two tax-related reasons for believing that investors might prefer a low dividend payout to a high payout: (1) taxes are not paid on capital gains until the stock is sold. (2) if a stock is held by someone until he or she dies, no capital gains tax is due at all--the beneficiaries who receive the stock can use the stock’s value on the death day as their cost basis and thus escape the capital gains tax.

a. 3. What do the three theories indicate regarding the actions management should take with respect to dividend payout?
---

**Answer:** If the dividend irrelevance theory is correct, then dividend payout is of no consequence, and the

firm may pursue any dividend payout. If the bird-in-the-hand theory is correct, the firm should set a high payout if it is to maximize its stock price. If the tax preference theory is correct, the firm should set a low payout if it is to maximize its stock price. Therefore, the theories are in total conflict with one another.

a. 4. What results have empirical studies of the dividend theories produced? How does all this affect what we can tell managers about dividend payouts?

**Answer:** Unfortunately, empirical tests of the theories have been inconclusive (because firms don't differ just with respect to payout), so we cannot tell managers whether investors prefer dividends or capital gains. Even though we cannot determine what the optimal dividend policy is, managers can use the types of analyses discussed in this chapter to help develop a rational and reasonable, if not completely optimal, dividend policy.

b. Discuss (1) the information content, or signaling, hypothesis, (2) the clientele effect, and (3) their effects on distribution policy.

**Answer:** 1. Different groups, or clienteles, of stockholders prefer different dividend payout policies. For example, many retirees, pension funds, and university endowment funds are in a low (or zero) tax bracket, and they have a need for current cash income. Therefore, this group of stockholders might prefer high payout stocks. These investors could, of course, sell some of their stock, but this would be inconvenient, transactions costs would be incurred, and the sale might have to be made in a down market. Conversely, investors in their peak earnings years who are in high tax brackets and who have no need for current cash income should prefer low payout stocks.

2. Clienteles do exist, but the real question is whether there are more members of one clientele than another, which would affect what a change in its dividend policy would do to the demand for the firm's stock. There are also costs (taxes and brokerage) to stockholders who would be forced to switch from one stock to another if a firm changes its policy. Therefore, we cannot say whether a policy change to appeal to one particular clientele or another would lower or raise a firm's cost of equity. MM argued that one clientele is as good as another, so in their view the existence of clienteles does not imply that one dividend policy is better than another. Still, no one has offered convincing proof that firms can disregard clientele effects. We know that stockholder shifts will occur if policy is changed, and since such shifts result in transaction costs and capital gains taxes, policy changes should not be taken lightly. Further, dividend policy should be changed slowly, rather than abruptly, in order to give stockholders time to adjust.
  
3. It has long been recognized that the announcement of a dividend increase often results in an increase in the stock price, while an announcement of a dividend cut typically causes the stock price to fall. One could argue that this observation supports the premise that investors prefer dividends to capital gains. However, MM argued that dividend announcements are signals through which management conveys information to investors. Information asymmetries exist--managers know more about their firms' prospects than do investors. Further, managers tend to raise dividends only when they believe that future earnings can comfortably support a higher dividend level, and they cut dividends only as a last resort. Therefore, (1) a larger-than-normal dividend increase "signals" that management believes the future is bright, (2) a smaller-than-expected increase, or a dividend cut, is a negative signal, and (3) if dividends are increased by a "normal" amount, this is a neutral signal.

c. 1. Assume that SSC has an \$800,000 capital budget planned for the coming year. You have determined that its present capital structure (60 percent equity and 40 percent debt) is optimal, and its net income is forecasted at \$600,000. Use the residual distribution model approach to determine SSC's total dollar distribution. Assume for now that the distribution is in the form of a dividend. Then, explain what would happen if net income were forecasted at \$400,000, or at \$800,000.

**Answer:** We make the following points:

- a. Given the optimal capital budget and the target capital structure, we must now determine the amount of equity needed to finance the projects. Of the \$800,000 required for the capital budget,  $0.6(\$800,000) = \$480,000$  must be raised as equity and  $0.4(\$800,000) = \$320,000$  must be raised as debt if we are to maintain the optimal capital structure:

Debt	\$320,000	40%	
Equity	480,000	60%	
	\$800,000	100%	

- b. If a residual exists--that is, if net income exceeds the amount of equity the company needs--then it should distribute the residual amount out as either dividends or stock repurchases. For now, we assume all payouts are in the form of dividends. Since \$600,000 of earnings is available, and only \$480,000 is needed, the residual is  $\$600,000 - \$480,000 = \$120,000$ , so this is the amount which should be paid out as dividends. Thus, the payout ratio would be  $\$120,000/\$600,000 = 0.20 = 20\%$ .
- c. If only \$400,000 of earnings were available, the theoretical break point would occur at  $BP = \$400,000/0.6 = \$666,667$ . Assuming the intersection of the investment opportunity set and marginal cost of capital was still at \$800,000, the firm would still need \$480,000 of equity. It should then retain all of its earnings and also sell \$80,000 of new stock. The residual policy would call for a zero payment.
- d. If \$800,000 of earnings was available, the dividend would be increased to  $\$800,000 - \$480,000 = \$320,000$ , and the payout ratio would rise to  $\$320,000/\$800,000 = 40\%$ .

c. 2. In general terms, how would a change in investment opportunities affect the payout ratio under the residual payment policy?

**Answer:** A change in investment opportunities would lead to an increase (if investment opportunities were good) or a decrease (if investment opportunities were not good) in the amount of equity needed,

hence in the residual dividend payout.

c. 3. What are the advantages and disadvantages of the residual policy? (Hint: don't neglect signaling and clientele effects.)

**Answer:** The primary advantage of the residual policy is that under it the firm makes maximum use of lower cost retained earnings, thus minimizing flotation costs and hence the cost of capital. Also, whatever negative signals are associated with stock issues would be avoided.

However, if it were applied exactly, the residual model would result in dividend payments which fluctuated significantly from year to year as capital requirements and internal cash flows fluctuated. This would (1) send investors conflicting signals over time regarding the firm's future prospects, and (2) since no specific clientele would be attracted to the firm, it would be an "orphan." These signaling and clientele effects would lead to a higher required return on equity which would more than offset the effects of lower flotation costs. Because of these factors, few if any publicly owned firms follow the residual model on a year-to-year basis.

Even though the residual approach is not used to set the annual dividend, it is used when firms establish their long-run dividend policy. If "normalized" cost of capital and investment opportunity conditions suggest that in a "normal" year the company should pay out about 60 percent of its earnings, this fact will be noted and used to help determine the long-run policy.

d. What are stock repurchases? Discuss the advantages and disadvantages of a firm's repurchasing its own shares.

**Answer:** A firm may distribute cash to stockholders by repurchasing its own stock rather than paying out cash dividends. Stock repurchases can be used (1) somewhat routinely as an alternative to regular dividends, (2) to dispose of excess (nonrecurring) cash that came from asset sales or from temporarily high earnings, and (3) in connection with a capital structure change in which debt is sold and the proceeds are used to buy back and retire shares.

Advantages of repurchases:

1. A repurchase announcement may be viewed as a positive signal that management believes the shares are undervalued.
2. Stockholders have a choice--if they want cash, they can tender their shares, receive the cash, and pay the taxes, or they can keep their shares and avoid taxes. On the other hand, one must accept a cash dividend and pay taxes on it.

3. If the company raises the dividend to dispose of excess cash, this higher dividend must be maintained to avoid adverse stock price reactions. A stock repurchase, on the other hand, does not obligate management to future repurchases.
4. Repurchased stock, called treasury stock, can be used later in mergers, when employees exercise stock options, when convertible bonds are converted, and when warrants are exercised. Treasury stock can also be resold in the open market if the firm needs cash. Repurchases can remove a large block of stock that is “overhanging” the market and keeping the price per share down.
5. Repurchases can be varied from year to year without giving off adverse signals, while dividends may not.
6. Repurchases can be used to produce large-scale changes in capital structure.

Disadvantages of repurchases:

1. A repurchase could lower the stock’s price if it is taken as a signal that the firm has relatively few good investment opportunities. On the other hand, though, a repurchase can signal stockholders that managers are not engaged in “empire building,” where they invest funds in low-return projects.
2. If the IRS establishes that the repurchase was primarily to avoid taxes on dividends, then penalties could be imposed. Such actions have been brought against closely held firms, but to our knowledge charges have never been brought against publicly held firms.
3. Selling shareholders may not be fully informed about the repurchase; hence they may make an uninformed decision and may later sue the company. To avoid this, firms generally announce repurchase programs in advance.
4. The firm may bid the stock price up and end up paying too high a price for the shares. In this situation, the selling shareholders would gain at the expense of the remaining shareholders. This could occur if a tender offer were made and the price was set too high, or if the repurchase was made in the open market and buying pressure drove the price above its equilibrium level.

e. Describe the series of steps that most firms take in setting dividend policy in practice.
--

**Answer:** Firms establish dividend policy within the framework of their overall financial plans. The steps in setting policy are listed below:

1. The firm forecasts its annual capital budgets and its annual sales, along with its working capital needs, for a relatively long-term planning horizon, often 5 years.
2. The target capital structure, presumably the one which minimizes the WACC while retaining sufficient reserve borrowing capacity to provide “financing flexibility,” will also be established.
3. With its capital structure and investment requirements in mind, the firm can estimate the approximate amount of debt and equity financing required during each year over the planning horizon.
4. A long-term target payout ratio is then determined, based on the residual model concept. Because of flotation costs and potential negative signaling, the firm will not want to issue common stock unless this is absolutely necessary. At the same time, due to the clientele effect, the firm will move cautiously from its past dividend policy, if a new policy appears to be warranted, and it will move toward any new policy gradually rather than in one giant step.
5. An actual dollar dividend, say \$2 per year, will be decided upon. The size of this dividend will reflect (1) the long-run target payout ratio and (2) the probability that the dividend, once set, will have to be lowered, or, worse yet, omitted. If there is a great deal of uncertainty about cash flows and capital needs, then a relatively low initial dollar dividend will be set, for this will minimize the probability that the firm will have to either reduce the dividend or sell new common stock. The firm will run its corporate planning model so that management can see what is likely to happen with different initial dividends and projected growth rates under different economic scenarios.

f. What are stock dividends and stock splits? What are the advantages and disadvantages of stock dividends and stock splits?

**Answer:** When it uses a stock dividend, a firm issues new shares in lieu of paying a cash dividend. For example, in a 5 percent stock dividend, the holder of 100 shares would receive an additional 5 shares. In a stock split, the number of shares outstanding is increased (or decreased in a reverse split) in an action unrelated to a dividend payment. For example, in a 2-for-1 split, the number of shares outstanding is doubled. A 100% stock dividend and a 2-for-1 stock split would produce the same effect, but there would be differences in the accounting treatments of the two

actions.

Both stock dividends and stock splits increase the number of shares outstanding and, in effect, cut the pie into more, but smaller, pieces. If the dividend or split does not occur at the same time as some other event which would alter perceptions about future cash flows, such as an announcement of higher earnings, then one would expect the price of the stock to adjust such that each investor's wealth remains unchanged. For example, a 2-for-1 split of a stock selling for \$50 would result in the stock price being cut in half, to \$25.

It is hard to come up with a convincing rationale for small stock dividends, like 5 percent or 10 percent. No economic value is being created or distributed, yet stockholders have to bear the administrative costs of the distribution. Further, it is inconvenient to own an odd number of shares as may result after a small stock dividend. Thus, most companies today avoid small stock dividends.

On the other hand, there is a good reason for stock splits or large stock dividends. Specifically, there is a widespread belief that an optimal price range exists for stocks. The argument goes as follows: if a stock sells for about \$20-\$80, then it can be purchased in round lots, hence at reduced commissions, by most investors. A higher price would put round lots out of the price range of many small investors, while a stock price lower than about \$20 would convey the image of a stock that is doing poorly. Thus, most firms try to keep their stock prices within the \$20 to \$80 range. If the company prospers, it will split its stock occasionally to hold the price down. (Also, companies that are doing poorly occasionally use reverse splits to raise their price.) Many companies do operate outside the \$20 to \$80 range, but most stay within it.

Another factor that may influence stock splits and dividends is the belief that they signal management's belief that the future is bright. If a firm's management would be inclined to split the stock or pay a stock dividend only if it anticipated improvements in earnings and dividends, then a split/dividend action could provide a positive signal and thus boost the stock price. However, if earnings and cash dividends did not subsequently rise, the price of the stock would fall back to its old level, or even lower, because managers would lose credibility.

Interestingly, one of the most astute investors of the 20th century, Warren Buffett, chairman of Berkshire-Hathaway, has never split his firm's stock. Berkshire currently sells for over \$34,000 per share, and its performance over the years has been absolutely spectacular. It may be that Berkshire's market value would be higher if it had a 425:1 stock split, or it may be that the conventional wisdom is wrong.

<b>g. What is a dividend reinvestment plan (drip), and how does it work?</b>
--

**Answer:** Under a dividend reinvestment plan (DRIP), shareholders have the option of automatically reinvesting their dividends in shares of the firm's common stock. In an open market purchase plan, a trustee pools all the dividends to be reinvested and then buys shares on the open market. Shareholders use the drip for three reasons: (1) brokerage costs are reduced by the volume purchases, (2) the drip is a convenient way to invest excess funds, and (3) the company generally pays all administrative costs associated with the operation.

In a new stock plan, the firm issues new stock to the DRIP members in lieu of cash dividends. No fees are charged, and many companies even offer the stock at a 5 percent discount from the market price on the dividend date on the grounds that the firm avoids flotation costs that would otherwise be incurred. Only firms that need new equity capital use new stock plans, while firms with no need for new stock use an open market purchase plan.

# Chapter 19

## Initial Public Offerings, Investment Banking, and Financial Restructuring

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 19-1
- a. A closely held corporation goes public when it sells stock to the general public. Going public increases the liquidity of the stock, establishes a market value, facilitates raising new equity, and allows the original owners to diversify. However, going public increases business costs, requires disclosure of operating data, and reduces the control of the original owners. The new issue market is the market for stock of companies that go public, and the issue is called an initial public offering (IPO).
  - b. A public offering is an offer of new common stock to the general public; in other words, an offer in which the existing shareholders are not given any preemptive right to purchase the new shares. A private placement is the sale of stock to only one or a few investors, usually institutional investors. The advantages of private placements are lower flotation costs and greater speed, since the shares issued are not subject to SEC registration.
  - c. A venture capitalist is the manager of a venture capital fund. The fund raises most of its capital from institutional investors and invests in start-up companies in exchange for equity. The venture capitalist gets a seat on the companies' boards of directors. Before an IPO, the senior management team and the investment banker make presentations to potential investors. They make presentations in tent to twenty cities, with three to five presentations per day, over a two week period. The spread is the difference between the price at which an underwriter sells the stock in an IPO and the proceeds that the underwriter passes on to the issuing firm. In other words, it is the fee collected by the underwriter, and it usually is seven percent of the offering price.
  - d. The Securities and Exchange Commission (SEC) is a government agency which regulates the sales of new securities and the operations of securities exchanges. The SEC, along with other government agencies and self-regulation, helps ensure stable markets, sound brokerage firms, and the absence of stock manipulation. Registration of securities is required of companies by the SEC before the securities can be offered to the public. The registration statement is used to summarize various financial and legal information about the company. Frequently, companies will file a master registration statement and then update it with a short-form statement just before an offering. This procedure is termed shelf registration because companies put new securities "on the shelf" and then later sell them when the market is right. Blue sky laws are laws that prevent the sale of securities that have little or no asset backing. The margin is the percentage of a stock's price that an investor has borrowed in order to purchase the stock. The SEC sets margin requirements, which is the maximum percentage of debt that can be used to purchase a stock. The SEC also controls trading by corporate insiders, who are the officers, directors, and major stockholders of the firm.
  - e. A prospectus summarizes information about a new security issue and the issuing company. A "red herring," or preliminary prospectus, may be distributed to potential buyers prior to approval of the registration statement by the SEC. After the registration has become effective, the securities, accompanied by the prospectus, may be offered for sale.

- f. The National Association of Securities Dealers (NASD) is an industry group primarily concerned with the operation of the over-the-counter (OTC) market.
- g. A best efforts arrangement versus an underwritten sale refers to two methods of selling new stock issues. In a best efforts sale, the investment banker is only committed to making every effort to sell the stock at the offering price. In this case, the issuing firm bears the risk that the new issue will not be fully subscribed. If the issue is underwritten, the investment banker agrees to buy the entire issue at a set price, and then resells the stock at the offering price. Thus, the risk of selling the issue rests with the investment banker.
- h. Refunding occurs when a company issues debt at current low rates and uses the proceeds to repurchase one of its existing high coupon rate debt issues. Often these are callable issues, which means the company can purchase the debt at a lower-than-market price. Project financings are arrangements used to finance mainly large capital projects such as energy explorations, oil tankers, refineries, utility power plants, and so on. Usually, one or more firms (sponsors) will provide the equity capital required by the project, while the rest of the project's capital is supplied by lenders and lessors. The most important aspect of project financing is that the lenders and lessors do not have recourse against the sponsors; they must be repaid from the project's cash flows and the equity cushion provided by the sponsors. Securitization is the process whereby financial instruments that were previously thinly traded are converted to a form that creates greater liquidity. Securitization also applies to the situation where specific assets are pledged as collateral for securities, and hence asset-backed securities are created. One example of the former is junk bonds; an example of the latter is mortgage-backed securities. Maturity matching refers to matching the maturities of debt used to finance assets with the lives of the assets themselves. The debt would be amortized such that the outstanding amount declined as the asset lost value due to depreciation.
- 19-2 No. The role of the investment banker is more important if the stock demand curve has a steep slope and the negative signaling effect is substantial. Under such conditions, the investment banker will have a harder time holding up the stock price.
- 19-3 No. The real value of a security is determined by the equilibrium forces of an efficient market. Assuming that the information provided on newly issued securities is accurate, the market will establish the value of a security regardless of the opinions rendered by the SEC, or, for that matter, opinions offered by any advisory service or analyst.
- 19-4
- Going public would tend to make attracting capital easier and to decrease flotation costs.
  - The increasing institutionalization of the "buy side" of the stock and bond markets should increase a firm's ability to attract capital and should reduce flotation costs.
  - Financial conglomerates can offer a variety of financial services and types of investments, thus it seems a company's ability to attract capital would increase and flotation costs would decrease.

- d. Elimination of the preemptive right would likely not affect a large company where percentage ownership is not as important. Indeed, the trend today seems to be for companies to eliminate the preemptive right.
- f. The introduction of shelf registration tended to speed up SEC review time and lower the costs of floating each new issue. Thus, the company's ability to attract new capital was increased.

19-5 Investment bankers must investigate the firms whose securities they sell, simply because, if an issue is overvalued and suffers marked price declines after the issue, the banker will find it increasingly difficult to dispose of the new issue. In other words, reputation is highly important in the investment banking industry.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

19-1 a. \$5 per share  
 Gross proceeds =  $(3,000,000)(\$5) = \$15,000,000$ .  
 Net profit =  $\$15,000,000 - \$14,000,000 - \$300,000 = \$700,000$ .

b. \$6 per share  
 Gross proceeds =  $(3,000,000)(\$6) = \$18,000,000$ .  
 Net profit =  $\$18,000,000 - \$14,000,000 - \$300,000 = \$3,700,000$ .

c. \$4 per share  
 Gross proceeds =  $(3,000,000)(\$4) = \$12,000,000$ .  
 Net profit =  $\$12,000,000 - \$14,000,000 - \$300,000 = -\$2,300,000$ .

19-2 Net proceeds per share =  $\$22(1 - 0.05) = \$20.90$ .  
 Number of shares to be sold =  $(\$20,000,000 + 150,000)/\$20.90 = 964,115$  shares.

19-3 a. If 100 shares are outstanding, then we have the following for Edelman:

	1999	2004
Earnings per share		\$8,160
Dividends per share		4,200
Book value per share		90,000

b. **Using the following two equations, the growth rate for EPS and DPS can be determined.**

$$(1 + g_{EPS})^5 EPS_{99} = EPS_{04}.$$

$$(1 + g_{DPS})^5 DPS_{99} = DPS_{04}.$$

$g_{DPS}$	Kennedy	Strasburg	Edelman	$g_{EPS}$
		8.4%		8.4%
		6.4		6.4
		8.0		7.4

c. Based on the figures in Part a, it is obvious that Edelman's stock would not sell in the range of \$25 to \$100 per share. The small number of shares outstanding has greatly inflated EPS, DPS, and book value per share. Should Edelman attempt to sell its stock based on the EPS and DPS above, it would have difficulty finding investors at the economically justified price.

- d. Edelman's management would probably be wise to split the stock so that EPS, DPS, and book value were closer to those of Kennedy and Strasburg. This would bring the price of the stock into a more reasonable range.
- e. A 4,000-for-1 split would result in 400,000 shares outstanding. If Edelman has 400,000 shares outstanding, then we would have the following:

<u>1999</u>	<u>2004</u>				
		Earnings per share		\$2.04	\$ 3.00
		Dividends per share		1.05	1.50
22.50		Book value	per		share

f.

		<u>ROE</u>
	Kennedy	15.00%
	Strasburg	13.64
	Edelman	13.33

g.

		<u>Payout Ratio</u>	
		<u>1999</u>	<u>2004</u>
	Kennedy	50%	50%
	Strasburg	50	50
	Edelman	51	50

All three companies seem to be following similar dividend policies, paying out about 50 percent of their earnings.

- h. D/A is 43 percent for Kennedy, 37 percent for Strasburg, and 55 percent for Edelman. This suggests that Edelman is more risky, hence should sell at relatively low multiples.

i.

		<u>P/E</u>
	Kennedy	$\$36/\$4.50 = 8.00\times$
	Strasburg	$\$65/\$7.50 = 8.67$

These ratios are not consistent with g and ROE; based on gs and ROEs, Kennedy should have the higher P/E. Probably size, listing status, and debt ratios are offsetting g and ROE.

j. The market prices of Kennedy and Strasburg yield the following multiples:

	Multiple of	Multiple of	Multiple of Book
		<u>EPS, 2004</u>	<u>DPS, 2004</u>
			<u>Value per Share, 2004</u>
Kennedy		8.00×	16.00×
Strasburg		8.67	17.33
			1.20×
			1.18

Applying these multiples to the data in Part e, we obtain the following market prices:

	Indicated Market Price		for
Edelman Stock			_____
<u>Based on Data of:</u>			
<u>Kennedy</u>	<u>Strasburg</u>		
Based on earnings, 2003		\$24.00	\$26.01
Based on dividends, 2003		24.00	26.00
Based on book value per share		27.00	26.55

k.  $\hat{r} = \frac{D_0(1+g)}{P_0} + g.$

*Kennedy*  $\hat{r} = \frac{\$2.25(1.084)}{\$36} + 8.4\% = 15.18.$

*Strasburg*  $\hat{r} = \frac{\$3.75(1.064)}{\$65} + 6.4\% = 12.54\%.$

*Edelman*  $\hat{P}_0 = \frac{D_1}{r - g}.$

*Based on Kennedy:*  $P_0 = \frac{1.50(1.077)}{0.152 - 0.077} = \$21.54.$

*Based on Strasburg:*  $P_0 = \frac{1.50(1.077)}{0.125 - 0.077} = \$33.66.$

**l. The potential range, based on these data, is between \$21.54 and \$33.66 a share. The data suggest that the price would be set toward the low end of the range: (1) Edelman has a high debt ratio, (2) Edelman is relatively small, and (3) Edelman is new and will not be traded on an exchange. The actual price would be based on negotiations between the underwriter and Edelman; we cannot say what the exact price would be, but the price would probably be set below \$21.54, with \$20 being a reasonable guess.**

- 19-4 a. Since the call premium is 11 percent, the total premium is  $0.11(\$40,000,000) = \$4,400,000$ . However, this is a tax deductible expense, so the relevant after-tax cost is  $\$4,400,000(1 - T) = \$4,400,000(0.60) = \$2,640,000$ .
- b. The dollar flotation cost on the new issue is  $0.04(\$40,000,000) = \$1,600,000$ . This cost is not immediately tax deductible, and hence the after-tax cost is also  $\$1,600,000$ . (Note that the flotation cost can be amortized and expensed over the life of the issue. The value of this tax savings will be calculated in Part e.)
- c. The flotation costs on the old issue were  $0.06(\$40,000,000) = \$2,400,000$ . These costs were deferred and are being amortized over the 25-year life of the issue, and hence  $\$2,400,000/25 = \$96,000$  are being expensed each year, or  $\$48,000$  each 6 months. Since the bonds were issued 5 years ago,  $(5/25)(\$2,400,000) = \$480,000$  of the flotation costs have already been expensed, and  $(20/25)(\$2,400,000) = \$1,920,000$  remain unexpensed.  
If the issue is refunded, the unexpensed portion of the flotation costs can be immediately expensed, and this would result in a tax savings of  $T(\$1,920,000) = 0.40(\$1,920,000) = \$768,000$ .

- d. The net after-tax cash outlay is  $\$3,472,000$ , as shown below:

	Old issue call premium	\$2,640,000	
		New issue flotation cost	1,600,000
		Tax savings on old issue flotation	costs
<u>(768,000)</u>		Net cash outlay	<u>\$3,472,000</u>

- e. The new issue flotation costs of  $\$1,600,000$  would be amortized over the 20-year life of the issue. Thus,  $\$1,600,000/20 = \$80,000$  would be expensed each year, or  $\$40,000$  each 6 months. The tax savings from this tax deduction is  $(0.40)\$40,000 = \$16,000$  per semiannual period.  
By refunding the old issue and immediately expensing the remaining old issue flotation costs, the firm forgoes the opportunity to continue to expense the old flotation costs over time. Specifically,  $\$2,400,000/25 = \$96,000$  each year, or  $\$48,000$  semiannually. The value of each  $\$48,000$  deduction forgone is  $0.40(\$48,000) = \$19,200$ .
- f. The interest on the old issue is  $0.11(\$40,000,000) = \$4,400,000$  annually, or  $\$2,200,000$  semiannually. Since interest payments are tax deductible, the after-tax semiannual amount is  $0.6(\$2,200,000) = \$1,320,000$ .  
The new issue carries an 8 percent coupon rate. Therefore, the annual interest would be  $0.08(\$40,000,000) = \$3,200,000$ , or  $\$1,600,000$  semiannually. The after-tax cost is thus  $0.6(\$1,600,000) = \$960,000$ . Thus, the after-tax net interest savings if refunding takes place would be  $\$1,320,000 - \$960,000 = \$360,000$  semiannually.
- g. The net amortization tax effects are  $-\$3,200$  per year for 20 years, while the net interest savings are  $\$360,000$  per year for 20 years. Thus, the net semiannual cash flow is  $\$356,800$ , as shown below.

Semiannual Flotation Cost Tax Effects:

Semiannual tax savings on new flotation:	\$16,000
Tax benefits lost on old flotation:	<u>(19,200)</u>
Net amortization tax effects	<u>(\$ 3,200)</u>

Semiannual Interest Savings Due To Refunding:

Semiannual interest on old bond:	\$1,320,000
Semiannual interest on new bond:	<u>(960,000)</u>
Net interest savings	<u>\$ 360,000</u>
Semiannual cash flow:	<u>\$ 356,800</u>

The cash flows are based on contractual obligations, and hence have about the same amount of risk as the firm's debt. Further, the cash flows are already net of taxes. Thus, the appropriate interest rate is GST's after-tax cost of debt. (The source of the cash to fund the net investment outlay also influences the discount rate, but most firms use debt to finance this outlay, and, in this case, the discount rate should be the after-tax cost of debt.) Finally, since we are valuing future flows, the appropriate debt cost is today's cost, or the cost of the new issue, and not the cost of debt floated 5 years ago. Thus, the appropriate discount rate is  $0.6(8\%) = 4.8\%$  annually, or 2.4 percent per semiannual period.

At this discount rate, the present value of the semiannual net cash flows is \$9,109,425:

$$PV = \$356,800(PVIFA_{2.4\%,40}) = \$9,109,425.$$

Alternatively, using a financial calculator, input  $N = 40$ ,  $I = 2.4$ ,  $PMT = -356800$ ,  $FV = 0$ ,  $PV = ?$   $PV = \$9,109,413$ .

- h. The bond refunding would require a \$3,472,000 net cash outlay, but it would produce \$9,109,413 in net savings on a present value basis. Thus, the NPV of refunding is \$5,637,413:

PV of net benefits	\$9,109,413
Cost	<u>(3,472,000)</u>
Refunding NPV	<u>\$5,637,413</u>

The decision to refund now rather than wait till later is much more difficult than finding the NPV of refunding now. If interest rates were expected to fall, and hence GST would be able to issue debt in the future below today's 8 percent rate, then it might pay to wait. However, interest rate movements are very difficult, if not impossible, to forecast, and hence most financial managers would probably take the "bird-in-the-hand" and refund now with such a large NPV. Note, though, that if the NPV had been quite small, say \$1,000, management would have undoubtedly waited, hoping that interest rates would fall further, and the cost of waiting (\$1,000) would not have been high enough to worry about.

- 19-5 a. Investment outlay required to refund the issue:

Call premium on old issue:	\$5,400,000
New flotation cost:	5,000,000

Tax savings on old flotation:	(1,666,667)
Additional interest on old issue:	450,000
Interest earned on investment:	<u>(225,000)</u>
Total investment outlay:	<u>\$8,958,333</u>

Annual Flotation Cost Tax Effects:

Annual tax savings on new flotation:	\$ 80,000
Tax benefits lost on old flotation:	<u>(66,667)</u>
Amortization tax effects	<u>\$ 13,333</u>

Annual Interest Savings Due to Refunding:

Annual interest on old bond:	\$5,400,000
Annual interest on new bond:	<u>(4,500,000)</u>
Net interest savings	<u>\$ 900,000</u>

Annual cash flows: \$ 913,333

NPV of refunding decision: \$2,717,128

Using a financial calculator, enter the cash flows into the cash flow register,  $I = 6$ ,  $NPV = ?$   
 $NPV = \$2,717,128$ .

- b. The company should consider what interest rates might be next year. If there is a high probability that rates will drop below the current rate, it may be more advantageous to refund later versus now. If there is a high probability that rates will increase, the firm should act now to refund the old issue. Also, the company should consider how much ill will is created with investors if the issue is called. If Tarpon is highly dependent on a small group of investors, it would want to avoid future difficulty in obtaining financing. However, bond issues are callable after a certain time and investors expect them to be called if rates drop considerably.

## **SOLUTION TO SPREADSHEET PROBLEM**

---

- 19-6 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 19 P6 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**Randy's, a family-owned restaurant chain operating in Alabama, has grown to the point where expansion throughout the entire southeast is feasible. The proposed expansion would require the firm to raise about \$15 million in new capital. Because Randy's currently has a debt ratio of 50 percent, and also because the family members already have all their personal wealth invested in the company, the family would like to sell common stock to the public to raise the \$15 million. However, the family does want to retain voting control. You have been asked to brief the family members on the issues involved by answering the following questions:**

**a. What agencies regulate securities markets?**

**Answer:** The main agency that regulates the securities market is the Securities And Exchange Commission. Some of the responsibilities of the SEC include: regulation of all national stock exchanges--companies whose securities are listed on an exchange must file annual reports with the SEC; prohibiting manipulation by pools or wash sales; controls over trading by corporate insiders; and control over the proxy statement and how it is used to solicit votes. The Federal Reserve Board controls flow of credit into security transactions through margin requirements. States also have some control over the issuance of new securities within their boundaries. The securities industry itself realizes the importance of stable markets, therefore, the various exchanges work closely with the sec to police transactions and to maintain the integrity and credibility of the system.

**b. How are start-up firms usually financed?**

**Answer:** The first financing comes from the founders. The first external financing comes from angels, who are wealthy individuals. The next external financing comes from a venture capital fund. The fund raises capital from institutional investors, usually around \$70 to \$80 million. The managers of the fund are called venture capitalists. The fund invests in ten to twelve companies, and the venture capitalist sits on their boards.

**c. Differentiate between a private placement and a public offering.**

**Answer:** In a private placement stock is sold directly to one or a small group of investors rather than being distributed to the public at large. A private placement has the advantage of lower flotation costs; however, since the stock would be bought by a small number of outsiders, it would not be actively traded, and a liquid market would not exist. Further, since it would not have gone through the SEC registration process, the holders would be unable to sell it except to a restricted set of “sophisticated” investors. Further, it might be difficult to find investors willing to invest large sums in the company and yet be minority stockholders. Thus, many of the advantages listed above would not be obtained. For these reasons, a public placement makes more sense in Randy’s situation.

**d. Why would a company consider going public? What are some advantages and disadvantages?**

**Answer:** A firm is said to be “going public” when it sells stock to the public for the first time. A company’s first stock offering to the public is called an “initial public offering (IPO).” Thus, Randy’s will go public if it goes through with its planned IPO. There are several advantages and disadvantages to going public:

Advantages to going public:

- Going public will allow the family members to diversify their assets and reduce the riskiness of their personal portfolios.
- It will increase the liquidity of the firm's stock, allowing the family stockholders to sell some stock if they need to raise cash.
- It will make it easier for the firm to raise funds. The firm would have a difficult time trying to sell stock privately to an investor who was not a family member. Outside investors would be more willing to purchase the stock of a publicly held corporation which must file financial reports with the sec.
- Going public will establish a value for the firm.

Disadvantages to going public:

- The firm will have to file financial reports with the SEC and perhaps with state officials. There is a cost involved in preparing these reports.
- The firm will have to disclose operating data to the public. Many small firms do not like having to do this, because such information is available to competitors. Also, some of the firm's officers, directors, and major stockholders will have to disclose their stock holdings, making it easy for others to estimate their net worth.
- Managers of publicly-owned corporations have a more difficult time engaging in deals which benefit them personally, such as paying themselves high salaries, hiring family members, and enjoying not-strictly-necessary, but tax-deductible, fringe benefits.
- If the company is very small, its stock may not be traded actively and the market price may not reflect the stock's true value.

The advantages of public ownership would be recognized by key employees, who would most likely be granted stock options, which would certainly be more valuable if the stock were publicly traded.

**e. What are the steps of an initial public offering?**

**Answer:** Select an investment banker, file the S-1 registration document with the SEC, choose a price range for the preliminary, or “red herring,” prospectus, go on a roadshow, set final price on final prospectus.

**f. What criteria are important in choosing an investment banker?**

**Answer:** (1) reputation and experience in the industry. (2) existing mix of institutional and retail (i.e., individual) clients. (3) support in the post-IPO secondary market, especially the reputation of the analyst who will cover the stock.

**g. Would companies going public use a negotiated deal or a competitive bid?**

**Answer:** The firm would almost certainly use a negotiated deal. The competitive bid process for setting investment bankers’ fees is feasible only for large, well-established firms on large issues, and even here the use of bids is rare for equity issues. This is because the process of making a bid is costly (mainly for the research necessary to establish the price, but also because of the need for sec registration), and investment bankers simply would not incur these costs unless they were assured of getting the deal or the issue was so large that a huge fee awaited the winner.

**h. Would the sale be on an underwritten or best efforts basis?**

**Answer:** Most stock offerings are done on an underwritten basis, but the price is not set until the investment banker has checked investors for interest in the stock, and has received oral assurances of commitments at a price that will virtually guarantee the success of the offering barring a major stock market collapse. So, there is little effective difference between a best efforts and an underwritten deal.

**i. Without actually doing any calculations, describe how the preliminary offering range for the price of an IPO would be determined?**

**Answer:** Since the firm is going public for the first time, there is no established price for its stock. The firm and its investment banker would project future earnings and free cash flows. The banker would then compare the firm with other restaurant firms of similar size. The banker would try to determine a price range for the firm's stock by applying the price/earnings ratios, price/dividends ratios, and price/book value ratios of similar firms to the firm's earnings, dividends, and book value data. The banker would also determine the price at which the firm's stock would have to sell to earn the same rate of return as other firms in its industry. On the basis of all these factors, the investment bankers would determine a ballpark price. They would then specify a range (i.e., \$10 to \$12) in the preliminary prospectus.

**j. What is a roadshow? What is bookbuilding?**

**Answer:** The senior management team, the investment banker, and the lawyer make presentations to potential institutional investors. They usually visit ten to twenty cities, and make three to five presentations in each city. Management can't say anything that is not in the registration statement, because the SEC imposes a "quiet period" from the time it makes the registration effective until 25 days after the stock begins trading. The purpose is to prevent select investors from getting information that is not available to other investors.

During the roadshow, the investment bankers asks the investors to indicate how many shares they plan on buying. The banker records this in his book. The banker hopes for oversubscription. Based on demand, the banker sets the final offer price on the evening before the stock is issued.

**k. Describe the typical first-day returns of an IPO and the long-term returns to IPO investors.**

**Answer:** First-day returns average 14.1%, with many stocks having much higher returns. The investment banker has an incentive to set a low price, both to make its brokerage customers happy and to make it easy to sell the issue, whereas the firm would like to set as high a price as possible. Returns over the two-year period following the IPO are generally lower than for comparable firms, indicating that the offering price is too low, but that the first-day run-up is too high.

**l. What are the direct and indirect costs of an IPO?**

**Answer:** The underwriter usually charges a 7% fee, based on the offer price. In addition, there are direct costs to lawyers, accountants, printers, etc. That can easily total \$400,000.

Indirect costs include the money left on the table, which is equal to the difference between the offer price and end-of-first-day price, multiplied by the number of shares. Also, much of management's time and attention is consumed by the IPO in the months preceding the IPO.

**m. What are equity carve-outs?**

**Answer:** Equity carve-outs are a special type of IPO in which a public company creates a new public company from one of its subsidiaries by issuing public stock in the subsidiary. The parent usually retains a controlling interest.

**n. In what other ways are investment banks involved in issuing securities?**

**Answer:** Investment bankers help companies with shelf registration (SEC rule 451) in which securities are registered but not all of the issue is sold at once. Instead, the company sells a percentage of the issue each time it needs to raise capital.

Investment bankers also help place private and public debt issues. They also help in seasoned equity offers, in which a public firm issues additional shares of stock.

**o. What is meant by going private? What are some advantages and disadvantages?**

**Answer:** Going private is the reverse of going public. Typically, the managers of a firm team up with a small group of outside investors, who furnish most of the equity capital, and purchase all of the

publicly held shares of the company. The new equity holders usually use a large amount of debt financing, up to 90 percent, to complete the purchase. Such a transaction is called a “leveraged buyout (LBO).”

Going private gives the managers greater incentives and more flexibility in running the company. It also removes the burden of sec filings, stockholder relations, annual reports, analyst meetings, and so on. The major disadvantage of going private is that it limits significantly the availability of new capital. Since the stock is not publicly traded, a new stock issue would not be practical, and, since such firms are normally leveraged to the hilt, it is tough to find additional debt financing. For this reason, it is common for firms that have recently gone private to sell off some assets to quickly reduce the debt burden to more conventional levels to give added financial flexibility.

After several years of operating the business as a private firm, the owners typically go public again. At this time, the firm is presumably operating at its peak, and it will command top dollar compared to when it went private. In this way, the equity investors of the private firm are able to recover their investment and, hopefully, make a tidy profit. So far LBOs have, on average, been extremely profitable--since the 1970s, when LBO firms such as Kohlberg Kravis Roberts (KKR) began operating, their annual rates of return are reported to have averaged over 50 percent annually. However, Wall Street is becoming increasingly concerned about the use of debt, and in the beginning of the nineties the number of new LBOs has fallen dramatically and some old ones have had major financial difficulties.

<b>p. How do companies manage the maturity structure of their debt?</b>
---

**Answer:** In discussing this question, we emphasize that, if markets are truly efficient and conditions are stable, the type of debt instrument will be immaterial, as the cost of each will be commensurate with its risk. However, if markets are not totally efficient (perhaps because management has information which investors do not have), if the company’s tax position changes, if some new security innovation is developed, or the like, then some types of securities might truly be less expensive, on a risk-adjusted basis, than others.

Factors that influence the decision to issue long-term bonds rather than short-term debt:

- Maturity matching (assets to be financed)
- Information asymmetries. If managers know that the firm has strong prospects, they will issue short-term debt and refinance later when the market recognizes their prospects.

**q. Under what conditions would a firm exercise a bond's call provision?**

**Answer:** Refunding decisions involve two separate questions: (1) is it profitable to call an outstanding issue in the current period and replace it with a new issue; and (2) if refunding is currently profitable, would the value of the firm be increased even more if the refunding were postponed to a later date? If these two conditions are true, a company would exercise their bond's call provision.

**r. Explain how firms manage the risk structure of their debt with: (1) project financing, and (2) securitization.**

- Answer:**
1. Project financings are arrangements used to finance mainly large capital projects such as energy explorations, oil tankers, refineries, utility power plants, and so on. Usually, one or more firms (sponsors) will provide the equity capital required by the project, while the rest of the project's capital is supplied by lenders and lessors. The most important aspect of project financing is that the lenders and lessors do not have recourse against the sponsors; they must be repaid from the project's cash flows and the equity cushion provided by the sponsors.
  2. Securitization is the process whereby financial instruments that were previously thinly traded are converted to a form that creates greater liquidity. Securitization also applies to the situation where specific assets are pledged as collateral for securities, and hence asset-backed securities are created. One example of the former is junk bonds; an example of the latter is mortgage-backed securities.

## Chapter 20

### Lease Financing

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 20-1 a. The lessee is the party leasing the property. The party receiving the payments from the lease (that is, the owner of the property) is the lessor.
- b. An operating lease, sometimes called a service lease, provides for both financing and maintenance. Generally, the operating lease contract is written for a period considerably shorter than the expected life of the leased equipment, and contains a cancellation clause. A financial lease does not provide for maintenance service, is not cancelable, and is fully amortized; that is, the lease covers the entire expected life of the equipment. In a sale and leaseback arrangement, the firm owning the property sells it to another firm, often a financial institution, while simultaneously entering into an agreement to lease the property back from the firm. A sale and leaseback can be thought of as a type of financial lease. A combination lease combines some aspects of both operating and financial leases. For example, a financial lease that contains a cancellation clause--normally associated with operating leases--is a combination lease. A synthetic lease is an arrangement between a company and a special purpose entity that it creates to borrow money and purchase equipment. Although the "lease" amounts to actually borrowing money guaranteed by the lessee, it doesn't appear on the company's books as an obligation. A special purpose entity (SPE) is a company set up to facilitate the creation of a synthetic lease. It borrows money that is guaranteed by the lessee, purchases equipment, and leases it to the lessee. Its purpose is keep the lessee from having to capitalize the lease and carry its payments on its books as a liability.**
- c. Off-balance sheet financing refers to the fact that for many years neither leased assets nor the liabilities under lease contracts appeared on the lessees' balance sheets. To correct this problem, the Financial Accounting Standards Board issued FASB Statement 13. Capitalizing means incorporating the lease provisions into the balance sheet by reporting the leased asset under fixed assets and reporting the present value of future lease payments as debt.
- d. FASB Statement 13 is the Financial Accounting Standards Board statement (November 1976) that spells out in detail the conditions under which a lease must be capitalized, and the specific procedures to follow.
- e. A guideline lease is a lease that meets all of the IRS requirements for a genuine lease. A guideline lease is often called a tax-oriented lease. If a lease meets the IRS guidelines, the IRS allows the lessor to deduct the asset's depreciation and allows the lessee to deduct the lease payments.
- f. The residual value is the market value of the leased property at the expiration of the lease. The estimate of the residual value is one of the key elements in lease analysis.
- g. The lessee's analysis involves determining whether leasing an asset is less costly than buying the asset. The lessee will compare the present value cost of leasing the asset with the present value cost of purchasing the asset (assuming the funds to purchase the asset are obtained through a loan). If the present value cost of the lease is less than the present value cost of purchasing, the asset should be leased. The lessee can also analyze the lease using the IRR approach. The IRR of the incremental cash flows of leasing versus purchasing represents the after-tax cost**

**rate implied in the lease contract. If this rate is lower than the after-tax cost of debt, there is an advantage to leasing. Finally, the lessee might evaluate the lease using the equivalent loan method, which involves comparing the net savings at Time 0 if the asset is leased with the present value of the incremental costs of leasing over the term of the lease. If the Time 0 savings is greater than the present value of the incremental costs, there is an advantage to leasing.**

The lessor's analysis involves determining the rate of return on the proposed lease. If the rate of return (or IRR) of the lease cash flows exceeds the lessor's opportunity cost of capital, the lease is a good investment. This is equivalent to analyzing whether the NPV of the lease is positive.

- h. The net advantage to leasing (NAL) gives the dollar value of the lease to the lessee. It is, in a sense, the NPV of leasing versus owning.
  - i. The alternative minimum tax (AMT), which is figured at about 20 percent of the profits reported to stockholders, is a provision of the tax code that requires profitable firms to pay at least some taxes if such taxes are greater than the amount due under standard tax accounting. The AMT has provided a stimulus to leasing for those firms paying the AMT because leasing lowers profits reported to stockholders.
- 20-2 An operating lease is usually cancelable and includes maintenance. Operating leases are, frequently, for a period significantly shorter than the economic life of the asset, so the lessor often does not recover his full investment during the period of the basic lease. A financial lease, on the other hand, is fully amortized and generally does not include maintenance provisions. An operating lease would probably be used for a fleet of trucks, while a financial lease would be used for a manufacturing plant.
- 20-3 You would expect to find that lessees, in general, are in relatively low income-tax brackets, while lessors tend to be in high tax brackets. The reason for this is that owning tends to provide tax shelters in the early years of a project's life. These tax shelters are more valuable to taxpayers in high brackets. However, current tax laws (1998) have reduced the depreciation benefits of owning, so tax rate differentials are less important now than in the past.
- 20-4 The banks, when they initially went into leasing, were paying relatively high tax rates. However, since municipal bonds are tax-exempt, their heavy investments in municipals lowered the banks' effective tax rates. Similarly, when the REIT loans began to sour, this further reduced the bank's income, and consequently cut the effective tax rate even further. Since the lease investments were predicated on obtaining tax shelters, and since the value of these tax shelters is dependent on the banks' tax rates, when the effective tax rates were lowered, this reduced the value of the tax shelters and consequently reduced the profitability of the lease investments.
- 20-5 a. Pros:

- The use of the leased premises or equipment is actually an exclusive right, and the payment for the premises is a liability that often must be met. Therefore, leases should be treated as both assets and liabilities.
- A fixed policy of capitalizing leases among all companies would add to the comparability of different firms. For example, Safeway Stores' leases should be capitalized to make the company comparable to A&P, which owns its stores through a subsidiary.
- The capitalization highlights the contractual nature of the leased property.
- Capitalizing of leases could help management make useful comparisons of operating results; that is, return on investment data.

b. Cons:

- Because the firm does not actually own the leased property, the legal aspect can be cited as an argument against capitalization.
- Capitalizing leases worsens some key credit ratios; that is, the debt-to-equity ratio and the debt-to-total capital ratio. This may hamper the future acquisition of funds.
- There is a question of choosing the proper discount rate at which to capitalize the leases.
- Some argue that other items should be listed on the balance sheet before leases; for example, service contracts, property taxes, and so on.
- Capitalizing leases violates the principle that liabilities should be recorded only when assets are purchased.

20-6 Lease payments, like depreciation, are deductible for tax purposes. If a 20-year asset were depreciated over a 20-year life, depreciation charges would be  $1/20$  per year (more if MACRS were used). However, if the asset were leased for, say, 3 years, tax deductions would be  $1/3$  each year for 3 years. Thus, the tax deductions would be *greatly accelerated*. The same total taxes would be paid over the 20 years, but because of the high deductions in the early years, taxes would be deferred more under the lease, and the PV of the future taxes would be reduced under the lease.

20-7 In fact, Congress did this in 1981. Depreciable lives were shorter than before; corporate tax rates were essentially unchanged (they were lowered very slightly on income below \$50,000); and the investment tax credit had been improved a bit by the easing of recapture if the asset was held for a short period. As a result, companies that were either investing at a very high rate or else were only marginally profitable were generating more depreciation and/or investment tax credits than they could use. These companies were able to "sell" their tax shelters through a leasing arrangement, being "paid" in the form of lower lease charges. A high-bracket lessor could earn a given after-tax return with lower rental charges, after the 1981 tax law changes, than previously because the lessor would get (1) the larger tax credits and (2) faster depreciation write-offs.

20-8 A cancellation clause would reduce the risk to the lessee since the firm would be allowed to terminate the lease at any point. Since the lease is less risky than a standard financial lease, and less risky than

straight debt, which cannot usually be prepaid without a prepayment charge, the discount rate on the cost of leasing might be adjusted to reflect lower risk. (Note that this requires *increasing* the discount rate since cash *outflows* are being discounted.) The effect on the lessor is just the opposite--risk is increased. (Note that this would also require an increase in the lessor's discount rate.)

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

20-1 a. (1) Reynolds' current debt ratio is  $\$400/\$800 = 50\%$ .

(2) If the company purchased the equipment its balance sheet would look like:

Current assets	\$300	Debt (including lease)	\$600	
Fixed assets		500		
Leased equipment	<u>200</u>	Equity	<u>\$400</u>	
Total assets		<u>\$1,000</u>	Total claims	
	<u>\$1,000</u>			

Therefore, the company's debt ratio =  $\$600/\$1,000 = 60\%$ .

(3) If the company leases the asset and does not capitalize the lease, its debt ratio =  $\$400/\$800 = 50\%$ .

b. The company's financial risk (assuming the implied interest rate on the lease is equivalent to the loan) is no different whether the equipment is leased or purchased.

20-2 Cost of owning:

			0	1
Cost				
Depreciation shield	(200)	40	40	<u>40</u>

PV at 6% =  $-\$127$ .

Cost of leasing:

			0	1
After-tax lease payment	(66)	(66)		

PV at 6% =  $-\$128$ .

Reynolds should buy the equipment, because the cost of owning is less than the cost of leasing.

20-3

3	4	Year			
		0	1	2	
I. Cost of Owning:					
	Net purchase price	(\$1,500,000)			
	Depr. tax savings <sup>a</sup>		<u>\$198,000</u>	<u>\$270,000</u>	<u>\$ 90,000</u>
	Net cash flow	<u>(\$1,500,000)</u>	<u>\$198,000</u>	<u>\$270,000</u>	<u>\$ 42,000</u>
	PV cost of owning at 9%	<u>(\$ 991,845)</u>			
II. Cost of Leasing:					
	Lease payment (AT)		(240,000)	(240,000)	(240,000)
	Purch. option price <sup>b</sup>				<u>(250,000)</u>
	Net cash flow	<u>\$ 0</u>	<u>(\$240,000)</u>	<u>(\$240,000)</u>	<u>(\$490,000)</u>
	PV cost of leasing at 9%	<u>(\$ 954,639)</u>			
III. Cost Comparison					
	Net advantage to leasing (NAL)= PV cost of owning - PV cost of leasing				
			= \$991,845 - \$954,639		
			= \$37,206.		

<sup>a</sup>Cost of new machinery: \$1,500,000.

<u>Year</u> <u>(Depreciation)</u>	MACRS <u>Allowance Factor</u>		<u>Deprec. Tax Savings</u> <u>Depreciation</u>	<u>T</u>
1	0.33	\$495,000	\$198,000	
2	0.45	675,000	270,000	
3	0.15	225,000	90,000	
4	0.07	105,000	42,000	

<sup>b</sup>Cost of purchasing the machinery after the lease expires.

Note that the maintenance expense is excluded from the analysis since Big Sky Mining will have to bear the cost whether it buys or leases the machinery. Since the cost of leasing the machinery is less than the cost of owning it, Big Sky Mining should *lease* the equipment.

20-4 a. *Balance sheets before lease is capitalized:*

Energen Balance Sheet (Thousands of Dollars)		
	Debt	
\$100		
	Equity	
<u>100</u>		
Total assets	<u>\$200</u>	Total claims
<u>\$200</u>		

Debt/assets ratio =  $\$100/\$200 = 50\%$ .

Hastings Corporation Balance Sheet (Thousands of Dollars)		
	Debt	
\$ 50		
		Equity
<u>100</u>		
Total assets	<u>\$150</u>	Total claims
<u>\$150</u>		

Debt/assets ratio =  $\$50/\$150 = 33\%$ .

b. *Balance sheet after lease is capitalized:*

Hastings Corporation Balance Sheet (Thousands of Dollars)		
	Assets	Debt
\$ 50		\$150
	Value of leased asset	50
50		PV of lease payments
	Equity	
<u>100</u>		
Total assets	<u>\$200</u>	Total claims
<u>\$200</u>		

Debt/assets ratio =  $\$100/\$200 = 50\%$ .

c. **Yes. Net income, as reported, would probably be less under leasing because the lease payment would be larger than the interest expense, both of which are income statement expenses. Additionally, total assets are significantly less under leasing without capitalization. The net result is difficult to predict, but we can state positively that both ROA**

**and ROE are affected by the choice of financing.**

20-5 a. Borrow and buy analysis:

<u>Year 2</u>	<u>Year 3</u>	<u>Year 0</u>	<u>Year 1</u>
	Loan payments		(430,731)
(430,731)	(430,731)		
	Interest tax savings		47,600
33,761	17,985		
	Depreciation tax savings	112,200	-
<u>153,000</u>	<u>51,000</u>		
	Net cash flow	<u>\$ 0</u>	<u>\$270,931</u>
<u>\$243,970</u>	<u>\$361,746</u>		

PV cost of owning @ 9.24%<sup>a</sup> = (\$729,956)

Depreciation Schedule<sup>b</sup>

<u>Year</u>	<u>Allowance</u>	<u>Depreciation</u>	
1	0.33		\$330,000
2	0.45		450,000
3	0.15		<u>150,000</u>

\$930,000

Loan Amortization Schedule

<u>Remaining Year Balance</u>	<u>Repayment</u>			of
	<u>Beginning Amount</u>	<u>Payment</u>	<u>Interest</u>	<u>Principal</u>
1 \$709,269	\$1,000,000	\$430,731	\$140,000	\$290,731
2 331,433	\$377,836	709,269	430,731	99,298
3 377,834		377,836 2*	430,731	52,897

\*Difference due to rounding.

Lease analysis:

<u>Year 2</u>	<u>Year 3</u>	<u>Year 0</u>	<u>Year 1</u>
	Lease payment		(320,000)
(320,000)	(320,000)		

108,800	Payment tax savings		108,800
	108,800		
(200,000) <sup>c</sup>	Mkt	Value	Machine
(\$211,200)	Net cash flow	\$ 0	(\$211,200)
	(\$411,200)		

PV cost of leasing @ 9.24% = (\$685,752)

Notes:

<sup>a</sup>Discount rate =  $14\% \times (1 - T) = 14\% \times (1 - 0.34) = 9.24\%$ .

<sup>b</sup>Depreciable basis = Cost = \$1,000,000. MACRS allowances = 33%, 45%, 15%. Depreciation tax savings =  $T(\text{Depreciation})$ .

<sup>c</sup>Cost of purchasing the machinery after the lease expires. Note that since the firm is purchasing the machine at the end of the lease, there are no tax effects due to the residual value (purchase price) being greater than the book value. If we were to assume that the firm would not want to keep the machine beyond the lease term, then we would show the residual value of selling the machine as an inflow under the purchase alternative, and there would be no residual value flow under the lease alternative. In that situation, there would be tax on the residual value from selling the machine:  $(\$200,000 - \$70,000)0.34 = \$44,200$ .

Note that the maintenance expense is excluded from the analysis since the firm will have to bear the cost whether it buys or leases the machinery. Since the cost of leasing the machinery is less than the cost of owning it ( $\$729,956 - \$685,752 = \$44,204$ ), the firm should *lease* the equipment.

- b. We assume that the company will buy the equipment at the end of 3 years if the lease plan is used; hence, the \$200,000 is an added cost under leasing. We discounted it at 9.24 percent, but it is risky, so should we use a higher rate? If we do, leasing looks even better. However, it really makes more sense in this instance to use a *lower* rate to discount the residual value so as to penalize the lease decision, because the residual value uncertainty increases the uncertainty of operations under the lease alternative. In general, for risk-averse decision makers, it makes intuitive sense to discount more risky future *inflows* at a higher rate, but risky future *outflows* at a lower rate. (Note that if the firm did not plan to continue using the equipment, then the \$200,000 salvage value should be a negative (inflow) value in the lease analysis. In that case, it would be appropriate to use a *higher* discount rate.)

## **SOLUTION TO SPREADSHEET PROBLEM**

---

- 20-6 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 20 P06 Build a Model.xls*) and on the instructor's side of the textbook's web site, <http://brigham.swcollege.com>.

## MINI CASE

---

Lewis Securities Inc. has decided to acquire a new market data and quotation system for its Richmond home office. The system receives current market prices and other information from several on-line data services, then either displays the information on a screen or stores it for later retrieval by the firm's brokers. The system also permits customers to call up current quotes on terminals in the lobby.

The equipment costs \$1,000,000, and, if it were purchased, Lewis could obtain a term loan for the full purchase price at a 10 percent interest rate. Although the equipment has a six-year useful life, it is classified as a special-purpose computer, so it falls into the MACRS 3-year class. If the system were purchased, a 4-year maintenance contract could be obtained at a cost of \$20,000 per year, payable at the *beginning* of each year. The equipment would be sold after 4 years, and the best estimate of its residual value at that time is \$200,000. However, since real-time display system technology is changing rapidly, the actual residual value is uncertain.

As an alternative to the borrow-and-buy plan, the equipment manufacturer informed Lewis that Consolidated Leasing would be willing to write a 4-year guideline lease on the equipment, including maintenance, for payments of \$260,000 at the *beginning* of each year. Lewis's marginal federal-plus-state tax rate is 40 percent. You have been asked to analyze the lease-versus-purchase decision, and in the process to answer the following questions:

a. 1. Who are the two parties to a lease transaction?

**Answer:** The two parties are the lessee, who uses the asset, and the lessor, who owns the asset.

a. 2. What are the five primary types of leases, and what are their characteristics?

**Answer:** The five primary types of leases are operating, financial, sale and leaseback, combination, and synthetic. An operating lease, sometimes called a service lease, provides for both financing and maintenance. Generally, the operating lease contract is written for a period considerably shorter than the expected life of the leased equipment, and contains a cancellation clause. A financial lease does not provide for maintenance service, is not cancelable, and is fully amortized; that is, the lease covers the entire expected life of the equipment. In a sale and leaseback arrangement, the firm owning the property sells it to another firm, often a financial institution, while simultaneously entering into an agreement to lease the property back from the firm. A sale and leaseback can be thought of as a type of financial lease. A combination lease combines some aspects of both operating and financial leases. For example, a financial lease which contains a

cancellation clause--normally associated with operating leases--is a combination lease. In a leveraged lease, the lessor borrows a portion of the funds needed to buy the equipment to be leased. A synthetic lease is created when a company creates a special purpose entity (SPE) that borrows and then purchases an asset (usually a long-term asset) and leases it back to the company. The company guarantees the SPE's debt, and enters into an operating lease with it. This arrangement has been used to avoid capitalizing the lease and therefore reporting it as a liability. Although the company has a liability—it has guaranteed the SPE's debt—it doesn't report the liability. And since the lease is an operating lease, it doesn't capitalize it and report the lease payments as a liability and the asset as an asset. Therefore, the transaction may leave no evidence on the balance sheet (except, perhaps, in the footnotes).

**a. 3. How are leases classified for tax purposes?**

**Answer:** A guideline lease is a lease that meets all of the IRS requirements for a genuine lease. A guideline lease is often called a tax-oriented lease. If a lease meets the IRS guidelines, the IRS allows the lessor to deduct the asset's depreciation and allows the lessee to deduct the lease payments.

**a. 4. What effect does leasing have on a firm's balance sheet?**

**Answer:** If the lease is classified as a capital lease, it is shown directly on the balance sheet. If it is an operating lease, it is only listed in the footnotes.

**a. 5. What effect does leasing have on a firm's capital structure?**

**Answer:** Leasing is a substitute for debt financing, so leasing increases a firm's financial leverage.

**b. 1. What is the present value cost of owning the equipment? (Hint: set up a time line which shows the net cash flows over the period  $t = 0$  to  $t = 4$ , and then find the PV of these net cash flows, or the pv cost of owning.)**

**Answer:** To develop the cost of owning, we begin by constructing the *depreciation schedule*: depreciable basis = \$1,000,000.

MACRS	Depreciation	End-Of-Year
-------	--------------	-------------

<u>Year</u>	<u>Rate</u>	<u>Expense</u>	<u>Book Value</u>
1	0.33	\$ 330,000	\$670,000
2	0.45	450,000	220,000
3	0.15	150,000	70,000
4	<u>0.07</u>	<u>70,000</u>	0
	<u>1.00</u>	<u>\$1,000,000</u>	

Cost Of Owning Time Line:

	2	3	4	0	1	
AT Loan Payment			-60,000	-60,000	-60,000	-1,060,000
Dep. Tax Savings <sup>1</sup>			132,000	180,000	60,000	28,000
Maintenance (AT) <sup>2</sup>		-12,000	-12,000	-12,000	-12,000	
Res. Value (AT) <sup>3</sup>						120,000
Net Cash Flow		<u>-12,000</u>	<u>60,000</u>	<u>108,000</u>	<u>-12,000</u>	<u>-912,000</u>

<sup>1</sup>Depreciation is a tax-deductible expense, so it produces a tax savings of  $t(\text{depreciation})$ . For example, the savings in year 1 is  $0.4(\$330,000) = \$132,000$ .

<sup>2</sup>Each maintenance expense is \$20,000, but it is tax deductible, so the after-tax flow is  $(1 - t)\$20,000 = \$12,000$ .

<sup>3</sup>The ending book value is \$0, so taxes must be paid on the full \$200,000 salvage (residual) value.

PV cost of owning (@6%) = \$591,741.

**b. 2. Explain the rationale for the discount rate you used to find the PV.**

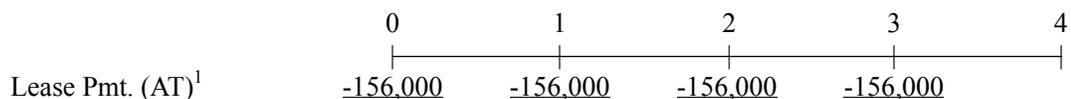
**Answer:** The proper discount rate depends on (1) the riskiness of the cash flow stream and (2) the general level of interest rates. The loan payments and the maintenance costs are fixed by contract, hence are not at all risky. The depreciation deductions are also “locked in,” but the tax rate could change. Thus, depreciation cash flows (tax savings) are not totally certain, but they are relatively certain. Only the residual value is highly uncertain. On balance, and in relation to

cash flows associated with such activities as capital budgeting, we conclude that the cash flows in the time line are relatively safe, so they should be discounted at a relatively low rate. In fact, they have about the same degree of riskiness as the firm's debt cash flows (which also have some tax rate risk, and which are also contractual in nature). Therefore, we conclude that leasing has about the same impact on the firm's financial risk as debt financing, so the appropriate discount rate is Lewis's cost of debt. (Note: the larger the residual value in relation to the other flows, the less justifiable is this statement.) Further, since the cash flows are stated on an after-tax basis, the rate should be the *after-tax* cost of debt. Lewis's before-tax debt cost is 10 percent, and since the firm is in the 40 percent tax bracket, its after-tax cost is  $10.0\%(1 - 0.40) = 6.0\%$ . Therefore, we use 6 percent as the discount rate.

Note: when we have been engaged as consultants on lease-versus-buy decisions, the proper discount rate is often discussed. We know of no way to specify exactly how to adjust for the salvage (residual) value risk. Therefore, what we have been doing is running the analysis on a spreadsheet model and making a data table where the dependent variable is the NAL as calculated below and the independent variable is the discount rate. Then, we produce a graph which shows the range of discount rates over which the NAL is positive. This usually heads off problems over the proper discount rate.

c. **What is Lewis's present value cost of leasing the equipment? (Hint: again, construct a time line.)**

**Answer:** If Lewis leased the equipment, its only cash flows would be the after-tax lease payments:



<sup>1</sup>each lease payment is \$260,000, but this is deductible, so the after-tax cost of the lease is  $(1 - t)(\$260,000) = \$156,000$ .

PV cost of leasing (@6%) = \$572,990.

**d. What is the net advantage to leasing (NAL)? Does your analysis indicate that Lewis should buy or lease the equipment? Explain.**

**Answer:** The net advantage to leasing (NAL) is \$18,751:

$$\begin{aligned} \text{NAL} &= \text{PV Cost Of Owning} - \text{PV Cost Of Leasing} \\ &= \$591,741 - \$572,990 = \$18,751. \end{aligned}$$

The NAL is positive, which indicates that the PV cost of owning is greater. Therefore, leasing is less expensive than borrowing and buying, so Lewis should lease the equipment rather than purchase it.

**e. Now assume that the equipment's residual value could be as low as \$0 or as high as \$400,000, but that \$200,000 is the expected value. Since the residual value is riskier than the other cash flows in the analysis, this differential risk should be incorporated into the analysis. Describe how this could be accomplished. (No calculations are necessary, but explain how you would modify the analysis if calculations were required.) What effect would increased uncertainty about the residual value have on Lewis's lease-versus-purchase decision?**

**Answer:** First, note that the residual value in a lease analysis will be shown either in the "cost of owning section" or in the "cost of leasing" section, depending on whether or not the company plans to continue using the leased asset at the expiration of the basic lease. If the lessee plans to *continue using the equipment*, then it will have to be purchased when the lease expires, and in this case the residual value appears as a cost in the leasing cost section. However, if the lessee plans not to continue using the equipment, then the residual value will not be shown in the leasing section--rather, it will be shown as an *inflow* in the cost of owning section. In Lewis's case, the asset will not be needed at the expiration of the lease, so the residual is shown as an inflow in the owning section. In this situation, we account for increased risk by *increasing* the rate used to discount the residual value cash flow, resulting in a lower present value of the residual cash flow. This leads to a higher cost of owning, so the greater the risk of the residual value, the higher the cost of owning, and the more attractive leasing becomes.

Note, though, that the situation would be different if Lewis planned to lease and then exercise a fair market value purchase option in order to continue using the equipment. Then the residual would be shown as a cost in the leasing section, and its higher risk would be reflected by discounting it at a *lower* rate. In that situation the riskiness of the residual would penalize rather than help the lease.

In the case at hand, the lessor, not the lessee, will own the asset at the end of the lease, so the lessor bears the residual value risk. In effect, the lease transaction passes the risk associated with the residual value from the lessee/user to the lessor. Of course, the lessor recognizes this, and as a result, assets with highly uncertain residual values will carry higher lease payments than assets with relatively certain residual values. However, the most successful leasing companies have developed expertise in renovating and disposing of used equipment, and this gives them an advantage over most lessees in reducing residual value risks.

Further, leasing companies usually deal with a wide array of assets, so residual value estimates that are too high on one asset may be offset by estimates that are too low on another.

**f. The lessee compares the cost of owning the equipment with the cost of leasing it. Now put yourself in the lessor’s shoes. In a few sentences, how should you analyze the decision to write or not write the lease?**

**Answer:** The lessor should view “writing” the lease as an investment, so the lessor should compare the return on the lease with returns available on alternative investments of similar risk.

**g. 1. Assume that the lease payments were actually \$280,000 per year, that Consolidated Leasing is also in the 40 percent tax bracket, and that it also forecasts a \$200,000 residual value. Also, to furnish the maintenance support, Consolidated would have to purchase a maintenance contract from the manufacturer at the same \$20,000 annual cost, again paid in advance. Consolidated Leasing can obtain an expected 10 percent pre-tax return on investments of similar risk. What would Consolidated’s NPV and IRR of leasing be under these conditions?**

**Answer:** The lessor must invest \$1,000,000 to buy the equipment, but then it expects to receive tax benefits and lease payments over the life of the lease. Note that the depreciation expenses calculated earlier also apply to the lessor, so we have this cash flow stream:

	0	1	2	3	4
Cost Of Asset	-1,000,000				
Dep. Tax Savings		132,000	180,000	60,000	28,000
Maintenance (AT)	-12,000	-12,000	-12,000	-12,000	
Lease Pmt.(AT)	168,000	168,000	168,000	168,000	
Res. Value (AT)					120,000
Net Cash Flow	<u>-844,000</u>	<u>288,000</u>	<u>336,000</u>	<u>216,000</u>	<u>148,000</u>

NPV @ 6% = \$25,325.  
IRR = 7.46%.

**g. 2. What do you think the lessor's NPV would be if the lease payment were set at \$280,000 per year? (Hint: the lessor's cash flows would be a "mirror image" of the lessee's cash flows.)**

**Answer:** With lease payments of \$260,000, the lessor's cash flows would be the "mirror image" of the lessee's NAL--the same dollars, but with signs reversed. Therefore, the lessor's NPV would be -\$18,751, the negative of the lessee's NAL. To verify this, note that a \$20,000 reduction in each lease payment would reduce the lessor's inflows by  $\$20,000(0.6) = \$12,000$  at the beginning of each year. The PV of this annuity is \$44,076, so the lessor's NPV would be  $\$25,325 - \$44,076 = -\$18,752$ , which is identical except for rounding differences.

**h. Lewis's management has been considering moving to a new downtown location, and they are concerned that these plans may come to fruition prior to the expiration of the lease. If the move occurs, Lewis would buy or lease an entirely new set of equipment, and hence management would like to include a cancellation clause in the lease contract. What impact would such a clause have on the riskiness of the lease from Lewis's standpoint? From the lessor's standpoint? If you were the lessor, would you insist on changing any of the lease terms if a cancellation clause were added? Should the cancellation clause contain any restrictive covenants and/or penalties of the type contained in bond indentures or provisions similar to call premiums?**

**Answer:** A cancellation clause would lower the risk of the lease to Lewis, the lessee, because then it would not be obligated to make the lease payments for the entire term of the lease. If its situation changed, so that Lewis either no longer needed the equipment or else wanted to change to a more technologically advanced product, then it could terminate the lease.

However, a cancellation clause would make the contract more risky for the lessor. Now the lessor bears not only the final residual value risk, but also the uncertainty of when the contract will be terminated.

To account for the additional risk, the lessor would undoubtedly increase the annual lease payment. Additionally, the lessor might include clauses that would prohibit cancellation for some period and/or impose a penalty fee for early cancellation. The decision as to whether or not to include a cancellation clause would depend on who was in a better position to bear the residual value risk, the lessee or the lessor. Often lessors have more expertise at disposing of

used equipment than lessees, and thus they are willing to include cancellation clauses without major increases in the required lease payments.

# Chapter 21

## Hybrid Financing: Preferred Stock, Warrants, and Convertibles

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 21-1
- a. Preferred stock is a hybrid security, having characteristics of both debt and equity. It is similar to equity in that it (1) is called “stock” and is included in the equity section of a firm’s balance sheet, (2) has no maturity date, and (3) has payments which are considered dividends--thus, they are not legally required and are not tax deductible. However, it is also similar to debt in that it (1) sets a fixed rate for dividends, (2) affords its holders no voting rights, and (3) has priority over common shareholders in the event of bankruptcy.
  - b. Cumulative dividends is a protective feature on preferred stock that requires all past preferred dividends to be paid before any common dividends can be paid. Arrearages are the preferred dividends that have not been paid, and hence are “in arrears.”
  - c. A warrant is an option issued by a company to buy a stated number of shares of stock at a specified price. Warrants are generally distributed with debt, or preferred stock, to induce investors to buy those securities at lower cost. A detachable warrant is one that can be detached and traded separately from the underlying security. Most warrants are detachable.
  - d. A stepped-up price is a provision in a warrant that increases the striking price over time. This provision is included to prod owners into exercising their warrants.
  - e. Convertible securities are bonds or preferred stocks that can be exchanged for (converted into) common stock, under specific terms, at the option of the holder. Unlike the exercise of warrants, conversion of a convertible security does not provide additional capital to the issuer.
  - f. The conversion ratio is the number of shares of common stock received upon conversion of one convertible security. The conversion price is the effective price per share of stock if conversion occurs. Thus, the conversion price is the par value of the convertible security divided by the conversion ratio. The conversion value is the value of the stock that the investor would receive if conversion occurred. Thus, the conversion value is the market price per share times the conversion ratio.
  - g. A “sweetener” is a feature that makes a security more attractive to some investors, thereby inducing them to accept a lower current yield. Convertible features and warrants are examples of sweeteners.

- 21-2 Preferred stock is best thought of as being somewhere between debt (bonds) and equity (common stock). Like debt, preferred stock imposes a fixed charge on the firm, affords its holders no voting rights, and has priority over common stock in the event of bankruptcy. However, like equity, its payments are considered dividends from both legal and tax standpoints, it has no maturity date, and it is carried on the firm's balance sheet in the equity section. From a creditor's viewpoint, preferred stock is more like common stock, but from a common stockholder's standpoint, preferred stock is more like debt.
- 21-3 The trend in stock prices subsequent to an issue influences whether or not a convertible issue will be converted, but conversion itself typically does not provide a firm with additional funds. Indirectly, however, conversion may make it easier for a firm to get additional funds by lowering the debt ratio, thus making it easier for the firm to borrow. In the case of warrants, on the other hand, if the price of the stock goes up sufficiently, the warrants are likely to be exercised and thus to bring in additional funds directly.
- 21-4 Either warrants or convertibles could be used by a firm that expects to need additional financing in the future--warrants, because when they are exercised, additional funds will be brought into the firm directly; convertibles, because when they are converted, the equity base is expanded and debt can be sold more easily. However, a firm that *does not* have additional funds requirements *would not* want to use warrants.
- 21-5
- a. The value of a warrant depends primarily on the expected growth of the underlying stock's price. This growth, in turn, depends in a major way on the plowback of earnings; the higher the dividend payout, the lower the retention (or plowback) rate; hence, the slower the growth rate. Thus, warrant values will be higher, other things held constant, the smaller the firm's dividend payout ratio. This effect is more pronounced for long-term than for short-term warrants.
  - b. The same general arguments as in Part a hold for convertibles. If a convertible is selling above its conversion value, raising the dividend will lower growth prospects, and, at the same time, increase the "cost" of holding convertibles (or warrants) in terms of forgone cash returns. Thus, raising the dividend payout rate *before* a convertible's conversion value exceeds its call price will *lower* the probability of eventual conversion, but raising the dividend *after* a convertible's conversion value exceeds its call price raises the probability that it will be converted soon.
  - c. The same arguments as in Part b apply to warrants.

- 21-6 The statement is made often. It is not really true, as a convertible's issue price reflects the underlying stock's *present price*. Further, when the bond or preferred stock is converted, the holder receives shares valued at the then-existing price, but effectively pays less than the market price for those shares.
- 21-7 If rights are used, they generally apply to voting securities. Although convertibles do not have voting rights, they are convertible into securities that do have the right to vote.
- 21-8 The convertible bond has an expected return which consists of an interest yield (10 percent) plus an expected capital gain. We know the expected capital gain must be at least 4 percent, because the total expected return on the convertible must be at least equal to that on the nonconvertible bond, 14 percent. In all likelihood, the expected return on the convertible would be higher than that on the straight bond, because a capital gains yield is riskier than an interest yield. The convertible would, therefore, probably be regarded as riskier than the straight bond, and  $r_c$  would exceed  $r_d$ . However, the convertible, with its interest yield, would probably be regarded as less risky than common stock. Therefore,  $r_d < r_c < r_s$ .

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

21-1 First issue: 20-year straight bonds with an 8% coupon.

**Second issue: 20-year bonds with 6% annual coupon with warrants. Both bonds issued at par \$1,000. Value of warrants = ?**

First issue:  $N = 20$ ;  $PV = -1000$ ,  $PMT = 80$ ,  $FV = 1000$  and solve for  $I = r_d = 8\%$ . (Since it sold for par, we should know that  $r_d = 8\%$ .)

Second issue:  $\$1,000 = \text{Bond} + \text{Warrants}$ .

This bond should be evaluated at 8% (since we know the 1st issue sold at par) to determine its present value. Then the value of the warrants can be determined as the difference between \$1,000 and the bond's present value.

$N = 20$ ;  $I = r_d = 8$ ;  $PMT = 60$ ,  $FV = 1000$ , and solve for  $PV = \$803.64$ .

Value of warrants =  $\$1,000 - \$803.64 = \$196.36$ .

21-2 Convertible Bond's Par value = \$1,000; Conversion price,  $P_c = \$40$ ;  
CR = ?

$$CR = \frac{\text{Par value}}{P_c} = \frac{\$1,000}{\$40} = 25 \text{ shares.}$$

21-3 a. Expiration value = Current price - Striking price.

<u>Current Price</u>	<u>Striking Price</u>	<u>Expiration Value</u>
\$ 20	\$25	-\$5 or 0
25	25	0
30	25	5
100	25	75

b. No precise answers are possible, but some "reasonable" warrant prices are as follows:

<u>Current Stock Price</u>	<u>Warrant Price</u>	<u>Premium</u>
\$20	\$ 2	\$ 7
25	4	4
30	7	2
100	76	1

- c. (1) The longer the life, the higher the warrant value.  
 (2) The more variable the stock price, the higher the warrant value.  
 (3) The higher the expected EPS growth rate, the higher the warrant price.  
 (4) Going from 0 to 100 percent payout would have two possible effects. First, it *might* affect the price of the stock causing a change in the formula value of the warrant; however, it is not at all clear that the stock price would change, let alone what the change would be. Second, and more important here, the increase in the payout ratio *drastically* lowers the expected growth rate. This reduces the chance of the stock going up in the future. This lowers the expected value of the warrant, hence the premium and the price of the warrant.

$$d. V_{\text{Package}} = \$1,000 = \frac{\text{Straight debt}}{\text{Value of the bond}} + \frac{\text{Value of the warrants}}{\text{the warrants}} = V_B + 40(\$3)$$

$$V_B = \$1,000 - \$150 = \$850.$$

$$\begin{aligned} \$850 &= \sum_{t=1}^{20} \frac{I}{(1+r_d)^t} + \frac{\$1,000}{(1+r_d)^{20}} = \sum_{t=1}^{20} \frac{I}{(1.12)^t} + \frac{\$1,000}{(1.12)^{20}} \\ &= I(7.4694) + \$1,000(0.1037) = I(7.6494) + \$103.70 \\ \$746.30 &= I(7.4694) \\ I &= \frac{\$746.30}{7.4694} = \$99.91 \approx \$100. \end{aligned}$$

Therefore, the company would set a coupon interest rate of 10 percent, producing an annual interest payment  $I = \$100$ .

- 21-4 a. Investment bankers often use the rule of thumb that the premium over the present price should be in the range of 10 to 30 percent. If the firm's growth rate is low, the premium would be closer to 10 percent, while a high growth rate firm would command a premium closer to 30 percent.  
 A 10 percent premium results in a conversion price of  $\$42(1.10) = \$46.20$ , while a 30 percent premium leads to a conversion price of  $\$42(1.30) = \$54.60$ . There has been heavy use of 18 to 20 percent premiums in recent years.
- b. Yes, to be able to force conversion if the market rises above the call price. If, in fact, the 10 percent growth estimate is correct, by 2008 earnings would be  $\$3(1.10)^4 = \$4.39$  and, if the P/E ratio remains at 14x, the stock price will go to  $\$4.39(14) = \$61.46$ , making forced conversion possible even if a 30 percent premium is set.

21-5 a. The premium of the conversion price over the stock price was 14.1 percent:  $\$62.75/\$55 - 1.0 = 0.141 = 14.1\%$ .

b. The before-tax interest savings is calculated as follows:

$$\$400,000,000(0.0875 - 0.0575) = \$12 \text{ million per year.}$$

However, the after-tax interest savings would be more relevant to the firm and would be calculated as  $\$12,000,000(1 - T)$ .

c. Assuming that the stock had not gone above \$62.75 during the fifteen years after it was issued, the bond would not have been converted. For example, if a bondholder converted the bond, the bondholder would receive about 15.9 shares of stock per bond, calculated as follows:

$$\text{Conversion ratio} = \text{CR} = \$1,000/\$62.75 = 15.936255 \text{ shares.}$$

If the stock price is \$32.75, then the value of the bond in conversion is

$$15.936255(\$32.75) = \$521.91.$$

At the time of issue, the value of the bond as a straight bond was \$668.30, calculated as follows:  $N = 80$ ,  $I = 8.75/2 = 4.375$ ,  $PV = ?$ ,  $PMT = 57.5/2 = 28.75$ ,  $FV = 1000$ . Solving,  $PV = -668.296$ . Notice that this implies that the value of the conversion feature at the time of issue was  $\$331.70 = \$1,000 - \$668.30$ .

If interest rates had not changed, then the value of the straight bond fifteen years after issue would have been \$697.44, calculated as follows:  $N = 50$ ,  $I = 8.75/2 = 4.375$ ,  $PV = ?$ ,  $PMT = 57.5/2 = 28.75$ ,  $FV = 1000$ . Solving,  $PV = -697.441$ . To make conversion more profitable than holding the bond, the market interest rate on straight debt would have to increase to 11.68 percent, calculated as follows:  $N = 50$ ,  $I = ?$ ,  $PV = 521.91$ ,  $PMT = 57.5/2 = 28.75$ ,  $FV = 1000$ . Solving,  $I = 5.841$ , so  $rd = 5.841(2) = 11.682$ . So unless interest rates were higher than 11.68 percent, the value of the straight bond would be greater than the value of conversion, so the bond would not be converted.

d. The value of straight bond would have increased from \$668.30 at the time of issue to \$697.44 fifteen years later, as calculated above, due to the fact that the bonds are closer to maturity (because a bond's value approaches its par value as it gets closer to maturity). However, the value of the conversion feature would have fallen sharply, for two reasons. First, the stock price fell from \$55 to \$32.75, and a decrease in stock price hurts the value of an option. Second, the time until maturity for the conversion fell from 40 years to 25 years, and a reduction in the remaining time to exercise an option hurts its value. Therefore, the bonds probably would have fallen below the \$1,000 issue price.

e. Had the rate of interest fallen to  $5 \frac{3}{4}$  percent, which is the coupon rate on the bonds, then they would have had a straight bond value of \$1,000. Although the value of the conversion feature would have dropped in value due to the decline in stock price and the decrease in the remaining

time for the conversion to be exercised, the value of the conversion feature would still have a positive value (because an option value can never be zero or below). Therefore, the bonds would probably have a price slightly above their par value of \$1,000.

21-6 a.

Balance Sheet  
Alternative 1

		Total current liabilities	\$150,000
		Long-term debt	--
		Common stock, par \$1	162,500
		Paid-in capital	437,500
		Retained earnings	<u>50,000</u>
Total assets	<u>\$800,000</u>	Total claims	<u>\$800,000</u>

Alternative 2

		Total current liabilities	\$ 150,000
		Long-term debt	--
		Common stock, par \$1	150,000
		Paid-in capital	450,000
		Retained earnings	50,000
Total assets	<u>\$ 800,000</u>	Total claims	<u>\$ 800,000</u>

Alternative 3

		Total current liabilities	\$ 150,000
		Long-term debt (8%)	500,000
		Common stock, par \$1	150,000
		Paid-in capital	450,000
		Retained earnings	50,000
Total assets	<u>\$1,300,000</u>	Total claims	<u>\$1,300,000</u>

		<u>Original</u>	<u>Plan 1</u>
<u>Plan 2</u>	<u>Plan 3</u>		
Number of shares		80,000	80,000
80,000	80,000		
Total shares		100,000	162,500
150,000	150,000		
Percent ownership		<u>80%</u>	<u>49%</u>
<u>53%</u>	<u>53%</u>		

		<u>Original</u>	<u>Plan 1</u>	<u>Plan 2</u>	<u>Plan 3</u>
c.	Total assets			\$ 550,000	\$800,000
\$800,000	\$1,300,000				
	EBIT			\$ 110,000	\$160,000
\$160,000	\$ 260,000				
	Interest				20,000
0	0	40,000			
	EBT				\$ 90,000
\$160,000	\$160,000	\$ 220,000			
	Taxes (40%)			36,000	64,000
64,000	88,000				
	Net income			<u>\$ 54,000</u>	<u>\$ 96,000</u>
<u>\$ 96,000</u>	<u>\$ 132,000</u>				

150,000	Number of shares	100,000	162,500
	150,000		
<u>\$0.64</u>	Earnings per share	<u>\$0.54</u>	<u>\$0.59</u>
	<u>\$0.88</u>		

d.

<u>Plan 1</u>	<u>Plan 2</u>	<u>Plan 3</u>	<u>Original</u>
\$150,000	\$ 650,000		\$400,000
<u>19%</u>	<u>50%</u>		<u>73%</u>
			<u>19%</u>

- e. Alternative 1 results in loss of control (to 49 percent) for the firm. Under it, he loses his majority of shares outstanding. Indicated earnings per share increase, and the debt ratio is reduced considerably (by 54 percentage points).

Alternative 2 results in maintaining control (53 percent) for the firm. Earnings per share increase, while a reduction in the debt ratio like that in Alternative 1 occurs.

Under Alternative 3 there is also maintenance of control (53 percent) for the firm. This plan results in the highest earnings per share (88 cents), which is an increase of 63 percent on the original earnings per share. The debt ratio is reduced to 50 percent.

Conclusions. If the assumptions of the problem are borne out in fact, Alternative 1 is inferior to 2, since the loss of control is avoided. The debt-to-equity ratio (after conversion) is the same in both cases. Thus, the analysis must center on the choice between 2 and 3.

The differences between these two alternatives, which are illustrated in Parts c and d, are that the increase in earnings per share is substantially greater under Alternative 3, but so is the debt ratio. With its low debt ratio (19 percent), the firm is in a good position for future growth under Alternative 2. However, the 50 percent ratio under 3 is not prohibitive and is a great improvement over the original situation. The combination of increased earnings per share and reduced debt ratios indicates favorable stock price movements in both cases, particularly under Alternative 3. There is the remote chance that the firm could lose its commercial bank financing under 3, since it was the bank which initiated the permanent financing suggestion. The additional funds, especially under 3, may enable the firm to become more current on its trade credit. Also, the bonds will no doubt be subordinated debentures.

Both Alternatives 2 and 3 are favorable alternatives. If the principal owner is willing to assume the risk of higher leverage, then 3 is slightly more attractive than 2. The actual attractiveness of Alternative 3 depends, of course, on the assumption that funds can be invested to yield 20 percent before interest and taxes. It is this fact that makes the additional leverage favorable and raises the earnings per share.

21-7 *Facts and analysis in the problem:*

$r_d = 14\%$ .  
 $r_s = \$2.18/\$30.00 + 9\% = 16.27\%$ .  
 $P_0 = \$30$ .  
 $D_0 = \$2$ .  
 $g = 9\%$ .

*Convertible:*

Par = \$1,000, 20-year.  
 Coupon = 10%.  
 R = 20 shares.  
 Call = Five-year deferment.  
 Call price = \$1,075 in Year 5, declines by \$5 per year.  
 Will be called when  $C_t = 1.2(\text{Par}) = \$1,200$ .  
 Find n (number of years) to anticipated call/conversion:

$$\begin{aligned}
 (P_0)(R)(1+g)^n &= \$1,200 \\
 (\$30)(20)(1+0.09)^n &= \$1,200 \\
 \$600(1.09)^n &= \$1,200.
 \end{aligned}$$

We need to find the number of years that it takes \$600 to grow to \$1,200 at a 9 percent interest rate. Using a financial calculator, the answer is  $n \approx 8$  years (note that if you are using an HP-12C, the number calculated for n is always rounded up, the solution using an HP-12C is  $n = 9$ ). Note that we could also solve for n as follows:

$$\begin{aligned}
 (1.09)^n &= \$1,200/\$600 = 2 \\
 n \ln(1.09) &= \ln(2) \\
 n(0.08618) &= 0.69315 \\
 n &= 0.69315/0.08618 = 8.04 \approx 8.
 \end{aligned}$$

*Straight-debt value of the convertible at  $t = 0$ :*  
 (Assumes annual payment of coupon)

At  $t = 0$  ( $n = 20$ ):

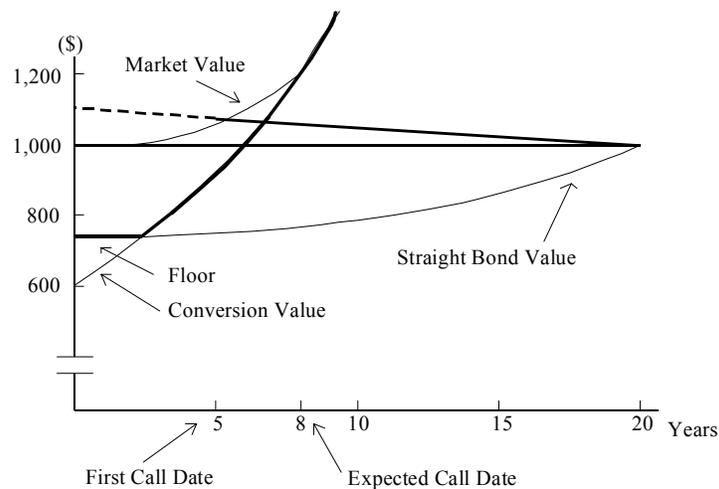
$$\begin{aligned}
 V &= \sum_{t=1}^{20} \frac{\$100}{(1+0.14)^t} + \frac{\$1,000}{(1+0.14)^{20}} \\
 &= \$100(6.6231) + \$1,000(0.0728) = \$735.
 \end{aligned}$$

V at t = 5 (n = 15): \$754.  
 V at t = 10 (n = 10): \$791.  
 V at t = 15 (n = 5): \$863.  
 V at t = 20 (n = 0): \$1,000.

*Conversion value:*

$CV_t = P_0(1.09)^n(20)$ .  
 $CV_0 = \$30(20) = \$600$ .  
 $CV_5 = \$30(1.09)^5(20) = \$923$ .  
 $CV_8 = \$30(1.09)^8(20) = \$1,196$ .  
 $CV_{10} = \$30(1.09)^{10}(20) = \$1,420$ .

a.



b. 
$$\$1,000 = \sum_{t=1}^8 \frac{\$100}{(1+r_c)^t} + \frac{\$1,200}{(1+r_c)^8}$$

Using a financial calculator, we find  $r_c = 11.65\%$ .

c. 
$$r_s = \frac{\$2(1.09)}{\$30} + 0.09 = 16.27\%. \quad r_d = 11.65\%$$

Generally, to clear the market at par value, the rate on the convertible bond should be between the cost of straight debt and the required return on equity, or in this case, between 14 percent and 16.27 percent. This reflects the fact that convertibles are more risky than straight debentures due to the less certain cash flows, but less risky than equity due to the floor on potential capital loss.

Several changes could be made to improve the return on the convertible:

- Reduce  $P_c$  (or increase  $R$ ). This would raise the  $C_t$  line (shift left) and move up the probable time of conversion. Discounting the cash flows over a shorter time period would raise the yield, holding the purchase price and cash flows constant.
- Increase the coupon yield. Higher annual payments would increase the yields, holding the time period constant.
- Use some combination of changes in  $R$  and the coupon to produce  $14\% < r_d < 16.27\%$ .

$$d. P_2 = \$30(1.09)^2 = \$35.643 = \frac{\text{Price of stock just before}}{\text{change in growth expectation}}$$

$$P_3 = \$2.38/0.1627 = \$14.628 = \frac{\text{Price of stock after changed}}{\text{growth expectations}}$$

Percentage decline in stock price = 59%.

Assuming zero future growth, the value of the stock will not increase, and the value of the convertible will depend only upon its value as a straight bond. Since the firm's interest payments are relatively low compared to what they would have been had straight debt been issued originally, the firm is unlikely to call the bond issue. Therefore, it would be valued according to its coupon, the current market rate on debt of that risk, and years remaining to maturity (18):

$$V_{\text{Bond}} = \sum_{t=1}^{18} \frac{\$100}{(1.14)^t} + \frac{\$1,000}{(1.14)^{18}} = \$741.$$

Prior to the change in expected growth from 9 to 0 percent, the market value would have been above the straight bond value: According to the graph, the bond would sell for about \$1,025. Thus, there would be a percentage decline of 28 percent in the value of the convertible, about half the 59 percent loss on the stock.

## SOLUTION TO SPREADSHEET PROBLEM

---

- 21-8 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 21 P08 Build a Model.xls*) and on the instructor's side of the textbook's web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**Paul Duncan, financial manager of Edusoft Inc., is facing a dilemma. The firm was founded five years ago to provide educational software for the rapidly expanding primary and secondary school markets. Although Edusoft has done well, the firm's founder believes that an industry shakeout is imminent. To survive, Edusoft must grab market share now, and this will require a large infusion of new capital.**

**Because he expects earnings to continue rising sharply and looks for the stock price to follow suit, Mr. Duncan does not think it would be wise to issue new common stock at this time. On the other hand, interest rates are currently high by historical standards, and with the firm's B rating, the interest payments on a new debt issue would be prohibitive. Thus, he has narrowed his choice of financing alternatives to two securities: (1) bonds with warrants or (2) convertible bonds. As Duncan's assistant, you have been asked to help in the decision process by answering the following questions:**

**a. How does preferred stock differ from both common equity and debt? Is preferred stock more risky than common stock? What is floating rate preferred stock?**

**Answer:** Preferred stock is a hybrid--it contains some features that are similar to debt and some features that are similar to common equity. Like debt, preferred payments to investors are contractually fixed, but like common equity, preferred dividends can be omitted without putting the company into default and thus into bankruptcy. Note, however, that the provisions of most preferred stock issues prevent a firm from paying common dividends when the preferred dividend has not been paid. Further, preferred dividends are generally cumulative; that is, dividends that are omitted accumulate (without interest) and must be paid before any common dividends can be paid. Finally, preferred stockholders can normally elect several directors if preferred dividends are omitted for some period, generally three consecutive quarters. Thus, preferred stock lies somewhere between common equity and debt in the risk/return spectrum. Floating rate preferred stock has a dividend payment that is indexed to the rate on treasury securities, so it almost always trades at par.

**b. What is a call option? How can knowledge of call options help a financial**

**manager to better understand warrants and convertibles?**

**Answer:** A *call option* is a contract which gives the holder the right, but not the obligation, to buy some defined asset, say a stock, at a specified price within some specified period of time. A *warrant* is a long-term option, and a *convertible* has built into it an implied call option. If financial managers understand how call options are valued, they can make better decisions regarding the structuring of warrant and convertible issues.

**c. One of the firm's alternatives is to issue a bond with warrants attached. Edusoft's current stock price is \$20, and its investment banker estimates that the cost of a 20-year, annual coupon bond without warrants would be 12 percent. The bankers suggest attaching 50 warrants, each with an exercise price of \$25, to each \$1,000 bond. It is estimated that each warrant, when detached and traded separately, would have a value of \$3.**

- 1. What coupon rate should be set on the bond with warrants if the total package is to sell for \$1,000?**

**Answer:** If the entire package is to sell for \$1,000, then

$$V_{\text{package}} = V_{\text{bond}} + V_{\text{warrants}} = \$1,000.$$

The 50 warrants each have an estimated value of \$3, so

$$V_{\text{warrants}} = 50(\$3) = \$150.$$

thus,

$$V_{\text{bond}} + \$150 = \$1,000 = \$850.$$

Therefore, the bonds must carry a coupon rate that will cause each bond to sell for \$850. The straight-debt rate is  $r_d = 12\%$ , so if the coupon were set at 12 percent, the bonds would sell at par, not at \$850. The coupon must therefore be below 12 percent, and it is found by solving for INT in this equation:

$$\begin{aligned} \$850 &= \text{INT}(\text{PVIFA}_{12\%,20}) + \$1,000(\text{PVIF}_{12\%,20}) \\ \text{INT} &\approx \$100. \end{aligned}$$

Alternatively, using a financial calculator, enter  $N = 20$ ,  $I = 12$ ,  $PV = -850$ , and  $FV = 1,000$  to solve for  $\text{PMT} = \$100$ .

Therefore, the required coupon rate is 10%. With a 10 percent coupon, the bonds would have a value of \$850, and hence the package of one bond plus 50 warrants would be worth \$1,000.

**c. 2. Suppose the bonds were issued and the warrants immediately traded on the open market for \$5 each. What would this imply about the terms of the issue? Did the company “win” or “lose”?**

**Answer:** If the warrants traded for \$5 immediately after issue, then the company would have set the terms of the bonds with warrants improperly, its stockholders would have been “losers,” and the purchasers of the bonds with warrants would have been “winners.” The 50 warrants would be worth  $50(\$5) = \$250$ , and the package would actually be worth  $\$850 + \$250 = \$1,100$ . Selling something worth \$1,100 for \$1,000 would impose an unnecessary cost of \$100 per bond on Edusoft’s shareholders. Because the package could have been sold with a lower coupon rate, the firm could have had lower future interest payments whose present value would be smaller by \$100.

**c. 3. When would you expect the warrants to be exercised? Assume they have a 10-year life; that is, they expire 10 years after issue.**

**Answer:** Generally, a warrant will sell in the open market at a premium above its expiration value, which is the value of the warrant if exercised. Thus, prior to expiration, an investor who wanted cash would sell his or her warrants in the marketplace rather than exercise them. Therefore, warrants tend not to be exercised until just before they expire.

However, note that in order to force warrant holders to exercise and thus to bring in equity capital, some warrants contain *exercise price step-up provisions*, whereby the exercise price increases in steps over the life of the warrant. Since the value of the warrant falls when the exercise price is increased, step-up provisions encourage holders of in-the-money warrants to exercise just prior to the timing of a step-up.

Finally, note that warrant holders will tend to exercise voluntarily if the dividend on the stock rises enough. No dividend is earned on a warrant, and high dividends increase the attractiveness of stocks over warrants. The expiration value of the warrant will fall if the stock price falls, and stock prices fall when the stock goes ex dividend. If the dividend is large, warrant holders can avoid recurring large losses by exercising.

**c. 4. Will the warrants bring in additional capital when exercised? If so, how much, and what type of capital?**

**Answer:** When exercised, each warrant will bring in the exercise price, which in this case means \$25 of equity capital, and holders will receive one share of common stock per warrant. Note that the



The IRR of this cash flow stream, 14.65 percent, is the pre-tax cost of the bond-with-warrants issue. This cost is higher than the 12 percent cost of straight debt because, from the investors' standpoint, the issue is riskier than straight debt. It is lower, though, than the cost of equity because part of the return is fixed by contract.

**d.** As an alternative to the bond with warrants, Mr. Duncan is considering convertible bonds. The firm's investment bankers estimate that Edusoft could sell a 20-year, 10.5 percent annual coupon, callable convertible bond for its \$1,000 par value, whereas a straight-debt issue would require a 12 percent coupon. The convertibles would be call protected for 5 years, the call price would be \$1,100, and the company would probably call the bonds as soon as possible after their conversion value exceeds \$1,200. Note, though, that the call must occur on an issue date anniversary. Edusoft's current stock price is \$20, its last dividend was \$1.48, and the dividend is expected to grow at a constant 8 percent rate. The convertible could be converted into 40 shares of Edusoft stock at the owner's option.

**1. What conversion price is built into the bond?**

**Answer:** Conversion Price =  $P_C = \frac{\text{Par value}}{\text{\# Shares received}} = \frac{\$1,000}{40} = \$25.$

The conversion price is similar to a warrant's exercise price, and, as with warrants, the conversion price is typically set at between 10 and 30 percent above the stock price on the issue date.

**d.** **2. What is the convertible's straight-debt value? What is the implied value of the convertibility feature?**

**Answer:** Since the required rate of return on a 20-year straight bond is 12 percent, the value of a 10.5 percent annual coupon bond is \$887.96:

$$V = \$105(PVIFA_{12\%,20}) + \$1,000(PVIF_{12\%,20}) = \$887.96.$$

Alternatively, using a financial calculator, enter  $N = 20$ ,  $I = 12$ ,

$PMT = 105$ , and  $FV = 1,000$  to solve for  $PV = \$887.96$ . However, the convertible would sell for  $\$1,000$ , so the implied value of the convertible feature is  $\$1,000 - \$887.96 = \$112.04$ . The convertibility value is analogous to the premium on a warrant.

**d. 3. What is the formula for the bond's expected conversion value in any year? What is its conversion value at year 0? At year 10?**

**Answer:** The conversion value in any year is simply the value of the stock one would receive upon converting. Since Edusoft is a constant growth stock, its price is expected to increase by  $g$  each year, and hence the expected stock price is  $P_t = P_0(1 + g)^t$ . The value of converting at any year is  $CR(P_t)$ , where  $CR$  is the number of shares received (the conversion ratio). Thus, the expected conversion value in any year is:

$$CV_t = CR(P_t) = CR(P_0)(1 + g)^t = 40(\$20)(1.08)^t,$$

And, hence, for year 0 and year 10, we have the following:

$$\text{Year 0: } CV_0 = 40(\$20)(1.08)^0 = \$800.$$

$$\text{Year 10: } CV_{10} = 40(\$20)(1.08)^{10} = \$1,727.14.$$

**d. 4. What is meant by the “floor value” of a convertible? What is the convertible’s expected floor value at year 0? At year 10?**

**Answer:** The floor value is simply the higher of the straight-debt value and the conversion value. At year 0, the straight-debt value is \$887.96 while the conversion value is \$800, and hence the floor value is \$887.96. At year 10, the conversion value of \$1,727 is clearly higher than the straight-debt value, and hence the conversion value sets the floor price for that year. The convertible, however, will generally sell above its floor value prior to maturity because the convertibility option carries additional value. (As discussed below, the price of the convertible can fall to the floor value if the dividends paid on the stock that would be received in conversion greatly exceed the interest paid on the bond.)

**d. 5. Assume that Edusoft intends to force conversion by calling the bond as soon as possible after its conversion value exceeds 20 percent above its par value, or  $1.2(\$1,000) = \$1,200$ . When is the issue expected to be called? (Hint: recall that the call must be made on an anniversary date of the issue.)**

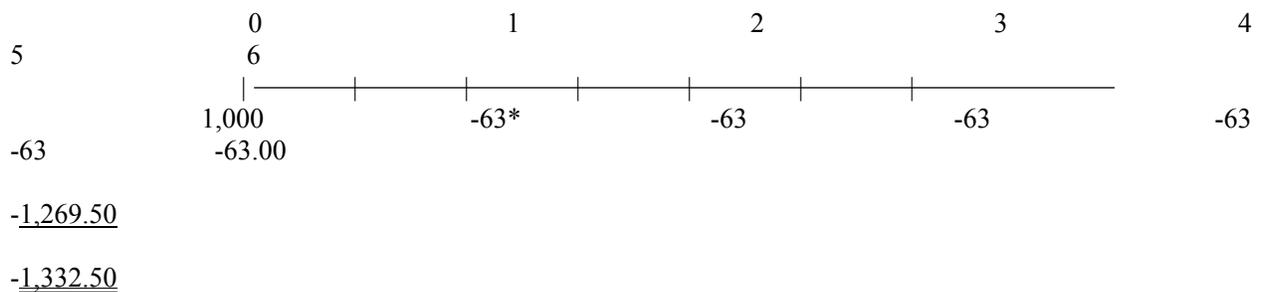
**Answer:** The easiest way to find the year conversion is expected is by recognizing that the conversion value begins at \$800, grows at the rate of 8% per year, and must rise to \$1,200. Then, simply input into a financial calculator,  $I = 8$ ,  $PV = 800$  (or  $-800$ ), and  $FV = 1200$ , and then press the  $n$  button to find the year. It is 5.27, and since the call must occur on an anniversary date, we would round up to 6, so the bond should be called after 6 years. (Note: some calculators automatically round up; the HP-12c is one. However, the HP-17b gives the unrounded answer 5.27.)

**d. 6. What is the expected cost of capital for the convertible to Edusoft? Does this cost appear to**



e.	<b>Edusoft's market value capital structure is as follows (in millions of dollars):</b>	
	<b>Debt</b>	<b>\$ 50</b>
	<b>Equity</b>	<b><u>50</u></b> <b>\$100</b>
<p><b>If the company raises \$20 million in additional capital by selling (1) convertibles or (2) bonds with warrants, what would its WACC be, and how would those figures compare with its current WACC? Edusoft's tax rate is 40 percent.</b></p>		

**Answer:** It is necessary to find the *after-tax* cost of the convertible, as follows:



$$*INT(1 - T) = 105(0.6) = 63.$$

The Solution Value Is  $r_{c(AT)} = 9.81\%$ .

The After-Tax Cost Of Straight Debt Is  $0.6(12\%) = 7.2\%$ .

The capital structure, with the convertibles added, would be as follows:

Straight Debt	\$ 50	41.67% $\approx$	40%
Convertibles	20	16.67 $\approx$	20%
Equity	<u>50</u>	<u>41.67</u> $\approx$	<u>40%</u>
	<u>\$120</u>	<u>100.00%</u>	<u>100%</u>

thus:

$$WACC (W/Convertibles) = 0.4(7.2\%) + 0.2(9.81\%) + 0.4(16\%) = 11.24\%.$$

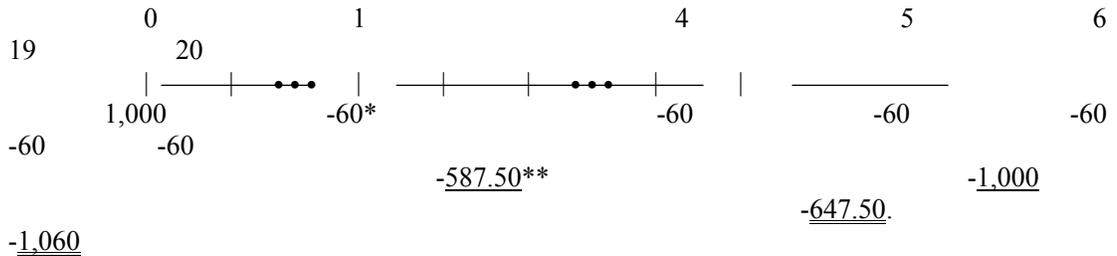
$$WACC (Current) = 0.5(7.2\%) + 0.5(16\%) = 11.6\%.$$

The convertibles would lower the WACC slightly, because the convertibles have a cost (9.81%) that is less than the current overall cost of capital to the firm (11.6%). This assumes, though, that the cost of equity would not be affected by the addition of convertible debt. In fact, this debt would increase somewhat the riskiness of the equity (and the other debt), but people would expect it to eventually be converted, at which point the equity ratio would increase, and the risk of leverage would decline.

Again, this demonstrates the difficulty of obtaining precise cost of capital estimates, and the necessity of using judgment in determining the cost of capital.

We assume that the warrants are converted in year 5, as described in part c(5) above.

The after-tax cost of the warrants would be:



\* $INT(1 - T) = 100(0.6) = 60$ .

\*\* $\#Warrants(Opportunity\ Loss/Warrant) = 50(11.75) = 587.50$ .

The IRR of this stream is 10.32%.

The capital structure, with the bond with warrants added, would be as follows:

Straight Debt	\$ 50	41.67% $\approx$	40%
Bond With Warrants	20	16.67 $\approx$	20%
Equity		<u>50</u>	<u>41.67</u> $\approx$ <u>40%</u>
		<u>\$120</u>	<u>100.00%</u> <u>100%</u>

thus:

$$WACC(W/Bond\ With\ Warrants) = 0.4(7.2\%) + 0.2(10.32\%) + 0.4(16\%) = 11.34\%$$

As you remember, the WACC without the bond with warrants was 11.6%, so the use of warrants decreases the cost of capital, since the cost of the bond with warrants is lower than the prior WACC. The WACC is higher than if convertibles were used because the cost of warrants is higher, apparently because investors think they are more risky. Also note that we assumed conversion in year 5 at an estimated stock price, so the cost of the bond with warrants is determined very arbitrarily.

f. **Mr. Duncan believes that the costs of both the bond with warrants and the convertible bond are close enough to one another to call them even, and also consistent with the risks involved. Thus, he will make his decision based on other factors. What are some of the factors which he should consider?**

**Answer:** One factor that should be considered is the firm's future needs for capital. If Edusoft anticipates a continuing need for capital, then warrants may be favored, because their exercise will bring in additional equity capital without the need to retire the accompanying low-coupon debt issue. Conversely, the convertible issue brings in no new funds at conversion, and the low-coupon debt will be gone when the bonds are converted.

Another factor is whether Edusoft wants to commit to 20 years of debt at this time. Conversion will remove the debt issue, while the exercise of warrants does not. Of course, if Edusoft's stock price does not rise over time, then neither the warrants nor the convertibles would be exercised, and the debt would remain outstanding in both cases.

**g. How do convertible bonds help reduce agency costs?**

**Answer:** Agency costs can arise due to conflicts between shareholders and bondholders, in the form of asset substitution (or bait-and-switch.) This happens when the firm issues low cost straight debt, then invests in risky projects. Bondholders suspect this, so they charge high interest rates. Convertible debt allows bondholders to share in upside potential, so it has low rate. Thus, convertible debt helps reduce this agency cost.

Information asymmetry occurs when a company knows its future prospects better than outside investors. Outside investors think the company will issue new stock only if future prospects are not as good as market anticipates, so issuing new stock send negative signal to market, causing the stock price to fall. A company with good future prospects can issue stock "through the back door" by issuing convertible bonds. This avoids the negative signal of issuing stock directly. Since prospects are good, bonds will likely be converted into equity, which is what the company wants to issue.

## Chapter 22

### Working Capital Management

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 22-1
- a. Working capital is a firm's investment in short-term assets--cash, marketable securities, inventory, and accounts receivable. Net working capital is current assets minus current liabilities. Net operating working capital is operating current assets minus operating current liabilities.
  - b. The inventory conversion period is the average length of time it takes to convert materials into finished goods and then to sell them. It is calculated by dividing total inventory by sales per day. The receivables collection period is the average length of time required to convert a firm's receivables into cash. It is calculated by dividing accounts receivable by sales per day. The cash conversion cycle is the length of time between the firm's actual cash expenditures on productive resources (materials and labor) and its own cash receipts from the sale of products (that is, the length of time between paying for labor and materials and collecting on receivables.) Thus, the cash conversion cycle equals the length of time the firm has funds tied up in current assets. The payables deferral period is the average length of time between a firm's purchase of materials and labor and the payment of cash for them. It is calculated by dividing accounts payable by credit purchases per day (COGS/365).
  - c. A relaxed NOWC policy refers to a policy under which relatively large amounts of cash, marketable securities, and inventories are carried and under which sales are stimulated by a liberal credit policy, resulting in a high level of receivables.  
A restricted NOWC policy refers to a policy under which holdings of cash, securities, inventories, and receivables are minimized; while a moderate current asset investment policy lies between the relaxed and restricted policies.  
A moderate NOWC policy matches asset and liability maturities. It is also referred to as the maturity matching, or "self-liquidating" approach.
  - d. Transactions balance is the cash balance associated with payments and collections; the balance necessary for day-to-day operations. A compensating balance is a checking account balance that a firm must maintain with a bank to compensate the bank for services rendered or for granting a loan. A precautionary balance is a cash balance held in reserve for random, unforeseen fluctuations in cash inflows and outflows.
  - e. A cash budget is a schedule showing cash flows (receipts, disbursements, and cash balances) for a firm over a specified period. The net cash gain or loss for the period is calculated as total collections for the period less total payments for the same period of time.  
The target cash balance is the desired cash balance that a firm plans to maintain in order to conduct business.
  - f. Trade discounts are price reductions that suppliers offer customers for early payment of bills.
  - g. An account receivable is created when a good is shipped or a service is performed, and payment for that good is not made on a cash basis, but on a credit basis.  
Days sales outstanding (DSO) is a measure of the average length of time it takes a firm's customers to pay off their credit purchases.

An aging schedule breaks down accounts receivable according to how long they have been outstanding. This gives the firm a more complete picture of the structure of accounts receivable than that provided by days sales outstanding.

- h. Credit policy is nothing more than the firm's policy on granting and collecting credit. There are four elements of credit policy, or credit policy variables. These are credit period, credit standards, collection policy, and discounts.

The credit period is the length of time for which credit is extended. If the credit period is lengthened, sales will generally increase, as will accounts receivable. This will increase the financing needs and possibly increase bad debt losses. A shortening of the credit period will have the opposite effect.

Credit standards determine the minimum financial strength required to become a credit, versus cash, customer. The optimal credit standards equate the incremental costs of credit to the incremental profits on increased sales.

The collection policy is the procedure for collecting accounts receivable. A change in collection policy will affect sales, days sales outstanding, bad debt losses, and the percentage of customers taking discounts.

Credit terms are statements of the credit period and any discounts offered--for example, 2/10, net 30.

Cash discounts are often used to encourage early payment and to attract customers by effectively lowering prices. Credit terms are usually stated in the following form: 2/10, net 30. This means a 2 percent discount will apply if the account is paid within 10 days, otherwise the account must be paid within 30 days.

- i. Permanent NOWC is the NOWC required when the economy is weak and seasonal sales are at their low point. Thus, this level of NOWC always requires financing and can be regarded as permanent. Temporary NOWC is the NOWC required above the permanent level when the economy is strong and/or seasonal sales are high.
- j. A moderate short-term financing policy matches asset and liability maturities. It is also referred to as the maturity matching, or "self-liquidating" approach. When a firm finances all of its fixed assets with long-term capital but part of its permanent current assets with short-term, nonspontaneous credit this is referred to as an aggressive short-term financing policy. With a conservative short-term financing policy permanent capital is used to finance all permanent asset requirements, as well as to meet some or all of the seasonal demands.
- k. A financing policy that matches asset and liability maturities. This is a moderate policy.
- l. Continually recurring short-term liabilities, especially accrued wages and accrued taxes.
- m. Trade credit is debt arising from credit sales and recorded as an account receivable by the seller and as an account payable by the buyer. Stretching accounts payable is the practice of deliberately paying accounts payable late. Free trade credit is credit received during the discount period. Credit taken in excess of free trade credit, whose cost is equal to the discount lost is termed costly trade credit.
- n. A promissory note is a document specifying the terms and conditions of a loan, including the amount, interest rate, and repayment schedule. A line of credit is an arrangement in which a

- bank agrees to lend up to a specified maximum amount of funds during a designated period. A revolving credit agreement is a formal, committed line of credit extended by a bank or other lending institution.
- o. Commercial paper is unsecured, short-term promissory notes of large firms, usually issued in denominations of \$100,000 or more and having an interest rate somewhat below the prime rate. A secured loan is backed by collateral, often inventories or receivables.
- 22-2 The two principal reasons for holding cash are for transactions and compensating balances. The target cash balance is not equal to the sum of the holdings for each reason because the same money can often partially satisfy both motives.
- 22-3 False. Both accounts will record the same transaction amount.
- 22-4 The four elements in a firm's credit policy are (1) credit standards, (2) credit period, (3) discount policy, and (4) collection policy. The firm is not required to accept the credit policies employed by its competition, but the optimal credit policy cannot be determined without considering competitors' credit policies. A firm's credit policy has an important influence on its volume of sales, and thus on its profitability.
- 22-5 If an asset's life and returns can be positively determined, the maturity of the asset can be matched to the maturity of the liability incurred to finance the asset. This matching will ensure that funds are borrowed only for the time they are required to finance the asset and that adequate funds will have been generated by the asset by the time the financing must be repaid.  
A basic fallacy is involved in the above discussion, however. Borrowing to finance receivables or inventories may be on a short-term basis because these turn over 8 to 12 times a year. But as a firm's sales grow, its investment in receivables and inventories grow, even though they turn over. Hence, longer-term financing should be used to finance the permanent components of receivables and inventory investments.
- 22-6 From the standpoint of the borrower, short-term credit is riskier because short-term interest rates fluctuate more than long-term rates, and the firm may be unable to repay the debt. If the lender will not extend the loan, the firm could be forced into bankruptcy.  
A firm might borrow short-term if it thought that interest rates were going to fall and, therefore, that the long-term rate would go even lower. A firm might also borrow short-term if it were only going to need the money for a short while and the higher interest would be offset by lower administration costs and no prepayment penalty. Thus, firms do consider factors other than interest rates when deciding on the maturity of their debt.
- 22-7 This statement is false. A firm cannot ordinarily control its accruals since payrolls and the timing of wage payments are set by economic forces and by industry custom, while tax payment dates are established by law.
- 22-8 Yes. If a firm is able to buy on credit at all, if the credit terms include a discount for early payment, and if the firm pays during the discount period, it has obtained "free" trade credit. However, taking additional trade credit by paying after the discount period can be quite costly.
- 22-9 Commercial paper refers to promissory notes of large, strong corporations. These notes have maturities that generally vary from one day to 9 months, and the return is usually 1½ to 3½ percentage

points below the prime lending rate. Mama and Pappa Gus could not use the commercial paper market.

## **SOLUTIONS TO END-OF-CHAPTER PROBLEMS**

---

22-1 Sales = \$10,000,000; S/I = 2×

$$\begin{aligned}\text{Inventory} &= S/2 \\ &= \frac{\$10,000,000}{2} = \$5,000,000.\end{aligned}$$

If S/I = 5×, how much cash is freed up?

$$\begin{aligned}\text{Inventory} &= S/5 \\ &= \frac{\$10,000,000}{5} = \$2,000,000.\end{aligned}$$

$$\text{Cash Freed} = \$5,000,000 - \$2,000,000 = \$3,000,000.$$

22-2 DSO = 17; Credit Sales/Day = \$3,500; A/R = ?

$$\text{DSO} = \frac{\text{A/R}}{\text{S}/365}$$

$$17 = \frac{\text{A/R}}{\$3,500}$$

$$\text{A/R} = 17 \times \$3,500 = \$59,500.$$

$$\begin{aligned}\text{22-3 Nominal cost of trade credit} &= \frac{3}{97} \times \frac{365}{30-15} \\ &= 0.0309 \times 24.33 = 0.7526 = 75.26\%.\end{aligned}$$

$$\text{Effective cost of trade credit} = (1.0309)^{24.33} - 1.0 = 1.0984 = 109.84\%.$$

$$\begin{aligned}\text{22-4 Effective cost of trade credit} &= (1 + 1/99)^{8.11} - 1.0 \\ &= 0.0849 = 8.49\%.\end{aligned}$$

22-5 Net purchase price of inventory = \$500,000/day.

Credit terms = 2/15, net 40.

$$\$500,000 \times 15 = \$7,500,000.$$

- 22-6 a.  $0.4(10) + 0.6(40) = 28$  days.  
 b.  $\$912,500/365 = \$2,500$  sales per day.  
 $\$2,500(28) = \$70,000 =$  Average receivables.  
 c.  $0.4(10) + 0.6(30) = 22$  days.  $\$912,500/365 = \$2,500$  sales per day.  
 $\$2,500(22) = \$55,000 =$  Average receivables.

Sales may also decline as a result of the tighter credit. This would further reduce receivables. Also, some customers may now take discounts further reducing receivables.

- 22-7 a.  $\frac{1}{99} \times \frac{365}{5} = 73.74\%$ .  
 b.  $\frac{2}{98} \times \frac{365}{50} = 14.90\%$ .  
 c.  $\frac{3}{97} \times \frac{365}{35} = 32.25\%$ .  
 d.  $\frac{2}{98} \times \frac{365}{35} = 21.28\%$ .  
 e.  $\frac{2}{98} \times \frac{365}{25} = 29.80\%$ .

- 22-8 a.  $\frac{3}{97} \times \frac{365}{45 - 20} = 45.15\%$ .

Because the firm still takes the discount on Day 20, 20 is used as the discount period in calculating the cost of nonfree trade credit.

- b. Paying after the discount period, but still taking the discount gives the firm more credit than it would receive if it paid within 15 days.

22-9 Sales per day =  $\frac{\$4,562,500}{365} = \$12,500$ .

Discount sales =  $0.5(\$12,500) = \$6,250$ .

A/R attributable to discount customers =  $\$6,250(10) = \$62,500$ .

A/R attributable to nondiscount customers:

Total A/R	\$437,500	
Discount customers' A/R		<u>62,500</u>
Nondiscount customers' A/R		<u>\$375,000</u>

Days sales outstanding  
nondiscount customers =  $\frac{\text{A/R}}{\text{Sales per day}} = \frac{\$375,000}{\$6,250} = 60 \text{ days}$ .

Alternatively,

DSO =  $\$437,500/\$12,500 = 35 \text{ days}$ .

$35 = 0.5(10) + 0.5(\text{DSO}_{\text{Nondiscount}})$   
 $\text{DSO}_{\text{Nondiscount}} = 30/0.5 = 60 \text{ days}$ .

Thus, although nondiscount customers are supposed to pay within 40 days, they are actually paying, on average, in 60 days.

Cost of trade credit to nondiscount customers equals the rate of return to the firm:

Nominal rate =  $\frac{2}{98} \times \frac{365}{60-10} = 0.0204(7.3) = 14.90\%$ .

Effective cost =  $(1 + 2/98)^{365/50} - 1 = 15.89\%$ .

22-10 Accounts payable:

Nominal cost =  $\left(\frac{3}{97}\right)\left(\frac{365}{80}\right) = (0.03093)(4.5625) = 14.11\%$ .

EAR cost =  $(1.03093)^{4.5625} - 1.0 = 14.91\%$ .

**22-11 a.**  $\begin{matrix} \text{Cash} & & \text{Inventory} & & \text{Receivables} & & \text{Payables} \\ \text{conversion} & = & \text{conversion} & + & \text{collection} & - & \text{deferral} \\ \text{cycle} & & \text{period} & & \text{period} & & \text{period} \end{matrix}$



22-13 a. Return on equity may be computed as follows:

	<u>Tight</u>	<u>Moderate</u>	<u>Relaxed</u>
Current assets (% of sales × Sales)		\$ 900,000	\$1,000,000
Fixed assets			<u>1,000,000</u>
<u>1,000,000</u>			<u>1,000,000</u>
Total assets			<u>\$1,900,000</u>
<u>\$2,200,000</u>			<u>\$2,000,000</u>
Debt (60% of assets)		\$1,140,000	\$1,200,000
Equity			<u>760,000</u>
<u>800,000</u>	<u>880,000</u>		
Total liab./equity			<u>\$1,900,000</u>
<u>\$2,200,000</u>			<u>\$2,000,000</u>
EBIT (12% × \$2 million)	\$ 240,000	\$ 240,000	\$ 240,000
Interest (8%)		<u>91,200</u>	<u>96,000</u>
<u>105,600</u>			
Earnings before taxes		\$ 148,800	\$ 144,000
134,400			\$
Taxes (40%)			<u>59,520</u>
<u>53,760</u>			<u>57,600</u>
Net income		<u>\$ 89,280</u>	<u>\$ 86,400</u>
<u>\$ 80,640</u>			
Return on equity		11.75%	10.80%
9.16%			

b. No, this assumption would probably not be valid in a real world situation. A firm's current asset policies, particularly with regard to accounts receivable, such as discounts, collection period, and collection policy, may have a significant effect on sales. The exact nature of this function may be difficult to quantify, however, and determining an "optimal" current asset level may not be possible in actuality.

c. As the answers to Part a indicate, the tighter policy leads to a higher expected return. However, as the current asset level is decreased, presumably some of this reduction comes from accounts receivable. This can be accomplished only through higher discounts, a shorter collection period, and/or tougher collection policies. As outlined above, this would in turn have some effect on sales, possibly lowering profits. More restrictive receivable policies might involve some additional costs (collection, and so forth) but would also probably reduce bad debt expenses. Lower current assets would also imply lower liquid assets; thus, the firm's ability to handle contingencies would be impaired. Higher risk of inadequate liquidity would increase the firm's risk of insolvency and thus increase its chance of failing to meet fixed charges. Also, lower inventories might mean lost sales and/or expensive production stoppages. Attempting to attach numerical values to these potential losses and probabilities would be extremely difficult.



22-15 a. 
$$\text{Average accounts payable} = \frac{\$3,650,000}{365 \text{ days}} \times 10 \text{ days} = \$10,000 \times 10 = \$100,000.$$

b. There is no cost of trade credit at this point. The firm is using “free” trade credit.

c. 
$$\text{Average payables (net of discount)} = \frac{\$3,650,000}{365} \times 30 = \$10,000 \times 30 = \$300,000.$$

Nominal cost =  $(2/98)(365/20) = 37.24\%$ ,

or  $\$74,490/(\$300,000 - \$100,000) = 37.25\%$ .

Effective cost =  $(1 + 2/98)^{365/20} - 1 = 0.4459 = 44.59\%$ .

d. Nominal rate =  $\frac{2}{98} \times \frac{365}{40-10} = 24.83\%$ .

Effective cost =  $(1 + 2/98)^{365/30} - 1 = 0.2786 = 27.86\%$ .

22-16 Trade Credit

Terms: 2/10, net 30. But the firm plans delaying payments 35 additional days, which is the equivalent of 2/10, net 65.

$$\begin{aligned} \text{Nominal cost} &= \frac{\text{Discount percent}}{100 - \text{Discount percent}} \times \frac{365}{\text{Days credit is outstanding} - \text{Discount period}} \\ &= \frac{2}{100 - 2} \times \frac{365}{65 - 10} = \frac{2}{98} \times \frac{365}{55} = 0.0204 (6.6364) = 13.54\% . \end{aligned}$$

Effective cost =  $(1 + 2/98)^{365/55} - 1 = 14.35\%$ .

**22-17 a. Size of bank loan = (Purchases/Day)(Days late)**

$$= \left( \frac{\text{Purchases}}{\text{Days payables outstanding}} \right) \left( \text{Days payables outstanding} - 30 \right)$$
$$= (\$600,000/60)(60 - 30) = \$10,000(30) = \$300,000.$$

Alternatively, one could simply recognize that accounts payable must be cut to half of its existing level, because 30 days is half of 60 days.

b. Given the limited information, the decision must be based on the rule-of-thumb comparisons, such as the following:

1. Debt ratio =  $(\$1,500,000 + \$700,000)/\$3,000,000 = 73\%$ .

Raattama's debt ratio is 73 percent, as compared to a typical debt ratio of 50 percent. The firm appears to be undercapitalized.

2. Current ratio =  $\$1,800,000/\$1,500,000 = 1.20$ .

The current ratio appears to be low, but current assets could cover current liabilities if all accounts receivable can be collected and if the inventory can be liquidated at its book value.

3. Quick ratio =  $\$400,000/\$1,500,000 = 0.27$ .

The quick ratio indicates that current assets, excluding inventory, are only sufficient to cover 27 percent of current liabilities, which is very bad.

The company appears to be carrying excess inventory and financing extensively with debt. Bank borrowings are already high, and the liquidity situation is poor. On the basis of these observations, the loan should be denied, and the treasurer should be advised to seek permanent capital, especially equity capital.

## SPREADSHEET PROBLEM

---

22-18 The detailed solution for the spreadsheet problem is available both on the instructor's resource CD-ROM and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**Dan Barnes, financial manager of Ski Equipment Inc. (SKI), is excited, but apprehensive. The company's founder recently sold his 51 percent controlling block of stock to Kent Koren, who is a big fan of EVA (Economic Value Added). EVA is found by taking the net after-tax operating profit and then subtracting the dollar cost of all the capital the firm uses:**

$$\begin{aligned} \text{EVA} &= \text{NOPAT} - \text{Capital costs} \\ &= \text{EBIT} (1 - T) - \text{WACC}(\text{Capital employed}). \end{aligned}$$

If EVA is positive, then the firm is creating value. On the other hand, if EVA is negative, the firm is not covering its cost of capital, and stockholders' value is being eroded. Koren rewards managers handsomely if they create value, but those whose operations produce negative EVAs are soon looking for work. Koren frequently points out that if a company can generate its current level of sales with less assets, it would need less capital. That would, other things held constant, lower capital costs and increase its EVA.

Shortly after he took control of SKI, Kent Koren met with SKI's senior executives to tell them of his plans for the company. First, he presented some EVA data that convinced everyone that SKI had not been creating value in recent years. He then stated, in no uncertain terms, that this situation must change. He noted that SKI's designs of skis, boots, and clothing are acclaimed throughout the industry, but something is seriously amiss elsewhere in the company. Costs are too high, prices are too low, or the company employs too much capital, and he wants SKI's managers to correct the problem or else.

Barnes has long felt that SKI's working capital situation should be studied--the company may have the optimal amounts of cash, securities, receivables, and inventories, but it may also have too much or too little of these items. In the past, the production manager resisted Barnes' efforts to question his holdings of raw materials inventories, the marketing manager resisted questions about finished goods, the sales staff resisted questions about credit policy (which affects accounts receivable), and the treasurer did not want to talk about her cash and securities balances. Koren's speech made it clear that such resistance would no longer be tolerated.

**Barnes also knows that decisions about working capital cannot be made in a vacuum. For example, if inventories could be lowered without adversely affecting operations, then less capital would be required, the dollar cost of capital would decline, and EVA would increase. However, lower raw materials inventories might lead to production slowdowns and higher costs, while lower finished goods inventories might lead to the loss of profitable sales. So, before inventories are changed, it will be necessary to study operating as well as financial effects. The situation is the same with regard to cash and receivables.**

	<u>SKI</u>	<u>INDUSTRY</u>
Current	1.75	2.25

<b>Quick</b>		<b>0.83</b>	<b>1.20</b>
<b>58.76%</b>	<b>Debt/Assets</b>		
<b>16.67</b>	<b>50.00%</b>	<b>Of</b>	<b>Cash</b>
<b>32.00</b>	<b>Turnover</b>	<b>And</b>	<b>Securities</b>
	<b>22.22</b>	<b>Days Sales Outstanding (365-Day Basis)</b>	
			<b>45.63</b>
<b>Inventory Turnover</b>		<b>4.82</b>	<b>7.00</b>
<b>Fixed Assets Turnover</b>		<b>11.35</b>	<b>12.00</b>
<b>Total Assets Turnover</b>		<b>2.08</b>	<b>3.00</b>
<b>Profit Margin On Sales</b>		<b>2.07%</b>	<b>3.50%</b>
<b>Return On Equity (ROE)</b>		<b>10.45%</b>	<b>21.00%</b>
<b>Payables Deferral Period</b>		<b>30.00</b>	<b>33.00</b>

- a. Barnes plans to use the ratios shown below as the starting point for discussions with SKI's operating executives. He wants everyone to think about the pros and cons of changing each type of current asset and how changes would interact to affect profits and EVA. Based on the table 22-1 data, does SKI seem to be following a relaxed, moderate, or restricted working capital policy?

**Answer:** A company with a relaxed working capital policy would carry relatively large amounts of current assets in relation to sales. It would be guarding against running out of stock or of running short of cash, or losing sales because of a restrictive credit policy. We can see that SKI has relatively low cash and inventory turnover ratios. For example, sales/inventories = 4.82 versus 7.0 for an average firm in its industry. Thus, SKI is carrying a lot of inventory per dollar of sales, which would meet the definition of a relaxed policy. Similarly, SKI's DSO is relatively high. Since DSO is calculated as receivables/sales per day, a high DSO indicates a lot of receivables per dollar of sales. Thus, SKI seems to have a relaxed working capital policy, and a lot of current assets.

**b. How can one distinguish between a relaxed but rational working capital policy and a situation in which a firm simply has a lot of current assets because it is inefficient? Does SKI's working capital policy seem appropriate?**

**Answer:** SKI may choose to hold large amounts of inventory to avoid the costs of “running short,” and to cater to customers who expect to receive their equipment in a short period of time. SKI may also choose to hold high amounts of receivables to maintain good relationships with its customers. However, if SKI is holding large stocks of inventory and receivables to better serve customers, it should be able to offset the costs of carrying that working capital with high prices or higher sales, and its ROE should be no lower than that of firms with other working capital policies.

It is clear from the data in table 22-1 that SKI is not as profitable as the average firm in its industry. This suggests that it simply has excessive working capital, and that it should take steps to reduce its working capital.

**c. Now, calculate the firm's cash conversion cycle. Assume a 365 day year.**

**Answer:** A firm's cash conversion cycle is calculated as:

$$\begin{array}{ccccccc} \text{Inventory} & \text{Receivables} & \text{Payables} & \text{Cash} & & & \\ \text{conversion} & + & \text{collection} & - & \text{deferral} & = & \text{conversion} \\ \text{period} & & \text{period} & & \text{period} & & \text{cycle} \end{array}$$

SKI's inventory turnover is given as 4.82 so we can calculate its inventory conversion period as:

$$\frac{365}{\text{Inventory turnover}} = \frac{365}{4.82} = 75.73 \approx 76 \text{ DAYS.}$$

SKI's receivables collection period is equal to its DSO. Its DSO is given as 45.63 days, or approximately 46 days.

We are given that its payables deferral period is 30 days, so now we have all the individual components to calculate SKI's cash conversion cycle.

$$76 \text{ days} + 46 \text{ days} - 30 \text{ days} = 92 \text{ days.}$$

Thus, SKI's cash conversion cycle is approximately 91 days.

**d. What might SKI do to reduce its cash without harming operations?**

**Answer:** To the extent that “cash and securities” consist of low-yielding securities, they could be sold off and the cash generated could be used to reduce debt, to buy back stock, or to invest in operating assets.

**In an attempt to better understand SKI’s cash position, Barnes developed a cash budget. Data for the first two months of the year are shown below. (Note that Barnes’ preliminary cash budget does not account for interest income or interest expense.) He has the figures for the other months, but they are not shown.**

SKI'S CASH BUDGET FOR JANUARY AND FEBRUARY

	November	December	January	February	March	April
<b>I. Collections And Purchases Worksheet</b>						
(1) Sales (Gross)	\$71,218	\$68,212.00	\$65,213.00	\$52,475.00	\$42,909	\$30,524
Collections:						
(2) During Month Of Sale						
(0.2)(0.98)(Month's Sales)		12,781.75	10,285.10			
(3) During First Month After Sale						
0.7(Previous Month's Sales)		47,748.40	45,649.10			
(4) During Second Month After Sale						
0.1(Sales 2 Months Ago)			<u>7,121.80</u>	<u>6,821.20</u>		
(5) Total Collections (Lines 2 + 3 + 4)			<u>\$67,651.95</u>	<u>\$62,755.40</u>		
Purchases:						
(6) 0.85(Forecasted Sales						
2 Months From Now)		\$44,603.75	\$36,472.65	\$25,945.40		
(7) Payments (1-Month Lag)			44,603.75	36,472.65		
<b>II. Cash Gain Or Loss For Month</b>						
(8) Collections (From Section I)		\$67,651.95	\$62,755.40			
(9) Payments For Purchases (From Section I)		44,603.75	36,472.65			
(10) Wages And Salaries			6,690.56	5,470.90		
(11) Rent			<u>2,500.00</u>	<u>2,500.00</u>		
(12) Taxes						
(13) Total Payments			<u>\$53,794.31</u>	<u>\$44,443.55</u>		
(14) Net Cash Gain (Loss) During Month						
(Line 8 - Line 13)			<u>\$13,857.64</u>	<u>\$18,311.85</u>		
<b>III. Cash Surplus Or Loan Requirement</b>						
(15) Cash At Beginning Of Month						
If No Borrowing Is Done			<u>\$ 3,000.00</u>	<u>\$16,857.64</u>		
(16) Cumulative Cash (Cash At Start, + Gain						
Or - Loss = Line 14 + Line 15)		16,857.64	35,169.49			
(17) Target Cash Balance			<u>1,500.00</u>	<u>1,500.00</u>		
(18) Cumulative Surplus Cash Or Loans Outstanding						
To Maintain \$1,500 Target Cash Balance						
(Line 16 - Line 17)			<u>\$15,357.64</u>	<u>\$33,669.49</u>		

**e. Should depreciation expense be explicitly included in the cash budget? Why or why not?**

**Answer:** No, depreciation expense is a noncash charge and should not appear explicitly in the cash budget that focuses on the actual cash flowing into and out of a firm. However, a firm's depreciation expense does impact its tax liability, and hence depreciation affects SKI's quarterly tax payments.

**f. In his preliminary cash budget, Barnes has assumed that all sales are collected and, thus, that SKI has no bad debts. Is this realistic? If not, how would bad debts be dealt with in a cash budgeting sense? (Hint: bad debts will affect collections but not purchases.)**

**Answer:** It is not realistic to assume zero bad debts. When credit is granted, bad debts should be expected. Collections in each month would be lowered by the percentage of bad debts. Payments would be unchanged, so the result would be that loan balances would be larger and cash surplus balances would be smaller by the difference in the collection amounts.

**g. Barnes' cash budget for the entire year, although not given here, is based heavily on his forecast for monthly sales. Sales are expected to be extremely low between May and September but then increase dramatically in the fall and winter. November is typically the firm's best month, when SKI ships equipment to retailers for the holiday season. Interestingly, Barnes' forecasted cash budget indicates that the company's cash holdings will exceed the targeted cash balance every month except for October and November, when shipments will be high but collections will not be coming in until later. Based on the ratios shown earlier, does it appear that SKI's target cash balance is appropriate? In addition to possibly lowering the target cash balance, what actions might SKI take to better improve its cash management policies, and how might that affect its EVA?**

**Answer:** The company's turnover of cash and its projected cash budget suggest that the company is holding too much cash. SKI could improve its EVA by either investing the cash in productive assets, or returning the cash to shareholders. If SKI uses the cash for profitable investments, its costs will remain the same, but its operating income will rise, thereby increasing EVA. On the other hand, if the company chooses to return the cash to its shareholders, for example, by increasing the dividend or repurchasing shares of common stock, the company's revenues would remain the same, but its overall cost of capital would fall, thereby increasing EVA.

**h. What reasons might SKI have for maintaining a relatively high amount of cash?**

**Answer:** If sales turn out to be considerably less than expected, the company could face a cash shortfall. A company may choose to hold large amounts of cash if it does not have much faith in its sales forecast or if it is very conservative. Unfortunately, given its current pressure to perform, SKI's management does not have the luxury to be extremely conservative.

**i. What are the three categories of inventory costs? If the company takes steps to reduce its inventory, what effect would this have on the various costs of holding inventory?**

**Answer:** The three categories of inventory costs are carrying costs, ordering costs, and the costs of running short. Carrying costs include the cost of capital tied up, storage and handling costs, insurance, property taxes, and depreciation and obsolescence. Ordering, shipping, and receiving costs include the cost of placing orders (including production and set-up costs) and shipping and handling costs. The costs of running short include loss of sales, loss of customer goodwill, and the disruption of production schedules.

If the firm reduces the amount of inventory it holds, carrying costs will be lowered; however, its ordering costs will increase because the firm will set up production runs more frequently. In addition, by reducing its inventory investment the firm could increase its chances of running short, which results in losses of sales and customer goodwill.

**j. Is there any reason to think that SKI may be holding too much inventory? If so, how would that affect EVA and ROE?**

**Answer:** As pointed out in part A, SKI's inventory turnover (4.82) is considerably lower than the average firm's turnover (7.00). This indicates that the firm is carrying a lot of inventory per dollar of sales.

By holding more inventory per dollar of sales than is necessary, the firm is increasing its costs, which reduces its ROE. In addition, this additional working capital must be financed, so EVA is lowered too.

**k. If the company reduces its inventory without adversely affecting sales, what effect should this have on the company's cash position (1) in the short run and (2) in the long run? Explain in terms of the cash budget and the balance sheet.**

**Answer:** Reducing inventory purchases will increase the company's cash holdings in the short run, thus reducing the amount of financing or the target cash balance needed. In the long run, the company is likely to reduce its cash holdings in order to increase its EVA. SKI can use the "excess cash" to make investments in more productive assets such as plant and equipment. Alternatively, the firm can distribute the "excess cash" to its shareholders through higher dividends or repurchasing its shares.

**l. Barnes knows that SKI sells on the same credit terms as other firms in its industry. Use the ratios presented earlier to explain whether SKI's customers pay more or less promptly than those of its competitors. If there are differences, does that suggest that SKI should tighten or loosen its credit policy? What four variables make up a firm's credit policy, and in what direction should each be changed by SKI?**

**Answer:** SKI's DSO is 45.63 days as compared with 32 days for the average firm in its industry. This suggests that SKI's customers are paying less promptly than those of its competitors. Because the firm's DSO is higher than the industry average, the firm should tighten its credit policy in an attempt to lower its DSO.

The four variables that make up a firm's credit policy are (1) discount amount and period, (2) credit period, (3) credit standards, and (4) collection policy. Cash discounts generally produce two benefits: (1) they attract new customers who view discounts as a price reduction, thus sales would increase, and (2) they cause a reduction in the days sales outstanding (DSO) since some established customers will pay more promptly to take advantage of the discount, thus the level of receivables held would decline. Discounts might encourage customers now paying late to pay more promptly. Of course, these benefits are offset to some degree by the dollar cost of the discounts. The effect on bad debt expense is indeterminate. If the firm tightened its credit policy it is unclear what the firm would do with its cash discount policy. The firm could decrease the discount period and keep discounts unchanged.

Credit period is the length of time allowed all "qualified" customers to pay for their purchases. The shorter a firm's credit period, the shorter the firm's days sales outstanding, and the lower the level of receivables held. A shorter credit period might also tend to decrease sales, especially when a competitor's credit period is longer than the firm's own credit period. The effect of the credit period on bad debt expense is indeterminate.

In order to qualify for credit in the first place, customers must meet the firm's credit standards. These dictate the minimum acceptable financial position required of customers to receive credit. Also, a firm may impose differing credit limits depending on the customer's financial strength. Tight credit standards would tend to decrease sales (fewer customers would qualify for credit), decrease the level of receivables held, and would cause a decrease in the amount of bad debt expenses. The level of receivables held would be decreased due to the lower level of sales and also the probability that customers now qualifying for credit would take less time to pay. Bad debt expenses should decrease due to raising customers' minimum acceptable financial positions.

Finally, collection policy refers to the procedures that the firm follows to collect past-due accounts. These can range from a simple letter or phone call to turning the account over to a collection agency. A tight collection policy would decrease the level of receivables held, as customers would decrease the length of time they took to pay their bills. A tight collection policy would also cause a decrease in the amount of bad debt losses the firm incurred.

A tightening of credit policy would tend to decrease sales, decrease the level of receivables held, and decrease the amount of bad debt expenses.

**m. Does SKI face any risks if it tightens its credit policy?**

**Answer:** A tighter credit policy may discourage sales. Some customers may choose to go elsewhere if they are pressured to pay their bills sooner.

**n. If the company reduces its DSO without seriously affecting sales, what effect would this have on its cash position (1) in the short run and (2) in the long run? Answer in terms of the cash budget and the balance sheet. What effect should this have on EVA in the long run?**

**Answer:** If customers pay their bills sooner, this will increase the company's cash position in the short run, which would decrease the amount of financing or the target cash balance needed. Over time, the

company would hopefully invest this cash in more productive assets, or pay it out to shareholders. Both of these actions would increase EVA.

**In addition to improving the management of its current assets, SKI is also reviewing the ways in which it finances its current assets. With this concern in mind, Dan is also trying to answer the following questions.**

**o. Is it likely that SKI could make significantly greater use of accruals?**

**Answer:** No, SKI could not make greater use of its accruals. Accruals arise because (1) workers are paid after they have actually provided their services, and (2) taxes are paid after the profits have been earned. Thus, accruals represent cash owed either to workers or to the IRS. The cost of accruals is generally considered to be zero, since no explicit interest must be paid on these items.

The amount of accruals is generally limited by the amount of wages paid and the firm's profitability, as well as by industry conventions regarding when wage payments are made and IRS regulations regarding tax payments. (Increasingly, Congress is putting businesses on a pay-as-you-go, or even pay-ahead-of-time basis through the use of estimated taxes.) A firm cannot ordinarily control its accruals. Firms use all the accruals they can, but they have little control over the levels of these accounts.

**p. Assume that SKI buys on terms of 1/10, net 30, but that it can get away with paying on the 40th day if it chooses not to take discounts. Also, assume that it purchases \$506,985 of equipment per year, net of discounts. How much free trade credit can the company get, how much costly trade credit can it get, and what is the percentage cost of the costly credit? Should SKI take discounts?**

**Answer:** If SKI's net purchases are \$506,985 annually, then, with a 1 percent discount, its gross purchases are  $\$506,985/0.99 = \$512,106$ . Net daily purchases from this supplier are  $\$506,985/365 = \$1,389$ .

If the discount is taken, then SKI must pay this supplier at the end of day 10 for purchases made on day 1, on day 11 for purchases made on day 2, and so on. Thus, in a steady state, SKI will on average have 10 days' worth of purchases in payables, so,

$$\text{Payables} = 10(\$1,389) = \$13,890.$$

If the discount is not taken, then SKI will wait 40 days before paying, so



matching is not possible because of (1) the uncertainty of asset lives and (2) some common equity must be used and common equity has no maturity.) With this strategy, the firm minimizes its risk that it will be unable to pay off maturing obligations. An aggressive financing policy occurs when the firm finances all of its fixed assets with long-term capital, but part of its permanent current assets with short-term, nonspontaneous credit. There are degrees of aggressiveness, in fact, a firm could choose to finance all of its permanent current assets and part of its fixed assets with short-term credit; this would be a highly aggressive position, and one that would subject the firm to the dangers of rising interest rates as well as to loan renewal problems. A conservative financing policy occurs when the firm finances all of its permanent asset requirements and some of its seasonal demands with permanent capital. This position is a very safe one. Therefore, an aggressive financing policy uses the greatest amount of short-term debt, while the conservative policy uses the least. The maturity matching policy falls between these two policies.

**r. What are the advantages and disadvantages of using short-term debt as a source of financing?**

**Answer:** Although using short-term credit is generally riskier than using long-term credit, short-term credit does have some significant advantages. A short-term loan can be obtained much faster than long-term credit. Lenders insist on a more thorough financial examination before extending long-term credit. If a firm's needs for funds are seasonal or cyclical, it may not want to commit to long-term debt because: (1) flotation costs are generally high for long-term debt but trivial for short-term debt; (2) prepayment penalties with long-term debt can be expensive. Short-term debt provides flexibility; (3) long-term loan agreements contain provisions that constrain a firm's future actions. Short-term credit agreements are less onerous; (4) the yield curve is normally upward sloping, indicating that interest rates are generally lower on short-term than on long-term debt.

Even though short-term debt is often less expensive than long-term debt, short-term debt subjects the firm to more risk than long-term financing. The reasons for this are: (1) if a firm uses long-term debt, its interest costs will be relatively stable over time; however, if the firm uses short-term debt, its interest expense will fluctuate widely. (2) if a firm borrows heavily on a short-term basis, it may find itself unable to repay this debt, and it may be in such a weak financial position that the lender will not extend the loan, which could force the firm into bankruptcy.

**s. Would it be feasible for SKI to finance with commercial paper?**

**Answer:** It would not be feasible for SKI to finance with commercial paper. Commercial paper is unsecured, short-term debt issued by large, financially strong firms and sold primarily to other business firms, to insurance companies, to pension funds, to money market mutual funds, and to banks. Maturities are generally 270 days (9 months) or less, because sec registration is required on maturities beyond 270 days. There is a very active, liquid market for commercial paper, and, since there is virtually no default risk, commercial paper rates are generally less than the prime rate, and not much more than the T-bill rate. Note, though, that issuers of commercial paper are required to have back-up lines of bank credit that can be used to pay off the paper if need be when it matures. These back-up credit lines have a cost, and this cost must be added to the interest rate on the paper to determine its effective cost. Since only large, well-known, financially strong companies can issue commercial paper, it would be impossible for SKI to tap this market.

## Chapter 23

### Derivatives and Risk Management

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 23-1
- a. A derivative is an indirect claim security that derives its value, in whole or in part, by the market price (or interest rate) of some other security (or market). Derivatives include options, interest rate futures, exchange rate futures, commodity futures, and swaps.
  - b. Corporate risk management relates to the management of unpredictable events that have adverse consequences for the firm. This effort involves reducing the consequences of risk to the point where there would be no significant adverse impact on the firm's financial position.
  - c. Financial futures provide for the purchase or sale of a financial asset at some time in the future, but at a price established today. Financial futures exist for Treasury bills, Treasury notes and bonds, CDs, Eurodollar deposits, foreign currencies, and stock indexes. While physical delivery of the underlying asset is virtually never taken, under forward contracts goods are actually delivered.
  - e. A hedge is a transaction that lowers a firm's risk of damage due to fluctuating stock prices, interest rates, and exchange rates. A natural hedge is a transaction between two counterparties where both parties' risks are reduced. The two basic types of hedges are long hedges, in which futures contracts are bought in anticipation of (or to guard against) price increases, and short hedges, in which futures contracts are sold to guard against price declines. A perfect hedge occurs when the gain or loss on the hedged transaction exactly offsets the loss or gain on the unhedged position.
  - f. A swap is an exchange of cash payment obligations, which usually occurs because the parties involved prefer someone else's payment pattern or type. A structured note is a debt obligation derived from another debt obligation, and permits a partitioning of risks to give investors what they want.
  - g. Commodity futures are futures contracts which involve the sale or purchase of various commodities, including grains, oilseeds, livestock, meats, fiber, metals, and wood.

- 23-2 If the elimination of volatile cash flows through risk management techniques does not significantly change a firm's expected future cash flows and WACC, investors will be indifferent to holding a company with volatile cash flows versus a company with stable cash flows. Note that investors can reduce volatility themselves: (1) through portfolio diversification, or (2) through their own use of derivatives.
- 23-3 The six reasons why risk management might increase the value of a firm is that it allows corporations to (1) increase their use of debt; (2) maintain their capital budget over time; (3) avoid costs associated with financial distress; (4) utilize their comparative advantages in hedging relative to the hedging ability of individual investors; (5) reduce both the risks and costs of borrowing by using swaps; and (6) reduce the higher taxes that result from fluctuating earnings.
- 23-4 There are several ways to reduce a firm's risk exposure. First, a firm can transfer its risk to an insurance company, which requires periodic premium payments established by the insurance company based on its perception of the firm's risk exposure. Second, the firm can transfer risk-producing functions to a third party. For example, contracting with a trucking company can in effect, pass the firm's risks from transportation to the trucking company. Third, the firm can purchase derivatives contracts to reduce input and financial risks. Fourth, the firm can take specific actions to reduce the probability of occurrence of adverse events. This includes replacing old electrical wiring or using fire resistant materials in areas with the greatest fire potential. Fifth, the firm can take actions to reduce the magnitude of the loss associated with adverse events, such as installing an automatic sprinkler system to suppress potential fires. Finally, the firm can totally avoid the activity that gives rise to the risk.
- 23-5 The futures market can be used to guard against interest rate and input price risk through the use of hedging. If the firm were concerned that interest rates will rise, it would use a short hedge, or sell financial futures contracts. If interest rates do rise, losses on the issue due to the higher interest rates would be offset by gains realized from repurchase of the futures at maturity--because of the increase in interest rates, the value of the futures would be less than at the time of issue. If the firm were concerned that the price of an input will rise, it would use a long hedge, or buy commodity futures. At the future's maturity date, the firm will be able to purchase the input at the original contract price, even if market prices have risen in the interim.

- 23-6 Swaps allow firms to reduce their financial risk by exchanging their debt for another party's debt, usually because the parties prefer the other's debt contract terms. There are several ways in which swaps reduce risk. Currency swaps, where firms exchange debt obligations denominated in different currencies, can eliminate the exchange rate risk created when currency must first be converted to another currency before making scheduled debt payments. Interest rate swaps, where counterparties trade fixed-rate debt for floating rate debt, can reduce risk for both parties based on their individual views concerning future interest rates.

SOLUTIONS TO END-OF-CHAPTER PROBLEMS

23-1 Futures contract settled at 100 16/32% of \$100,000 contract value, so  $PV = 1.005 \times \$1,000 = \$1,005 \times 100$  bonds = \$100,500. Using a financial calculator, we can solve for  $r_d$  as follows:

$N = 40$ ;  $PV = -1005$ ;  $PMT = 30$ ;  $FV = 1000$ ; solve for  $I = r_d = 2.9784\% \times 2 = 5.9569\% \approx 5.96\%$ .

If interest rates increase to 6.9569%, then we would solve for PV as follows:  $N = 40$ ;  $I = 6.9569/2 = 3.47845$ ;  $PMT = 30$ ;  $FV = 1000$ ; solve for  $PV = \$897.4842 \times 100 = \$89,748.42$ . Thus, the contract's value has decreased from \$100,500 to \$89,748.42.

23-2 a. In this situation, the firm would be hurt if interest rates were to rise by June, so it would use a short hedge, or sell futures contracts. Since futures contracts are for \$100,000 in Treasury bonds, the firm must sell 100 contracts to cover the planned \$10,000,000 June bond issue. Since futures maturing in June are selling for 95 17/32 of par, the value of Zinn's futures is about \$9,553,125. Should interest rates rise by June, Zinn Company will be able to repurchase the futures contracts at a lower cost, which will help offset their loss from financing at the higher interest rate. Thus, the firm has hedged against rising interest rates.

b. The firm would now pay 13 percent on the bonds. With an 11 percent coupon rate, the bond issue would bring in only \$8,898,149, so the firm would lose  $\$10,000,000 - \$8,898,149 = \$1,101,851$ :

$N = 20$ ;  $I = 13/2 = 6.5$ ;  $PMT = 0.11/2 \times 10,000,000 = 550,000$ ;  $FV = 10,000,000$ ; and solve for  $PV = \$8,898,149$ .

However, the value of the short futures position began at \$9,553,125:

95 17/32 of \$10,000,000 =  $0.9553125(\$10,000,000) = \$9,553,125$ , or roughly  $N = 40$ ;  $PMT = 300,000$ ;  $FV = 10,000,000$ ;  $PV = -9,553,125$ ; solve for  $I = 3.200\%$  per six months. The nominal annual yield is  $2(6.400\%) = 6.40\%$ . (Note that the future contracts are on hypothetical 20-year, 6 percent semiannual coupon bonds which are yielding 6.40 percent.)

Now, if interest rates increased by 200 basis points, to 8.40 percent, the value of the futures contract will drop to \$7,693,948:

$N = 40$ ;  $I = 6.40/2 = 4.20$ ;  $PMT = 300,000$ ;  $FV = 10,000,000$ ; and solve for  $PV = \$7,693,948$ .

Since Zinn Company sold the futures contracts for \$9,553,125, and will, in effect, buy them back at \$7,693,948, the firm would make a  $\$9,553,125 - \$7,693,948 = \$1,859,177$  profit on the transaction ignoring transaction costs.

Thus, the firm gained \$1,859,177 on its futures position, but lost \$1,101,851 on its underlying bond issue. On net, it gained  $\$1,859,177 - \$1,101,851 = \$757,326$ .

c. In a perfect hedge, the gains on futures contracts exactly offset losses due to rising interest rates. For a perfect hedge to exist, the underlying asset must be identical to the futures asset. Using the Zinn Company example, a futures contract must have existed on Zinn's own debt (it existed on Treasury bonds) for the company to have an opportunity to create a perfect hedge. In reality, it is

virtually impossible to create a perfect hedge, since in most cases the underlying asset is not identical to the futures asset.

23-3 If Carter issues floating rate debt and then swaps, its net cash flows will be:  $-(\text{LIBOR} + 2\%) - 7.95\% + \text{LIBOR} = -9.95\%$ . This is less than the 10% rate at which it could directly issue fixed rate debt, so the swap is good for Carter.

If Brencce issues fixed rate debt and then swaps, its net cash flows will be:  $-11\% + 7.95\% - \text{LIBOR} = -(\text{LIBOR} + 3.05\%)$ . This is less than the rate at which it could directly issue floating rate debt ( $\text{LIBOR} + 3\%$ ), so the swap is good for Brencce.



## SOLUTION TO SPREADSHEET PROBLEM

---

- 23-4 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 23-4 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

Assume that you have just been hired as a financial analyst by Tennessee Sunshine Inc., a mid-sized Tennessee company that specializes in creating exotic sauces from imported fruits and vegetables. The firm's CEO, Bill Stooksbury, recently returned from an industry corporate executive conference in San Francisco, and one of the sessions he attended was on the pressing need for smaller companies to institute corporate risk management programs. Since no one at Tennessee Sunshine is familiar with the basics of derivatives and corporate risk management, Stooksbury has asked you to prepare a brief report that the firm's executives could use to gain at least a cursory understanding of the topics.

To begin, you gathered some outside materials on derivatives and corporate risk management and used these materials to draft a list of pertinent questions that need to be answered. In fact, one possible approach to the paper is to use a question-and-answer format. Now that the questions have been drafted, you have to develop the answers.

a. **Why might stockholders be indifferent whether or not a firm reduces the volatility of its cash flows?**

**Answer:** If volatility in cash flows is not caused by systematic risk, then stockholders can eliminate the risk of volatile cash flows by diversifying their portfolios. Also, if a company decided to hedge away the risk associated with the volatility of its cash flows, the company would have to pass on the costs of hedging to the investors. Sophisticated investors can hedge risks themselves and thus they are indifferent as to who actually does the hedging.

b. **What are six reasons risk management might increase the value of a corporation?**

**Answer:** There are no studies proving that risk management either does or does not add value. However, there are six reasons why risk management might increase the value of a firm. Risk management allows corporations to (1) increase their use of debt; (2) maintain their capital budget over time; (3) avoid costs associated with financial distress; (4) utilize their comparative advantages in hedging relative to the hedging ability of individual investors; (5) reduce both the risks and costs of borrowing by using swaps; and (6) reduce the higher taxes that result from fluctuating earnings.

c. **What is corporate risk management? Why is it important to all firms?**

**Answer:** Corporate risk management is the management of unpredictable events that have adverse consequences for the firm. This function is very important to a firm since it involves reducing

the consequences of risk to the point where there should be no significant adverse effects on the firm's financial position.

d. Risks that firms face can be categorized in many ways. Define the following types of risk: (1) speculative risks; (2) pure risks; (3) demand risks; (4) input risks; (5) financial risks; (6) property risks; (7) personnel risks; (8) environmental risks; (9) liability risks; and (10) insurable risks.

- Answer:**
1. Speculative risks are those that offer the chance of a gain as well as a loss, such as buying an ownership share in a company.
  2. Pure risks are those that only offer the prospect of losses, such as a product liability or malpractice lawsuit (from the defendant's standpoint).
  3. Demand risks are those associated with the demand for a firm's products or services, such as new products developed by competitors.
  4. Input risks are those associated with a firm's input costs, including materials and labor.
  5. Financial risks are those that result from financial transactions, such as interest rate and currency exchange rate risks.
  6. Property risks are associated with destruction of a firm's productive assets, including the threat of fire, floods, and riots.
  7. Personnel risks are risks that result from human actions, such as theft and fraud.
  8. Environmental risks include those risks associated with polluting the environment.
  9. Liability risks are connected with product, service, or employee liability, such as costs incurred as a result of improper actions by employees or damages resulting from defective products.
  10. Insurable risks are those that typically can be covered by insurance.

e. What are the three steps of corporate risk management?

**Answer:** The three steps are:

Identify the risks faced by the firm;

Measure the potential impact of the risks identified; and

Decide how each relevant risk should be handled.

f. What are some actions that companies can take to minimize or reduce risk exposures?

**Answer:** There are several actions that companies can take to minimize or reduce their risk exposure. First, companies can transfer risk to an insurance company by paying periodic premiums. Second, companies can transfer functions that produce risk to third parties, such as eliminating risks associated with transportation by contracting with a trucking company. Third, purchase derivatives contracts to reduce input and financial risk. Fourth, companies can take actions to reduce the probability of occurrence of an adverse event, such as replacing old wiring to reduce the possibility of fire. Fifth, actions can be taken to reduce the magnitude of the loss associated with adverse events, such as installing automatic sprinkler systems. Finally, companies can simply avoid the activities that give rise to risk.

g. What is financial risk exposure? Describe the following concepts and techniques that can be used to reduce financial risks: (1) derivatives; (2) futures markets; (3) hedging; and (4) swaps.

**Answer:** Financial risk exposure refers to the risk inherent in the financial markets due to price fluctuations.

1. A derivative is a security whose value stems, or is derived, from the values of other assets. Options and futures contracts are two types of derivatives that are used to manage security price exposure.
2. Futures markets involve contracts that call for the purchase or sale of a financial (or real) asset at some future date, but at a price which is fixed today. Thus, these markets provide the opportunity to reduce financial risk exposure.
3. Hedging is generally conducted where a price change could negatively affect a firm's profits. A long hedge involves the purchase of future contracts in anticipation of, or to guard against, price increases. A short hedge, or sale of futures, is made when the firm is concerned about price declines in commodities or financial securities.
4. Swaps involve the exchange of cash payment obligations on debt between two parties, usually because each party prefers the terms of the other's debt contract. Swaps can reduce each firm's financial risk. For example, currency exchange rate risk can be eliminated if a U.S.

firm with a pound-denominated debt could swap their debt with a British firm that has an equivalent dollar-denominated debt.

h. Describe how commodity futures markets can be used to reduce input price risk.

**Answer:** Essentially, the purchase of a commodity futures contract will allow a firm to make a future purchase of the input material at today's price, even if the market price on the good has risen substantially in the interim.

## Chapter 24

# Bankruptcy, Reorganization, and Liquidation

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 24-1
- a. Informal debt restructuring is the agreement between the creditors and troubled firm to change the existing debt terms. An extension postpones the required payment date, while a composition is a reduction in creditor claims. Extension provides payment in full, though delayed. Conversely, composition involves a reduced cash settlement. Restructuring often involves both extension and composition. A reorganization in bankruptcy is a court-approved attempt to keep a company alive by changing its capital structure. A reorganization must adhere to the standards of fairness and feasibility.
  - b. Assignment is an informal procedure for liquidating debts which transfers title to a debtor's assets to a third person, known as an assignee or trustee. Assignment normally yields creditors a larger amount than they would receive in a formal bankruptcy. However, an assignment does not automatically result in a full and legal discharge of all the debtor's liabilities, nor does it protect the creditors against fraud. Liquidation is the sale of the assets of a firm and the distribution of the proceeds to the creditors and owners in a specific priority. The decision whether to reorganize or liquidate should be based on the value of the firm if it is rehabilitated versus the value of the assets if they are sold off individually. The procedure that promises higher returns to the creditors and owners would be adopted. The standard of fairness states that claims must be recognized in the order of their legal and contractual priority. In simpler terms, the reorganization must be fair to all parties. The standard of feasibility states that there must be a reasonably high probability of successful rehabilitation and profitable future operations.
  - c. The absolute priority doctrine states that claims must be paid in strict accordance with the priority of each claim, regardless of the consequence to other claimants. The relative priority doctrine is more flexible and gives a more balanced consideration to all claimants than does the absolute priority doctrine.
  - d. The Bankruptcy Reform Act of 1978 was enacted to speed up and streamline bankruptcy proceedings. This law represents a shift to a relative priority doctrine of creditors' claims. Chapter 11 of the Bankruptcy Act is the business reorganization chapter. Under this chapter, a case is started when a firm's management or its creditors file a petition with the bankruptcy court. A committee of unsecured creditors is then appointed by the court to negotiate with the firm's management. Existing management may stay in office unless a trustee is appointed by the court. If no fair and feasible reorganization can be worked out, the firm will be liquidated under the procedures spelled out in Chapter 7 of the act. Chapter 7 of the Federal Bankruptcy Reform Act accomplishes three important tasks during a liquidation: (1) it provides safeguards against fraud by the debtor, (2) it provides for an equitable distribution of the debtor's assets among the creditors, and (3) it allows insolvent debtors to discharge all their obligations and to start new businesses unhampered by a burden of prior debt.
  - e. The priority of claims in liquidation is established in Chapter 7 of the Bankruptcy Act to provide an equitable distribution of the debtor's assets among the creditors.
  - f. Extension and composition are both characteristics of debt restructuring. In an extension, creditors postpone the dates of required interest or principal payments, or both. In a composition,

creditors voluntarily reduce their fixed claims on the debtor by accepting a lower principal amount, reducing the interest rate on the debt, accepting equity in place of debt, or some combination of these changes. Workouts are voluntary reorganization plans arranged between creditors and generally sound companies experiencing temporary financial difficulties. Workouts typically require some restructuring of the old firm's debt. Cramdowns are bankruptcy court-mandated reorganization plans which are binding on all parties. Prepackaged bankruptcy is a new type of reorganization which combines the advantages of informal workouts and formal Chapter 11 reorganization. Holdout is a problematic characteristic of informal reorganizations where all of the involved parties do not agree to the voluntary plan. Holdouts are usually made by creditors in an effort to receive full payment on claims.

24-2 *The rehabilitation plan may be accepted because of the following:*

- Expenses of liquidation may consume a large proportion of the assets.
- The going-concern value of a firm is always substantially greater than its liquidating value. Hence, to preserve the life of the firm is to preserve a substantial portion of its value.
- They may retain a stable customer for the future.
- On balance, the creditors will accept a plan for financial rehabilitation because it appears that the funds they will receive will be much larger under this procedure.

24-3 Not necessarily. The going-concern value of a firm is a function of its outlook--it might be improved by changing the management or otherwise improving operations. The firm may be temporarily distressed.

24-4 *Liquidations usually result in losses for the following reasons:*

- Assets typically have characteristics which make their value in existing uses greater than when resold.
- The organizational value of a company is lost when liquidation takes place.

- Because the claims of numerous parties must be adjudicated, considerable administrative, accounting, and legal costs may be incurred.

*Partial liquidation over a period would have the following results:*

- Probably would not decrease losses.
- Failure to institute the necessary operating and management changes might cause losses to continue and might cause further deterioration in the value of the company. It is often said that a swift major "surgery" for a business firm is preferred to an extended illness.

24-5 Because public utilities and railroads often involve essential services, reorganizations and mergers rather than liquidations are likely to take place. This is less true for industrial companies.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

24-1 a. The pro forma balance sheet follows (in millions of dollars):

Current assets	\$159 <sup>a</sup>	Current liabilities	\$ 42
Net fixed assets	153	Advance payments	78
Goodwill	15	Reserves	6
		Subordinated debentures	90 <sup>b</sup>
		\$2.40 preferred stock, \$37.50 par value (1,200,000 shares)	45 <sup>c</sup>
		Common stock, \$1.50 par value (6,000,000 shares)	9
		Retained earnings	<u>57</u>
Total assets	<u>\$327</u>	Total claims	<u>\$327</u>

Notes:

<sup>a</sup>\$168 less \$9 used to retire the \$10.50 preferred stock.

<sup>b</sup>(1.2 million shares)(\$75 par value) = \$90.

<sup>c</sup>(1.2 million shares)(\$37.50 par value) = \$45.

b. The pro forma income statement (in millions of dollars) follows:

Net sales	\$540.0
Operating expense	<u>516.0</u>
Net operating income	\$ 24.0
Other income	<u>3.0</u>
EBIT \$ 27.0	
Interest expense	<u>7.2<sup>a</sup></u>
EBT	\$ 19.8
Taxes (50%)	<u>9.9</u>
Net income	\$ 9.9
Dividends on \$2.40 preferred	<u>2.9<sup>b</sup></u>
Income available to common stockholders	<u>\$ 7.0</u>

Notes:

<sup>a</sup>0.08(\$90 million par value) = \$7.2.

<sup>b</sup>\$2.40(1.2 million shares) = \$2.9.

**Thus, the increase in income available to common shareholders is \$7.0 - \$5.7 = \$1.3 million.**

c. The earnings required before the recapitalization is \$7.8 million/(1 - 0.5) = \$15.6 million. We divide the preferred dividends by (1 - T) since \$15.6 million must be earned to provide the \$7.8

million needed after-tax. After recapitalization, the firm requires  $\$2.9 \text{ million} / 0.5 = \$5.8 \text{ million}$  to cover the preferred dividend payment, and  $\$7.2 \text{ million}$  to cover the interest expense for a total of  $\$13.0 \text{ million}$ . Since interest expense is tax deductible, only  $\$7.2 \text{ million}$  in pre-tax earnings are required to cover the interest expense. Thus, required earnings will decrease by  $\$15.6 \text{ million} - \$13.0 \text{ million} = \$2.6 \text{ million}$  if the reorganization takes place.

- d. The debt ratio before reorganization is  $\$120 \text{ million} / \$336 \text{ million} = 0.357 = 35.7\%$ . After reorganization the debt ratio is  $\$210 \text{ million} / \$327 \text{ million} = 0.642 = 64.2\%$ . Note that advance payments by customers are counted as debt while reserves are not. If preferred stock is treated as debt, the debt ratio actually declines slightly from 78.6 percent to 78.0 percent. The reorganization is in the best interests of the shareholders because under reorganization (1) earnings to shareholders are increased, (2) earnings required to cover fixed charges (including preferred dividends) are decreased, and (3) income debentures are less risky to the shareholders than preferred stock.

- 24-2 a. Creditor claims total  $\$1,100,000$  while the trustee has an additional  $\$50,000$  in claims, yet the liquidation produced only  $\$600,000$  in proceeds. Since the proceeds are insufficient to satisfy the creditor and trustee claims, the shareholders receive nothing.
- b. The mortgage bondholders have priority claim against the proceeds from the sale of pledged property. Thus, the  $\$400,000$  from the fixed assets must first be distributed to the first and second mortgage bondholders. The first mortgage holders receive their full claim of  $\$300,000$ , while the second mortgage holders receive the remaining  $\$100,000$ . This constitutes the total  $\$400,000$ , so none of the proceeds from the sale of pledged assets are available for distribution to general creditors. Additionally, the second mortgage holders have  $\$100,000$  in unsatisfied claims which become general creditor claims.

- c. The priority claimants are the mortgage bondholders, trustee, workers, and government. The remaining claimants are general creditors. There is \$200,000 available after the \$400,000 distribution to the mortgage bondholders. This is distributed to the remaining priority claimants as follows:

<u>Claimant</u>	<u>Amount</u>
Trustee's expenses	\$ 50,000
Workers' wages due	30,000
Governments' taxes due	<u>40,000</u>
Total	<u>\$120,000</u>

- d. Of the total \$600,000 received from the liquidation, \$520,000 has been distributed to priority claimants. This leaves \$80,000 to distribute to the general creditors. But the general creditor claims total \$630,000:

<u>Account</u>	<u>Claim</u>
Accounts payable	\$ 50,000
Notes payable	180,000
Second mortgage bonds	100,000
Debentures	200,000
Subordinated debentures	<u>100,000</u>
Total	<u>\$630,000</u>

**Note that the second mortgage holders' unsatisfied claim of \$100,000 is included. Each claimant, before subordination adjustment, would receive \$80,000/\$630,000 = 0.1270 of his or her claim. Therefore, the general creditors would receive:**

<u>Account</u>	<u>Amount Received</u>
Accounts payable	\$ 6,350
Notes payable	22,860
Second mortgage bonds	12,700 (plus
	25,400
Debentures	
Subordinated debentures	<u>12,700</u>
Total	<u>\$ 80,000</u>

\$100,000)

Finally, the subordination adjustment must be made. The subordinated debentures are subordinate to notes payable. Therefore, the subordinate debenture holders must relinquish all claims until the note payable holders are fully satisfied. Since the note payable holders are \$180,000 - \$22,860 = \$157,140 short of being fully satisfied, the full \$12,700 initially allocated to the subordinated debenture holders must be relinquished to the notes payable holders resulting in \$22,860 + \$12,700 = \$35,560 for the notes payable holders and nothing (of the general creditor portion) for the subordinate debenture holders.

24-3 a. The total amount available for distribution is \$3,190,000 proceeds + \$10,000 cash = \$3,200,000. The total creditor and trustee claims are \$6,800,000 + \$200,000 = \$7,000,000. Since the claims far exceed the available funds, preferred and common stockholders will receive nothing.

b. The following table shows the liquidation distribution (in thousands of dollars):

<u>Claimant</u>	<u>Priority Distribution</u>	<u>Creditor Distribution</u>	<u>Subordination Adjustment</u>	<u>Percentage</u>
Accounts payable		\$ 384	\$ 384	24%
Notes payable		120	500	100
Wages payable	\$ 150	150	150	100
Taxes payable	50	50	50	100
Mortgage bonds	1,600	1,696	1,696	85
Subordinated Debentures		600	220	9
Trustee	<u>200</u>	<u>200</u>	<u>200</u>	100
	<u>\$2,000</u>	<u>\$3,200</u>	<u>\$3,200</u>	

- Funds remaining after the priority distribution =  $\$3,200 - \$2,000 = \$1,200$ .
- General creditor claims total  $\$1,600 + \$500 + \$400 + \$2,500 = \$5,000$ .
- After the general creditor distribution, notes payable is  $\$500 - \$120 = \$380$  short. Therefore, subordinated debentures must give up \$380, leaving  $\$600 - \$380 = \$220$ .

## SOLUTION TO SPREADSHEET PROBLEM

---

- 24-4 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 24-4 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**Kimberly MacKenzie, president of Kim's Clothes Inc., a medium-sized manufacturer of women's casual clothing, is worried. Her firm has been selling clothes to Russ Brothers department store for more than ten years, and she has never experienced any problems in collecting payment for the merchandise sold. Currently, Russ Brothers owes Kim's Clothes \$65,000 for spring sportswear that was delivered to the store just two weeks ago. Kim's concern was brought about by an article that appeared in yesterday's *Wall Street Journal* that indicated that Russ Brothers was having serious financial problems. Further, the article stated that Russ Brothers' management was considering filing for reorganization, or even liquidation, with a federal bankruptcy court.**

Kim's immediate concern was whether or not her firm would collect its receivables if Russ Brothers went bankrupt. In pondering the situation, Kim also realized that she knew nothing about the process that firms go through when they encounter severe financial distress. To learn more about bankruptcy, reorganization, and liquidation, Kim asked Ron Mitchell, the firm's chief financial officer, to prepare a briefing on the subject for the entire board of directors. In turn, Ron asked you, a newly hired financial analyst, to do the groundwork for the briefing by answering the following questions:

a. 1. What are the major causes of business failure?

**Answer:** The major causes of business failure consist of economic factors, such as industry weakness and poor location, and financial factors, such as too much debt and insufficient capital. However, most business failures occur because a number of factors combine to make the business unsustainable.

a. 2. Do business failures occur evenly over time?

**Answer:** A fairly large number of businesses fail each year, but the number in any one year has never been a large percentage of the total business population. The failure rate of businesses, however, has tended to fluctuate with the state of the economy.

a. 3. Which size of firm, large or small, is more prone to business failure? Why?

**Answer:** Bankruptcy is more frequent among smaller firms. While bankruptcy does occur in large firms, they tend to get more help from external sources to avoid it, given their greater impact on the economy and, in the case of large financial institutions, the financial world. The federal government's bailouts of Chrysler and Lockheed are good examples of this external assistance.

**b. What key issues must managers face in the financial distress process?**

**Answer:** As a manager begins to face financial distress, he or she must begin to consider the following key issues:

- Is this a temporary cash flow problem (technical insolvency), or is it a permanent problem caused by asset values having fallen below debt obligations (insolvency in bankruptcy)?
- Who should bear the losses if this is a permanent problem?
- Would the firm be more valuable if it continued to operate or if it were liquidated and sold off in pieces?
- Should the firm file for bankruptcy, or should it try to use informal procedures?
- Who should control the firm during liquidation or reorganization?

Obviously, answers to these questions are needed to chart the course of the firm while under financial distress.

c. **What informal remedies are available to firms in financial distress? In answering this question, define the following terms: (1) workout, (2) restructuring, (3) extension, (4) composition, (5) assignment, and (6) assignee (trustee).**

**Answer:** When faced with financial distress, it is often desirable for firms to pursue informal reorganizations or liquidations with creditors, given the costs associated with legal bankruptcy. Creditors generally prefer informal reorganization plans when dealing with economically sound companies whose financial difficulties appear to be temporary. These voluntary informal plans, commonly called workouts, tend to involve some type of restructuring, where current debt terms are revised to facilitate the firm's ability to make payments. Such restructurings typically involve extension and/or composition. In an extension, creditors postpone the dates of required interest or principal payments, or both. Creditors tend to prefer extensions when developing reorganization plans because they promise eventual payment in full. In a composition, creditors voluntarily reduce their fixed claims on the debtor by either accepting a lower principal amount or accepting equity in place of debt. This can be a desirable alternative if bankruptcy becomes a real possibility, since composition can help the creditor and debtor avoid the many costs associated with legal bankruptcy.

Informal liquidations can also be used if it is decided that the firm is worth more by selling it off in pieces. Assignment is an informal procedure for liquidating a firm. It calls for title to the debtor's assets to be transferred to a third party, known as the assignee or trustee. The assignee is required to liquidate the firm's assets either through a private sale or a public auction, and then to distribute the proceeds among the firm's creditors on a pro rata basis.

d. Briefly describe U.S. Bankruptcy Law, including the following terms: (1) chapter 11, (2) chapter 7, (3) trustee, (4) voluntary bankruptcy, and (5) involuntary bankruptcy.

**Answer:** U. S. Bankruptcy laws were first enacted in 1898 to ensure that businesses worth more as ongoing concerns were not shut down by individual creditors desiring liquidation and full payment. The Bankruptcy Reform Act Of 1978 revised these laws to streamline and expedite bankruptcy proceedings. Current bankruptcy law consists of eight chapters, the most important of which are Chapter 7, which details the procedures to be followed when liquidating a company, and Chapter 11, the business reorganization chapter. When a petition for bankruptcy is filed in federal court, the petition can be either voluntary or involuntary. A voluntary petition is filed by the distressed firm's management; an involuntary petition is filed by its creditors. The court will appoint a committee of unsecured creditors to negotiate a reorganization, which may include restructuring. A trustee will be appointed if current management is incompetent or fraud is suspected; otherwise the existing management will retain control. If no fair and feasible reorganization can be worked out, then the firm will be liquidated under Chapter 7 procedures.

**e. What are the major differences between an informal reorganization and reorganization in bankruptcy? In answering this question, be sure to discuss the following items: (1) common pool problem, (2) holdout problem, (3) automatic stay, (4) cramdown, and (5) fraudulent conveyance.**

**Answer:** There are many differences between voluntary reorganizations and reorganizations in bankruptcy. Voluntary reorganizations are far less costly and relatively simple to create as compared to reorganizations in bankruptcy. As a result, voluntary reorganizations typically allow creditors to

recover more money, and sooner, than they would under legal bankruptcy. However, reorganizations in bankruptcy have their advantages. First, they avoid holdout problems which can arise with voluntary reorganizations (which occur when all creditors do not agree to the voluntary plan). Second, because of the automatic stay provision, bankruptcy avoids the common pool problem, where efforts to foreclose on the firm by one creditor cause the remaining creditors to initiate foreclosure as well. Automatic stay, which is granted to all firms in bankruptcy, limits creditors' abilities to foreclose unilaterally on the firm to collect their claims. Third, under bankruptcy, interest and principal payments may be delayed without penalty until a reorganization plan is approved. Fourth, bankruptcy permits the firm to issue debtor in possession (dip) financing to enhance the ability of the firm to borrow funds for short-term liquidity purposes. Finally, bankruptcy gives the debtor exclusive right to submit a proposed reorganization plan for agreement from the parties affected.

While bankruptcy gives the firm a chance to work out its problems without the threat of creditor foreclosure, it does not give the debtor free reign over the firm's assets. First, bankruptcy law gives creditors the right to petition the bankruptcy court to block almost any action the firm might take while in bankruptcy. Second, fraudulent conveyance statutes, which are part of debtor-creditor law in most states, protect creditors from unjustified transfers of property by a firm in financial distress.

In bankruptcy, it is much easier to gain acceptance of a reorganization plan, because the bankruptcy court will lump the creditors into classes. Each class is considered to have accepted a reorganization plan if a majority of the creditors in the class (holding at least two-thirds of the amount of debt) vote for the plan, and the plan will be approved by the court if it is deemed to be "fair and equitable" to the dissenting parties. This procedure, in which the court mandates a reorganization plan in spite of dissent, is called a cramdown.

**f. What is a prepackaged bankruptcy? Why have prepackaged bankruptcies become more popular in recent years?**

**Answer:** Prepackaged bankruptcy is a relatively new type of reorganization which is a hybrid--combining the advantages of both the informal reorganization and formal Chapter 11 reorganization. The debtor obtains agreement from all, or almost all, creditors to a reorganization plan prior to filing for bankruptcy. The plan is then filed along with, or shortly after filing, the bankruptcy petition. This method can avoid the holdout problems of voluntary reorganizations, preserve creditors' claims, and provide favorable tax treatment.

**g. Briefly describe the priority of claims in a Chapter 7 liquidation.**

**Answer:** Chapter 7 of the federal bankruptcy reform act provides for an equitable distribution of the debtor's assets among the creditors. The distribution of assets is governed by the following priority of claims:

- Secured creditors (who are entitled to the proceeds of the sale of specific property pledged for a lien or a mortgage).
- Trustee's costs to administer and operate the bankrupt firm.
- Expenses incurred after an involuntary case has begun but before a trustee has been appointed.
- Wages due workers if earned within three months prior to filing of the petition in bankruptcy.
- Claims for unpaid contributions to employee benefit plans that should have been paid within six months prior to filing.
- Unsecured claims for customer deposits.
- Taxes due to federal, state, county, and any other government agency.
- Unfunded pension plan liabilities.

- General, or unsecured, creditors.
- Preferred stockholders.
- Common stockholders.

**h. Assume that Russ Brothers did indeed fail, and that it had the following balance sheet when it was liquidated (in millions of dollars):**

<b>Current assets</b>	<b>\$40.0</b>	<b>Accounts payable</b>	<b>\$10.0</b>
Net fixed assets	5.0	Notes payable (to banks)	5.0
		Accrued wages	0.3
		Federal taxes	0.5
		State and local taxes	0.2
		<b>Current liabilities</b>	<b><u>\$16.0</u></b>
		First mortgage	\$ 3.0
		Second mortgage	0.5
		Subordinated debentures <sup>a</sup>	4.0
		<b>Total long-term debt</b>	<b><u>\$ 7.5</u></b>
		Preferred stock	1.0
		Common stock	13.0
		Paid-in capital	2.0
		Retained earnings	5.5
		<b>Total equity</b>	<b><u>\$21.5</u></b>
<b>Total assets</b>	<b><u>\$45.0</u></b>	<b>Total claims</b>	<b><u>\$45.0</u></b>

<sup>A</sup>the debentures are subordinated to the notes payable.

The liquidation sales resulted in the following proceeds:

From sale of current assets	\$14,000,000
From sale of fixed assets	<u>2,500,000</u>
<b>Total receipts</b>	<b><u>\$16,500,000</u></b>

For simplicity, assume that there were no trustee's fees or any other claims against the liquidation proceeds. Also, assume that the mortgage bonds are secured by the entire amount of fixed assets. What would each claimant receive from the liquidation distribution?

**Answer:** The following table shows the liquidation distribution (millions of dollars):  
 Distribution to Priority Claimants  
 (in millions)

Proceeds from the sale of assets	\$16.5
Less:	
1. 1st mortgage (paid from sale of fixed assets)	2.5
2. Accrued wages	0.3
3. Taxes due to federal, state, and local governments	<u>0.7</u>
Funds available for distribution to general creditors	<u>\$13.0</u>

Distribution to General Creditors

Gen'l creditor claims	Amt. Of claim	pro rata distrib. <sup>1</sup>	Distribution after subord. adjustment	Percentage Original claim received
1st mortgage	\$ 0.5	\$ 0.325	\$ 0.325	94%
2nd mortgage	0.5	0.325	0.325	65
Notes payable	5.0	3.250	5.000	100
Accts. Payable	10.0	6.500	6.500	65
Subord. Deben. <sup>2</sup>	<u>4.0</u>	<u>2.600</u>	<u>0.850</u>	21
Total	<u>\$20.0</u>	<u>\$13.000</u>	<u>\$13.000</u>	

**Notes:**

- \$13 million is available for distribution to general creditors; however, there is \$20 million in general creditor claims, so the pro rata distribution will be  $\$13/\$20 = 0.65$ , or 65 cents on the dollar.
- The debentures are subordinated to the notes payable. The amount of the unsatisfied notes payable is  $\$5.0 - \$3.25 = \$1.75$  million.  
 \$1.75 million is reallocated from the subordinated debentures to notes payable.

## Chapter 25

# Mergers, LBOs, Divestitures, and Holding Companies

### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 25-1
- a. Synergy occurs when the whole is greater than the sum of its parts. When applied to mergers, a synergistic merger occurs when the postmerger earnings exceed the sum of the separate companies' premerger earnings. A merger is the joining of two firms to form a single firm.
  - b. A horizontal merger is a merger between two companies in the same line of business. In a vertical merger, a company acquires another firm that is "upstream" or "downstream"; for example, an automobile manufacturer acquires a steel producer. A congeneric merger involves firms that are interrelated, but not identical, lines of business. One example is Prudential's acquisition of Bache & Company. In a conglomerate merger, unrelated enterprises combine, such as Mobil Oil and Montgomery Ward.
  - c. A friendly merger occurs when the target company's management agrees to the merger and recommends that shareholders approve the deal. In a hostile merger, the management of the target company resists the offer. A defensive merger occurs when one company acquires another to help ward off a hostile merger attempt. A tender offer is the offer of one firm to buy the stock of another by going directly to the stockholders, frequently over the opposition of the target company's management. A target company is a firm that another company seeks to acquire. Breakup value is a firm's value if its assets are sold off in pieces. An acquiring company is a company that seeks to acquire another firm.
  - d. An operating merger occurs when the operations of two companies are integrated with the expectation of obtaining synergistic gains. These may occur due to economies of scale, management efficiency, or a host of other reasons. In a pure financial merger, the companies will not be operated as a single unit, and no operating economies are expected.
  - e. The discounted cash flow (DCF) method to valuing a business involves the application of capital budgeting procedures to an entire firm rather than to a single project. The market multiple method applies a market-determined multiple to net income, earnings per share, sales, book value, or number of subscribers, and is a less precise method than DCF.
  - f. Under purchase accounting, the acquiring firm is assumed to have "bought" the acquired company in much the same way it would buy any capital asset. Any excess of the purchase price over the book value of assets is added to goodwill, which may be expensed for Federal income tax purposes, but may not be expensed for shareholder reporting.
  - g. A white knight is a friendly competing bidder that a target management likes better than the company making a hostile offer, and the target solicits a merger with the white knight as a preferable alternative.  
A poison pill is a deliberate action that a company takes which makes it a less attractive takeover target. A golden parachute is a payment made to executives that are forced out when a merger takes place. A proxy fight is an attempt to gain control of a firm by soliciting stockholders to vote for a new management team.

- h. A joint venture involves the joining together of parts of companies to accomplish specific, limited objectives. Joint ventures are controlled by the combined management of the two (or more) parent companies. A corporate or strategic alliance is a cooperative deal that stops short of a merger.
  - i. A divestiture is the opposite of an acquisition. That is, a company sells a portion of its assets, often a whole division, to another firm or individual. In a spin-off, a holding company distributes the stock of one of the operating companies to its shareholders. Thus, control passes from the holding company to the shareholders directly. A leveraged buyout is a transaction in which a firm's publicly owned stock is acquired in a mostly debt-financed tender offer, and a privately owned, highly leveraged firm results. Often, the firm's own management initiates the LBO.
  - j. A holding company is a corporation formed for the sole purpose of owning stocks in other companies. A holding company differs from a stock mutual fund in that holding companies own sufficient stock in their operating companies to exercise effective working control. An operating company is a company controlled by a holding company. A parent company is another name for a holding company. A parent company will often have control over many subsidiaries.
  - k. Arbitrage is the simultaneous buying and selling of the same commodity or security in two different markets at different prices, and pocketing a risk-free return. In the context of mergers, risk arbitrage refers to the practice of purchasing stock in companies that may become takeover targets.
- 25-2 Horizontal and vertical mergers are most likely to result in governmental intervention, but mergers of this type are also most likely to result in operating synergy. Conglomerate and congeneric mergers are attacked by the government less often, but they also are less likely to provide any synergistic benefits.
- 25-3 A tender offer might be used. Although many tender offers are made by surprise and over the opposition of the target firm's management, tender offers can and often are made on a "friendly" basis. In this case, management (the board of directors) of the target company endorses the tender offer and recommends that shareholders tender their shares.
- 25-4 An operating merger involves integrating the company's operations in hopes of obtaining synergistic benefits, while a pure financial merger generally does not involve integrating the merged company's operations.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

25-1  $FCF_1 = 2.00(1.05) = \$2.1$  million;  $g = 5\%$ ;  $b = 1.4$ ;  $r_{RF} = 5\%$ ;  $RP_M = 6\%$ ;  $w_d = 30\%$ ;  $T = 40\%$ ;  $r_d = 8\%$   
 $V_{ops} = ?$   $P_0 = ?$

$$\begin{aligned}r_s &= r_{RF} + RP_M(b) \\ &= 5\% + 6\%(1.4) \\ &= 13.4\%\end{aligned}$$

$$\begin{aligned}WACC &= w_d r_d (1-T) + w_s r_s \\ &= 0.30(8\%)(0.60) + 0.70(13.4\%) \\ &= 10.82\%\end{aligned}$$

$$\begin{aligned}V_{ops} &= \frac{FCF_0(1+g)}{WACC - g} \\ &= \frac{\$2.1}{0.1082 - 0.05}\end{aligned}$$

$$\begin{aligned}V_s &= V_{ops} - \text{debt} \\ &= 36.08 - 10.82 = \$25.26 \text{ million}\end{aligned}$$

$$\begin{aligned}\text{Price} &= 25.26 \text{ million} / 1 \text{ million shares} \\ &= \$25.26 / \text{share}.\end{aligned}$$

- 25-2  $FCF_1 = \$2.5$  million,  $FCF_2 = \$2.9$  million and  $FCF_3 = \$3.4$  million;  $g = 5\%$ ;  $b = 1.4$ ;  $r_{RF} = 5\%$ ;  $RP_M = 6\%$ ;  $w_d = 30\%$ ;  $T = 40\%$ ;  $r_d = 8\%$   $V_{ops} = ?$   $P_0 = ?$

WACC was calculated in problem 1 to be 10.82%. Since the horizon capital structure is the same as in problem 1, the WACC is the same.

$$\begin{aligned} \text{Horizon Value}_3 &= FCF_3(1+g)/(WACC - g) \\ &= 3.4 (1.05)/(.1082 - 0.05) \\ &= \$61.34 \text{ million} \end{aligned}$$

Tax shields in years 1 through 3 are:

$$\begin{aligned} TS_1 = TS_2 = TS_3 &= \text{Interest} \times T \\ &= 1,500,000 \times 0.40 \\ &= 600,000 \end{aligned}$$

FCF + Tax Shield + Horizon Value =

$$\text{Year 1: } 2.5 \text{ million} + 600,000 = 3.1 \text{ million}$$

$$\text{Year 2: } 2.9 \text{ million} + 600,000 = 3.5 \text{ million}$$

$$\text{Year 3: } 3.4 \text{ million} + 600,000 + 61.34 \text{ million} = 65.34 \text{ million}$$

The unlevered cost of equity based on the pre-merger required rate of return and pre-merger capital structure is:

$$\begin{aligned} r_{sU} &= w_d r_d + w_s r_{sL} \quad \text{Note: } r_s \text{ was calculated in problem 1 to be } 13.4\% \\ &= 0.30(8\%) + 0.70(13.4\%) \\ &= 11.78\% \end{aligned}$$

The present value of the FCFs, the tax shields, and the horizon value at the unlevered cost of equity is:

$$\begin{aligned} V_{ops} &= \frac{3.1}{1.1178} + \frac{3.5}{(1.1178)^2} + \frac{65.34}{(1.1178)^3} \\ &= \$52.36 \text{ million} \end{aligned}$$

$$\begin{aligned} \text{Equity value to Harrison} &= V_{ops} - \text{Debt} \\ &= 52.36 \text{ million} - 10.82 \text{ million} \\ &= 41.54 \text{ million} \end{aligned}$$

or \$41.54 per share since there are 1 million shares outstanding.

- 25-3 On the basis of the answers in Problems 25-1 and 25-2, the bid for each share should range between \$25.26 and \$41.54.

25-4 The difference between this problem and problem 25-2 is the discount rate used at the horizon. Since  $r_{sU} = 11.78\%$ ,  $r_{sL}$  with 45% debt and an 8.5% cost of debt is:

$$\begin{aligned}
 r_{sL} &= r_{sU} + (r_{sU} - r_d)(D/S) \\
 &= 11.78\% + (11.78\% - 8.5\%)(0.45/0.55) \\
 &= 14.46\% \\
 \text{WACC} &= w_d r_d(1-T) + w_s r_s \\
 &= 0.45(8.5\%)(1-0.40) + 0.55(14.46\%) \\
 &= 10.25\%
 \end{aligned}$$

The new horizon value at this WACC is:

$$\begin{aligned}
 \text{Horizon Value}_3 &= FCF_3(1+g)/(WACC - g) \\
 &= 3.4(1.05)/(.1025 - 0.05) \\
 &= \$68.0 \text{ million}
 \end{aligned}$$

The new present value is:

$$\begin{aligned}
 V_{\text{ops}} &= \frac{3.1}{1.1178} + \frac{3.5}{(1.1178)^2} + \frac{3.4 + 0.6 + 68}{(1.1178)^3} \\
 &= \$57.13 \text{ million}
 \end{aligned}$$

The value of the equity is  $\$57.13 \text{ million} - 10.82 = 46.31 \text{ million}$ , or  $\$43.61$  per share.

- 25-5 a. The appropriate discount rate reflects the riskiness of the cash flows. Thus, it is Conroy's unlevered cost of equity that should be used to discount the free cash flows and tax shields in years 1-4. The horizon value should be calculated using Conroy's WACC, adjusting for the increased leverage. Since Conroy's  $b = 1.3$ , its current cost of equity,  $r_{sL} = 6\% + 1.3(4.5\%) = 11.85\%$ . Since its percentage of debt is 25% and the rate on its debt is 9%, its unlevered cost of equity is

$$\begin{aligned} r_{sU} &= w_d r_d + w_s r_{sL} \\ &= 0.25(9\%) + 0.75(11.85\%) \\ &= 11.14\% \end{aligned}$$

At the new capital structure of 40 percent debt with a rate of 9.5 percent, the new levered cost of equity and WACC will be:

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_d)(D/S) \\ &= 11.14\% + (11.14\% - 9.5\%)(0.40/0.60) \\ &= 12.23\% \\ \text{WACC} &= w_d r_d(1-T) + w_s r_s \\ &= 0.40(9.5\%)(1-0.35) + 0.60(12.23\%) \\ &= 9.81\% \end{aligned}$$

- b. The horizon value is:  
 Horizon Value<sub>4</sub> =  $FCF_4(1+g)/(WACC - g)$   
 =  $2.0(1.06)/(0.0981 - 0.06)$   
 = \$55.64 million

The interest tax shields are calculated as interest payment x Tax rate. These tax shields, free cash flows, and horizon value are to be discounted at the unlevered cost of equity:

Year	1	2	3	4
5				
	----- ----- ----- ----- -----			
Tax Shield		1.2(.35)	1.7(.35)	2.1(.35)
Free Cash Flow		1.3	1.5	1.75
2.0				
Horizon				Value
55.64				
Total		1.72	2.10	2.73
58.38				

The present value of these cash flows is the value of operations:

$$\begin{aligned} V_{ops} &= \frac{1.72}{1.1114} + \frac{2.10}{(1.1114)^2} + \frac{2.73}{(1.1114)^3} + \frac{58.38}{(1.1114)^4} \\ &= \$43.50 \text{ million} \end{aligned}$$

$$\begin{aligned} \text{Equity} &= V_{ops} - \text{debt} \\ &= \$43.5 - 10 = \$33.5 \text{ million is the maximum amount to pay.} \end{aligned}$$



- 25-6 a. The horizon value should be calculated using BCC's WACC based on its new capital structure. The intermediate free cash flows, tax shields, and the horizon value should be discounted at BCC's unlevered cost of equity. To calculate all of these items: First, find BCC's pre-merger cost of equity and unlevered cost of equity:

$$r_{sL} = r_{RF} + (RP_M)b = 6\% + (4\%)1.40 = 11.6\%.$$

$$r_{sU} = w_d r_d + w_s r_{sL} = 0.40(10\%) + 0.60(11.6\%) = 10.96\%$$

after the merger, BCC will have 50 percent of debt costing 10%, so its levered cost of equity and WACC will be:

$$\begin{aligned} r_{sL} &= r_{sU} + (r_{sU} - r_d)(D/S) \\ &= 10.96\% + (10.96\% - 10\%)(0.50/0.50) \\ &= 11.92\% \end{aligned}$$

$$\begin{aligned} \text{WACC} &= w_d r_d(1-T) + w_s r_s \\ &= 0.5(10\%)(1-0.35) + 0.5(11.92\%) \\ &= 9.21\% \end{aligned}$$

- b. The free cash flows are NOPAT - net retentions = (Sales – CGS – selling expenses)(1-T) – net retentions. CGS is 65% of sales:

	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
Net sales	\$450.00	\$518.00	\$555.00	\$600.00
Cost of Goods Sold	\$292.50	\$336.70	\$360.75	\$390.00
SGA	<u>\$45.00</u>	<u>\$53.00</u>	<u>\$60.00</u>	<u>\$68.00</u>
EBIT	\$112.50	\$128.30	\$134.25	\$142.00
Taxes on EBIT (35%)	<u>\$39.38</u>	<u>\$44.91</u>	<u>\$46.99</u>	<u>\$49.70</u>
NOPAT	\$73.12	\$83.39	\$87.26	\$92.30
Net Retentions	<u>\$50.00</u>	<u>\$80.00</u>	<u>\$75.00</u>	<u>\$70.00</u>
FCF	\$23.12	\$3.39	\$12.26	\$22.30

See part d for calculations of the tax shields.

- c. Horizon value =  $22.30(1.07)/(0.0921-0.07) = \$1,079.68$ .
- d.  $V_{ops}$  = PV of FCF, Tax shield, and Horizon value at the unlevered cost of equity. The tax shields are interest x tax rate:

	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
Interest	\$40.00	\$45.00	\$47.00	\$52.00
Tax shield	\$14.00	\$15.75	\$16.45	\$18.20
FCF	\$23.12	\$3.39	\$12.26	\$22.30
Horizon value				\$1,079.68
Total CF	\$37.12	\$19.14	\$28.71	\$1,120.18

NPV of total FCF at unlevered cost of equity, 10.96%, =  $V_{ops} = \$808.08 = \$0.809$  million.  
 Value of BCC's equity =  $V_{ops} - Debt = \$0.809 \text{ million} - \$0.300 = \$0.509$  million.

## SOLUTION TO SPREADSHEET PROBLEMS

---

25-7 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 25 P07 Build a Model.xls*) and on the instructor's side of the accompanying book site, <http://brigham.swcollege.com>.

## MINI CASE

---

Hager's Home Repair Company, a regional hardware chain, which specializes in "do-it-yourself" materials and equipment rentals, is cash rich because of several consecutive good years. One of the alternative uses for the excess funds is an acquisition. Doug Zona, Hager's treasurer and your boss, has been asked to place a value on a potential target, Lyons' Lighting, a small chain which operates in an adjacent state, and he has enlisted your help.

The table below indicates Zona's estimates of Lyons' earnings potential if it came under Hager's management (in millions of dollars). The interest expense listed here includes the interest (1) on Lyons' existing debt, which is \$55 million at a rate of 9%, and (2) on new debt expected to be issued over time to help finance expansion within the new "L division," the code name given to the target firm. If acquired, Lyons' Lighting will face a 40% tax rate.

Security analysts estimate that Lyons' beta is 1.3. The acquisition would not change Lyons' capital structure. Zona realizes that Lyons' Lighting also generates depreciation cash flows, all of which must be reinvested in the division to replace worn-out equipment. The net retentions in the table below are required reinvestment in addition to these depreciation cash flows. Zona estimates the risk-free rate to be 9 percent and the market risk premium to be 4 percent. He also estimates that free cash flows after 2008 will grow at a constant rate of 6 percent. Following are projections for sales and other items.

	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	
Net sales	\$60.0	\$90.0	\$112.5	\$127.5	
Cost of goods sold (60%)		36.0	54.0	67.5	76.5
Selling/administrative expense		4.5	6.0	7.5	9.0
Interest expense	5.0	6.5	6.5	7.0	
Required net retentions		0.0	7.5	6.0	4.5

Hager's management is new to the merger game, so Zona has been asked to answer some basic questions about mergers as well as to perform the merger analysis. To structure the task, Zona has developed the following questions, which you must answer and then defend to Hager's board.

- a. Several reasons have been proposed to justify mergers. Among the more prominent are (1) tax considerations, (2) risk reduction, (3) control, (4) purchase of assets at below-replacement cost, (5) synergy, and (6) globalization. In general, which of the reasons are economically justifiable? Which are not? Which fit the situation at hand? Explain.**

**Answer:** The economically justifiable rationales for mergers are synergy and tax consequences. Synergy occurs when the value of the combined firm exceeds the sum of the values of the firms taken separately. (if synergy exists, then the whole is greater than the sum of the parts, and hence synergy is also called the "2 + 2 = 5" effect.)

A synergistic merger creates value, which must be apportioned between the stockholders of the merging companies. Synergy can arise from four sources: (1) operating economies of scale in management, production, marketing, or distribution; (2) financial economies, which could include higher debt capacity, lower transactions costs, or better coverage by securities' analysts which can lead to higher demand and, hence, higher prices; (3) differential management efficiency, which implies that new management can increase the value of a firm's assets; and (4) increased market power due to reduced competition. Operating and financial economies are socially desirable, as are mergers that increase managerial efficiency, but mergers that reduce competition are both undesirable and illegal.

Another valid rationale behind mergers is tax considerations. For example, a firm which is highly profitable and consequently in the highest corporate tax bracket could acquire a company with large accumulated tax losses, and immediately use those losses to shelter its current and future income. Without the merger, the carry-forwards might eventually be used, but their value would be higher if used now rather than in the future.

The motives that are generally less supportable on economic grounds are risk reduction, purchase of assets at below replacement cost, control, and globalization. Managers often state that diversification helps to stabilize a firm's earnings stream and thus reduces total risk, and hence benefits shareholders.

Stabilization of earnings is certainly beneficial to a firm's employees, suppliers, customers, and managers. However, if a stock investor is concerned about earnings variability, he or she can diversify more easily than can the firm. Why should firm a and firm b merge to stabilize earnings when stockholders can merely purchase both stocks and accomplish the same thing? Further, we know that well-diversified shareholders are more concerned with a stock's market risk than its stand-alone risk, and higher earnings instability does not necessarily translate into higher market risk.

Sometimes a firm will be touted as a possible acquisition candidate because the replacement value of its assets is considerably higher than its market value. For example, in the early 1980s, oil companies could acquire reserves more cheaply by buying out other oil companies than by exploratory drilling. However, the value of an asset stems from its expected cash flows, not

from its cost. Thus, paying \$1 million for a slide rule plant that would cost \$2 million to build from scratch is not a good deal if no one uses slide rules.

In recent years, many hostile takeovers have occurred. To keep their companies independent, and also to protect their jobs, managers sometimes engineer defensive mergers, which make their firms more difficult to "digest." Also, such defensive mergers are usually debt-financed, which makes it harder for a potential acquirer to use debt financing to finance the acquisition. In general, defensive mergers appear to be designed more for the benefit of managers than for that of the stockholders.

An increased desire to become globalized has resulted in many mergers. To merge just to become international is not an economically justified reason for a merger; however, increased globalization has led to increased economies of scale. Thus, synergies often result--which is an economically justifiable reason for mergers. Synergy appears to be the reason for this merger.

**b. Briefly describe the differences between a hostile merger and a friendly merger.**

**Answer:** In a friendly merger, the management of one firm (the acquirer) agrees to buy another firm (the target). In most cases, the action is initiated by the acquiring firm, but in some situations the target may initiate the merger. The managements of both firms get together and work out terms which they believe to be beneficial to both sets of shareholders. Then they issue statements to their stockholders recommending that they agree to the merger. Of course, the shareholders of the target firm normally must vote on the merger, but management's support generally assures that the votes will be favorable.

If a target firm's management resists the merger, then the acquiring firm's advances are said to be hostile rather than friendly. In this case, the acquirer, if it chooses to, must make a direct appeal to the target firm's shareholders. This takes the form of a tender offer, whereby the target firm's shareholders are asked to "tender" their shares to the acquiring firm in exchange for cash, stock, bonds, or some combination of the three. If 51 percent or more of the target firm's shareholders tender their shares, then the merger will be completed over management's objection.

**c. What are the steps in valuing a merger?**

**Answer:** When the capital structure is changing rapidly, as in many mergers, the WACC changes from year-to-year and it is difficult to apply the corporate valuation model in these cases. The APV model works better when the capital structure is changing. The steps are:

1. Project  $FCF_t$ ,  $TS_T$ , horizon growth rate, and horizon capital structure.
2. Calculate the unlevered cost of equity,  $r_{su}$ .
3. Calculate WACC at horizon.
4. Calculate horizon value using constant growth corporate valuation model.
5. Calculate Vops as PV of  $FCF_t$ ,  $TS_T$  and horizon value, all discounted at  $r_{su}$ .

**d. Use the data developed in the table to construct the L division's free cash flows for 2005 through 2008. Why are we identifying interest expense separately since it is not normally included in calculating free cash flow or in a capital budgeting cash flow analysis? Why are net retentions deducted in calculating free cash flow?**

**Answer:** The easiest approach here is to calculate the free cash flows for the L division, assuming that the acquisition is made (in millions of dollars).

	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>
Net sales	\$60.0	\$90.0	\$112.5	\$127.5

	Cost of goods sold (60%)	36.0	54.0	67.5	76.5
	Selling/admin. Expenses	<u>4.5</u>	<u>6.0</u>	<u>7.5</u>	<u>9.0</u>
	EBIT			19.5	30.0
37.5	42.0				
	Taxes on EBIT(40%)		<u>7.8</u>	<u>12.0</u>	<u>15.0</u>
<u>16.8</u>					
	NOPAT	11.7	18.0	22.5	25.2
	Net retentions	0.0	7.5	6.0	4.5
	Free cash flow			11.7	10.5
16.5	20.7				
	Interest expense			5.0	6.5
6.5	7.0				
	Interest tax savings			2.0	2.6
2.6	2.8				

Note that these free cash flows are identical to what you would construct to use the corporate valuation model or to use standard capital budgeting procedures, except that we have also included separate lines for the interest expense and interest tax savings (which are calculated as interest x tax rate and are also called interest tax shields). In many merger analyses the debt levels change so dramatically that using the corporate value model would require re-estimating the WACC every year. Instead, the APV model breaks up the value of operations into two components:

$$V_{\text{operations}} = V_{\text{unlevered}} + V_{\text{tax shield}}$$

The free cash flows and interest tax savings are discounted separately at the unlevered cost of equity. This is more convenient to use than the corporate value model because the unlevered cost of equity can be used even when the capital structure is changing.

Also, in straight capital budgeting and the simplest application of the corporate value model all debt involved is new debt, which is issued to fund the asset additions. Hence, the debt involved all costs the same,  $r_d$ , and this cost is accounted for by discounting the cash flows at the firm's WACC. However, in a merger the acquiring firm usually both assumes the existing debt of the target and issues new debt to help finance the takeover. Thus, the debt involved has different costs, and hence cannot be accounted for as a single cost in the WACC. The easiest solution is to explicitly include the interest tax shield and use the APV.

In regards to retentions, all of the cash flows from an individual project are available for use throughout the firm, since capital expenditures are explicitly accounted for. Similarly, we account for capital expenditures within the acquired firm when we calculate free cash flow. There are two equivalent ways to calculate free cash flow:

NOPAT

+ Depreciation  
= Operating Cash Flow

- Gross Retentions  
= Free Cash Flow

OR:

NOPAT

- Net Retentions  
= Free Cash Flow

Where Net Retentions = Gross Retentions – Depreciation.

The interest tax savings are cash flows that are also available to pay interest, principal, or for other use within the firm. In the corporate valuation model (which assumed a stable capital structure) we accounted for the value of these tax savings by using a lower cost of capital--the debt component of the WACC is reduced by the factor  $(1-t)$ . In the APV we discount at the higher unlevered cost of equity and take these tax savings into account explicitly.

Note that in many cases, and in this case, the corporate valuation model can be used at the horizon to calculate the horizon value. This is because in many cases the firm is at a stable capital structure by the horizon and in this case the corporate valuation model is easier to apply. So the steps are:

(1) apply corporate valuation model at horizon to get the horizon value (2) discount the free cash flows and tax shields before the horizon, along with the horizon value, at the unlevered cost of equity. This gives the value of operations. (3) subtract the current level of debt to get the current equity value.

<p><b>e. Conceptually, what is the appropriate discount rate to apply to the cash flows developed in part c? What is your actual estimate of this discount rate?</b></p>
--

**Answer:** As discussed above, the free cash flows, tax shields and horizon value should all be discounted at the unlevered cost of equity. This cost should be calculated based on the target's risk, not the acquirer's risk. Hager's investment bankers have estimated that Lyons' Lighting's beta is currently 1.3. The horizon value should be calculated using Lyons' WACC, which is based on the costs of debt and equity after any change in leverage.

To obtain the unlevered required rate of return we first need the levered required rate of return. Note that  $r_{rf} = 7\%$  and  $r_{pm} = 4\%$ . Thus, the 1 division's levered required rate of return on equity is:

$$\begin{aligned}
r_{s(\text{Lyons' Lighting})} &= r_{rf} + (r_m - r_{rf})b_{\text{Lyons' Lighting}} \\
&= 7\% + (4\%)1.3 = 12.2\%.
\end{aligned}$$

The unlevered cost of equity, based on a 20% debt ratio, cost of debt of 9%, and a levered cost of equity of 12.2% is:

$$\begin{aligned}
r_{su} &= w_d r_d + w_s r_{sl} \\
&= 0.20(9\%) + 0.80(12.2\%) = 11.56\%
\end{aligned}$$

Since Hager's will maintain Lyons' current capital structure of 20% debt at the horizon, the WACC to be used in the horizon value calculation can be based on the levered cost of equity calculated above. If, as we discuss in a later part to this mini-case, Lyons' capital structure is to be changed, then a new levered cost of equity must be calculated based on this new capital structure, and the WACC calculation based on this new levered cost of equity.

$$\begin{aligned}
\text{WACC} &= w_d r_d(1 - T) + w_s r_{sL} \\
&= 0.20(9\%)(1 - 0.40) + 0.80(12.2\%) = 10.84\%
\end{aligned}$$

**f. What is the estimated horizon, or continuing, value of the acquisition; that is, what is the estimated value of the L division's cash flows beyond 2008? What is Lyons' value to Hager's shareholders? Suppose another firm were evaluating Lyons' as an acquisition candidate. Would they obtain the same value? Explain.**

**Answer:** The 2008 cash flow is \$20.7 million, and it is expected to grow at a 6 percent constant growth rate in 2009 and beyond. With a constant growth rate and stable capital structure, the corporate value model can be used to value the cash flows beyond 2008:

$$\begin{aligned}
\text{Horizon value} &= \frac{(2008 \text{ Cash flow})(1 + g)}{\text{WACC} - g} \\
&= \frac{\$20.7(1.06)}{0.1084 - 0.06} \\
&= \$453.3 \text{ million.}
\end{aligned}$$

Adding the horizon value, the total cash flow stream looks like this (in millions of

dollars):

		<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>
Annual free cash flow	\$11.7	\$10.5	\$16.5	\$ 20.7	
Horizon value					453.3
Interest tax shield		<u>2.0</u>	<u>2.6</u>	<u>2.6</u>	<u>2.8</u>
Total cash flow		<u>\$13.7</u>	<u>\$13.1</u>	<u>\$19.1</u>	<u>\$476.8</u>

Now, the value of Lyons' operations is the present value of this stream, discounted at its unlevered cost of equity, 11.6%. The present value is \$344.4 million.

The value of Lyons' equity is this value of operations less its current debt of \$55 million, for an equity value of \$289.4million.

If another firm were valuing Lyons', they would probably obtain an estimate different from \$289.4 million. Most important, the synergies involved would likely be different, and hence the cash flow estimates would differ. Also, another potential acquirer might use different financing, or have a different tax rate, and hence estimate a different discount rate at the horizon and have different interest tax shields.

**g. Assume that Lyons' has 20 million shares outstanding. These shares are traded relatively infrequently, but the last trade, made several weeks ago, was at a price of \$11 per share. Should Hager's make an offer for Lyons'? If so, how much should it offer per share?**

**Answer:** With a current price of \$11 per share and 20 million shares outstanding, Lyons' current market value is  $\$11(20) = \$220$  million. Since Lyons' expected value to Hager's is \$289.4 million, it appears that the merger would be beneficial to both sets of stockholders. The difference,  $\$289.4 - \$220.0 = \$69.4$  million, is the added value to be apportioned between the stockholders of both firms.

The offering range is from \$11 per share to  $\$289.4/20 = \$14.47$  per share. At \$11, all of the benefit of the merger goes to Hager's shareholders, while at \$14.47, all of the value created goes to Lyons' shareholders. If Hager's offers more than \$14.47 per share, then wealth would be transferred from Hager's stockholders to Lyons' stockholders.

As to the actual offering price, Hager's should make the offer as low as possible, yet acceptable to Lyons' shareholders. A low initial offer, say \$11.50 per share, would probably be rejected and the effort wasted. Further, the offer may influence other potential suitors to consider Lyons', and they could end up outbidding Hager's. Conversely, a high price, say \$14, passes almost all of the gain to Lyons' stockholders, and Hager's managers should retain as much of the synergistic value as possible for their own shareholders.

Note that this discussion assumes that Lyons' \$11 price is a "fair," equilibrium value in the absence of a merger. Since the stock trades infrequently, the \$11 price may not represent a fair minimum price. Lyons' management should make an evaluation (or hire someone to make the evaluation) of a fair price and use this information in its negotiations with Hager's.

**h. How would the analysis be different if Hager's intended to recapitalize Lyons' with 40% debt costing 10% at the end of four years?**

Answer: The free cash flows and the unlevered cost of equity would be unchanged. If we assume that the interest payments in the first 4 years are unchanged, and the intention is to use 40 percent debt at the horizon, then the horizon levered cost of equity would increase, and the levered WACC would decrease.

$$\begin{aligned} \text{New levered cost of equity} &= r_{sl} = r_u + (r_u - r_d)(d/s) \\ &= 11.6\% + (11.6\% - 10\%)(0.40/0.60) \\ &= 12.6\% \end{aligned}$$

$$\begin{aligned} \text{New WACC} &= w_d r_d(1 - t) + w_s r_{sl} \\ &= 0.40(10\%)(1 - 0.40) + 0.60(12.6\%) = 9.96\% \end{aligned}$$

The new horizon value is based on this new WACC:

$$\begin{aligned} \text{New horizon value} &= \frac{(\text{2008 Cash flow})(1 + g)}{\text{WACC} - g} \\ &= \frac{\$20.7(1.06)}{0.0996 - 0.06} \\ &= \$554.1 \text{ million.} \end{aligned}$$

Assuming Hager's will keep the same debt level for the first four years as assumed and then target a 40% debt level in the horizon, the new value of operations is the PV of the free cash flows, tax shields from before, but using this new horizon value:

New  $v_{ops}$  = \$409.5 million

Less debt of \$55 million leaves equity of \$354.5 million. This is \$65.0 million, or \$3.25 per share, more than at a 20% debt level. The difference in value is due to the added interest tax shield at the higher debt level.

**i. There has been considerable research undertaken to determine whether mergers really create value and, if so, how this value is shared between the parties involved. What are the results of this research?**

**Answer:** Most researchers agree that takeovers increase the wealth of the shareholders of target firms, for otherwise they would not agree to the offer. However, there is a debate as to whether mergers benefit the acquiring firm's shareholders. The results of these studies have shown, on average, the stock prices of target firms increase by about 30 percent in hostile tender offers, while in friendly mergers the average increase is about 20 percent. However, for both hostile and friendly deals, the stock prices of acquiring firms, on average, remain constant. Thus, one can conclude that (1) acquisitions do create value, but (2) that shareholders of target firms reap virtually all the benefits.

**j. What method is used to account for mergers?**

**Answer:** Mergers must be accounted for using purchase accounting, in which the acquired company is treated as any other capital asset purchase. The old method called "pooling accounting" has been eliminated.

**k. What merger-related activities are undertaken by investment bankers?**

**Answer:** The investment banking community is involved with mergers in a number of ways. Several of these activities are: (1) helping to arrange mergers, (2) aiding target companies in developing and implementing defensive tactics, (3) helping to value target companies, (4) helping to finance mergers, and (5) risk arbitrage--speculating in the stocks of companies that are likely takeover targets.

Hopefully, investment bankers are not giving kickbacks to company executives who give them business, or providing fraudulent analyst reports to pump up the stocks of companies they would like to do business with.

**l. What is a leveraged buyout (LBO)? What are some of the advantages and disadvantages of going private?**

**Answer:** A leveraged buyout is a situation in which a small group of investors (which usually include the firm's managers) borrows heavily to buy all the shares of a company. Advantages to going private include administrative cost savings, increased managerial incentives, increased managerial flexibility, increased shareholder participation, and increased financial leverage. The main disadvantage of going private is not having access to the large amounts of capital available in the equity market, making it difficult to fund a firm's projects.

**m. What are the major types of divestitures? What motivates firms to divest assets?**

**Answer:** The three primary types of divestitures are (1) the sale of an operating unit to another firm, (2) setting up the business to be divested as a separate corporation and then "spinning it off" to the divesting firm's stockholders, and (3) outright liquidation of assets. The reasons for divestitures vary widely. Sometimes companies need cash either to finance expansion in their primary business lines or to reduce a large debt burden. Sometimes firms divest to unload losing assets that would otherwise drag the company down, or divesting may be the result of an antitrust settlement, where the government requires a breakup.

**n. What are holding companies? What are their advantages and disadvantages?**

**Answer:** Holding companies are corporations formed for the sole purpose of owning the stocks of other companies. The advantages include the ability to control a company without owning all its stocks and the ability to isolate risks. Disadvantages include the possible taxation of earnings at both the subsidiary and parent levels. Holding companies can also be easily dissolved by regulators.

## Chapter 26

### Multinational Financial Management

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 26-1
- a. A multinational corporation is one that operates in two or more countries.
  - b. The exchange rate specifies the number of units of a given currency that can be purchased for one unit of another currency. The fixed exchange rate system was in effect from the end of World War II until August 1971. Under the system, the U. S. dollar was linked to gold at the rate of \$35 per ounce, and other currencies were then tied to the dollar. Under the floating exchange rate system, which is currently in effect, the forces of supply and demand are allowed to determine currency prices with little government intervention.
  - c. A country has a deficit trade balance when it imports more goods from abroad than it exports. Devaluation is the lowering, by governmental action, of the price of its currency relative to another currency. For example, in 1967 the British pound was devalued from \$2.80 per pound to \$2.50 per pound. Revaluation, the opposite of devaluation, occurs when the relative price of a currency is increased.
  - d. Exchange rate risk refers to the fluctuation in exchange rates between currencies over time. A convertible currency is one which can be traded in the currency markets and can be redeemed at current market rates. When an exchange rate is pegged, the rate is fixed against a major currency such as the U. S. dollar. Consequently, the values of the pegged currencies move together over time.
  - e. Interest rate parity holds that investors should expect to earn the same return in all countries after adjusting for risk. Purchasing power parity, sometimes referred to as the “law of one price,” implies that the level of exchange rates adjusts so that identical goods cost the same in different countries.
  - f. The spot rate is the exchange rate which applies to “on the spot” trades, or, more precisely, exchanges that occur two days following the day of trade. In other words, the spot rate is for current exchanges. The forward exchange rate is the prevailing exchange rate for exchange (delivery) at some agreed-upon future date, usually 30, 90, or 180 days from the day the transaction is negotiated. Forward exchange rates are analogous to future prices on commodity exchanges. Discounts (or premiums) on forward rates occur when the forward exchange rate differs from the spot rate. When the forward rate is below the spot rate, the forward rate is said to be at a discount. Conversely, when the forward rate is above the spot rate, it is said to be at a premium.
  - g. Repatriation of earnings is the cash flow, usually in the form of dividends or royalties, from the foreign branch or subsidiary to the parent company. These cash flows must be converted to the

- currency of the parent, and thus are subject to future exchange rate changes. A foreign government may restrict the amount of cash that may be repatriated. Political risk refers to the possibility of expropriation and to the unanticipated restriction of cash flows to the parent by a foreign government.
- h. A Eurodollar is a U. S. dollar on deposit in a foreign bank, or a foreign branch of a U. S. bank. Eurodollars are used to conduct transactions throughout Europe and the rest of the world. An international bond is any bond sold outside of the country of the borrower. There are two types of international bonds: Eurobonds and foreign bonds. A Eurobond is any bond sold in some country other than the one in whose currency the bond is denominated. Thus, a U. S. firm selling dollar bonds in Switzerland is selling Eurobonds. A foreign bond is a bond sold by a foreign borrower but denominated in the currency of the country in which the issue is sold. Thus, a U. S. firm selling bonds denominated in Swiss francs in Switzerland is selling foreign bonds.
- i. The Euro is a currency used by the nations in the European Monetary Union who signed the Treaty of Maastricht.
- 26-2 The U. S. dollar. The primary reason for using the dollar was that it provided a relatively stable benchmark, and it was accepted universally for transaction purposes.
- 26-3 Under the fixed exchange rate system, the fluctuations were limited to +1% and -1%. Under the floating exchange rate system, there are no agreed-upon limits.
- 26-4 A dollar will buy more Swiss francs.
- 26-5 There will be an excess supply of dollars in the foreign exchange markets, and thus, will tend to drive down the value of the dollar. Foreign investments in the United States will increase.
- 26-6 Taking into account differential labor costs abroad, transportation, tax advantages, and so forth, U. S. corporations can maximize long-run profits. There are also non-profit behavioral and strategic considerations, such as maximizing market share and enhancing the prestige of corporate officers.
- 26-7 The foreign project's cash flows have to be converted to U. S. dollars, since the shareholders of the U. S. corporation (assuming they are mainly U. S. residents) are interested in dollar returns. This subjects them to exchange rate risk, and therefore requires an additional risk premium. There is also a risk premium for political risk (mainly the risk of expropriation). However, foreign investments also help diversify cash flows, so the net effect on the required rate of return is ambiguous.
- 26-8 A Eurodollar is a dollar deposit in a foreign bank, normally a European bank. The foreign bank need not be owned by foreigners--it only has to be located in a foreign country. For example, a Citibank subsidiary in Paris accepts Eurodollar deposits. The Frenchman's deposit at Chase Manhattan Bank in New York is not a Eurodollar deposit. However, if he transfers his deposit to a bank in London or Paris, it would be.
- The existence of the Eurodollar market makes the Federal Reserve's job of controlling U. S. interest rates more difficult. Eurodollars are outside the direct control of the U. S. monetary authorities. Because of this, interest rates in the U. S. cannot be insulated from those in other parts of

the world. Thus, any domestic policies the Federal Reserve might take toward interest rates would be affected by the Eurodollar market.

- 26-9 No, interest rate parity implies that an investment in the U. S. with the same risk as a similar investment in a foreign country should have the same return. Interest rate parity is expressed as:

$$\frac{f_t}{e_0} = \frac{1 + r_h}{1 + r_f}$$

Interest rate parity shows why a particular currency might be at a forward premium or discount. A currency is at a forward premium whenever domestic interest rates are higher than foreign interest rates. Discounts prevail if domestic interest rates are lower than foreign interest rates. If these conditions do not hold, then arbitrage will soon force interest rates back to parity.

- 26-10 Purchasing power parity assumes there are neither transaction costs nor regulations which limit the ability to buy and sell goods across different countries. In many cases, these assumptions are incorrect, which explains why PPP is often violated. An additional complication, when empirically testing to see whether PPP holds, is that products in different countries are rarely identical. Frequently, there are real or perceived differences in quality, which can lead to price differences in different countries.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

26-1 \$1 = 9 Mexican pesos; \$1 = 111.23 Japanese yen; Cross exchange rate, yen/peso = ?

$$\text{Cross Rate: } \frac{\text{Dollar}}{\text{Peso}} \times \frac{\text{Yen}}{\text{Dollar}} = \frac{\text{Yen}}{\text{Peso}}.$$

Note that an indirect quotation is given for Mexican; however, the cross rate formula requires a direct quotation. The indirect quotation is the reciprocal of the direct quotation. Since \$1 = 9 pesos, then 1 peso = \$0.1111.

$$\begin{aligned} \text{Yen/Peso} &= 0.1111 \text{ dollars per peso} \times 111.23 \text{ yen per dollar} \\ &= 12.358 \text{ yen per peso.} \end{aligned}$$

26-2  $r_{\text{Nom}}$ , 6-month T-bills = 7%;  $r_{\text{Nom}}$  of similar default-free 6-month Japanese bonds = 5.5%; Spot exchange rate: 1 Yen = \$0.009; 6-month forward exchange rate =  $f_t$  = ?

$$\frac{f_t}{e_0} = \frac{(1 + r_h)}{(1 + r_f)}.$$

$$r_f = 5.5\%/2 = 2.75\%.$$

$$r_h = 7\%/2 = 3.5\%.$$

$$e_0 = \$0.009.$$

$$\frac{f_t}{\$0.009} = \frac{1.035}{1.0275}$$

$$1.0275 f_t = \$0.00932$$

$$f_t = \$0.00907.$$

The 6-month forward exchange rate is 1 yen = \$0.00907.

26-3 U. S. T.V. = \$500; French T.V. = 550 euros; Spot rate between euro and dollar = ?

$$P_h = P_f(e_0)$$
$$\$500 = 550 \text{ euros}(e_0)$$
$$500/550 = e_0$$
$$\$0.9091 = e_0.$$

1 euro = \$0.9091 or \$1 = 1 / 0.9091 = 1.1000 euros.

26-4 Dollars should sell for 1/1.50, or 0.6667 pounds per dollar.

26-5 The price of francs is \$0.60 today. A 10 percent appreciation will make it worth \$0.66 tomorrow. A dollar will buy  $1/0.66 = 1.5152$  francs tomorrow.

26-6 Cross rate = francs/dollars  $\times$  dollars/pounds = francs/pounds  
 $= 1.6 \times 1.5 = 14.16$  francs per pound.

26-7 The U. S. dollar liability of the corporation falls from  $\$0.75(5,000,000) = \$3,750,000$  to  $\$0.70(5,000,000) = \$3,500,000$ , corresponding to a gain of 250,000 U. S. dollars for the corporation. However, the real economic situation might be somewhat different. For example, the loan is presumably a long-term loan. The exchange rate will surely change again before the loan is paid. What really matters, in an economic sense, is the expected present value of future interest and principal payments denominated in U. S. dollars. There are also possible gains and losses on inventory and other assets of the firm. A discussion of these issues quickly takes us outside the scope of this textbook.

26-8 a. The automobile's value has increased because the dollar has declined in value relative to the yen.

b.  $245/108 = 2.2685$ , so  $\$8,000 \times 2.1491 = \$18,148.00$ .

Note that this represents a 4.9% compound annual increase over 17 years.

- 26-9 a. SFr. 1,000,000 (1.6590 \$/SFr.) = \$1,659,000, or  
 SFr. 1,000,000 / \$0.6028 = \$1,658,925.  
 (Difference is due to rounding.)
- b. SFr. 1,000,000/SFr. 0.6075 = \$1,646,091, or  
 FF. 1,000,000 × \$1.6460 = \$1,646,000.
- c. If the exchange rate is SFr. 0.500 to \$1 when payment is due in 3 months, the SFr. 1,000,000 will cost:

$$\text{SFr. } 1,000,000 / \text{SFr. } 0.500 = \$2,000,000,$$

which is more than the spot price today and more than purchasing a forward contract for 90 days.

- 26-10 a.  $r_{\text{Nom}}$  of 90-day U. S. risk-free securities = 5%; of 90-day German risk-free securities = 5.3%;  $e_0 = 1 \text{ euro} = \$0.80$ ;  $f_t$  selling at premium or discount = ?

$$\frac{f_t}{e_0} = \frac{(1 + r_h)}{(1 + r_f)}$$

$$r_h = 5\%/4 = 1.25\%; r_f = 5.3\%/4 = 1.325\%; e_0 = \$0.80.$$

$$\frac{f_t}{\$0.80} = \frac{1.0125}{1.01325}$$

$$\frac{f_t}{\$0.80} = 0.9993.$$

$$f_t = \$0.7994.$$

The forward rate is selling at a discount, since a euro buys fewer dollars in the forward market than it does in the spot. In other words, in the spot market \$1 would buy  $1/0.80 = 1.25$  euros, but at the forward rate \$1 would buy  $1/0.7994 = 1.2509$  euros; therefore, the forward currency is said to be selling at a discount.

- b. The 90-day forward rate is  $f_t = \$0.7994$ .

- 26-11  $e_0 = 1 \text{ yen} = \$0.0086$ ;  $f_t = 1 \text{ yen} = \$0.0086$ ;  $r_{\text{Nom}}$  of 90-day Japanese risk-free securities = 4.6%;  $r_{\text{Nom}}$  of 90-day U. S. risk-free securities = ?

$$\frac{f_t}{e_0} = \frac{(1 + r_h)}{(1 + r_f)}$$

$$r_f = 4.6\%/4 = 1.15\%; r_h = ?$$

$$1 = \frac{(1 + r_h)}{1.0115}$$
$$1 + r_h = 1.0115$$
$$r_h = 0.0115.$$

$$r_{\text{Nom}} = 1.15\% \times 4 = 4.6\%.$$

- 26-12  $\$1 = 7.8 \text{ pesos}$ ;  $\text{CD} = \$15.00$ ; Price of CD in Mexico = ?

$$P_h = P_f(e_0).$$

$$1 \text{ Peso} = 1/7.8 = \$0.1282.$$

$$\$15 = P_f(\$0.1282)$$
$$\frac{\$15}{\$0.1282} = 117 \text{ pesos.}$$

Check:  $e_0 = \$15/117 \text{ pesos} = \$0.1282$  for 1 peso.

## **SOLUTION TO SPREADSHEET PROBLEM**

---

- 26-13 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution for FM11 Ch 26 P13 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.



## MINI CASE

---

Citrus Products Inc. is a medium-sized producer of citrus juice drinks with groves in Indian River County, Florida. Until now, the company has confined its operations and sales to the United States, but its CEO, George Gaynor, wants to expand into Europe. The first step would be to set up sales subsidiaries in Spain and Sweden, then to set up a production plant in Spain, and, finally, to distribute the product throughout the European Common Market. The firm's financial manager, Ruth Schmidt, is enthusiastic about the plan, but she is worried about the implications of the foreign expansion on the firm's financial management process. She has asked you, the firm's most recently hired financial analyst, to develop a 1-hour tutorial package that explains the basics of multinational financial management. The tutorial will be presented at the next board of director's meeting. To get you started, Schmidt has supplied you with the following list of questions.

**a. What is a multinational corporation? Why do firms expand into other countries?**

**Answer:** Use the examples given here when discussing why firms "go international."

1. To seek new markets. Coca-Cola and McDonald's have expanded around the world to seek new markets. Likewise, Sony, Toshiba, and other Japanese consumer electronics manufacturers have aggressively pushed into the U. S.
2. To seek raw materials. U. S. Oil companies have searched around the world for years for new sources of oil. It is not surprising that a large company like Chevron has oil production facilities not only in the continental U. S. and Alaska, but also in the North Sea, Nigeria, Angola, and Australia. Currently, the company is trying to get a foothold in the Soviet Union.
3. To seek new technology. No one country has the lead in all technologies, so many companies are going global to ensure access to new technologies. For example, in the last several years, there have been four joint ventures between Japanese and American chip manufacturers for the sole purpose of exchanging technology.

4. To avoid political and regulatory hurdles. The most prominent example here is the move by Toyota, Honda, Mazda, and Mitsubishi to produce cars and trucks in the U. S. to avoid import quotas.
5. To diversify. By establishing worldwide production facilities and markets, firms can cushion the impact of adverse economic trends in any single country.

**b. What are the six major factors which distinguish multinational financial management from financial management as practiced by a purely domestic firm?**

- Answer:**
1. Different currency denominations. Cash flows in various parts of multinational corporate systems will be denominated in different currencies. Hence, an analysis of exchange rates, and the effect of fluctuating currency values, must be included in all financial analyses.
  2. Economic and legal ramifications. Each country in which a firm operates will have its own unique political and economic institutions, and institutional differences can cause significant problems when the corporation tries to coordinate and control worldwide operations. For example, tax laws vary from country to country, and what makes sense in one country regarding taxes may not in another. Similarly, differences in legal systems, such as the common law of Great Britain versus French civil law, complicate legal matters.
  3. Language differences. The ability to communicate is critical in all business matters, and U. S. business men and women have been notoriously poor in learning other languages. In effect, it is easier for foreign firms to invade our markets than for us to invade theirs. It is interesting to note, though, that English has become the international business language. Many business school programs in Europe, for example, Nijenrode in the Netherlands, are conducted in English rather than in the host country's language. Also, some multinational companies, such as ABB, a large Swedish firm headquartered in Zurich, have adopted English as the language of corporate communication. Although English is now spoken by most international business people, knowledge of other languages remains critical to the success of multinational firms.
  4. Cultural differences. Different countries, and even different regions in a single country, have unique cultural heritages that shape values and influence the role of business in the society. Such differences affect consumption patterns, defining the appropriate firm goals, attitudes toward risk taking, dealings with employees, and so on. For example, most Japanese workers view their jobs as a lifetime commitment, while many American workers view theirs

as temporary until something better comes along. To give another illustration, consider PepsiCo's move into the Japanese market by its Frito-Lay subsidiary. At first, Frito-Lay marketed popular American products such as Ruffles potato chips and Doritos corn chips. These products did poorly, and the Japanese venture almost failed, but it was saved when the company began producing a chip with soy sauce and seaweed flavoring.

5. Role of governments. Except for certain industries, the role of government in the U. S. is to create an environment which promotes free enterprise and competition. However, in many countries, the government takes a much more active role in business affairs, and in some countries, a multinational firm must deal directly with the government to conduct business.
6. Political risk. Nations exercise sovereign rights over their people and property. Thus, a government can seize the assets of a multi-national corporation, or restrict the repatriation of earnings from the country, and the affected company has no recourse for recovery.

**c. Consider the following illustrative exchange rates.**

	<b>U. S. Dollars required to buy one unit of foreign currency</b>
<b>Euro</b>	<b>0.8000</b>
<b>Swedish krona</b>	<b>0.1000</b>

**1. Are these currency prices direct quotations or indirect quotations?**

**Answer:** Since they are the prices of foreign currencies expressed in dollars, they are direct quotations.

**c. 2. Calculate the indirect quotations for Euros and Kronas.**

**Answer:** Indirect quotations, which are the number of units of foreign currency that can be purchased with one U. S. Dollar, are merely the reciprocal of the direct quotation. Here, the table is repeated with the indirect quotations added:

	Direct quotation: U. S. Dollars required to buy one unit of <u>foreign currency</u>	Indirect quotation: number of units of foreign currency per <u>U. S. Dollar</u>
Euro	0.8000	1.2500
Swedish krona	0.1000	10.0000

**c. 3. What is a cross rate? Calculate the two cross rates between euros and kronas.**

**Answer:** The exchange rate between any two currencies which does not involve U. S. Dollars is a cross rate. Here are the two cross rates between euros and kronas:

$$\begin{aligned}\text{Cross rate} &= \frac{\text{Euros}}{\text{Dollar}} \times \frac{\text{Dollars}}{\text{Krona}} \\ &= 1.25 \times 0.1000 = 0.125 \text{ euros per krona.}\end{aligned}$$

$$\begin{aligned}\text{And, Cross rate} &= \frac{\text{Kronas}}{\text{Dollar}} \times \frac{\text{Dollars}}{\text{Euro}} \\ &= 10.00 \times 0.8000 = 8.00 \text{ kronas per euro.}\end{aligned}$$

Note that the two cross rates are reciprocals of one another. Also, note that the cross rates can be calculated by dividing either the direct or indirect quotations. Thus, there are numerous ways of calculating cross rates.

**c. 4. Assume citrus products can produce a liter of orange juice and ship it to Spain for \$1.75. If the firm wants a 50 percent markup on the product, what should the orange juice sell for in Spain?**

**Answer:** There are 200.00 pesetas to the dollar, so the juice must sell for  $(\$1.75)(1.50)(1.25) = 3.28$  euros.

**c. 5. Now assume Citrus Products begins producing the same liter of orange juice in Spain. The product costs 2.0 euros to produce and ship to Sweden, where it can be sold for 20 kronas. What is the dollar profit on the sale?**

**Answer:** 2.0 euros are equal to  $2.0(8.00 \text{ kronas/euro}) = 16$  kronas, so the profit on the sale in Sweden is  $20 - 16 = 4$  kronas. Now, there are 0.1000 dollars per krona, so the dollar profit is  $4(0.1000) = \$0.40$ .

**c. 6. What is exchange rate risk?**

**Answer:** The volatility inherent in a floating exchange rate system increases the uncertainty of cash flows that must be translated from one currency into another. This increase in uncertainty is exchange rate risk.

**d. Briefly describe the current International Monetary System. How does the**

**current system differ from the system that was in place prior to August 1971?**

**Answer:** The current international monetary system is a floating rate system. In this system, currency exchange rates are allowed to fluctuate in response to market conditions with a minimum of governmental intervention. Central banks, like the U. S. Federal Reserve and Germany's Bundesbank, do intervene in the currency markets to smooth out fluctuations, but it is impossible for a central bank to permanently prop up a weak currency. Also, governments do enter into agreements to try to keep currencies within predetermined ranges. However, if market forces move the exchange rate outside one of these ranges, there is little that the countries can do other than adjust the target range.

Prior to 1971, the world operated on a fixed exchange rate system. The value of the U. S. Dollar was linked to gold at the fixed price of \$35 per ounce, and the values of other currencies were then tied to the dollar. For example, in 1964, the British pound was fixed at \$2.80 for 1 pound, with a 1 percent permissible fluctuation around this rate. Thus, the British government had to regularly intervene in the foreign exchange market to keep the pound in the range of \$2.77 to \$2.83. When the pound fell, the Bank of England had to buy pounds, offering either foreign currencies or gold in exchange. Conversely, if the pound reached the top of the range, the Bank of England would sell pounds.

In 2002, the full implementation of the "euro" is expected to be complete. The national currencies of the 11 participating countries will be phased out in favor of the "euro." The newly formed European Central Bank will control the monetary policy of the EMU.

When a currency increases in value relative to another currency, it is said to *appreciate*. Under the fixed exchange rate system, strong currencies had to be *revalued* occasionally, which changed the tie to other currencies to a new, higher rate. Conversely, a currency that loses value is said to *depreciate*, and such currencies had to be devalued under the old fixed rate system.

**e. What is a convertible currency? What problems arise when a multinational company operates in a country whose currency is not convertible?**

**Answer:** A currency is convertible when it is traded on the world currency exchanges and when the issuing country stands ready to redeem the currency at market rates.

When a country's currency is not convertible, it is difficult for multinational companies to conduct business in that country, because there is no easy way to return profits earned to the company's home country. Often, in this situation, it is necessary to engage in some kind of barter arrangement to promote investment.

**f. What is the difference between spot rates and forward rates? When is the forward rate at a premium to the spot rate? At a discount?**

**Answer:** *Spot rates* are the rates paid to buy currency for immediate delivery (actually, two days after the date of the trade). *Forward rates* are the rates paid to buy currency for delivery at some agreed-upon date in the future (say, 90 days).

If the forward currency is less valuable than the spot currency, the forward rate is said to be at a *discount* to the spot rate. Conversely, if the forward currency is more valuable than the spot currency, the forward currency is said to sell at a *premium*.

Firms use currency forward markets to *hedge* against adverse exchange rate fluctuations that might occur before a transaction is completed. To illustrate, suppose a U. S. importer buys German appliances for sale in the U. S. The terms are net 90, so the importer must pay in German marks in 90 days. The dollar could weaken against the mark over the period, and hence force the importer to use more dollars to buy the merchandise. To guard against this possibility, the importer could buy marks for delivery in 90 days, thus locking in the current forward rate.

**g. What is interest rate parity? Currently, you can exchange 1 euro for 0.8100 dollars in the 180-day forward market, and the risk-free rate on 180-day securities is 6 percent in the United States and 4 percent in Spain. Does interest rate parity hold? If not, which securities offer the highest expected return?**

**Answer:** Interest rate parity holds that investors should expect to earn the same return in all countries after adjusting for risk. What is the implied forward rate, given the spot rate of 0.8000?

$$e_0 = 1 \text{ euro} = \$0.8000; r_h = 6\%/2 = 3.00\%; r_f = 4\%/2 = 2.00\%.$$

$$\frac{f_t}{e_0} = \frac{1 + r_h}{1 + r_f}$$

$$\frac{f_t}{0.8000} = \frac{1.03}{1.02}$$

$$f_t = \$0.8078.$$

If interest rate parity held, then  $f_t = \$0.8078$ ; however,  $f_t = \$0.8100$ , so parity doesn't hold.

The Spanish securities offer the highest return as calculated below:

1. Assume you convert \$1,000 to pesetas in the spot market. In the spot market,  $e_0 = \frac{1}{\$0.8000}$  OR 1.25 euros per dollar. Convert  $\$1,000 \times 1.25 \text{ euros/dollar} = 1,250 \text{ euros}$ .
2. Invest 1,250 euros in the 180-day Spanish security which offers a semi-annual return of  $4\%/2 = 2\%$ . So, in 180 days you will receive  $1,250 \text{ pesetas} \times 1.02 = 1,275 \text{ euros}$ .
3. Agree today to exchange the 1,275 euros 180 days from now at a 180-day forward exchange rate of  $f_t = 0.8100$  dollars per euro. Your dollar return after 180 days =  $1,275 \text{ euros} \times 0.8100 \text{ dollars per euro} = \$1,032.75$ .
4. The investment's expected 180-day return =  $\$32.75/\$1,000 = 0.03275 = 3.275\%$ , or a nominal return of  $2 \times 3.275\% = 6.55\%$ .

**h. What is purchasing power parity? If grapefruit juice costs \$2.00 a liter in the United States and purchasing power parity holds, what should be the price of grapefruit juice in Spain?**

**Answer:** Purchasing power parity, sometimes referred to as the law of one price (LOP), implies that the level of exchange rates adjusts so that identical goods cost the same amount in different countries.

$$\text{Purchasing power parity} = P_h = P_f(e_0)$$

$$e_0 = P_h/P_f$$

$$\$0.8000 = \$2.00/P_f$$

$$P_f = \$2.00/\$0.8000 = 2.50 \text{ EUROS.}$$

**i. What impact does relative inflation have on interest rates and exchange rates?**

**Answer:** To illustrate, consider the situation between Japan and the U. S. Japan has generally had a lower inflation rate than the U. S., so Japanese interest rates have been lower than U. S. interest rates. This might tempt treasurers of U. S. multinational firms to borrow in Japan rather than in the U. S. However, a foreign currency will, on average, depreciate (or appreciate) at a percentage rate approximately equal to the amount by which its inflation rate exceeds (or is less than) our own. Thus, the dollar has generally weakened against the yen over time, so it would take more and more dollars to pay back interest denominated in yen.

**j. Briefly discuss the international capital markets.**

**Answer:** Individuals buy securities issued by foreign governments and firms, and U. S. Firms issue securities abroad. These transactions take place in the international capital markets. Here is a brief description of the major international capital markets:

1. A *eurodollar* is a U. S. dollar deposited in a bank outside the United States. The major difference between a “regular” dollar and a eurodollar is its location. This places eurodollars outside the direct control of U. S. monetary authorities, so regulations such as fractional reserves and FDIC insurance premiums do not apply. Eurodollars are borrowed by U. S. and foreign individuals, corporations, and governments which need dollars for various purposes. Since the borrower must pay back the lender in dollars, eurodollar transactions are not used to convert currencies, but rather represent another source of dollar borrowing.

Interest rates on eurodollars are tied to the *London Interbank Offer Rate (LIBOR)*, which is the rate of interest offered by the largest and strongest London banks on eurodollar deposits. LIBOR rates are generally 0.5 to 1.0 percentage points higher than the rate on comparable deposits offered by domestic banks in the U. S. The eurodollar market deals mostly with short maturities, generally less than one year, although loans of up to 5 years have occurred.

2. *International bonds*, which are any bond sold outside the country of the borrower, fall into two categories. *Foreign bonds* are bonds sold by a foreign borrower, but denominated in the currency of the country in which they are sold. Thus, when Bell Canada sells bonds in the U. S. denominated in U. S. dollars, the firm is selling foreign bonds. In general, foreign bonds have to meet all the regulations of the country in which they are issued.

*Eurobonds* are bonds sold in some country other than the one in whose currency the bond is denominated. For example, when Mercedes-Benz (a German company) sell bonds denominated in German marks in Switzerland, these bonds are eurobonds. In general, countries do not apply as stringent requirements on bonds denominated in a foreign currency as they do bonds denominated in the home currency. Further, most eurobonds are issued in bearer form, so buyers have anonymity, both for tax and other purposes. For these reasons, investors are usually willing to accept somewhat lower yields on eurobonds than on foreign bonds or “regular” bonds. Thus, U. S. firms can often sell eurobonds denominated in dollars at lower cost than similar domestic issues.

<b>k. To what extent do average capital structures vary across different countries?</b>
---

**Answer:** There is some evidence that average capital structures vary among the large industrial countries. One problem, however, when interpreting these numbers is that different countries often use very different accounting conventions, which makes it difficult to compare capital structures.

A recent study attempts to control for differences in accounting practices. This study suggests that differences in accounting practices can explain much of the cross-country variation in capital structures. After adjusting for these accounting differences, capital structures are more similar across different countries than a previous study had suggested.

<b>l. What is the impact of multinational operations on each of the following financial management topics?</b>
--

- |                     |
|---------------------|
| 1. Cash management. |
|---------------------|

**Answer:** Although multinational and domestic firms have the same objectives for cash management and use similar procedures, the multinational firm faces a more complex task. Since the distances

involved are much greater, multinational firms tend to rely more on lockbox systems and wire transfers. Also, since multinational firms have access to more financial markets than do domestic firms, multinational companies are more likely to have global concentration banks, say in Tokyo, New York, London, and Zurich, and excess funds are transferred around the world to take advantage of the best rates available. Short-term borrowings are handled in the same way, with many more opportunities available to the firm. However, whenever the borrowing or lending takes place in a currency other than dollars, it is necessary to consider the possibility of adverse exchange rate movements.

1. 2. Capital budgeting decisions.

**Answer:** The same general principles which apply to domestic capital budgeting also apply to foreign capital budgeting. However, foreign capital budgeting is complicated by the following three primary factors:

1. Tax law differences. Foreign operations are usually taxed at the local level, and then funds *repatriated*, or returned, to the parent corporation may be subject to additional U. S. taxes.
2. Political risk. Foreign governments have the right to restrict the amount of funds that can be repatriated. In extreme cases, foreign governments can even expropriate the assets owned by U. S. companies without offering any compensation.
3. Exchange rate risk. Funds repatriated from foreign operations have to be converted into dollars, so foreign capital projects are subject to exchange rate risk.

1. 3. Credit management.

**Answer:** Granting credit is riskier for a multinational firm than for a domestic corporation because, in addition to the normal risk of default, the credit granting corporation must also worry about exchange rate fluctuations between the time the credit is given and the time the payment must be made. In addition to being riskier, credit is more important for international business, because much of the commerce on which lesser-developed countries depend could not occur if the seller did not grant credit.

1. 4. Inventory management.

**Answer:** As with other aspects of financial management, inventory management in a multinational setting is similar to but more complex than that in a purely domestic firm. For example, where should Exxon store its inventories of crude oil and refined products, and how much should be stored at each location? The answer depends on many factors, including shipping times, carrying costs, import quotas and taxes, differential taxes on inventories, and expected exchange rate movements. These factors greatly complicate inventory decisions within multinational firms.

## Chapter 27

### Banking Relationships

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 27-1 a. Cash discounts are often used to encourage early payment and to attract customers by effectively lowering prices. Credit terms are usually stated in the following form: 2/10, net 30. This means a 2 percent discount will apply if the account is paid within 10 days, otherwise the account must be paid within 30 days.
- b. Seasonal dating sets the invoice date, or date at which the credit and discount periods begin, to a time during the buyer's own selling season, regardless of the actual sale date.
- c. **An aging schedule breaks down accounts receivable according to how long they have been outstanding. This gives the firm a more complete picture of the structure of accounts receivable than that provided by days sales outstanding. Days sales outstanding (DSO) is a measure of the average length of time it takes a firm's customers to pay off their credit purchases.**
- d. The payments pattern approach is a procedure which measures any changes that might occur in customers' payment behavior. The advantage of this approach is that it is not affected by changes in sales levels due to cyclical or seasonal factors. The uncollected balances schedule, which is an integral part of the payments pattern approach, helps a firm monitor its receivables better and also forecast future receivables balances.
- e. The situation when interest is not compounded, that is, interest is not earned on interest, is simple interest. Discount interest is interest that is calculated on the face amount of a loan but is paid in advance. Add-on interest is interest that is calculated and added to funds received to determine the face amount of an installment loan.
- 27-2 The latest date for paying and taking discounts is May 10. The date by which the payment must be made is June 9.
- 27-3 False. An aging schedule will give more detail, especially as to what percentage of accounts are past due and what percentage of accounts are taking discounts.
- 27-4 No. Although B sustains slightly more losses due to uncollectible accounts, its credit manager may have a wise policy that is generating more sales revenues (and thus profits) than would be the case if he had a policy which cut those losses to zero.

27-5		<u>A/R</u>	<u>Sales</u>	<u>Profit</u>
	a. The firm tightens its credit standards.	<u>-</u>		<u>-</u>
<u>0</u>				
	b. The terms of trade are changed from 2/10, net 30, to 3/10, net 30.		<u>0</u>	
<u>+</u>	<u>0</u>			
	c. The terms are changed from 2/10 net 30, to 3/10, net 40.		<u>0</u>	<u>+</u>
<u>0</u>				
	d. The credit manager gets tough with past-due accounts.		<u>-</u>	<u>-</u>
<u>0</u>				

Explanations:

- a. When a firm “tightens” its credit standards, it sells on credit more selectively. It will likely sell less and certainly will make fewer credit sales. Profit may be affected in either direction.
- b. The larger cash discount will probably induce more sales, but they will likely be from customers who pay bills quickly. Further, some of the current customers who do not take the 2 percent discount may be induced to start paying earlier. The effect of this would be to reduce accounts receivable, so accounts receivable and profits could go either way.
- c. A less stringent credit policy in terms of the credit period should stimulate sales. The accounts receivable could go up or down depending upon whether customers take the new higher discount or delay payments for the 10 additional days, and depending upon the amount of new sales generated.
- d. If the credit manager gets tough with past due accounts, sales will decline, as will accounts receivable.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

27-1 Analysis of change:

Projected Income Statement	Projected Statement Under Current Credit Policy	Credit Policy Change	Income Effect of Under New Credit
Policy			
Gross sales	\$1,600,000		+\$ 25,000
\$1,625,000			
Less: Discounts	0		0
0	0		
Net sales		\$1,600,000	+\$ 25,000
\$1,625,000			
Variable costs		1,200,000	+ 18,750
1,218,750			
Profit before credit costs and taxes		\$ 400,000	+\$ 6,250
\$ 406,250			
Credit-related costs:			
Cost of carrying receivables*		15,781	+ 8,260
24,041			
Collection expense		35,000	- 13,000
22,000			
Bad debt losses		24,000	+ 16,625
40,625			
Profit before taxes		\$ 325,219	-\$ 5,635
\$ 319,584			
Taxes (40%)		130,088	- 2,254
127,834			
Net income		\$ 195,131	-\$ 3,381
\$ 191,750			

\*Cost of carrying receivables:

$$\left( \text{DSO} \right) \left( \frac{\text{Sales}}{\text{per day}} \right) \left( \frac{\text{Variable}}{\text{cost ratio}} \right) \left( \frac{\text{Cost of}}{\text{funds}} \right)$$

$$\text{Current policy} = (30) \left( \frac{\$1,600,000}{365} \right) (0.75)(0.16) = \$15,781.$$

$$\text{New policy} = (45) \left( \frac{\$1,625,000}{365} \right) (0.75)(0.16) = \$24,041.$$

Since the change in profitability is negative, the firm should not relax its collection efforts.

27-2 Analysis of change:

Projected Income Statement	Statement Under Current	Projected Credit Policy Credit	Income Effect of Under New Policy
<u>Change</u>	<u>Credit Policy</u>		
Gross sales		\$2,500,000	-\$125,000
\$2,375,000			
Less: Discounts			<u>0</u>
<u>0</u>	<u>0</u>		
Net sales		\$2,500,000	-\$125,000
\$2,375,000			
Variable costs		<u>2,125,000</u>	- <u>106,250</u>
<u>2,018,750</u>			
Profit before credit costs and taxes		\$ 375,000	-\$ 18,750
\$ 356,250			
Credit-related costs:			
Cost of carrying receivables*		99,555	- 64,711
34,844			
Bad debt losses			<u>0</u>
<u>0</u>	<u>0</u>		
Profit before taxes		\$ 275,445	+\$ 45,961
\$ 321,406			
Taxes (40%)		<u>110,178</u>	+ <u>18,384</u>
<u>128,562</u>			
Net income		<u>\$ 165,267</u>	+ <u>\$ 27,577</u>
<u>\$ 192,844</u>			

\*Cost of carrying receivables:

$$\left( \text{DSO} \right) \left( \frac{\text{Sales}}{\text{per day}} \right) \left( \frac{\text{Variable}}{\text{cost ratio}} \right) \left( \frac{\text{Cost of}}{\text{funds}} \right)$$

$$\text{Current policy} = (95) \left( \frac{\$2,500,000}{365} \right) (0.85)(0.18) = \$99,555.$$

$$\text{New policy} = (35) \left( \frac{\$2,375,000}{365} \right) (0.85)(0.18) = \$34,844.$$

The firm should change its credit terms since the change in profitability is positive.



27-3 a. March receivables =  $\$120,000(0.8) + \$100,000(0.5) = \$146,000$ .  
 June receivables =  $\$160,000(0.8) + \$140,000(0.5) = \$198,000$ .

b. 1st Quarter:  $ADS = (\$50,000 + \$100,000 + \$120,000)/90 = \$3,000$ .  
 $DSO = \$146,000/\$3,000 = 48.7$  days.

2nd Quarter:  $ADS = (\$105,000 + \$140,000 + \$160,000)/90 = \$4,500$ .  
 $DSO = \$198,000/\$4,500 = 44.0$  days.

Cumulative:  $ADS = (\$50,000 + \$100,000 + \$120,000 + \$105,000 + \$140,000 + \$160,000)/180 = \$3,750$ ,

or  $ADS = (\$3,000 + \$4,500)/2 = \$3,750$ .  
 $DSO = \$198,000/\$3,750 = 52.8$  days.

<u>Age of Accounts</u>	<u>Dollar Value</u>	<u>Percent of Total</u>
0 - 30 days	\$128,000	65%
31 - 60	70,000	35
61 - 90	<u>0</u>	<u>0</u>
	<u>\$198,000</u>	<u>100%</u>

<u>Month</u>	<u>Sales</u>	<u>Receivables</u>	<u>Receivables/Sales</u>
April	\$105,000	\$ 0	0%
May	140,000	70,000	50
June	<u>160,000</u>	<u>128,000</u>	<u>80</u>
		<u>\$198,000</u>	<u>130%</u>

27-4 \$25,000 interest-only loan, 11% nominal rate. Interest calculated as simple interest based on 365-day year. Interest for 1st month = ?

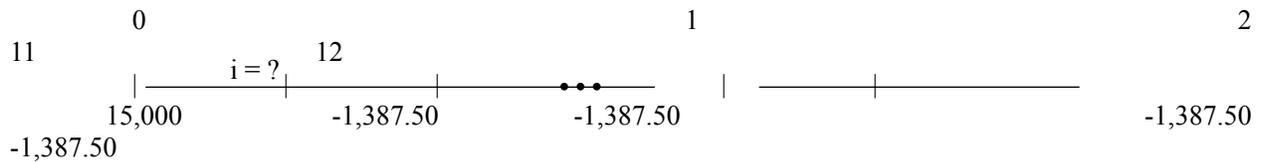
Interest rate per day =  $0.11/365 = 0.000301$ .

Interest charge for period =  $(31)(0.11/365)(\$25,000) = \$233.56$ .

27-5 \$15,000 installment loan, 11% nominal rate.  
 Effective annual rate, assuming a 365-day year = ?

Add-on interest =  $0.11(\$15,000) = \$1,650$ .

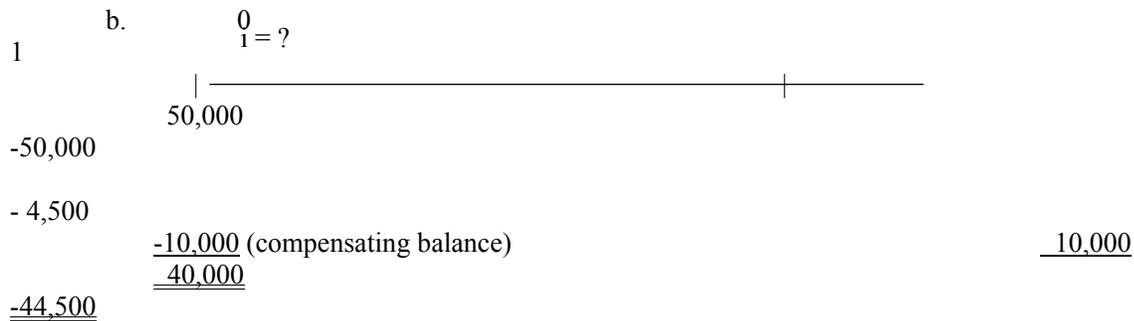
$$\text{Monthly Payment} = \frac{\$15,000 + \$1,650}{12} = \$1,387.50.$$



With a financial calculator, enter  $N = 12$ ,  $PV = 15000$ ,  $PMT = -1387.50$ ,  $FV = 0$ , and then press  $I$  to obtain 1.6432%. However, this is a monthly rate.

$$\begin{aligned} \text{Effective annual rate}_{\text{Add-on}} &= (1 + r_d)^n - 1.0 \\ &= (1.016432)^{12} - 1.0 \\ &= 1.2160 - 1.0 = 0.2160 = 21.60\%. \end{aligned}$$

27-6 a. Effective rate = 12%.



With a financial calculator, enter  $N = 1$ ,  $PV = 40000$ ,  $PMT = 0$ , and  $FV = -44500$  to solve for  $I = 11.25\%$ .

Note that, if Hawley actually needs \$50,000 of funds, he will have to borrow  $\frac{\$50,000}{1 - 0.2} = \$62,500$ .

The effective interest rate will still be 11.25%.

c.  $i = ?$

	-----	
	50,000	
-50,000	- 4,375 (discount interest) - 7,500 (compensating balance)	<u>7,500</u> <u>-42,500</u>
	<u>38,125</u>	

With a financial calculator, enter  $N = 1$ ,  $PV = 38125$ ,  $PMT = 0$ , and  $FV = -42500$  to solve for  $I = 11.4754\% \approx 11.48\%$ .

Note that, if Hawley actually needs \$50,000 of funds, he will have to borrow  $\frac{\$50,000}{1 - 0.0875 - 0.15} = \$65,573.77$ . The effective interest rate will still be 11.48%.

d. Approximate annual rate =  $\frac{(0.08)(\$50,000)}{(\$50,000/2)} = \frac{\$4,000}{\$25,000} = 16\%$ .

Precise effective rate:

$$\$50,000 = \sum_{t=1}^{12} \frac{\$4,166.67}{(1+r_d)^t} + \frac{\$4,000}{(1+r_d)^{12}}$$

$r_d$ , the monthly interest rate, is 1.1326%, found with a financial calculator. Input  $N = 12$ ;  $PV = 50000$ ;  $PMT = -4166.67$ ;  $FV = -4000$ ; and  $I = ?$ . The precise effective annual rate is  $(1.011326)^{12} - 1.0 = 14.47\%$ .

Alternative b has the lowest effective interest rate.

27-7 Accounts payable:

$$\text{Nominal cost} = \left(\frac{3}{97}\right)\left(\frac{360}{80}\right) = (0.0204)(7.2) = 14.69\%$$

$$\text{EAR cost} = (1.03093)^{4.5} - 1.0 = 14.69\%$$

Bank loan:

	-----	
	0 $i = ?$	1
500,000		-500,000
	<u>-60,000</u> (discount interest)	

440,000

With a financial calculator, enter  $N = 1$ ,  $PV = 440000$ ,  $PMT = 0$ , and  $FV = -500000$  to solve for  $I = 13.636\% \approx 13.64\%$ .

Note that, if Masson actually needs \$500,000 of funds, he will have to borrow  $\frac{\$500,000}{1 - 0.12} = \$568,181.82$ . The effective interest rate will still be 13.64%.

The bank loan is the lowest cost source of capital available to D.J. Masson at 13.64%.

27-8 a. Simple interest: 12%.

b. 3-months:  $(1 + 0.115/4)^4 - 1 = 12.0055\%$ , or use the interest conversion feature of your calculator as follows:

NOM% = 11.5; P/YR = 4; EFF% = ?    EFF% = 12.0055%.

c. Add-on: Interest = Funds needed( $r_d$ ).

$$\begin{aligned}\text{Loan} &= \text{Funds needed}(1 + r_d). \\ \text{PMT} &= \text{Loan}/12.\end{aligned}$$

Assume you borrowed \$100. Then,  $\text{Loan} = \$100(1.06) = \$106$ .  
 $\text{PMT} = \$106/12 = \$8.8333$ .

$$\$100 = \sum_{t=1}^{12} \frac{\$8.8333}{(1 + r_d)^t}.$$

Enter  $N = 12$ ,  $PV = 100$ ,  $PMT = -8.8333$ ,  $FV = 0$ , and press I to get  
 $I = 0.908032\% = r_d$ . This is a monthly periodic rate, so the effective annual rate =  
 $(1.00908032)^{12} - 1 = 0.1146 = 11.46\%$ .

d. Trade credit:  $1/99 = 1.01\%$  on discount if pay in 15 days, otherwise pay 45 days later. So, get  $60 - 15 = 45$  days of credit at a cost of  $1/99 = 1.01\%$ . There are  $360/45 = 8$  periods, so the effective cost rate is:

$$(1 + 1/99)^8 - 1 = (1.0101)^8 - 1 = 8.3723\%.$$

Thus, the least expensive type of credit for Yonge is trade credit with an effective cost of 8.3723 percent.

27-9 a. The quarterly interest rate is equal to  $11.25\%/4 = 2.8125\%$ .

$$\begin{aligned} \text{Effective annual rate} &= (1 + 0.028125)^4 - 1 \\ &= 1.117336 - 1 = 0.117336 = 11.73\%. \end{aligned}$$

b.  $i = ?$

1

	-----	
	1,500,000	
-1,500,000	-33,750 (discount interest)	
	<u>-300,000 (compensating balance)</u>	<u>300,000</u>
	<u>1,166,250</u>	<u>-1,200,000</u>

With a financial calculator, enter  $N = 1$ ,  $PV = 1166250$ ,  $PMT = 0$ , and  $FV = -1200000$  to solve for  $I = 2.89389\% \approx 2.89\%$ . However, this is a periodic rate.

$$\text{Effective annual rate} = (1 + 0.0289389)^4 - 1 = 12.088\% \approx 12.09\%.$$

Note that, if Gifts Galore actually needs \$1,500,000 of funds, it will have to borrow  $\frac{\$1,500,000}{1 - 0.0225 - 0.2} = \frac{\$1,500,000}{0.7775} = \$1,929,260.45$ . The effective interest rate will still be  $12.088\% \approx 12.09\%$ .

c. Installment loan:

$$\begin{aligned} \text{PMT} &= (\$1,500,000 + \$33,750)/3 = \$511,250. \\ \text{INPUT } N &= 3, \text{ PV} = 1500000, \text{ PMT} = -511250, \text{ FV} = 0. \\ \text{OUTPUT } I &= 1.121\% \text{ per month. Nominal annual rate} = 12(1.121\%) = 13.45\%. \end{aligned}$$

27-10 a. Malone's current accounts payable balance represents 60 days purchases. Daily purchases can be calculated as  $\frac{\$500}{60} = \$8.33$ .

If Malone takes discounts then the accounts payable balance would include only 10 days purchases, so the A/P balance would be  $\$8.33 \times 10 = \$83.33$ .

If Malone doesn't take discounts but pays in 30 days, its A/P balance would be  $\$8.33 \times 30 = \$250$ .

b. Takes Discounts:

If Malone takes discounts its A/P balance would be \$83.33. The cash it would need to be loaned is \$500 - \$83.33 = \$416.67.

Since the loan is a discount loan with compensating balances, Malone would require more than a \$416.67 loan.

$$\text{Face amount of loan} = \frac{\$416.67}{1 - 0.15 - 0.20} = \frac{\$416.67}{0.65} = \$641.03.$$

Doesn't Take Discounts:

If Malone doesn't take discounts, its A/P balance would be \$250. The cash needed from the bank is \$500 - \$250 = \$250.

$$\text{Face amount of loan} = \frac{\$250}{1 - 0.15 - 0.20} = \frac{\$250}{0.65} = \$384.62.$$

c. Nonfree Trade Credit:

Nominal annual cost:

$$\frac{\text{Discount \%}}{100 - \text{Discount \%}} \times \frac{360}{\text{Days credit is outstanding} - \text{Discount period}} = \frac{1}{99} \times \frac{360}{20} = 18.18\%.$$

$$\text{Effective cost: } \left(1 + \frac{1}{99}\right)^{18} - 1 = (1.0101)^{18} - 1 = 1.1983 - 1 = 19.83\%.$$

Bank Loan: 15% Discount Loan with 20% compensating balance.

Assume the firm doesn't take discounts so it needs \$250 and borrows \$384.62. (The cost will be the same regardless of how much the firm borrows.)

0		
1		
		384.62
		-384.62
		-57.69 Discount interest
		<u>+76.92</u>
		<u>-76.92</u> Compensating balance
		<u>-307.70</u>
		<u>250.00</u>

With a financial calculator, input the following data, N = 1, PV = 250, PMT = 0, FV = -307.70, and then solve for I = 23.08%.

Just to show you that it doesn't matter how much the firm borrows, assume the firm takes discounts and it reduces A/P to \$83.33 so it needs \$416.67 cash and borrows \$641.03.

0		
1		
		641.03
		-641.03
		-96.15 Discount interest
		<u>+128.21</u>
		<u>-128.21</u> Compensating balance
		<u>-512.82</u>
		<u>416.67</u>

With a financial calculator, input the following data, N = 1, PV = 416.67, PMT = 0, FV = -512.82, and then solve for I = 23.08%.

Because the cost of nonfree trade credit is less than the cost of the bank loan, Malone should forgo discounts and reduce its payables only to \$250,000.

d. Pro Forma Balance Sheet (Thousands of Dollars):

Cash <sup>a</sup>	\$ 126.9	Accounts payable	\$ 250.0
Accounts receivable	450.0	Notes payable <sup>b</sup>	434.6
Inventory	750.0	Accruals	50.0
Prepaid interest	<u>57.7</u>		—
Total current assets	\$1,384.6	Total current liabilities	\$ 734.6
Fixed assets	750.0	Long-term debt	150.0
		Common equity	<u>1,250.0</u>
Total assets	<u>\$2,134.6</u>	Total claims	<u>\$2,134.6</u>

<sup>a</sup> \$384,615(0.2) = \$76,923 = Compensating balance.

Cash = \$50 + \$76.923 = \$126.9.

<sup>b</sup> Notes payable = \$50 + \$384.6 = \$434.6.

- e. To reduce the accounts payable by \$250,000, which reflects the 1% discount, Malone must pay the full cost of the payables, which is  $\$250,000/0.99 = \$252,525.25$ . The lost discount is the difference between the full cost of the payables and the amount that is reported net of discount:  $\text{Lost discount} = \$252,525.25 - \$250,000.00 = \$2,525.25$ . The after-tax cost of the lost discount is  $\$2,525.25(1-0.40) = \$1,515.15$ . Notice that this provides a tax shield in the amount of  $\$2,525.25(0.40) = \$1,010.10$ . The total amount of cash that Malone needs to pay down \$250,000 of accounts payable is the gross amount minus the tax shield:  $\$252,525.25 - \$1,010.10 = \$251,515.15$ .

$$\text{Face amount of loan} = \frac{\$251,515.15}{1-0.15-0.20} = \frac{\$251,515.15}{0.65} = \$386,946.38.$$

Pro Forma Balance Sheet (Thousands of Dollars):

Cash <sup>a</sup>	\$ 127.4	Accounts payable	\$ 250.0
Accounts receivable	450.0	Notes payable <sup>b</sup>	436.9
Inventory	750.0	Accruals	50.0
Prepaid interest	<u>58.0</u>		—
Total current assets	\$1,385.4	Total current liabilities	\$ 736.9
Fixed assets	750.0	Long-term debt	150.0
		Common equity <sup>c</sup>	<u>1,248.5</u>
Total assets	<u>\$2,135.4</u>	Total claims	<u>\$2,135.4</u>

<sup>a</sup>  $\$386,946.38(0.2) = \$77,389.27 = \text{Compensating balance.}$

Cash =  $\$50 + \$77.4 = \$127.4$ .

<sup>b</sup> Notes payable =  $\$50 + \$386.9 = \$436.9$ .

<sup>c</sup> Common equity = Previous common equity – after-tax lost discount  
 =  $\$1,250 - \$1.5 = \$1,248.5$

27-11 a. 1. *Line of credit:*  
 Commitment fee =  $(0.005)(\$2,000,000)(11/12) = \$ 9,167$   
 Interest =  $(0.11)(1/12)(\$2,000,000) = \underline{18,333}$   
 Total

\$27,500

2. *Trade discount:*

a. Nominal rate =  $\left(\frac{2}{98}\right)\left(\frac{360}{30}\right) = 24.49 \approx 24.5\%$ .

Total cost =  $0.245(\$2,000,000)/12 = \$40,833$ .

b. Effective cost =  $(1 + 2/98)^{360/30} - 1 = 0.2743 = 27.43\%$ .

Total cost =  $0.2743(\$2,000,000)/12 = \$45,717$ .

3. *30-day commercial paper:*

Interest =  $(0.095)(\$2,000,000)(1/12) = \$15,833$

Transaction fee =  $(0.005)(\$2,000,000) = \underline{10,000}$

\$25,833

4. *60-day commercial paper:*

Interest =  $(0.09)(\$2,000,000)(2/12) = \$30,000$

Transaction fee =  $(0.005)(\$2,000,000) = \underline{10,000}$

\$40,000

Marketable securities interest received  
 =  $(0.094)(\$2,000,000)(1/12) = -15,667$

Transactions cost, marketable securities  
 =  $(0.004)(\$2,000,000) = \underline{+8,000}$

\$32,333

The 30-day commercial paper has the lowest cost.

- b. The lowest cost of financing is not necessarily the best. The use of 30-day commercial paper is the cheapest; however, sometimes the commercial paper market is tight and funds are not available. This market also is impersonal. A banking arrangement may provide financial counseling and a long-run relationship in which the bank performs almost as a "partner and counselor" to the firm. Note also that while the use of 60-day commercial paper is more expensive than the use of 30-day paper, it provides more flexibility in the event the money is needed for more than 30 days. However, the line of credit provides even more flexibility than the 60-day commercial paper and at a lower cost.

## SOLUTION TO SPREADSHEET PROBLEMS

---

- 27-12 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 27-12 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**Rich Jackson, a recent finance graduate, is planning to go into the wholesale building supply business with his brother, Jim, who majored in building construction. The firm would sell primarily to general contractors, and it would start operating next January. Sales would be slow during the cold months, rise during the spring, and then fall off again in the summer, when new construction in the area slows. Sales estimates for the first 6 months are as follows (in thousands of dollars):**

<u>Jan</u>	<u>\$100</u>
Feb	200
Mar	300
Apr	300
May	200
Jun	100

**The terms of sale are net 30, but because of special incentives, the brothers expect 30 percent of the customers (by dollar value) to pay on the 10th day following the sale, 50 percent to pay on the 40th day, and the remaining 20 percent to pay on the 70th day. No bad debt losses are expected, because Jim, the building construction expert, knows which contractors are having financial problems.**

**a. Discuss, in general, what it means for the brothers to set a credit and collections policy.**

**Answer:** When a firm sets its credit and collections policy it determines four things:

1. The credit period, which is the length of time buyers are given to pay for their purchases
2. The discounts that are given for early payment.
3. The credit standards, which are the financial strength requirements for customers to purchase on credit from the firm.
4. The collection policy, which is how hard the company will work to collect slow-paying accounts.

These policies determine the level of sales and also the level of accounts receivable. Note that although sales contribute to profitability, additional accounts receivable require the investment of funds, so a firm must take both the profits from additional sales and the additional capital required to fund accounts receivable when it determines a credit policy.

**b. Assume that, on average, the brothers expect annual sales of 18,000 items at an average price of \$100 per item. (use a 365-day year.)**

1. **What is the firm's expected days sales outstanding (DSO)?**

**Answer:** Days sales outstanding = DSO =  $0.3(10) + 0.5(40) + 0.2(70) = 37$  days, vs. 30-day credit period. One would expect some customers to pay somewhat slowly, so a 37-day DSO is probably not too bad.

**b. 2. What is its expected average daily sales (ADS)?**

**Answer:** Average daily sales = ADS =  $\frac{18,000(\$100)}{365} = \$4,931$  per day.

**b. 3. What is its expected average accounts receivable level?**

**Answer:** Accounts receivable (A/R) = (DSO)(ADS) =  $37(\$4,931) = \$182,466$ . Thus, \$182,466 of receivables are outstanding, and the firm must raise capital to carry receivables. If collections could be speeded up, and DSO reduced, then A/R, and hence the required financing, would be reduced.

**b. 4. Assume that the firm's profit margin is 25 percent. How much of the receivables balance must be financed? What would the firm's balance sheet figures for accounts receivable, notes payable, and retained earnings be at the end of one year if notes payable are used to finance the investment in receivables? Assume that the cost of carrying receivables had been deducted when the 25 percent profit margin was calculated.**

**Answer:** Although the firm has \$182,466 in receivables, the entire amount does not have to be financed, since 25 percent of the sales price is profit. This means that 75 percent of the price represents costs of materials, labor, rent, utilities, insurance, and so on. Thus, the firm must finance only  $0.75(\$182,466) = \$136,849$  of the receivables balance. Disregarding other assets and liabilities, its balance sheet would look like this if notes payable are used to finance receivables:

Accounts receivable	\$182,466	Notes payable	\$136,849
		Retained earnings	<u>45,616</u>
			<u>\$182,466</u>

**b. 5. If bank loans have a cost of 12 percent, what is the annual dollar cost of carrying the receivables?**

**Answer:** Cost of carrying receivables =  $0.12(\$136,849) = \$16,422$ . In addition, there is an opportunity cost associated with not having the use of the profit component of the receivables.

**c. What are some factors that influence (1) a firm's receivables level and (2) the dollar cost of carrying receivables?**

- Answer:**
1. As shown in question B.3. Above, receivables are a function of the average daily sales and the days sales outstanding. Exogenous economic factors such as the state of the economy and competition within the industry affect average daily sales, but so does the firm's credit policy. The days sales outstanding depends mainly on credit policy, although poor economic conditions can lead to a reduction in customers' ability to make payments.
  2. For a given level of receivables, the lower the profit margin, the higher the cost of carrying receivables, because the greater the portion of each sales dollar that must actually be financed. Similarly, the higher the cost of the financing, the higher the dollar cost of carrying the receivables.

- d. Assuming that the monthly sales forecasts given previously are accurate, and that customers pay exactly as was predicted, what would the receivables level be at the end of each month? To reduce calculations, assume that 30 percent of the firm's customers pay in the month of sale, 50 percent pay in the month following the sale, and the remaining 20 percent pay in the second month following the sale. Note that this is a different assumption than was made earlier. Use the following format to answer parts c and d:

<u>Month</u>	<u>Sales</u>	<u>E.O.M. A/R</u>	<u>Quarterly</u>		<u>DSO = (A/R)/(ADS)</u>
			<u>Sales</u>	<u>ADS</u>	
Jan	\$100	\$ 70			
Feb	200	160			
Mar	300	250	\$600	\$6.59	37.9
Apr	300				
May	200				
Jun	100				

**Answer:** (Note: from this point on, the solutions are expressed in thousands of dollars. Also, the table given below is developed in the solutions to parts D and E.)

At the end of January, 30 percent of the \$100 in sales will have been collected, so  $(1 - 0.3)(\$100) = 0.7(\$100) = \$70$  will remain outstanding, that is, in the receivables account. At the end of February,  $30\% + 50\% = 80\%$  of January's sales will have been collected, so receivables associated with January sales will be  $(1 - 0.3 - 0.5)(\$100) = 0.2(\$100) = \$20$ . Of February's \$200 in sales, 30 percent will have been collected, so  $0.7(\$200) = \$140$  will remain outstanding. Thus, the receivables balance at the end of February will be \$20 from January's sales plus \$140 from February's sales, for a total of \$160.

By the end of march, all of January's sales will have been collected, but 20 percent of February's sales and 70 percent of march's sales will still be outstanding, so receivables will equal

$0.2(\$200) + 0.7(\$300) = \$250$ . Following this logic, the receivables balance at the end of any month can be estimated as follows:

$$A/R = 0.7(\text{sales in that month}) + 0.2(\text{sales in previous month}).$$

Month	Sales	E.O.M. A/R	Quarterly		DSO = (A/R)/(ADS)
			Sales	ADS	
Jan	\$100	\$ 70			
Feb	200	160			
Mar	300	250	\$600	\$6.59	37.9
Apr	\$300	\$270			
May	200	200			
Jun	100	110	\$600	\$6.59	16.7

e. **What is the firm's forecasted average daily sales for the first 3 months? For the entire half-year? The days sales outstanding is commonly used to measure receivables performance. What DSO is expected at the end of March? At the end of June? What does the DSO indicate about customers' payments? Is DSO a good management tool in this situation? If not, why not?**

**Answer:** For the first quarter, sales totaled  $\$100 + \$200 + \$300 = \$600$ , so ads =  $\$600/91 = \$6.59$ . Although the sales pattern is different, ads for the second quarter, and hence for the full half-year, is also  $\$6.59$ . Note that we can rearrange the formula for receivables as follows:

$$A/R = (DSO)(ADS)$$

$$DSO = \frac{A/R}{ADS}$$

$$\text{March: } DSO = \frac{\$250}{\$6.59} = 37.9 \text{ days; } \text{June: } DSO = \frac{\$110}{\$6.59} = 16.7 \text{ days.}$$

Thus, at the end of March, DSO = 37.9 days, while at the end of June, DSO = 16.7 days.<sup>2</sup>

Looking at the DSO, it appears that customers are paying significantly faster in the second quarter than in the first. However, the receivables balances were created assuming a constant payment pattern, so the DSO is giving a false measure of customers' payment performance. The underlying cause of the problem with the DSO is the seasonal variability in sales. If there were

---

<sup>2</sup>Even if one confined ads to the months which contributed to receivables, Feb/Mar and May/Jun, first quarter ADS =  $\$8.33$  and DSO = 30 days, while half-year ads =  $\$5.00$  and DSO = 22 days, differences would still appear.

no seasonal pattern, and hence sales were a constant \$200 each month, then the DSO would be 27 days in both March and June, indicating that customers' payment patterns had remained steady.

f. Construct aging schedules for the end of March and the end of June (use the format given below). Do these schedules properly measure customers' payment patterns? If not, why not?

Age of account (days)	March		June	
	A/R	%	A/R	%
0 – 30	\$210	84%		
31 – 60	40	16		
61 – 90	0	0		
	<u>\$250</u>	<u>100%</u>		

Answer: Aging schedule:

Age of account (days)	March			June		
	A/R		%	A/R		%
0 – 30	\$210	Mar	84%	\$ 70	Jun	64%
31 – 60	40	Feb	16	40	May	36
61 – 90	0	Jan	0			Apr
<u>0</u>	<u>\$250</u>		<u>100%</u>	<u>\$110</u>		<u>100</u>

To see how these aging schedules were constructed, consider first the end-of-March schedule. At that time, 30 percent of March's sales had been collected, so 70 percent remained uncollected:  $0.7(\$300) = \$210$ . February's contribution to receivables is  $0.2(\$200) = \$40$ . Finally, by the end of March, all of January's sales had been collected, so none of January's sales remained outstanding. Thus, the receivables account totals \$250 at the end of March, which is consistent with the answer to part C.

Note that the end-of-June aging schedule suggests that customers are paying more slowly than in the earlier quarter. However, we know that the payment pattern has remained constant, so the firm's customers' payment performance has not changed. Again, a seasonally fluctuating sales level is the cause of the problem: aging schedules give incorrect signals if sales are trending up or down. If sales were a constant \$200 in each month, then both aging schedules would indicate that 78 percent of receivables were 0 – 30 days old and 22 percent were 31 - 60 days old.

- g. Construct the uncollected balances schedules for the end of March and the end of June. Use the format given below. Do these schedules properly measure customers' payment patterns?**

March				June			
Month	Sales	contribution to A/R	sales ratio	A/R-to-month	sales	contribution to A/R	sales ratio
Jan	\$100	\$ 0	0%		Apr		
Feb	200	40	20		May		
Mar	300	<u>210</u>	<u>70</u>		Jun		

**Answer:** Uncollected balances schedules:

Month month's sales	Sales	Contribution to end-of-period A/R	Ratio of month's A/R to
<u>(1)</u>	<u>(2)</u>	<u>(3)</u>	
Jan	\$100		\$ 0
0%			
Feb	200		40
20			
Mar	300		<u>210</u>
<u>70</u>			
End of quarter A/R			<u>\$250</u>
<u>90%</u>			
Apr	\$300		\$ 0
0%			
May	200		40
20			
Jun	100		<u>70</u>
<u>70</u>			
end of quarter A/R			<u>\$110</u>
<u>90%</u>			

In column 3 above, the contribution of each month's sales to the firm's receivables balance is identified. To illustrate, at the end of March, all of January's sales had been collected, but only 80 percent of February's sales had been collected, so \$40 remained outstanding. Similarly, 70 percent of March's sales were still outstanding, so March's contribution to receivables was  $0.7(\$300) = \$210$ .

The focal point of the uncollected balances schedule is column 4, the receivables-to-sales ratio. When we compare March and June, we see no difference, which is what we should see, given that there has been no change in the payment pattern. Thus, the uncollected balances schedule gives a true picture of customers' payment patterns, even when sales fluctuate. Note

also (1) that any increase in column 4 from a month in one quarter to the corresponding month in the next quarter is "bad" in the sense that it indicates a slowdown in payments, and (2) that the bottom line gives a summary of the changes in payment patterns.

**h. Assume that it is now July of year 1, and the brothers are developing pro forma financial statements for the following year. Further, assume that sales and collections in the first half-year matched the predicted levels. Using the year 2 sales forecasts as shown next, what are next year's pro forma receivables levels for the end of March and for the end of June?**

	Predicted Predicted contribution	Predicted	
<u>Month</u> <u>to receivables</u>	<u>sales</u>		<u>A/R-to-sales ratio</u>
<b>Jan</b>	<b>\$150</b>		<b>0%</b>
Feb	300		20
60			
<b>Mar</b>	<b>500</b>		<b>70</b>
<b>350</b>			
		<b>projected March 31 A/R balance = \$410</b>	
<b>Apr</b>	<b>\$400</b>		
<b>May</b>	<b>300</b>		
<b>Jun</b>	<b>200</b>		
		<b>Projected June 30 A/R balance =</b> <u>    </u>	

**Answer:** The uncollected balances schedule can be used to forecast the pro forma receivables balance. For forecasting, the historical receivables-to-sales ratios are generally assumed to be good predictors of future payment patterns, and hence are applied to the sales forecasts to develop the expected receivables:

	Predicted sales	Predicted A/R-to-sales ratio	Predicted contribution to receivables
<b>Jan</b>	<b>\$150</b>	<b>0%</b>	
Feb	300		20
60			
<b>Mar</b>	<b>500</b>		<b>70</b>
<b>350</b>			
		<b>projected March 31 A/R balance = \$410</b>	

Apr	\$400	0%
\$ 0		
May	300	20
60		
Jun	200	70
<u>140</u>		

projected June 30 A/R balance = \$200

i. Assume now that it is several years later. The brothers are concerned about the firm's current credit terms, which are now net 30, which means that contractors buying building products from the firm are not offered a discount, and they are supposed to pay the full amount in 30 days. Gross sales are now running \$1,000,000 a year, and 80 percent (by dollar volume) of the firm's *paying* customers generally pay the full amount on day 30, while the other 20 percent pay, on average, on day 40. Two percent of the firm's gross sales end up as bad debt losses.

The brothers are now considering a change in the firm's credit policy. The change would entail (1) changing the credit terms to 2/10, net 20, (2) employing stricter credit standards before granting credit, and (3) enforcing collections with greater vigor than in the past. Thus, cash customers and those paying within 10 days would receive a 2 percent discount, but all others would have to pay the full amount after only 20 days. The brothers believe that the discount would both attract additional customers and encourage some existing customers to purchase more from the firm—after all, the discount amounts to a price reduction. Of course, these customers would take the discount and, hence, would pay in only 10 days.

The net expected result is for sales to increase to \$1,100,000; for 60 percent of the paying customers to take the discount and pay on the 10th day; for 30 percent to pay the full amount on day 20; for 10 percent to pay late on day 30; and for bad debt losses to fall from 2 percent to 1 percent of gross sales. The firm's operating cost ratio will remain unchanged at 75 percent, and its cost of carrying receivables will remain unchanged at 12 percent.

To begin the analysis, describe the four variables that make up a firm's credit policy, and explain how each of them affects sales and collections. Then use the information given in part H to answer parts I through N.

**Answer:** The four variables which make up a firm's credit policy are (1) the discount offered, including the amount and period; (2) the credit period; (3) the credit standards used when determining who shall receive credit, and how much credit; and (4) the collection policy.

Cash discounts generally produce two benefits: (1) they attract both new customers and expanded sales from current customers, because people view discounts as a price reduction, and (2) discounts cause a reduction in the days sales outstanding, since both new customers and some established customers will pay more promptly in order to get the discount. Of course, these benefits are offset to some degree by the dollar cost of the discounts themselves.

The credit period is the length of time allowed to all "qualified" customers to pay for their purchases. In order to qualify for credit in the first place, customers must meet the firm's credit standards. These dictate the minimum acceptable financial position required of customers to receive credit. Also, a firm may impose differing credit limits depending on the customer's financial strength as judged by the credit department.

Finally, collection policy refers to the procedures that the firm follows to collect past-due accounts. These can range from a simple letter or phone call to turning the account over to a collection agency.

How the firm handles each element of credit policy will have an influence on sales, speed of collections, and bad debt losses. The object is to be tough enough to get timely payments and to minimize bad debt losses, yet not to create ill will and thus lose customers.

**j. Under the current credit policy, what is the firm's days sales outstanding (DSO)? What would the expected DSO be if the credit policy change were made?**

**Answer:** Old (current) situation:  $DSO_0 = 0.8(30) + 0.2(40) = 32$  days. New situation:  $DSO_n = 0.6(10) + 0.3(20) + 0.1(30) = 15$  days. Thus, the new credit policy is expected to cut the DSO in half.

**k. What is the dollar amount of the firm's current bad debt losses? What losses would be expected under the new policy?**

**Answer:** Old (current) situation:  $BDL_o = 0.02(\$1,000,000) = \$20,000$ . New situation:  $BDL_n = 0.01(\$1,100,000) = \$11,000$ . Thus, the new policy is expected to cut bad debt losses sharply.

**l. What would be the firm's expected dollar cost of granting discounts under the new policy?**

**Answer:** Current situation: under the current, no discount policy, the cost of discounts is \$0.  
New situation: of the \$1,100,000 gross sales expected under the new policy, 1 percent is lost to bad debts, so good sales =  $0.99(\$1,100,000) = \$1,089,000$ . Since 60 percent of the good sales are discount sales, discount sales =  $0.6(\$1,089,000) = \$653,400$ . Finally, the discount is 2 percent, so the cost of discounts is expected to be  $0.02(\$653,400) = \$13,068$ .

**m. What is the firm's current dollar cost of carrying receivables? What would it be after the proposed change?**

**Answer:** Current situation: the firm's average daily sales currently amount to  $\$1,000,000/365 = \$2,739.73$ . The DSO is 32 days, so accounts receivable amount to  $32(\$2,739.73) = \$87,671$ . However, only 75 percent of this total represents cash costs--the remainder is profit--so the investment in receivables (the actual amount that must be financed) is  $0.75(\$87,671) = \$65,753$ . At a cost of 12 percent, the annual cost of carrying the receivables is  $0.12(\$65,753) = \$7,890$ .  
New situation: the cost of carrying the receivables balance under the new policy would be \$4,068:

$$(\$1,100,000/365)(15)(0.75)(0.12) = \$4,068.$$

n. What is the incremental after-tax profit associated with the change in credit terms? Should the company make the change? (assume a tax rate of 40 percent.)

<u>Old</u>	<u>Difference</u>	<u>New</u>
<b>Gross sales</b>		
<b>\$1,000,000</b>		
Less		<b>discounts</b>
<b>0</b>		
<b>Net sales</b>		
<b>\$1,000,000</b>		
<b>Production costs</b>		
<b>750,000</b>		
Profit before credit		
Costs		<b>and taxes</b>
\$ 250,000		
Credit-related costs:		
Carrying		<b>costs</b>
7,890		
Bad		<b>debt losses</b>
20,000		
Profit		<b>before taxes</b>
\$ 222,110		
Taxes		<b>(40%)</b>
88,844		
Net		<b>income</b>
<b>\$ 133,266</b>		

**Answer:** The income statements and differentials under the two credit policies are shown below:

	<u>New</u>	<u>Old</u>	<u>Difference</u>
Gross sales	\$1,100,000	\$1,000,000	\$100,000
Less discounts	<u>13,068</u>	<u>0</u>	<u>13,068</u>
Net sales	\$1,086,932	\$1,000,000	\$ 86,932
Production costs	<u>825,000</u>	<u>750,000</u>	<u>75,000</u>
Profit before credit			
Costs and taxes	\$ 261,932	\$ 250,000	\$ 11,932
Credit-related costs:			
Carrying costs	4,068	7,890	(3,822)
Bad debt losses	<u>11,000</u>	<u>20,000</u>	<u>(9,000)</u>
Profit before taxes	\$ 246,846	\$ 222,110	\$ 24,754
Taxes (40%)	<u>98,745</u>	<u>88,844</u>	<u>9,902</u>
Net income	<u>\$ 148,118</u>	<u>\$ 133,266</u>	<u>\$ 14,852</u>

Thus, if expectations are met, the credit policy change would increase the firm's annual after-tax profit by \$14,884. Since there are no non-cash expenses involved here, the \$14,884 is also the incremental cash flow expected under the new policy.

However, the new policy is not riskless. If the firm's customers do not react as predicted, then the firm's profits could actually decrease as a result of the change. The amount of risk involved in the decision depends on the uncertainty inherent in the estimates, especially the sales estimate. Typically, it is very difficult to predict customers' responses to credit policy changes. Further, a credit policy change may prompt the company's competitors to change their own credit terms, and this could offset the expected increase in sales. Thus, the final decision is judgmental. If the prospect of an annual \$14,884 increase in net income is sufficient to compensate for the risks involved, then the change should be made. (note: large, national companies often make credit policy changes in a given region in an effort to determine how customers and competitors will react, and then use the information gained when setting national policy. Note also that credit policy changes may not be announced in a "broadcast" sense so as to slow down competitors' reactions.)

**o. Suppose the firm makes the change, but its competitors react by making similar changes to their own credit terms, with the net result being that gross sales remain at the current \$1,000,000 level. What would the impact be on the firm's post-tax profitability?**

**Answer:** If sales remain at \$1,000,000 after the change is made, then the following situation would exist:

Gross sales	\$1,000,000
Less discounts	<u>11,880</u>
Net sales	\$ 988,120
Production costs	<u>750,000</u>
Profit before credit	
Costs and taxes	\$ 238,120
Credit costs:	
Carrying costs	3,699
Bad debt losses	<u>10,000</u>
Profit before taxes	\$ 224,421
Taxes (40%)	<u>89,769</u>
Net income	<u><u>\$ 134,653</u></u>

Under the old terms the net income was \$133,266, so the policy change would result in a slight incremental gain of  $\$134,653 - \$133,266 = \$1,387$ .



- 9,756.10	(discount interest)	<u>12,195.12</u>
<u>-12,195.12</u>	(compensating balance)	<u>-109,756.10</u>
<u>100,000.00</u>		

With a financial calculator, enter  $n = 1$ ,  $PV = 100000$ ,  $pmt = 0$ , and  $FV = -109756.10$  to solve for  $i = 9.7561\% \approx 9.76\%$ .

4. In an installment (add-on) loan, the interest is calculated and added on to the required cash amount, and then this sum is the face amount of loan, and it is amortized by equal payments over the stated life. Thus, the interest would be  $\$100,000 \times 0.08 = \$8,000$ , the face amount would be  $\$108,000$ , and each monthly payment would be  $\$9,000$ :  $\$108,000/12 = \$9,000$ .

However, the firm would receive only  $\$100,000$ , and it must begin to repay the principal after only one month. Thus, it would get the use of  $\$100,000$  in the first month, the use of  $\$100,000 - \$9,000 = \$91,000$  in the second month, and so on, for an average of  $\$100,000/2 = \$50,000$  over the year. Since the interest expense is  $\$8,000$ , the approximate cost is 16 percent, or twice the stated rate:

$$\text{Approximate cost} = \frac{\text{INTEREST}}{\text{AMOUNT RECEIVED}/2} = \frac{\$8,000}{\$50,000} = 0.16 = 16\%.$$

To find the exact effective annual rate, recognize that Jaws has received \$100,000 and must make 12 monthly payments of \$9,000:

$$\begin{aligned} PV &= \sum_{t=1}^{12} \frac{PMT}{(1+i)^t} \\ 100,000 &= \sum_{t=1}^{12} \frac{\$9,000}{(1+i)^t} \end{aligned}$$

Enter in  $n = 12$ ,  $PV = 100000$ , and  $pmt = -9000$  in a financial calculator, we find the monthly rate to be 1.2043%, which converts to an effective annual rate of 15.45 percent:

$$(1.012043)^{12} - 1.0 = 0.1545 = 15.45\%,$$

which is close to the 16 percent approximate annual interest rate.

If the loan were for 90 days:

1. Simple interest. The brothers would have had to pay  $(0.08/4)(\$100,000) = 0.02(\$100,000) = \$2,000$  in interest after 3 months, plus repay the principal. In this case the nominal 2 percent rate must be converted to an annual rate, and the effective annual rate is 8.24 percent:

$$EAR_{\text{simple}} = (1.02)^4 - 1 = 1.0824 - 1 = 0.0824 = 8.24\%.$$

In general, the shorter the maturity (within a year), the higher the effective cost of a simple loan.

2. Discount interest. If jaws borrows \$100,000 face value at a nominal rate of 8 percent, discount interest, for 3 months, then  $m = 12/3 = 4$ , and the interest payment is  $(0.08/4)(\$100,000) = \$2,000$ , so

$$\begin{aligned} EAR_{\text{discount}} &= \left( 1 + \frac{\$2,000}{\$100,000 - \$2,000} \right)^4 - 1 \\ &= (1.0204)^4 - 1 = 0.0842 = 8.42\%. \end{aligned}$$

Discount interest imposes less of a penalty on shorter-term than on longer-term loans.

3. Discount interest with compensating balance. Everything is the same as in #2 above, except that we must add the compensating balance term to the denominator.

$$\begin{aligned} \text{EAR} &= \left( 1.0 + \frac{\$2,000}{\$100,000 - \$2,000 - \$10,000} \right)^4 - 1 \\ &= (1.0227)^4 - 1 = 0.0941 = 9.41\% \end{aligned}$$

**g. How large would the loan actually be in each of the cases in part f?**

**Answer:** Simple interest. The face value of the loan would be \$100,000.

Discount interest. The face value of the loan is calculated as:

$$\text{Face value} = \frac{\text{FUNDS REQUIRED}}{1 - \text{NOMINAL RATE}} = \frac{\$100,000}{1 - 0.08} = \$108,695.65.$$

Discount interest with compensating balance. The face value of the loan is calculated as:

$$\text{Face value} = \frac{\text{FUNDS REQUIRED}}{1 - \text{NOMINAL RATE} - \text{CB}} = \frac{\$100,000}{1 - 0.08 - 0.10} = \$121,951.22.$$

Installment loan. The face value of the loan is \$100,000. Note that jaws would only have full use of the \$100,000 for the first month and, over the course of the year, it would only have approximate use of  $\$100,000/2 = \$50,000$ .

Quarterly basis: simple interest. The face value of the loan is \$100,000.

Discount interest. The face value is calculated as:

$$\text{Face value} = \frac{\text{FUNDS REQUIRED}}{1 - \text{NOMINAL RATE}} = \frac{\$100,000}{1 - 0.02} = \$102,040.82.$$

Discount interest with compensating balance. The face value of the loan is calculated as:

$$\text{Face value} = \frac{\text{FUNDS REQUIRED}}{1 - \text{NOMINAL RATE} - \text{CB}} = \frac{\$100,000}{1 - 0.02 - 0.10} = \$113,636.36.$$

**Chapter 28**  
**Advance Issues in Cash Management**  
**and Inventory Control**  
**ANSWERS TO END-OF-CHAPTER QUESTIONS**

---

- 28-1
- a. The Baumol model is a model for establishing the firm's target cash balance that closely resembles the EOQ model used for inventory. The model assumes (1) that the firm uses cash at a steady, predictable rate, (2) that the firm's cash inflows from operations also occur at a steady, predictable rate, and (3) that its net cash outflows therefore also occur at a steady rate. The model balances the opportunity cost of holding cash against the transactions costs associated with replenishing the cash account.
  - b. Carrying costs are the costs of carrying inventory. Ordering costs are the costs of ordering inventory. Total inventory costs are the sum of ordering and carrying costs.
  - c. The Economic Ordering Quantity (EOQ) is the order quantity that minimizes the costs of ordering and carrying inventories. The EOQ model is the equation used to find the EOQ. The range around the optimal ordering quantity that may be ordered without significantly affecting total inventory costs is the EOQ range.
  - d. The reorder point is the inventory level at which a new order is placed. Safety stock is inventory held to guard against larger-than-normal sales and/or shipping delays.
  - e. The red line method is a technique for inventory control, as is the two-bin method. Computerized inventory control systems are just what the name implies. In the red line method, a line is drawn around the inside of a bin at the level of the reorder point, and the inventory clerk places an order when the red line shows. The two-bin method is similar--when the first bin is exhausted, items are ordered. With a computerized inventory control system, the computer starts with an inventory count in memory. As withdrawals are made, they are recorded by the computer, and the inventory balance is revised. When the reorder point is reached, the computer automatically places an order, and when the order is received, the recorded balance is increased.
  - f. Just-in-time systems refer to receiving inventories just as they are needed. Firms that employ such systems are attempting to minimize inventory carrying costs.  
Out-sourcing is the practice of purchasing components rather than making them in-house.
- 28-2
- a. Our suppliers switch from delivering by train to air freight. - (a below)

- |    |  |   |           |
|----|--|---|-----------|
| b. | We change from producing just in time to meet seasonal sales to steady, year-round production. | + |           |
| c. | Competition in the markets in which we sell increases.   | 0 | (c below) |
| d. | The rate of general inflation increases.   | 0 |           |
| e. | Interest rates rise; other things are constant.  | - | (e below) |

(a) Lower safety stock will be required because delivery time is shortened.

(c) On the one hand, the need to stay competitive may require large inventories, but if the market gets competitive, sales may fall off and the need for inventories may diminish.

(e) EOQ and inventories are lower, since carrying costs are higher.

28-3 When money is tight, interest rates are generally high. This means that near-cash assets have high returns; hence, it is expensive to hold idle cash balances. Firms tend to economize on their cash balance holdings during tight-money periods.

- 28-4
- a. Better synchronization of cash inflows and outflows would allow the firm to keep its transactions balance at a minimum, and would therefore lower the target cash balance.
  - b. Improved sales forecasts would tend to lower the target cash balance.
  - c. A reduction in the portfolio of U.S. Treasury bills (marketable securities) would cause the firm's cash balance to rise if the Treasury bills had been held in lieu of cash balances.
  - d. An overdraft system will enable the firm to hold less cash.
  - e. If the amount borrowed equals the increase in check-writing, the target cash balance will not change. Otherwise, the target cash balance may rise or fall, depending on the relationship between the amount borrowed and the number of checks written.
  - f. The firm will tend to hold more Treasury bills, and the target cash balance will tend to decline.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

28-1 a.  $EOQ = \sqrt{\frac{2(F)(S)}{(C)(P)}} = \sqrt{\frac{2(\$15)(90,000)}{(0.2)(1.5)}} = \sqrt{9,000,000} = 3,000$  bags per order.

b. The maximum inventory, which is on hand immediately after a new order is received, is 4,000 bags (3,000 + 1,000 safety stock). At \$1.50 per bag the dollar cost is \$6,000.

c.  $\text{Average inventory} = \frac{3,000}{2} + 1,000 = 1,500 + 1,000 = 2,500$  bags or \$3,750.

d.  $\frac{90,000}{3,000} = 30$  orders per year.  $\frac{365 \text{ days}}{30} = 12.1 \approx 12$  days.

The company must place an order every 12 days.

28-2 a.  $C^* = \sqrt{\frac{2(F)(T)}{r}} = \text{Optimal transaction size}$ .  $F = \$27$ ;  $T = \$4,500,000$ ;  $r = 12\%$ .

$$C^* = \sqrt{\frac{2(\$27)(\$4,500,000)}{0.12}} = \$45,000.$$

b. Average cash balance =  $\$45,000/2 = \$22,500$ .

c. Transfers per year =  $\$4,500,000/\$45,000 = 100$ , or one approximately every  $3.6 \approx 4$  days.

d. Total cost =  $\frac{C^*}{2}(r) + \frac{T}{C^*}(F)$   
 $= \frac{\$45,000}{2}(0.12) + \frac{\$4,500,000}{\$45,000}(\$27)$   
 $= \$2,700 + \$2,700 = \$5,400.$

If it maintained an average balance of \$50,000, this would mean transfers of \$100,000. There would be  $\$4,500,000/\$100,000 = 45$  transfers per year. The cost would be  $0.12(\$50,000) + 45(\$27) = \$7,215$ . If it maintained a zero balance, it would have to make 360 transfers per year, so its cost would be  $360(\$27) = \$9,720$ .

## SOLUTIONS TO SPREADSHEET PROBLEMS

---

- 28-6 The detailed solution for the problem is available both on the instructor's resource CD-ROM (in the file *Solution to FM11 Ch 28 P06 Build a Model.xls*) and on the instructor's side of the web site, <http://brigham.swcollege.com>.

## MINI CASE

---

**Andria Mullins, financial manager of Webster Electronics, has been asked by the firm's CEO, Fred Weygandt, to evaluate the company's inventory control techniques and to lead a discussion of the subject with the senior executives. Andria plans to use as an example one of Webster's "big ticket" items, a customized computer microchip which the firm uses in its laptop computer. Each chip costs Webster \$200, and in addition it must pay its supplier a \$1,000 setup fee on each order. Further, the minimum order size is 250 units; Webster's annual usage forecast is 5,000 units; and the annual carrying cost of this item is estimated to be 20 percent of the average inventory value.**

**Andria plans to begin her session with the senior executives by reviewing some basic inventory concepts, after which she will apply the EOQ model to Webster's microchip inventory. As her assistant, you have been asked to help her by answering the following questions:**

**a. Why is inventory management vital to the financial health of most firms?**

**Answer:** Inventory management is critical to the financial success of most firms. If insufficient inventories are carried, a firm will lose sales. Conversely, if excess inventories are carried, a firm will incur higher costs than necessary. Worst of all, if a firm carries large inventories, but of the wrong items, it will incur high costs and still lose sales.

**b. What assumptions underlie the EOQ model?**

**Answer:** the standard form of the EOQ model requires the following assumptions:

- All values are known with certainty and constant over time.
- Inventory usage is uniform over time. For example, a retailer would sell the same number of units each day.
- All carrying costs are variable, so carrying costs change proportionally with changes in inventory levels.
- All ordering costs are fixed per order; that is, the company pays a fixed amount to order and receive each shipment of inventory, regardless of the number of units ordered.

These assumed conditions are not met in the real world, and, as a result, safety stocks are carried, and these stocks raise average inventory holdings above the amounts that result from the "pure" EOQ model.

**c. Write out the formula for the total costs of carrying and ordering inventory, and then use the formula to derive the EOQ model.**

**Answer:** Under the assumptions listed above, total inventory costs (TIC) can be expressed as follows:

$$\text{TIC} = \text{total carrying costs} + \text{total ordering costs} = CP(Q/2) + F(S/Q) \quad (1)$$

Here,

C = annual carrying cost as a percentage of inventory value.

P = purchase price per unit.

Q = number of units in each order.

F = fixed costs per order.

S = annual usage in units.

Note that  $S/Q$  is the number of orders placed each year, and, if no safety stocks are carried,  $Q/2$  is the average number of units carried in inventory during the year.

The economic (optimal) order quantity (EOQ) is that order quantity which minimizes total inventory costs. Thus, we have a standard optimization problem, and the solution is to take the first derivative of equation 1 with respect to quantity and set it equal to zero:

$$\frac{d(\text{TIC})}{dQ} = \frac{(C)(P)}{2} - \frac{(F)(S)}{Q^2} = 0.$$

Now, solving for Q, we obtain:

$$\frac{(C)(P)}{2} = \frac{(F)(S)}{Q^2}$$

$$Q^2 = \frac{2(F)(S)}{(C)(P)}$$

$$Q = \text{EOQ} = \sqrt{\frac{2(F)(S)}{(C)(P)}}$$

**d. What is the EOQ for custom microchips? What are total inventory costs if the EOQ is ordered?**

**Answer:**  $\text{EOQ} = \sqrt{\frac{2(F)(S)}{(C)(P)}} = \sqrt{\frac{2(\$1,000)(5,000)}{0.2(\$200)}} = \sqrt{250,000} = 500 \text{ units.}$

When 500 units are ordered each time an order is placed, total inventory costs equal \$20,000:

$$\begin{aligned} \text{TIC} &= \text{CP}(Q/2) + F(S/Q) \\ &= 0.2(\$200)(500/2) + \$1,000(5,000/500) \\ &= \$40(250) + \$1,000(10) = \$10,000 + \$10,000 = \$20,000. \end{aligned}$$

Note that the average inventory of custom microchips is 250 units, and that 10 orders are placed per year. Also, at the EOQ level, total carrying costs equal total ordering costs.

**e. What is Webster's added cost if it orders 400 units at a time rather than the EOQ quantity? What if it orders 600 per order?**

**Answer:** 400 units:

$$\begin{aligned} \text{TIC} &= \text{CP}(Q/2) + \text{F}(S/Q) = 0.2(\$200)(400/2) + \$1,000(5,000/400) \\ &= \$8,000 + \$12,500 = \$20,500. \end{aligned}$$

$$\text{added cost} = \$20,500 - \$20,000 = \$500.$$

600 units:

$$\begin{aligned} \text{TIC} &= 0.2(\$200)(600/2) + \$1,000(5,000/600) \\ &= \$12,000 + \$8,333 = \$20,333. \end{aligned}$$

$$\text{added cost} = \$20,333 - \$20,000 = \$333.$$

Note the following points:

- At any order quantity other than  $\text{EOQ} = 500$  units, total inventory costs are higher than they need be.
- The added cost of not ordering the  $\text{EOQ}$  amount is not large if the quantity ordered is close to the  $\text{EOQ}$ . For example, if the order size is 20 percent above the  $\text{EOQ}$  (600 units),  $\text{tic}$  increases by only  $\$333/\$20,000 = 1.67\%$ .
- If the quantity ordered is less than the  $\text{EOQ}$ , then total carrying costs decrease, but total ordering costs increase. At  $q = 400$  units, carrying costs fall by \$2,000 per year, but ordering costs increase by \$2,500. The net result is an increase in total costs.
- If the quantity ordered is greater than the  $\text{EOQ}$ , then total carrying costs increase, but total ordering costs decrease. At  $Q = 600$  units, carrying costs increase by \$2,000, but ordering costs fall by only \$1,667, so the net result is an increase in total costs.

**f. Suppose it takes 2 weeks for Webster's supplier to set up production, make and test the chips, and deliver them to Webster's plant. Assuming certainty in delivery times and usage, at what inventory level should Webster reorder? (assume a 52-week year, and assume that Webster orders the  $\text{EOQ}$  amount.)**

**Answer:** With an annual usage of 5,000 units, Webster's weekly usage rate is  $5,000/52 \approx 96$  units. If the order lead time is 2 weeks, then Webster must reorder each time its inventory reaches  $2(96) = 192$  units. Then, after 2 weeks, as it uses its last microchip, the new order of 500 chips arrives.

**g. Of course, there is uncertainty in Webster's usage rate as well as in delivery times, so the company must carry a safety stock to avoid running out of chips and having to halt production. If a 200-unit safety stock is carried, what effect would this have on total inventory costs? What is the new reorder point? What protection does the safety stock provide if usage increases, or if delivery is delayed?**

**Answer:** There are two ways to view the impact of safety stocks on total inventory costs. Webster's total cost of carrying the operating inventory is \$20,000 (see part d). Now the cost of carrying an additional 200 units is  $CP(\text{safety stock}) = 0.2(\$200)(200) = \$8,000$ . Thus, total inventory costs are increased by \$8,000, for a total of  $\$20,000 + \$8,000 = \$28,000$ .

Another approach is to recognize that, with a 200-unit safety stock, Webster's average inventory is now  $(500/2) + 200 = 450$  units. Thus, its total inventory cost, including safety stock, is \$28,000:

$$\begin{aligned} \text{TIC} &= CP(\text{average inventory}) + F(S/Q) \\ &= 0.2(\$200)(450) + \$1,000(5,000/500) \\ &= \$18,000 + \$10,000 = \$28,000. \end{aligned}$$

Webster must still reorder when the operating inventory reaches 192 units. However, with a safety stock of 200 units in addition to the operating inventory, the reorder point becomes  $200 + 192 = 392$  units. Since Webster will reorder when its microchip inventory reaches 392 units, and since the expected delivery time is 2 weeks, Webster's normal 96 unit usage could rise to  $392/2 = 196$  units per week over the 2-week delivery period without causing a stockout. Similarly, if usage remains at the expected 96 units per week, Webster could operate for  $392/96 \approx 4$  weeks versus the normal two weeks while awaiting delivery of an order.

**h. Now suppose Webster's supplier offers a discount of 1 percent on orders of 1,000 or more. Should Webster take the discount? Why or why not?**

**Answer:** First, note that since the discount will only affect the orders for the operating inventory, the discount decision need not take account of the safety stock. Webster's current total cost of its

operating inventory is \$20,000 (see part d). If Webster increases its order quantity to 1,000 units, then its total costs for the operating inventory would be \$24,800:

$$\begin{aligned} \text{TIC} &= \text{CP}(Q/2) + \text{F}(S/Q) \\ &= 0.2(\$198)(1,000/2) + \$1,000(5,000/1,000) = \$19,800 + \$5,000 \\ &= \$24,800. \end{aligned}$$

Note that we have reduced the unit price by the amount of the discount. Since total costs are \$24,800 if Webster orders 1,000 chips at a time, the incremental annual cost of taking the discount is  $\$24,800 - \$20,000 = \$4,800$ . However, Webster would save 1 percent on each chip, for a total annual savings of  $0.01(\$200)(5,000) = \$10,000$ . Thus, the net effect is that Webster would save  $\$10,000 - \$4,800 = \$5,200$  if it takes the discount, and hence it should do so.

**i. For many firms, inventory usage is not uniform throughout the year, but, rather, follows some seasonal pattern. Can the EOQ model be used in this situation? If so, how?**

**Answer:** The EOQ model can still be used if there are seasonal variations in usage, but it must be applied to shorter periods during which usage is approximately constant. For example, assume that the usage rate is constant, but different, during the summer and winter periods. The EOQ model could be applied separately, using the appropriate annual usage rate, to each period, and during the transitional fall and spring seasons inventories would be either run down or built up with special seasonal orders.

**j. How would these factors affect an EOQ analysis?**

**1. The use of just-in-time procedures.**

**Answer:** Just-in-time procedures are designed specifically to reduce inventories. If a just in time system were put in place, it would largely obviate the need for using the EOQ model.

**j. 2. The use of air freight for deliveries.**

**Answer:** Air freight would presumably shorten delivery times and reduce the need for safety stocks. It might or might not affect the EOQ.

**j. 3. The use of a computerized inventory control system, wherein as units were removed from stock, an electronic system automatically reduced the inventory account and, when the order point was hit, automatically sent an electronic message to the supplier placing an order. The electronic system ensures that inventory records are accurate, and that orders are placed promptly.**

**Answer:** Computerized control systems would, generally, enable the company to keep better track of its existing inventory. This would probably reduce safety stocks, and it might or might not affect the EOQ.

**j. 4. The manufacturing plant is redesigned and automated. Computerized process equipment and state-of-the-art robotics are installed, making the plant highly flexible in the sense that the company can switch from the production of one item to another at a minimum cost and quite quickly. This makes short production runs more feasible than under the old plant setup.**

**Answer:** The trend in manufacturing is toward flexibly designed plants, which permit small production runs without high setup costs. This reduces inventory holdings of final goods.

**Chapter 29**  
**Pension Plan Management**  
**ANSWERS TO END-OF-CHAPTER QUESTIONS**

---

- k. Webster runs a \$100,000 cash deficit per month, requiring periodic transfers from its marketable securities portfolio. Broker fees are \$32 per transfer and Webster earns 7% on its investment portfolio. Can Andrea use the EOQ model to determine how frequently Webster should liquidate part of its portfolio?

**Answer:** The EOQ model can be applied directly to this problem.

$EOQ = \sqrt{\frac{2F(S)}{(C)(P)}}$  where  $F = \$32$ ,  $S = 12(\$100,000) = \$1,200,000$  worth of cash needed each year, and the carrying cost per dollar per year is 7%, which is the opportunity cost for investing that dollar.

$$EOQ = C^* = \sqrt{\frac{2F(S)}{(C)(P)}} = \sqrt{\frac{2(32)(1,200,000)}{0.07}} = 33,123.$$

So Webster should liquidate its portfolio in chunks of about \$33,000. This translates to  $1,200,000/33,123 = 36$  times a year, or  $52/36 = 1.44$  or about every week and a half.

- 29-1
- a. Under a defined benefit plan, the employer agrees to give retirees a specifically defined benefits package. The payments could be set in final form as of the retirement date, or they could be indexed to increase with the cost of living.
  - b. Under a defined contribution plan, companies can agree to make specific payments into a retirement fund, and then have retirees receive benefits from the plan depending on the investment success of the plan.
  - c. Under a profit-sharing plan, the employer makes payments into a retirement fund, but the payments vary with the level of corporate profits.
  - d. The cash balance plan is a new type of retirement plan developed in the late 1990s. It is like a defined benefit plan in some respects and like a defined contribution plan in others. Cash balance plans work like this: An account is created for each employee. The company promises to put a specified percentage of the employee's monthly salary into the plan, and to pay a specified return on the plan's assets, often the T-bill rate.

- e. An employee's pension rights are said to be vested if they provide a claim on pension fund assets, even if the employee leaves the company prior to retirement.
- f. Portability refers to a pension plan that an employee can carry from one employer to another.
- g. A pension plan is fully funded when the present value of expected retirement benefits is equal to the fund's assets on hand. If assets on hand exceed the present value of expected benefits, then the plan is said to be overfunded. If present value of benefits exceeds assets, then the fund is underfunded.
- h. The actuarial rate of return is the discount rate used to determine the present value of future benefits under the plan. It is also the rate of return at which the fund's assets are assumed to be invested.
- i. The Employee Retirement Income Security Act (ERISA) of 1974 is the basic federal law governing the administration and structure of corporate pension plans.
- j. The Pension Benefit Guarantee Corporation (PBGC) is a government run insurance system created by the ERISA to ensure that employees of companies which go bankrupt before their plans are fully funded will receive benefits.
- k. Federal Accounting Standards Board (FASB) Statement 87, "Employers Accounting for Pension Plans," and FASB Statement 35, "Accounting and Reporting by Defined Benefit Plans," provide firms with current guidance for reporting pension costs, assets, and liabilities. For defined contribution plans, FASB rules require the annual contribution to be shown on the income statement, with a note to the financial statements explaining the entry. Conversely, the rules for defined benefit plans require far more complex reporting procedures. In this case, the fund's overall funding status must be reported directly on the balance sheet if the plan is underfunded, and the annual pension expense must be shown on the income statement. In addition, the firm must provide information concerning the breakdown of the fund's annual pension expense and the composition of the fund's assets in the notes section of the annual report.
- l. Funding strategy for a pension fund involves two decisions: (1) how fast should any unfunded liability be reduced, and (2) what rate of return should be assumed in the actuarial calculations?
- m. The investment strategy for a pension plan deals with the question: Given the assumed actuarial rate of return, how should the portfolio be structured?
- n. Asset allocation models are used by pension fund managers to help plan funding and investment strategies. These models examine the risk/return relationships of portfolios with various mixes of assets under different economic scenarios.
- o. The Jensen alpha is a numerical measure of a portfolio's performance as compared to a "market" portfolio, such as the S&P 500. The alpha measures the vertical distance of a portfolio's return above or below the Security Market Line. It represents the extra return (positive or negative) after adjustment for the portfolio's market risk.
- p. Tapping fund assets refers to usage of pension fund assets for a corporation's own benefit. Given that corporate sponsors administer defined benefit plans which have assets running into the hundreds of billions of dollars, to what extent should a corporation be able to tap its pension fund?

Should companies be able to use funds to fight off takeovers? There are no easy answers to these questions.

- q. Health care benefits are offered by most companies as part of their retirement packages, usually until the retirees reach age 65 and become eligible for Medicare. With the population aging and Health care costs surging, the present liability of estimated future costs of retiree health care represents a large portion of many companies' net worth. Also, a 1990 FASB rule requires companies to accrue, or set up a reserve for, future medical benefits of retirees. These factors have resulted in many companies either scrapping or significantly reducing coverage of their retiree health benefits.

29-2 Ideally, the employee will choose the plan that provides the incremental cash flows (both costs and benefits) that maximize the employee's expected utility of consumption. However, there are many economic variables involved which have profound effects on the expected value of the plans. These include employee's expected work life, potential number of employers, vesting provisions of funds, risks of adequate funding of pension funds, expected inflation, and the likelihood of unexpected inflation. Because these factors can vary so much between individual employees and employers, no meaningful generalizations about these variables' specific effects on pension funds can be made.

29-3 From an employer's standpoint, the defined benefit plan's major advantage is promotion of low employee turnover. The economic consequences of job-changing are not desirable under a defined benefit plan, since benefits are frozen at the time of separation, instead of adjusted for inflation over time. Thus, defined benefit plans provide incentive to stay with the firm for a long period.

**However, there are several disadvantages associated with defined benefit plans. First, the plan puts greater risk on employers, since it guarantees to pay employees a fixed retirement benefit regardless of the firm's ability to fully fund the plan. Second, the employer's future cash contributions to the plan are uncertain, thus hampering financial planning efforts. This is particularly true if retirement benefits are based on final years' salaries, which can grow at different rates than inflation and other assumed levels. Finally, because of FASB Statement 87, there are greater financial reporting requirements associated with defined benefit plans.**

Defined contribution plans avoid many of the problems of defined benefit plans, since future payments are based on the rate of return on the pension plan's portfolio. Furthermore, since employee retirement benefits are not fixed, defined contribution plans are exempt from the reporting requirement of FASB Statement 87. However, since retirement benefits are based on the portfolio's return, the defined contribution plan provides no strong incentives for employees to remain with the firm, as do defined benefit plans.

The greater risks involved with a defined benefit plan are a major reason why, in general, only large corporations, such as IBM and GM, can afford to offer them to employees.

29-4 Pension fund data are found in the annual report section entitled "Notes to Consolidated Financial Statements." For example, the 1991 IBM Annual Report indicated a present value of pension

benefits of \$16.2 billion for its U. S. plan and a plan asset value of \$25.2 billion. IBM's pension fund information covers about 1.5 pages in its report, because its defined benefit plan requires more disclosure than a company having a defined contribution plan like Rubbermaid, with a few paragraphs in its 1991 Annual Report devoted to pension plans and other employee benefits. In accordance with FASB Statement 87, firms with underfunded or overfunded plans must incorporate the shortage or excess directly into the firm's balance sheet. Thus, firm's having underfunded plans with large liabilities and significant current contributions will report lower profits and a weaker financial condition than firms that have their plans fully funded or overfunded.

- 29-5 If the returns on these assets are less than perfectly positively correlated with the fund's other assets, then the addition of such investments as foreign stocks and precious metals would lower the overall risk of the portfolio. In other words, if these assets have a lower beta than the fund's portfolio, then adding them will lower the beta of the fund. However, the returns on foreign stocks and precious metals are typically quite volatile, and such assets are generally not suitable for meeting current payment obligations.
- 29-6
- a. Defined benefit plans carry with them economic incentive to discriminate against older workers in hiring, while defined contribution plans and cash balance plans are neutral in this regard.
  - b. There is an economic incentive for employers to discriminate against women in their hiring practices if they use defined benefit plans, since women tend to live longer than men.
  - c. Defined benefit plans contribute to lower employee turnover that would reduce training costs.
  - d. Pension benefits in a defined benefit plan are usually based on number of years worked and either the final, or the last several years' salary. This means that unions are more likely to work with a firm to ensure its survival, and thus ensure the survival of the pension plan, if it has a defined benefit plan. However, the level of benefits and the details of their calculation may be the subject of intense negotiation by the union. On the other hand, the ultimate benefits under a defined contribution plan depend on the actuarial return on the assets invested in the plan, with few details to be negotiated except the annual contribution that the firm makes. Under such a plan, a union has little pension-induced incentive to be "flexible" with the company (although it certainly may be flexible to keep the company solvent and keep jobs for its workers!), and the primary negotiation point with respect to the plan is the level of contributions. Note that with a cash balance plan, the union may also want to negotiate the guaranteed rate of return on the plan's assets.
- 29-7 Most economists would argue that insurance premiums of any type should reflect the relative risk to the insurer. Thus, corporate liability insurance is higher for drug manufacturers than for greeting card makers, and life insurance is higher for smokers than for nonsmokers. Following this line of reasoning, PBGC insurance premiums should be higher for those firms whose pension plans are more likely to require a PBGC bailout.

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

---

- 29-1 a. His wage in the final year of working is \$179,700:

$$\$20,000(1.05)^{45} = \$20,000(8.9850) = \$179,700.$$

Thus, his annual retirement benefit is \$80,865:

$$\$179,700(0.01)(45) = \$80,865.$$

- b. Assuming an actuarial rate of 10 percent, CC must accumulate \$615,066 by the time of Mr. Jones's retirement:

$$PV = \$80,865(PVIFA_{10\%,15}) = \$615,066.$$

CC must contribute \$856 per year over Mr. Jones's 45-year working life to accumulate \$615,066.

$$\begin{aligned} \$615,066 &= PMT(FVIFA_{10\%,45}) \\ PMT &= \$856. \end{aligned}$$

- c. Final year wage =  $\$20,000(1.05)^{20} = \$53,066$ .  
Annual retirement benefit =  $\$53,066(0.01)(20) = \$10,613$ .  
Lump sum required =  $\$10,613(PVIFA_{10\%,15}) = \$80,723$ .  
Annual contribution = \$1,409:  
 $\$80,723 = PMT(FVIFA_{10\%,20})$   
 $PMT = \$1,409$ .

We see that the older worker requires  $\$1,409 - \$856 = \$553$  more in annual pension fund contributions. Thus, from a pension funding standpoint alone, CC would favor a younger worker.

- d. Ms. Brown would receive the same retirement benefit as computed for Mr. Jones in Part a, \$80,865 per year. However, Ms. Brown would receive the benefit for 25 years rather than 15 years. Thus, her annual pension cost would be \$1,021:

$$\begin{aligned} PV &= \$80,865(PVIFA_{10\%,25}) = \$734,015. \\ \$734,015 &= PMT(FVIFA_{10\%,45}) \\ PMT &= \$1,021. \end{aligned}$$

Thus, the company is actually "paying" Ms. Brown more than they are paying Mr. Jones. Whether this is equitable or not is a matter of debate.

- 29-2 a. Required return =  $r = r_{RF} + (r_M - r_{RF})b = 10\% + (6\%)1.2 = 17.2\%$ .  
 Realized return =  $\bar{r} = 18.0\%$ .  
 Alpha =  $\bar{r} - r = 18.0\% - 17.2\% = 0.8$  percentage points.
- b. If the portfolio return was net of all transactions costs and management fees, then the portfolio manager "outperformed the market" on a risk-adjusted basis. This may be due to his extraordinary ability to identify undervalued stocks or, more commonly, sheer luck.
- c. It would be impossible to predict next year's performance based on one year's historical performance.

- 29-3 a. Find the present value (today's value) of the firm's obligations.

To simplify calculations, find the value of each 5-year period's payment as of the beginning of the period. For example, the value at Time 10 of the payments for Years 11-15 is:

10	11	12	13	14	15
$r = 10\%$					
2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000

$N = 5$ ,  $I = 10$ ,  $PMT = -2500000$ , and  $FV = 0$ . Solve for  $PV = \$9,476,967 =$  Value at Year 10.

0	• • •	10	• • •	15	• • •	20	• • •	25	• • •	30
9,476,967	7,581,574	5,686,180	3,790,787	1,895,393	\$3,653,781	1,814,969	845,214	349,874	108,622	<u>\$6,772,460</u>

- b. Since the benefits, the underfunded. assets are less than the plan is PV of

$$\text{Funding ratio} = \frac{\text{Fund market value}}{\text{PV of benefits}} = \frac{\$6,000,000}{\$6,772,460} = 0.89.$$

## MINI CASE

---

**Southeast Tile Distributors Inc. is a building tile wholesaler that originated in Atlanta but is now considering expansion throughout the region to take advantage of continued strong population growth. The company has been a "mom and pop" operation supplemented by part-time workers, so it currently has no corporate retirement plan. However, the firm's owner, Andy Johnson, believes that it will be necessary to start a corporate pension plan to attract the quality employees needed to make the expansion succeed. Andy has asked you, a recent business school graduate who has just joined the firm, to learn all that you can about pension funds, and then prepare a briefing paper on the subject. To help you get started, he sketched out the following questions:**

**a. How important are pension funds to the U. S. Economy?**

**Answer:** Pension funds constitute the largest class of investors. In 2001, the funds had assets of over \$11 trillion and they owned more than 33 percent of all U. S. Stocks. Thus, pension funds are a major force in the financial markets.

**b. Define the following pension fund terms:**

1. Defined benefit plan
2. Defined contribution plan
3. Profit sharing plan
4. Cash balance plan
5. Vesting
6. Portability
7. Fully funded; overfunded; underfunded
8. Actuarial rate of return
9. Employee Retirement Income Security Act (ERISA)
10. Pension Benefit Guarantee Corporation (PBGC)

**Answer:**

1. Under a defined benefit plan, the employer agrees to give retirees a specific defined benefit, such as \$500 per month, 80 percent of his or her average salary over the 5 years preceding retirement, or 2.5 percent of his or her highest salary for each year of employment.
2. In a defined contribution plan, companies agree to make specific payments into a retirement fund, and then the retirees receive benefits from the plan depending on the investment success of the plan.
3. Under a profit sharing plan, the employer makes payments into the retirement fund that vary with the level of corporate profits.

4. The cash balance plan is a new type of retirement plan developed in the late 1990s. It is like a defined benefit plan in some respects and like a defined contribution plan in others. Cash balance plans work like this: an account is created for each employee. The company promises to put a specified percentage of the employee's monthly salary into the plan, and to pay a specified return on the plan's assets, often the t-bill rate.
5. An employee is vested if he or she has the right to receive pension benefits even if they leave the company prior to retirement. If the employee loses his or her pension rights upon leaving the company prior to retirement, the rights are said to be nonvested. Most plans today have deferred vesting, in which pension rights are nonvested for the first few years, say 5, and then become fully vested at that point.
6. A portable pension plan is one that an employee can carry from one employer to another. Portability is especially important in industries where job changes are frequent--as in trucking and construction--and union-administered plans are typically used to make portability possible.
7. If the present value of expected retirement benefits is equal to plan assets on hand, the plan is said to be fully funded. If assets exceed the present value of benefits, then the plan is overfunded, while the plan is underfunded if the present value of benefits exceeds assets. If the plan is underfunded, an unfunded pension liability is said to exist.
8. The discount rate used to determine the present value of future benefits is called the actuarial rate of return. This rate is also the rate of return at which the fund's assets are assumed to be invested.
9. The Employee Retirement Income Security Act Of 1974 (ERISA) is the basic federal law governing the administration and structure of corporate pension plans.
10. The Pension Benefit Guarantee Corporation (PBGC) is a government-run insurance company created by the ERISA to ensure that employees of companies which go bankrupt before their plans are fully funded will receive benefits.

**c. What two organizations provide guidelines for reporting pension fund activities to stockholders? Describe briefly how pension fund data are reported in a firm's financial statements. (hint: consider both defined contribution and defined benefit plans.)**

**Answer:** The Financial Accounting Standards Board (FASB), together with the SEC, establishes the rules under which a firm reports its financial results, including its income and asset positions, to stockholders. The reporting of defined contribution plans is relatively simple: the annual contribution is shown on the firm's income statement and a note explains the entry. However, the reporting of defined benefit plans is more complex. In this case, the fund's overall funding status must be reported directly on the balance sheet if the plan is underfunded, and the annual pension expense must be shown on the income statement. In addition, the firm must provide information concerning the breakdown of the fund's annual pension expense and the composition of the fund's assets in the notes section of the annual report.

**d. Assume that an employee joins the firm at age 25, works for 40 years to age 65, and then retires. The employee lives another 15 years, to age 80, and during retirement draws a pension of \$20,000 at the end of each year. How much must the firm contribute annually**

**(at year-end) over the employee's working life to fully fund the plan by retirement age if the plan's actuarial rate of return is 10 percent? Draw a graph which shows the value of the employee's pension fund over time. Why is real-world pension fund management much more complex than indicated in this illustration?**

**Answer:** The employee will draw an annual pension (an annuity) of \$20,000 for 15 years. Thus, the firm must accumulate \$152,121.59 in the pension plan by the time the employee retires to fully fund the retirement:

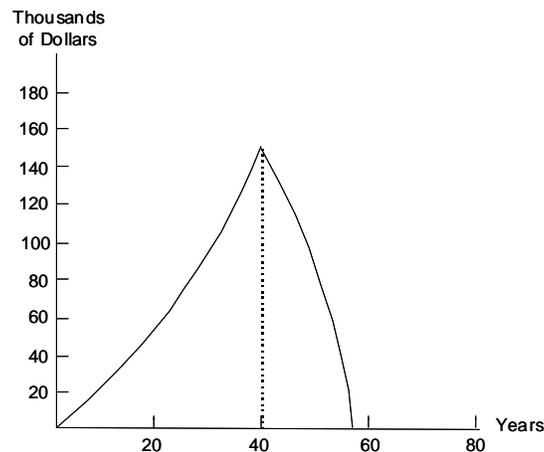
$$\$20,000(PVIFA_{10\%,15 \text{ YEARS}}) = \$152,121.59.$$

Alternatively, using a financial calculator, input  $n = 15$ ,  $i = 10$ ,  $PMT = 20000$ , and  $FV = 0$ , to solve for  $PV = \$152,121.59$ . Since the company has 40 years to accumulate this amount, its annual pension contribution is \$343.71:

$$\begin{aligned} PMT(FVIFA_{10\%,40 \text{ years}}) &= \$152,121.59 \\ PMT &= \$343.71. \end{aligned}$$

Alternatively, using a financial calculator, input  $n = 40$ ,  $i = 10$ ,  $PV = 0$ , and  $FV = 152121.59$ , to solve for  $PMT = \$343.71$ .

A graph of the employee's pension fund assets looks like this:



Real-world pension fund management is much more complex because of uncertainties regarding (1) how long the employee will work for the firm, (2) the salary of the employee over time, and (3) the rate of return that can be earned on pension contributions.

**e. Discuss the risks to both the plan sponsor and plan beneficiaries under the four types of pension plans.**

**Answer:** The defined benefit plan places most of the risks on the company, because it guarantees to pay a more or less fixed retirement benefit regardless of its ability to fully fund the plan. Conversely, the defined contribution and profit sharing plans place most of the risks on the employees, because their benefits depend on the return that the fund assets earn, and, in the case of a profit sharing plan, the profits of the company. The cash balance plan seems to be a "middle of the road" plan in

terms of risk for both employees and employers. The company's payment obligations are fixed and known, while employees are guaranteed a specified return, often the T-bill rate. So far, this type of plan has saved companies money, because the rates paid on the accounts have been substantially less than the returns companies have actually earned on the assets backing the plans.

**f. How does the type of pension plan influence decisions in each of the following areas:**

**1. The possibility of age discrimination in hiring?**

**Answer:** Defined benefit plans are more costly to firms when older workers are hired as opposed to younger workers, because the firm has a much shorter time to accumulate the needed funds.

**f. 2. The possibility of sex discrimination in hiring?**

**Answer:** Since women live longer than men, female employees are more costly than male employees to firms that have defined benefit plans.

**f. 3. Employee training costs?**

**Answer:** To the extent that defined benefit plans encourage employees to stay with a single company, they reduce training costs.

**f. 4. The militancy of unions when a company faces financial adversity?**

**Answer:** Since defined benefit plan benefits are usually tied to the number of years worked and the final (or last several) year's salary, unions are more likely to work with a firm to ensure its survival if it has a defined benefit plan.

**g. What are the two components of a plan's funding strategy? What is the primary goal of a plan's investment strategy?**

**Answer:** The two components of a plan's funding strategy are:

! How fast should any unfunded liability be reduced?

! What rate of return should be assumed in the actuarial calculations?

The primary goal of a plan's investment strategy is to structure the portfolio to minimize the risk of not achieving the assumed actuarial rate of return.

**h. How can a corporate financial manager judge the performance of pension plan managers?**

**Answer:** Pension plan managers can be judged in several ways. One way is to compare the realized return on the manager's portfolio with the equilibrium return commensurate for the riskiness of the portfolio. This is called alpha analysis, where alpha is the realized return minus the SML return for a portfolio with the same beta. Another way to judge a portfolio manager is to compare his or her historical returns with other managers having the same investment objectives.

**i. What is meant by "tapping" pension fund assets? Why is this action so controversial?**

**Answer:** Pension fund assets are tapped when a company terminates an overfunded defined benefit plan, uses a portion of the funds to purchase annuities which provide the promised pensions to employees, and then recovers the excess for the firm. This action is controversial because some people believe that pension fund assets belong to the employees, and hence firms that do this are "robbing" their employees. Conversely, courts have held that pension fund assets belong to the firm, and hence firms can recover assets as long as this action does not jeopardize the employee's future pension benefits.

**j. What has happened to the cost of retiree health benefits over the last decade? How are retiree health benefits reported to shareholders?**

**Answer:** Because of the increased number of retirees, and the dramatic escalation in health care costs over the past 10 years, many companies are facing situations where retiree health care costs are forecasted to be as high, or higher, than pension costs. A 1990 FASB rule requires companies to accrue, or set up a reserve for, future medical benefits for retirees. Prior to this rule, companies merely deducted these benefit payments from income in the year of payment. Now, they must take current write-offs to account for vested future medical benefits. This new rule has focused the need for companies to carefully assess their abilities to continue generous health plans for retirees, and many companies are now trimming benefits.

## Chapter 30

### Financial Management in Not-for-Profit Businesses

#### ANSWERS TO END-OF-CHAPTER QUESTIONS

---

- 30-1 The major difference in ownership structure is that investor-owned firms have well-defined owners, who own stock in the business and exercise control over the firm through the proxy mechanism. Conversely, not-for-profit firms do not have stockholders. Control rests in a board of trustees comprised mostly of community leaders who have no direct economic interest in the firm. Because of this ownership structure difference, the goals of investor-owned and not-for-profit firms are quite different as well.
- 30-2 No. The asymmetric information theory refers to a preferred "pecking order" of financing by corporate managers, with new common stock being the least preferred because of the negative signals that new stock issues typically send to investors. Since not-for-profit firms have no common stock, this theory is not applicable.
- 30-3 No. The break in an investor-owned firm's MCC schedule is due to the higher cost involved with issuing new common stock once the firm's retained earnings has been exhausted. Since not-for-profit firms do not have common stock, there are no such breaks in their MCC schedules. In fact, all of a not-for-profit firm's fund capital, which includes retained earnings, grants from government entities, and private contributions, have a common opportunity cost to the firm, which is the return that could be expected from investing in the stock of a similar type investor-owned company.
- 30-4
- a. Without access to tax-exempt debt, all of the benefits to using debt for a not-for-profit firm would disappear. Thus, in accordance with MM capital structure theory, and considering financial distress and agency costs related to debt, the firm's optimal capital structure would be zero debt.
  - b. No. Managers of not-for-profit firms do not have the same degree of flexibility as investor-owned firms in raising equity capital. Thus, it is often necessary for not-for-profit firms to use more than the theoretically optimal amount of debt when new fund capital cannot be obtained for needed services.

- 30-5 Since not-for-profit businesses are expected to provide a social value in addition to an economic benefit, project analysis must consider social value along with expected cash flows. The summation of a project's net present social and cash flow values is its total net present value (TNPV). If the TNPV is  $\geq 0$ , then the project is deemed acceptable.
- To perform this analysis, the social value of a project must be quantified in some manner for each year of the project's life, and then discounted back to Year 0. This requires the not-for-profit firm to quantify the social value of the services provided by the project in each year, and to determine the discount rate that is to be applied to those services.
- Obviously, such determinations are very subjective. For example, the social value of a service could vary based on who benefits from it. The proper discount rate for a social value stream is also a controversial topic. While few organizations attempt to quantify these benefits, not-for-profit organizations should attempt to do so when evaluating proposed projects given their social-benefit orientation.
- 30-6 Since most not-for-profit firms have a myriad of different products or services, a new project's contribution to the riskiness of the overall firm's portfolio of projects, or its corporate risk, is the most relevant risk. Stand-alone risk would be relevant if the firm had only one project. Market risk does not apply to not-for-profit firms since shareholder wealth maximization is not their primary goal.
- 30-7 No. If perfect information existed, then all potential buyers and bond insurance companies would have the same full knowledge of the risks inherent in the not-for-profit firm's bond. Accordingly, an equilibrium rate would be established for the firm's bond based on this risk. Since no asymmetric information exists within the market, it would not be possible to obtain rates lower than this equilibrium level. Even if the not-for-profit firm purchased insurance to obtain AAA bond rates, the insurance company would charge a fee which effectively would eliminate this interest savings. Thus, under an efficient information scenario, the savings in interest provided by the insurance would be exactly offset by the fee required by the insurer.

## MINI CASE

---

Sandra McCloud, a finance major in her last term of college, is currently scheduling her placement interviews through the university's career resource center. Her list of companies is typical of most finance majors: several commercial banks, a few industrial firms, and one brokerage house. However, she noticed that a representative of a not-for-profit hospital is scheduling interviews next week, and the position--that of financial analyst--appears to be exactly what Sandra has in mind. Sandra wants to sign up for an interview, but she is concerned that she knows nothing about not-for-profit organizations and how they differ from the investor-owned firms that she has learned about in her finance classes. In spite of her worries, Sandra scheduled an appointment with the hospital representative, and she now wants to learn more about not-for-profit businesses before the interview.

To begin the learning process, Sandra drew up the following set of questions. See if you can help her answer them.

a. First, consider some basic background information concerning the differences between not-for-profit organizations and investor-owned firms.

1. What are the key features of investor-owned firms? How do a firm's owners exercise control?

**Answer:** Investor-owned firms have three primary characteristics: (1) the owners (shareholders) of the firm are well defined, and they exercise control by voting for the firm's board of directors; (2) the firm's residual earnings belong to the owners, so management is responsible to this single, well-defined group for the firm's profitability; and (3) the firm is subject to taxation at the federal, state, and local levels.

**a. 2. What is a not-for-profit corporation? What are the major control differences between investor-owned and not-for-profit businesses?**

**Answer:** A not-for-profit corporation is one that is organized and operated solely for religious, charitable, scientific, public safety, literary, or educational purposes. Generally, not-for-profit firms qualify for tax-exempt status. Not-for-profit corporations differ from investor-owned corporations in that they have no shareholders, and hence all residual earnings are retained within the firm. Control of not-for-profit firms rests with a board of trustees composed mainly of community leaders who have no economic interests in the firm.

**a. 3. How do goals differ between investor-owned and not-for-profit businesses?**

**Answer:** Since not-for-profit firms have no shareholders, they are not concerned with the goal of maximizing shareholder wealth as are investor-owned firms. The goals of not-for-profit firms are usually outlined in the mission statement of the firm, and they generally relate to providing some socially valuable service in a financially sound manner.

**b. Now consider the cost of capital estimation process.**

**1. Is the weighted average cost of capital (WACC) relevant to not-for-profit businesses?**

**Answer:** Yes. In general, the WACC estimation for not-for-profit firms parallels that for investor-owned firms.

**b. 2. Is there any difference between the WACC formula for investor-owned firms and that for not-for-profit businesses?**

**Answer:** There are two major differences. First, since not-for-profit firms pay no taxes, there are no tax effects associated with debt financing. Second, a not-for-profit firm's cost of equity, or cost of fund capital, is much more controversial than for investor-owned firms.

**b. 3. What is fund capital? How is the cost of fund capital estimated?**

**Answer:** Unlike investor-owned firms that raise equity capital by selling new common shares and retaining earnings, not-for-profit firms raise the equivalent of equity capital, called fund capital, by retaining profits, receiving government grants, and receiving private contributions. The cost of fund capital is an opportunity cost to the not-for-profit firm; namely, the return the firm could realize by investing the capital in securities of similar risk. For example, the opportunity cost of fund capital to a not-for-profit hospital would be the return it could realize by investing in the securities of a comparable investor-owned hospital.

**c. Just as in investor-owned firms, not-for-profit businesses use a mix of debt and equity (fund) financing.**

**1. Is the trade-off theory of capital structure applicable to not-for-profit businesses? What about the asymmetric information theory?**

**Answer:** As with investor-owned firms, not-for-profit firms' optimal capital structures should also be based on the tradeoffs between the benefits and costs of debt financing. Not-for-profit firms have about the same effective costs of debt (since they have access to the tax-exempt debt market) and equity as investor-owned firms of similar risk. Thus, we would expect the trade-off theory of capital to be equally applicable to not-for-profit firms; the firm's opportunity cost of fund capital should rise as more and more debt is used, and the firm should be subject to the same financial distress and agency costs from using debt as encountered by investor-owned firms.

The asymmetric information theory, however, is not applicable to not-for-profit firms, since they do not issue common stock.

**c. 2. What problem do not-for-profit businesses encounter when they attempt to implement the trade-off theory?**

**Answer:** The major problem encountered by not-for-profit firms in implementing the trade-off theory is their lack of flexibility in raising equity capital. Not-for-profit firms do not have access to the typical equity markets. Thus, it's harder for them to raise fund capital, via government grants and private contributions, than it is for investor-owned firms to issue new common stock. As a consequence, it is often necessary for not-for-profit firms to delay worthy projects because of insufficient funding, or to use more than the theoretically optimal amount of debt.

**d. Consider the following questions relating to capital budgeting decisions.**

**1. Why is capital budgeting important to not-for-profit businesses?**

**Answer:** Capital budgeting is important to not-for-profit firms because the financial impact of each capital investment should be fully understood in order to ensure the firm's long-term financial health. Substantial investment in unprofitable projects could lead to bankruptcy and closure, which obviously would eliminate the social value provided by the firm to the community.

**d. 2. What is social value? How can the net present value method be modified to include the social value of proposed projects?**

**Answer:** Social value are those benefits realized from capital investment in addition to cash flow returns, such as charity care and other community services. When the social value of a project is considered, the total net present value of the project equals the standard net present value of the project's expected cash flow stream plus the net present social value of the project. This requires the social value of the project provided over its life to be quantified and discounted back to year 0. There is much subjectivity in this process, but it is prudent for not-for-profit businesses to consider the net present social value of projects under consideration as part of their standard capital budgeting procedures.

**d. 3. Which of the three project risk measures--stand-alone, corporate, and market--is relevant to not-for-profit businesses?**

**Answer:** Corporate risk, or the additional risk a project adds to the overall riskiness of the firm's portfolio of projects, is the most relevant risk for a not-for-profit firm, since most not-for-profit firms offer a wide variety of products and services. Stand-alone risk would only be relevant if the project were the only one the firm would be involved with. Market risk is not relevant at all, since not-for-profit firms do not have stockholders.

**d. 4. What is a corporate beta? How does it differ from a market beta?**

**Answer:** The corporate beta is a quantitative measure of corporate risk; it is the slope of the corporate characteristic line, which is the regression line that results when the project's returns are plotted on the y axis and the returns on the firm's total operations are plotted on the x axis. A project's corporate beta measures the volatility of returns on the project relative to the firm as a whole (or

relative to the firm's average project, which has a beta of 1.0). A project's market beta is a similar quantitative measure of a project's market risk, but it measures the volatility of project returns relative to returns on the market.

**d. 5. In general, how is project risk actually measured within not-for-profit businesses? How is project risk incorporated into the decision process?**

**Answer:** In most instances, it is very difficult to develop accurate assessments of a project's corporate risk. Thus, not-for-profit firms often use the project's stand-alone risk, along with a subjective notion of how the project fits into the firm's other operations, as an estimate of corporate risk. This practice is not inappropriate. Corporate risk and stand-alone risk tend to be highly correlated, since most projects under consideration tend to be in the same line of business as the firm's other operations. Thus, incorporation of risk into investment decisions is a somewhat subjective process but nonetheless is one that should be conducted.

**e. Not-for-profit businesses have access to many of the same long-term financing sources as do investor-owned firms.**

**1. What are municipal bonds? How do not-for-profit health care businesses access the municipal bond market?**

**Answer:** Municipal bonds are bonds issued by state and local governments. The primary difference between municipal bonds and corporate or treasury bonds is that municipal bonds are exempt from federal income taxes and state income taxes in the state of issue.

Not-for-profit health care firms cannot issue municipal bonds directly to investors. Rather, the bonds are issued through some municipal health facilities authority. The authority has no obligation regarding the payment of principal or interest, but acts only as a conduit for the issuing corporation.

**e. 2. What is credit enhancement, and what effect does it have on debt costs?**

**Answer:** Credit enhancement is, simply, bond insurance that guarantees the repayment of a municipal bond's principal and interest. When issuers purchase credit enhancement from insurers, the bond is rated on the basis of the insurer's financial strength rather than the issuer's. Since credit

enhancement raises the bond rating, interest costs are reduced. However, the issuer must bear the added cost of the bond insurance.

**e. 3. What are a not-for-profit business's sources of fund capital?**

**Answer:** The three major sources of fund capital are (1) the excess of revenues over expenses (retentions), (2) charitable contributions, and (3) government grants.

**e. 4. What impact does the inability to issue common stock have on a not-for-profit business's capital structure and capital budgeting decisions?**

**Answer:** The inability to issue common stock has a significant impact on a not-for-profit firm's financial flexibility. First, the lack of access to equity capital effectively imposes capital rationing, so the firm may not be able to undertake all projects deemed worthwhile. Second, in order to invest in projects considered necessary, the firm may have to take on more than the optimal amount of debt capital.

**f. What unique problems do not-for-profit businesses encounter in financial analysis and planning? What about short-term financial management?**

**Answer:** In general, financial analysis and planning, as well as short-term financial management, are the same regardless of the type of ownership. However, the unique features of not-for-profit organizations--especially the lack of financial flexibility--creates some minor differences in implementation.