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Capital Structure: Basic Concepts

14

OPENING CASE

What do Apple, Qualcomm, and MetLife have in common? In 2015, all three companies made announcements that would alter their balance sheets. Apple, for example, announced it would issue \$16.5 billion in new bonds that were to be used to buy back the company's shares, among other uses. Digital communications company Qualcomm issued \$10 billion in debt, with interest rates ranging from 1.4 percent to 4.8 percent to fund a stock buyback. What made Qualcomm's situation unique was that when the company issued the bonds, it had no long-term debt on its balance sheet. Finally, as for insurer MetLife, the company announced it would issue \$1.5 billion in bonds to repurchase the company's preferred stock. So, why did these companies decide to swap debt for equity? We will explore this question and other issues in this chapter.

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14.1 THE CAPITAL STRUCTURE QUESTION AND THE PIE THEORY

How should a firm choose its debt–equity ratio? We call our approach to the capital structure question the **pie model**. If you are wondering why we chose this name, just take a look at Figure 14.1. The pie in question is the sum of the financial claims of the firm, debt and equity in this case. We *define* the value of the firm to be this sum. Hence, the value of the firm, V , is:

$$V = B + S$$

[14.1]

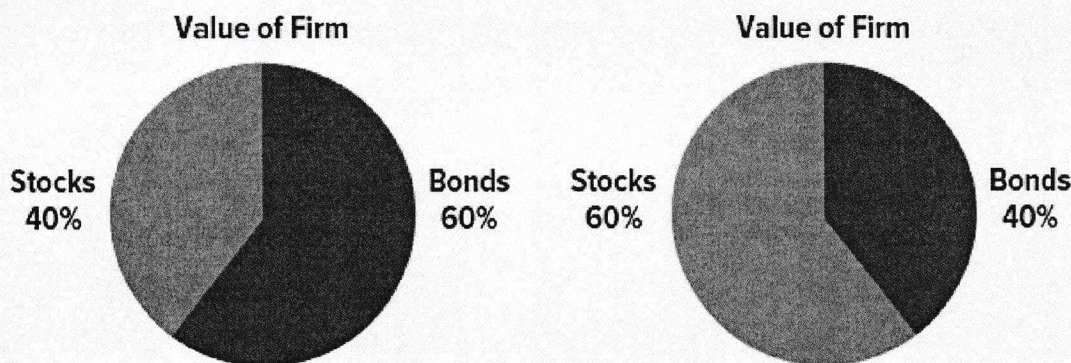
where B is the market value of the debt and S is the market value of the equity. Figure 14.1 presents two possible ways of slicing this pie between stock and debt: 40 percent–60 percent and 60 percent–40 percent. If the goal of the management of the firm is to make the firm as valuable as possible, then the firm should pick the debt–equity ratio that makes the pie—the total value—as big as possible.

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FIGURE 14.1
Two Pie Models of Capital Structure



This discussion begs two important questions:

1. Why should the stockholders in the firm care about maximizing the value of the entire firm? After all, the value of the firm is, by definition, the sum of both the debt and the equity. Instead, why should the stockholders not prefer the strategy that maximizes their interests only?
2. What is the ratio of debt to equity that maximizes the shareholders' interests?

Let us examine each of the two questions in turn.

14.2 MAXIMIZING FIRM VALUE VERSUS MAXIMIZING STOCKHOLDER INTERESTS

The following example illustrates that the capital structure that maximizes the value of the firm is the one that financial managers should choose for the shareholders.

EXAMPLE 14.1

Debt and Firm Value

Suppose the market value of the J. J. Sprint Company is \$1,000. The company currently has no debt, and each of J. J. Sprint's 100 shares of stock sells for \$10. A company such as J. J. Sprint with no debt is called an *unlevered* company. Further suppose that J. J. Sprint plans to borrow \$500 and pay the \$500 proceeds to shareholders as an extra cash dividend of \$5 per share. After the issuance of debt, the firm becomes *levered*. The investments of the firm will not change as a result of this transaction. What will the value of the firm be after the proposed restructuring?

Management recognizes that, by definition, only one of three outcomes can occur from restructuring. Firm value after restructuring can be either (1) greater than the original firm value of \$1,000, (2) equal to \$1,000, or (3) less than \$1,000. After consulting with investment bankers, management believes that restructuring will not change firm value more than \$250 in either direction.

Thus, it views firm values of \$1,250, \$1,000, and \$750 as the relevant range. The original capital structure and these three possibilities under the new capital structure are presented next.

	NO DEBT (ORIGINAL CAPITAL STRUCTURE)	VALUE OF DEBT PLUS EQUITY AFTER PAYMENT OF DIVIDEND (THREE POSSIBILITIES)		
		(1)	(2)	(3)
Debt	\$ 0	\$ 500	\$ 500	\$500
Equity	<u>1,000</u>	<u>750</u>	<u>500</u>	<u>250</u>
Firm value	\$1,000	\$1,250	\$1,000	\$750

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Note that the value of equity is below \$1,000 under any of the three possibilities. This can be explained in one of two ways. First, the table shows the value of the equity *after* the extra cash dividend is paid. Since cash is paid out, a dividend represents a partial liquidation of the firm. Consequently, there is less value in the firm for the equityholders after the dividend payment. Second, in the event of a future liquidation, stockholders will be paid only after bondholders have been paid in full. Thus, the debt is an encumbrance of the firm, reducing the value of the equity.

Of course, management recognizes that there are infinite possible outcomes. The above three are to be viewed as *representative* outcomes only. We can now determine the payoff to stockholders under the three possibilities.

	PAYOFF TO SHAREHOLDERS AFTER RESTRUCTURING		
	(1)	(2)	(3)
Capital gains	-\$250	-\$500	-\$750
Dividends	<u>500</u>	<u>500</u>	<u>500</u>
Net gain or loss to stockholders	\$250	\$ 0	-\$250

No one can be sure ahead of time which of the three outcomes will occur. However, imagine that managers believe that Outcome (1) is most likely. They should definitely restructure the firm because the stockholders would gain \$250. That is, although the price of the stock declines by \$250 to \$750, they receive \$500 in dividends. Their net gain is \$250 ($= -\$250 + 500$). Also, notice that the value of the firm would rise by \$250 ($= \$1,250 - 1,000$).

Alternatively, imagine that managers believe that Outcome (3) is most likely. In this case, they should not restructure the firm because the stockholders would expect a \$250 loss. That is, the stock falls by \$750 to \$250 and they receive \$500 in dividends. Their net loss is $-\$250$ ($= -\$750 + 500$). Also, notice that the value of the firm would change by $-\$250$ ($= \$750 - 1,000$).

Finally, imagine that the managers believe that Outcome (2) is most likely. Restructuring would not affect the stockholders' interest because the net gain to stockholders in this case is zero. Also, notice that the value of the firm is unchanged if Outcome (2) occurs.

This example explains why managers should attempt to maximize the value of the firm. In other words, it answers Question (1) in Section 14.1. We find in this example that:

Managers should choose the capital structure that they believe will have the highest firm value, because this capital structure will be most beneficial to the firm's stockholders.¹

Clearly J. J. Sprint should borrow \$500 if it expects Outcome (1). Note however that this example does not tell us which of the three outcomes is most likely to occur. Thus, it does not tell us whether debt should be added to J. J. Sprint's capital structure. In other words, it does not answer Question (2) in Section 14.1. This second question is treated in the next section.

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14.3 FINANCIAL LEVERAGE AND FIRM VALUE: AN EXAMPLE



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Leverage and Returns to Shareholders

The previous section shows that the capital structure producing the highest firm value is the one that maximizes shareholder wealth. In this section, we wish to determine that optimal capital structure. We begin by illustrating the effect of capital structure on returns to stockholders. We will use a detailed example which we encourage students to study carefully. Once we have this example under our belts, we will be ready to determine the optimal capital structure.

Trans Am Corporation currently has no debt in its capital structure. The firm is considering issuing debt to buy back some of its equity. Both its current and proposed capital structures are presented in Table 14.1. The firm's assets are \$8,000. There are 400 shares of the all-equity firm, implying a market value per share of \$20. The proposed debt issue is for \$4,000, leaving \$4,000 in equity. The interest rate is 10 percent.

The effect of economic conditions on earnings per share is shown in Table 14.2 for the current capital structure (all-equity). Consider first the middle column where earnings are *expected* to be \$1,200. Since assets are \$8,000, the return on assets (ROA) is 15 percent ($= \$1,200/8,000$). Because assets equal equity for this all-equity firm, return on equity (ROE) is also 15 percent. Earnings per share (EPS) are \$3.00 ($= \$1,200/400$). Similar calculations yield EPS of \$1.00 and \$5.00 in the cases of recession and expansion, respectively.

The case of leverage is presented in Table 14.3. ROA in the three economic states is identical in Tables 14.2 and 14.3, because this ratio is calculated before interest is considered. Since debt is \$4,000 here, interest is \$400 ($= .10 \times \$4,000$). Thus, earnings after interest are \$800 ($= \$1,200 - 400$) in the middle (expected) case. Since equity is \$4,000, ROE is 20 percent ($= \$800/\$4,000$). Earnings per share are \$4.00 ($= \$800/200$). Similar calculations yield earnings of \$0 and \$8.00 for recession and expansion, respectively.

Tables 14.2 and 14.3 show that the effect of financial leverage depends on the company's earnings before interest. If earnings before interest are equal to \$1,200, the return on equity (ROE) is higher under the proposed structure. If earnings before interest are equal to \$400, the ROE is higher under the current structure.

TABLE 14.1 Financial Structure of Trans Am Corporation

	CURRENT	PROPOSED
Assets	\$8,000	\$8,000
Debt	\$0	\$4,000

Equity (market and book)	\$8,000	\$4,000
Interest rate	10%	10%
Market value/share	\$20	\$20
Shares outstanding	400	200

The proposed capital structure has leverage, whereas the current structure is all equity.

TABLE 14.2 Trans Am's Current Capital Structure: No Debt

	RECESSION	EXPECTED	EXPANSION
Return on assets (ROA)	5%	15%	25%
Earnings	\$400	\$1,200	\$2,000
Return on equity (ROE) = Earnings/Equity	5%	15%	25%
Earnings per share (EPS)	\$1.00	\$3.00	\$5.00

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TABLE 14.3 Trans Am's Proposed Capital Structure: Debt = \$4,000

	RECESSION	EXPECTED	EXPANSION
Return on assets (ROA)	5%	15%	25%
Earnings before interest (EBI)	\$400	\$1,200	\$2,000
Interest	<u>- 400</u>	<u>-400</u>	<u>-400</u>
Earnings after interest	\$0	\$800	\$1,600
Return on equity (ROE) = Earnings after interest/Equity	0%	20%	40%
Earnings per share (EPS)	\$0	\$4.00	\$8.00

This idea is represented in Figure 14.2. The solid line represents the case of no leverage. The line begins at the origin, indicating that earnings per share (EPS) would be zero if earnings before interest (EBI) were zero. The EPS rises in tandem with a rise in EBI.

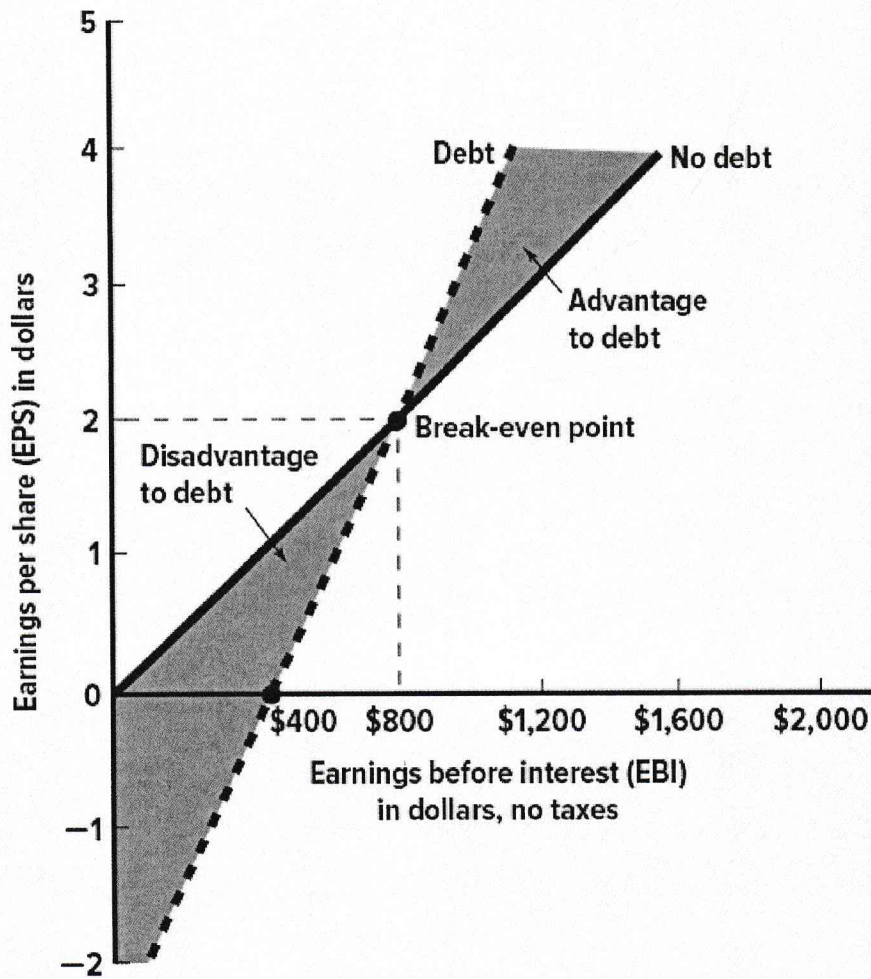
The dotted line represents the case of \$4,000 of debt. Here, EPS is negative if EBI is zero. This follows because \$400 of interest must be paid regardless of the firm's profits.

Now consider the slopes of the two lines. The slope of the dotted line (the line with debt) is higher than the slope of the solid line. This occurs because the levered firm has *fewer* shares of stock outstanding than the unlevered firm. Therefore, any increase in EBI leads to a greater rise in EPS for the levered firm because the earnings increase is distributed over fewer shares of stock.

Because the dotted line has a lower intercept but a higher slope, the two lines must intersect. The *break-even* point occurs at \$800 of EBI. Were earnings before interest to be \$800, both firms would produce \$2 of earnings per share (EPS). Because \$800 is breakeven, earnings above \$800 lead to greater EPS for the levered firm. Earnings below \$800 lead to greater EPS for the unlevered firm.

FIGURE 14.2

Financial Leverage: EPS and EBI for the Trans Am Corporation



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The Choice between Debt and Equity

Tables 14.2 and 14.3 and Figure 14.2 are important because they show the effect of leverage on earnings per share. Students should study the tables and figure until they feel comfortable with the calculation of each number in them. However, we have not yet presented the punch line. That is, we have not yet stated which capital structure is better for Trans Am.

At this point, many students believe that leverage is beneficial, because EPS is expected to be \$4.00 with leverage and only \$3.00 without leverage. However, leverage also creates *risk*. Note that in a recession, EPS is higher (\$1.00 versus \$0) for the unlevered firm. Thus, a risk-averse investor might prefer the all-equity firm, while a risk-neutral (or less risk-averse) investor might prefer leverage. Given this ambiguity, which capital structure *is* better?

Modigliani and Miller (MM or M & M) have a convincing argument that a firm cannot change the total value of its outstanding securities by changing the proportions of its capital structure. In other words, the value of the firm is always the same under different capital structures. In *still* other words, no capital structure is any better or worse than any other capital structure for the firm's stockholders. This rather pessimistic result is the famous **MM Proposition I**.²

Their argument compares a simple strategy, which we call Strategy A, with a two-part strategy, which we call Strategy B. Both of these strategies for shareholders of Trans Am are illuminated in Table 14.4. Let us now examine the first strategy.

STRATEGY A—BUY 100 SHARES OF THE LEVERED EQUITY

The first line in the top panel of Table 14.4 shows EPS for the proposed levered equity in the three economic states. The second line shows the earnings in the three states for an individual buying 100 shares. The next line shows that the cost of these 100 shares is \$2,000.

Let us now consider the second strategy, which has two parts to it:

TABLE 14.4 Payoff and Cost to Shareholders of Trans Am Corporation under the Proposed Structure and under the Current Structure with Homemade Leverage

	RECESSION	EXPECTED	EXPANSION
Strategy A: Buy 100 Shares of Levered Equity			
EPS of <i>levered</i> equity (taken from last line of Table 14.3)	\$0	\$4	\$8
Earnings per 100 shares	\$0	\$400	\$800
Initial cost = 100 shares @ \$20/share = \$2,000			
Strategy B: Homemade Leverage			
Earnings per 200 shares in current	\$1 × 200 =	\$3 × 200 =	\$5 × 200 =
<i>Unlevered</i> Trans Am	200	600	1,000
Interest at 10% on \$2,000	<u>- 200</u>	<u>- 200</u>	<u>- 200</u>
Net earnings	\$0	\$400	\$800

Initial cost = 200 shares @ \$20/share - \$2,000 =
\$2,000

Cost of stock

Amount
borrowed

Investor receives the same payoff whether she (1) buys shares in a levered corporation or (2) buys shares in an unlevered firm and borrows on personal account. Her initial investment is the same in either case. Thus, the firm neither helps nor hurts her by adding debt to the capital structure.

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STRATEGY B—HOMEMADE LEVERAGE

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1. Borrow \$2,000 from either a bank or, more likely, a brokerage house. (If the brokerage house is the lender, we say that this activity is *going on margin*.)
2. Use the borrowed proceeds plus your own investment of \$2,000 (a total of \$4,000) to buy 200 shares of the current unlevered equity at \$20 per share.

The bottom panel of Table 14.4 shows payoffs under Strategy *B*, which we call the *homemade leverage* strategy. First, observe the middle column, which indicates that 200 shares of the unlevered equity are *expected* to generate \$600 of earnings. Assuming that the \$2,000 is borrowed at a 10 percent interest rate, the interest expense is \$200 ($= .10 \times \$2,000$). Thus, the net earnings are expected to be \$400. A similar calculation generates net earnings of either \$0 or \$800 in recession or expansion, respectively.

Now, let us compare these two strategies, both in terms of net earnings and in terms of initial cost. The top panel of the table shows that Strategy *A* generates earnings of \$0, \$400, and \$800 in the three states. The bottom panel of the table shows that Strategy *B* generates the *same* net earnings in the three states.

The top panel of the table shows that Strategy *A* involves an initial cost of \$2,000. Similarly, the bottom panel shows an *identical* net cost of \$2,000 for Strategy *B*.

This shows a very important result. Both the cost and the payoff from the two strategies are the same. Thus, one must conclude that Trans Am is neither helping nor hurting its stockholders by restructuring. In other words, an investor is not receiving anything from corporate leverage that she could not receive on her own.

Note that, as shown in Table 14.1, the equity of the unlevered firm is valued at \$8,000. Since the equity of the levered firm is \$4,000 and its debt is \$4,000, the value of the levered firm is also \$8,000. Now suppose that, for whatever reason, the value of the levered firm were actually greater than the value of the unlevered firm. Here, Strategy *A* would cost more than Strategy *B*. In this case, an investor would prefer to borrow on his own account and invest in the stock of the unlevered firm. He would get the same net earnings each year as if he had invested in the stock of the levered firm. However, his cost would be less. The strategy would not be unique to our investor. Given the higher value of the levered firm, no rational investor would invest in the stock of the levered firm. Anyone desiring shares in the levered firm would get the same dollar return more cheaply by borrowing to finance a purchase of the unlevered firm's shares. The equilibrium result would be, of course, that the value of the levered firm would fall and the value of the unlevered firm would rise until they became equal. At this point, individuals would be indifferent between Strategy *A* and Strategy *B*.

This example illustrates the basic result of Modigliani-Miller (MM) and is, as we have noted, commonly called their Proposition I. We restate this proposition as:

MM Proposition I (no taxes): The value of the levered firm is the same as the value of the unlevered firm.

This is generally considered the beginning point of modern managerial finance. Before MM, the effect of leverage on the value of the firm was considered complex and convoluted. Modigliani and Miller showed a blindingly simple result: If levered firms are priced too high, rational investors will simply borrow on their personal accounts to buy shares in unlevered firms. This substitution is often

called *homemade leverage*. As long as individuals borrow (and lend) on the same terms as the firms, they can duplicate the effects of corporate leverage on their own.

The example of Trans Am Corporation shows that leverage does not affect the value of the firm. Since we showed earlier that stockholders' welfare is directly related to the firm's value, the example indicates that changes in capital structure cannot affect the stockholders' welfare.

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A Key Assumption

The MM result hinges on the assumption that individuals can borrow as cheaply as corporations. If, alternatively, individuals can only borrow at a higher rate, one can easily show that corporations can increase firm value by borrowing.

Is this assumption of equal borrowing costs a good one? Individuals who want to buy stock and borrow can do so by establishing a margin account with a brokerage firm. Under this arrangement, the brokerage firm loans the individual a portion of the purchase price. For example, the individual might buy \$10,000 of stock by investing \$6,000 of her own funds and borrowing \$4,000 from the brokerage firm. Should the stock be worth \$9,000 on the next day, the individual's net worth or equity in the account would be \$5,000 ($= \$9,000 - 4,000$).³

The brokerage firm fears that a sudden price drop will cause the equity in the individual's account to be negative, implying that the brokerage firm may not get her loan repaid in full. To guard against this possibility, stock exchange rules require that the individual make additional cash contributions (replenish her margin account) as the stock price falls. Because (1) the procedures for replenishing the account have developed over many years, and (2) the brokerage firm holds the stock as collateral, there is little default risk to the brokerage firm.⁴ In particular, if margin contributions are not made on time, the brokerage firm can sell the stock in order to satisfy her loan. Therefore, brokerage firms generally charge low interest, with many rates being only slightly above the risk-free rate.

By contrast, corporations frequently borrow using illiquid assets (e.g., plant and equipment) as collateral. The costs to the lender of initial negotiation and ongoing supervision, as well as of working out arrangements in the event of financial distress, can be quite substantial. Thus, it is difficult to argue that individuals must borrow at higher rates than corporations.

14.4 MODIGLIANI AND MILLER: PROPOSITION II (NO TAXES)

Risk to Equityholders Rises with Leverage

At a Trans Am corporate meeting, a corporate officer said, "Well, maybe it does not matter whether the corporation or the individual levers—as long as some leverage takes place. Leverage benefits investors. After all, an investor's expected return rises with the amount of the leverage present." He then pointed out that, as shown in Tables 14.2 and 14.3, the expected return on unlevered equity is 15 percent while the expected return on levered equity is 20 percent.

However, another officer replied, "Not necessarily. Though the expected return rises with leverage, the *risk* rises as well." This point can be seen from an examination of Tables 14.2 and 14.3. With earnings before interest (EBI) varying between \$400 and \$2,000, earnings per share (EPS) for the stockholders of the unlevered firm vary between \$1.00 and \$5.00. EPS for the stockholders of the levered firm varies between \$0 and \$8.00. This greater range for the EPS of the levered firm implies greater risk for the levered firm's stockholders. In other words, levered stockholders have better returns in good times than do unlevered stockholders, but they have worse returns in bad times. The

two tables also show greater range for the ROE of the levered firm's stockholders. The above interpretation concerning risk applies here as well.

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The same insight can be taken from Figure 14.2. The slope of the line for the levered firm is greater than the slope of the line for the unlevered firm. This means that the levered stockholders have better returns in good times than do unlevered stockholders but worse returns in bad times, implying greater risk with leverage. In other words, the slope of the line measures the risk to stockholders, since the slope indicates the responsiveness of EPS to changes in firm performance (earnings before interest). page 431

Proposition II: Required Return to Equityholders Rises with Leverage

Since levered equity has greater risk, it should have a greater expected return as compensation. In our example, the market *requires* only a 15 percent expected return for the unlevered equity, but it requires a 20 percent expected return for the levered equity.

This type of reasoning allows us to develop **MM Proposition II**. Here, MM argue that the expected return on equity is positively related to leverage, because the risk to equity-holders increases with leverage.

To develop this position recall that the firm's weighted average cost of capital, R_{WACC} , can be written as:⁵

$$R_{WACC} = \frac{S}{B + S} \times R_S + \frac{B}{B + S} \times R_B \quad [14.2]$$

where:

R_B = The cost of debt

R_S = The expected return on equity or stock, also called the *cost of equity* or the *required* return on equity

R_{WACC} = The firm's weighted average cost of capital

B = The value of the firm's debt or bonds

S = The value of the firm's stock or equity

Equation 14.2 is quite intuitive. It simply says that a firm's weighted average cost of capital is a weighted average of its cost of debt and its cost of equity. The weight applied to debt is the proportion of debt in the capital structure, and the weight applied to equity is the proportion of equity in the capital structure. Calculations of R_{WACC} from Equation 14.2 for both the unlevered and the levered firm are presented in Table 14.5.

TABLE 14.5 Cost of Capital Calculations for Trans Am

$$R_{WACC} = \frac{S}{B+S} \times R_S + \frac{B}{B+S} \times R_B$$

$$\text{Unlevered firm: } 15\% = \frac{\$8,000}{\$8,000} \times 15\%^* + \frac{0}{\$8,000} \times 10\%^{\dagger}$$

$$\text{Levered firm: } 15\% = \frac{\$4,000}{\$8,000} \times 20\%^{**} + \frac{\$4,000}{\$8,000} \times 10\%^{\dagger}$$

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An implication of MM Proposition I is that R_{WACC} is a constant for a given firm, regardless of the capital structure.⁶ For example, Table 14.5 shows that R_{WACC} for Trans Am is 15 percent, with or without leverage.

Let us now define R_0 to be the *cost of capital for an all-equity firm*. For the Trans Am Corp., R_0 is calculated as:

$$R_0 = \frac{\text{Expected earnings of unlevered firm}}{\text{Unlevered equity}} = \frac{\$1,200}{\$8,000} = .15, \text{ or } 15\%$$

As can be seen from Table 14.5, R_{WACC} is equal to R_0 for Trans Am. In fact, R_{WACC} must *always* equal R_0 in a world without corporate taxes.

Proposition II states the expected return of equity, R_S , in terms of leverage. The exact relationship, derived by setting $R_{WACC} = R_0$ and then rearranging Equation 14.2, is:

MM Proposition II (no taxes):

$$R_S = R_0 + \frac{B}{S} (R_0 - R_B) \quad [14.3]$$

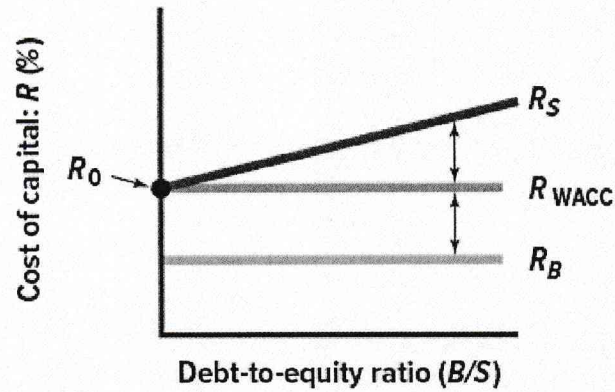
Equation 14.3 implies that the required return on equity is a linear function of the firm's debt-to-equity ratio. Examining Equation 14.3, we see that if R_0 exceeds the debt rate, R_B , then the cost of equity rises with increases in the debt-equity ratio, B/S . Normally, R_0 should exceed R_B . That is, because even unlevered equity is risky, it should have an expected return greater than that of riskless debt. Note that Equation 14.3 holds for Trans Am in its levered state:

$$.20 = .15 + \frac{\$4,000}{\$4,000} (.15 - .10)$$

Figure 14.3 graphs Equation 14.3. As you can see, we have plotted the relation between the cost of equity, R_S , and the debt-equity ratio, B/S , as a straight line. What we witness in Equation 14.3 and illustrate in Figure 14.3 is the effect of leverage on the cost of equity.

FIGURE 14.3

The Cost of Equity, the Cost of Debt, and the Weighted Average Cost of Capital: MM Proposition II with No Corporate Taxes



$$R_S = R_0 + (R_0 - R_B)B/S$$

R_S is the cost of equity.

R_B is the cost of debt.

R_0 is the cost of capital for an all-equity firm.

R_{WACC} is a firm's weighted average cost of capital. In a world with no taxes,

R_{WACC} for a levered firm is equal to R_0 .

R_0 is a single point while R_S , R_B , and R_{WACC} are all entire lines.

The cost of equity capital, R_S , is positively related to the firm's debt-equity ratio.

The firm's weighted average cost of capital, R_{WACC} , is invariant to the firm's debt-equity ratio.

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As the firm raises the debt-equity ratio, each dollar of equity is levered with additional debt. page 433
This raises the risk of equity and therefore the required return, R_S , on the equity.

Figure 14.3 also shows that R_{WACC} is unaffected by leverage, a point we made above. (It is important for students to realize that R_0 , the cost of capital for an all-equity firm, is represented by a single dot on the graph. By contrast, R_{WACC} is an entire line.)

EXAMPLE 14.2

MM Propositions I and II

Lutheran Motors, an all-equity firm, has expected earnings of \$10 million per year in perpetuity. The firm pays all of its earnings out as dividends, so that the \$10 million may also be viewed as the stockholders' expected cash flow. There are 10 million shares outstanding, implying expected annual cash flow of \$1 per share. The cost of capital for this unlevered firm is 10 percent. In addition, the firm will soon build a new plant for \$4 million. The plant is expected to generate additional cash flow of \$1 million per year. These figures can be described as:

CURRENT COMPANY	NEW PLANT
Cash flow: \$10 million	Initial outlay: \$4 million
Number of outstanding shares: 10 million	Additional annual cash flow: \$1 million

The project's net present value is:

$$-\$4 \text{ million} + \frac{\$1 \text{ million}}{.1} = \$6 \text{ million}$$

assuming that the project is discounted at the same rate as the firm as a whole. Before the market knows of the project, the *market value* balance sheet of the firm is:

LUTERAN MOTORS	
Balance Sheet (all Equity)	
Old assets: $\frac{\$10 \text{ million}}{.1} = \100 million	Equity \$100 million
	(10 million shares of stock)

The value of the firm is \$100 million, because the cash flow of \$10 million per year is capitalized (discounted) at 10 percent. A share of stock sells for \$10 (= \$100 million/10 million) because there are 10 million shares outstanding.

The market value balance sheet is a useful tool of financial analysis. Because students are often thrown off guard by it initially, we recommend extra study here. The key is that the market value balance sheet has the same form as the balance sheet that accountants use. That is, assets are placed on the left-hand side whereas liabilities and owners' equity are placed on the right-hand side. In addition, the left-hand side and the right-hand side must be equal. The difference between a market value balance sheet and the accountant's balance sheet is in the numbers. Accountants value items in terms of historical cost (original purchase price less depreciation), whereas financial analysts value items in terms of market value.

The firm will either issue \$4 million of equity or debt. Let us consider the effect of equity and debt financing in turn.

Stock Financing Imagine that the firm announces that in the near future, it will raise \$4 million in equity in order to build a new plant. The stock price, and therefore the value of the firm, will rise to reflect the positive net present value of the plant. According to efficient markets, the increase occurs immediately. That is, the rise occurs on the day of the announcement, not on the date of

PF

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either the onset of construction of the plant or the forthcoming stock offering. The market value balance sheet becomes: page 434

LUTERAN MOTORS
Balance Sheet
(upon announcement of equity issue to construct plant)

Old assets	\$100 million	Equity	\$106 million
			(10 million shares of stock)

NPV of plant:

$$-\$4 \text{ million} + \frac{\$1 \text{ million}}{.1} = 6 \text{ million}$$

Total assets	\$106 million
--------------	---------------

Note that the NPV of the plant is included in the market value balance sheet. Because the new shares have not yet been issued, the number of outstanding shares remains 10 million. The price per share has now risen to \$10.60 (= \$106 million/10 million) to reflect news concerning the plant.

Shortly thereafter, \$4 million of stock is issued or *floated*. Because the stock is selling at \$10.60 per share, 377,358 (= \$4 million/\$10.60) shares of stock are issued. Imagine that funds are put in the bank temporarily before being used to build the plant. The market value balance sheet becomes:

LUTERAN MOTORS
Balance Sheet
(upon issuance of stock but before construction begins on plant)

Old assets	\$100 million	Equity	\$110 million
			(10,377,358 shares of stock)

NPV of plant: 6 million

Proceeds from new issue
of stock (currently
placed in bank) 4 million

Total assets	\$110 million
--------------	---------------

The number of shares outstanding is now 10,377,358 because 377,358 new shares were issued. The price per share is \$10.60 (= \$110,000,000/10,377,358). Note that the price has not changed. This is consistent with efficient capital markets, because the stock price should only move due to new information.

Of course, the funds are placed in the bank only temporarily. Shortly after the new issue, the \$4 million is given to a contractor who builds the plant. To avoid problems in discounting, we assume that the plant is built immediately. The balance sheet then becomes:

LUTERAN MOTORS
Balance Sheet
(upon completion of the plant)

Old assets	\$100 million	Equity	\$110 million
			(10,377,358 shares of stock)
PV of plant: + $\frac{\$1 \text{ million}}{.1} =$		10 million	
<hr/>			
Total assets	\$110 million		

Though total assets do not change, the composition of the assets does change. The bank account has been emptied to pay the contractor. The present value of cash flows of \$1 million a year from the plant is reflected as an asset worth \$10 million. Because the building expenditures of \$4 million have

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already been paid, they no longer represent a future cost. Hence, they no longer reduce the value of the plant. According to efficient capital markets, the price per share of stock remains \$10.60. page 435

Expected yearly cash flow from the firm is \$11 million, \$10 million of which comes from the old assets and \$1 million from the new. The expected return to equityholders is:

$$R_s = \frac{\$11 \text{ million}}{\$110 \text{ million}} = .10, \text{ or } 10\%$$

Because the firm is all equity, $R_s = R_0 = .10$.

Debt Financing Alternatively, imagine the firm announces that, in the near future, it will borrow \$4 million at 6 percent to build a new plant. This implies yearly interest payments of \$240,000 (= \$4,000,000 × .06). Again, the stock price rises immediately to reflect the positive net present value of the plant. Thus, we have:

LUTERAN MOTORS			
Balance Sheet			
(upon announcement of debt issue to construct plant)			
Old assets	\$100 million	Equity	\$106 million
			(10 million shares of stock)
NPV of plant:			
	$-\$4 \text{ million} + \frac{\$1 \text{ million}}{.1} =$	6 million	
<hr/>			
Total assets	\$106 million		

The value of the firm is the same as in the equity financing case because (1) the same plant is to be built and (2) MM proved that debt financing is neither better nor worse than equity financing.

At some point, \$4 million of debt is issued. As before, the funds are placed in the bank temporarily. The market value balance sheet becomes:

LUTERAN MOTORS			
Balance Sheet			
(upon issuance but before construction begins on plant)			
Old assets	\$100 million	Debt	\$ 4 million
NPV of plant:	6 million	Equity	\$106 million
			(10 million shares of stock)
Proceeds from debt issue (currently invested in bank)	4 million		
<hr/>			
Total assets	\$110 million	Debt plus equity	\$110 million

Note that debt appears on the right-hand side of the balance sheet. The stock price is still \$10.60, in accordance with our discussion of efficient capital markets.

Finally, the contractor receives \$4 million and builds the plant. The market value balance sheet becomes:

LUTERAN MOTORS			
Balance Sheet			
(upon completion of the plant)			
Old assets	\$100 million	Debt	\$4 million
PV of plant	10 million	Equity	\$106 million
			(10 million shares of stock)
<hr/>			
Total assets	\$110 million	Debt plus equity	\$110 million

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The only change here is that the bank account has been depleted to pay the contractor. The equityholders expect yearly cash flow after interest of:

$$\begin{array}{rcccccc}
 \$10,000,000 & + & \$1,000,000 & - & \$240,000 & = & \$10,760,000 \\
 \text{Cash flow on} & & \text{Cash flow on} & & \text{Interest} & & \\
 \text{old assets} & & \text{new assets} & & (\$4 \text{ million} \times .06) & &
 \end{array}$$

The equityholders expect to earn a return of:

$$\frac{\$10,760,000}{\$106,000,000} = 10.15\%$$

This return of 10.15 percent for levered equityholders is higher than the 10 percent return for the unlevered equityholders. This result is sensible because, as we argued earlier, levered equity is riskier. In fact, the return of 10.15 percent should be exactly what MM Proposition II predicts. This prediction can be verified by plugging values into Equation 14.3:

$$R_S = R_0 + \frac{B}{S} \times (R_0 - R_B)$$

Doing so, we obtain:

$$10.15\% = 10\% + \frac{\$4,000,000}{\$106,000,000} \times (10\% - 6\%)$$

This example was useful for two reasons. First, we wanted to introduce the concept of market value balance sheets, a tool that will prove useful elsewhere in the text. Among other things, this technique allows one to calculate the price per share of a new issue of stock. Second, the example illustrates three aspects of Modigliani and Miller:

1. The example is consistent with MM Proposition I because the value of the firm is \$110 million after either equity or debt financing.
2. Students are often more interested in stock price than in firm value. We show that the stock price is always \$10.60, regardless of whether debt or equity financing is used.
3. The example is consistent with MM Proposition II. The expected return to equityholders rises from 10 to 10.15 percent, just as Equation 14.3 states. This rise occurs because the equityholders of a levered firm face more risk than do the equityholders of an unlevered firm.

MM: An Interpretation

The Modigliani-Miller results indicate that managers cannot change the value of a firm by repackaging the firm's securities. Though this idea was considered revolutionary when it was originally proposed in the late 1950s, the MM approach and proof have since met with wide acclaim.⁷

MM argue that the firm's overall cost of capital cannot be reduced as debt is substituted for equity, even though debt appears to be cheaper than equity. The reason for this is that as the firm adds debt, the remaining equity becomes more risky. As this risk rises, the cost of equity capital rises as a result. The increase in the cost of the remaining equity capital offsets the higher proportion of the firm financed by low-cost debt. In fact, MM prove that the two effects exactly offset each other, so that both the value of the firm and the firm's overall cost of capital are invariant to leverage.

MM use an interesting analogy to food. They consider a dairy farmer with two choices. On the one hand, he can sell whole milk. On the other hand, by skimming, he can sell a combination of cream and low-fat milk. Though the farmer can get a high price for the cream, he gets a low price for the low-fat milk, implying no net gain. In fact, imagine that the proceeds from the whole-milk strategy were less than those from the cream–low-fat milk strategy. Arbitrageurs would buy the whole milk, perform the skimming operation themselves, and resell the cream and low-fat milk separately. Competition between

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arbitrageurs would tend to boost the price of whole milk until proceeds from the two strategies became equal. Thus, the value of the farmer's milk is invariant to the way in which the milk is packaged.

SUMMARY OF MODIGLIANI-MILLER PROPOSITIONS WITHOUT TAXES

Assumptions

- No taxes.
- No transaction costs.
- Individuals and corporations borrow at same rate.

Results

Proposition I: $V_L = V_u$ (Value of levered firm equals value of unlevered firm)

Proposition II: $R_s = R_0 + \frac{B}{S}(R_0 - R_B)$

Intuition

Proposition I: Through homemade leverage, individuals can either duplicate or undo the effects of corporate leverage.

Proposition II: The cost of equity rises with leverage, because the risk to equity rises with leverage.

Food found its way into this chapter earlier, when we viewed the firm as a pie. MM argue that the size of the pie does not change, no matter how stockholders and bondholders divide it. MM say that a firm's capital structure is irrelevant; it is what it is by some historical accident. The theory implies that firms' debt-equity ratios could be anything. They are what they are because of whimsical and random managerial decisions about how much to borrow and how much stock to issue.

Although scholars are always fascinated with far-reaching theories, students are perhaps more concerned with real-world applications. Do real-world managers follow MM by treating capital structure decisions with indifference? Unfortunately for the theory, virtually all companies in certain industries, such as banking, choose high debt-to-equity ratios. Conversely, companies in other industries, such as pharmaceuticals, choose low debt-to-equity ratios. In fact, almost any industry has a debt-to-equity ratio to which companies in that industry tend to adhere. Thus, companies do not appear to be selecting their degree of leverage in a frivolous or random manner. Because of this, financial economists (including MM themselves) have argued that real-world factors may have been left out of the theory.

Though many of our students have argued that individuals can only borrow at rates above the corporate borrowing rate, we disagreed with this argument earlier in the chapter. But when we look elsewhere for unrealistic assumptions in the theory, we find two:⁸

1. Taxes were ignored.
2. Bankruptcy costs and other agency costs were not considered.

We turn to taxes in the next section. Bankruptcy costs and other agency costs will be treated in the next chapter. A summary of the main Modigliani-Miller results without taxes is presented in the nearby boxed section.

14.5 TAXES

The Basic Insight

The previous part of this chapter showed that firm value is unrelated to debt in a world without taxes. We now show that, in the presence of corporate taxes, the firm's value is positively related to its debt. The basic intuition can be seen from a pie chart, such as

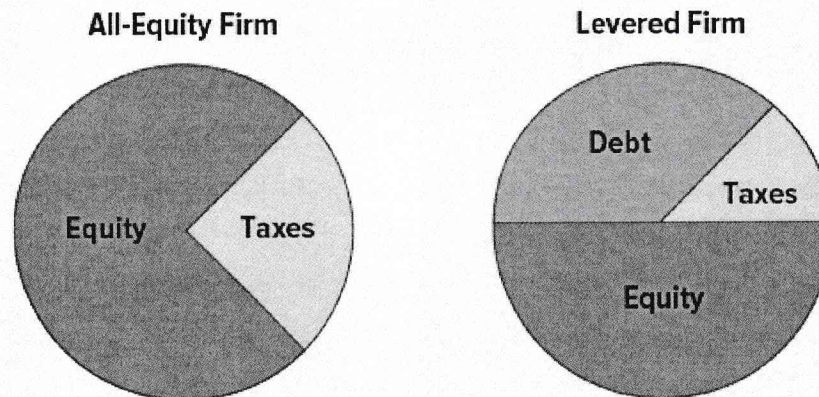
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the one in Figure 14.4. Consider the all-equity firm on the left. Here, both equityholders and the IRS have claims on the firm. The value of the all-equity firm is, of course, that part of the pie owned by the equityholders. The proportion going to taxes is simply a cost.

FIGURE 14.4
Two Pie Models of Capital Structure under Corporate Taxes



The levered firm pays less in taxes than does the all-equity firm. Thus, the sum of the debt plus the equity of the levered firm is greater than the equity of the unlevered firm.

The pie on the right for the levered firm shows three claims: equityholders, debtholders, and taxes. The value of the levered firm is the sum of the value of the debt and the value of the equity. In selecting between the two capital structures in the picture, a financial manager should select the one with the higher value. Assuming that the total area is the same for both pies,⁹ value is maximized for the capital structure paying the least in taxes. In other words, the manager should choose the capital structure that the IRS hates the most.

We will show that due to a quirk in U.S. tax law, the proportion of the pie allocated to taxes is less for the levered firm than it is for the unlevered firm. Thus, managers should select high leverage.

EXAMPLE 14.3

Taxes and Cash Flow

The Water Products Company has a corporate tax rate, t_c , of 35 percent and expected earnings before interest and taxes (EBIT) of \$1 million each year. Its entire earnings after taxes are paid out as dividends.

The firm is considering two alternative capital structures. Under Plan I, Water Products would have no debt in its capital structure. Under Plan II, the company would have \$4,000,000 of debt, B . The cost of debt, R_B , is 10 percent.

The chief financial officer for Water Products makes the following calculations:

PLAN I PLAN II