
CHAPTER 15

CAPITAL STRUCTURE: *BASIC*

CONCEPTS

Answers to Concepts Review and Critical Thinking Questions

1. Assumptions of the Modigliani-Miller theory in a world without taxes: 1) Individuals can borrow at the same interest rate at which the firm borrows. Since investors can purchase securities on margin, an individual's effective interest rate is probably no higher than that for a firm. Therefore, this assumption is reasonable when applying MM's theory to the real world. If a firm were able to borrow at a rate lower than individuals, the firm's value would increase through corporate leverage. As MM Proposition I states, this is not the case in a world with no taxes. 2) There are no taxes. In the real world, firms do pay taxes. In the presence of corporate taxes, the value of a firm is positively related to its debt level. Since interest payments are deductible, increasing debt reduces taxes and raises the value of the firm. 3) There are no costs of financial distress. In the real world, costs of financial distress can be substantial. Since stockholders eventually bear these costs, there are incentives for a firm to lower the amount of debt in its capital structure. This topic will be discussed in more detail in later chapters.
2. False. A reduction in leverage will decrease both the risk of the stock and its expected return. Modigliani and Miller state that, in the absence of taxes, these two effects exactly cancel each other out and leave the price of the stock and the overall value of the firm unchanged.
3. False. Modigliani-Miller Proposition II (No Taxes) states that the required return on a firm's equity is positively related to the firm's debt-equity ratio [$R_S = R_0 + (B/S)(R_0 - R_B)$]. Therefore, any increase in the amount of debt in a firm's capital structure will increase the required return on the firm's equity.
4. Interest payments are tax deductible, where payments to shareholders (dividends) are not tax deductible.
5. Business risk is the equity risk arising from the nature of the firm's operating activity, and is directly related to the systematic risk of the firm's assets. Financial risk is the equity risk that is due entirely to the firm's chosen capital structure. As financial leverage, or the use of debt financing, increases, so does financial risk and, hence, the overall risk of the equity. Thus, Firm B could have a higher cost of equity if it uses greater leverage.
6. No, it doesn't follow. While it is true that the equity and debt costs are rising, the key thing to remember is that the cost of debt is still less than the cost of equity. Since we are using more and more debt, the WACC does not necessarily rise.

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7. Because many relevant factors such as bankruptcy costs, tax asymmetries, and agency costs cannot easily be identified or quantified, it is practically impossible to determine the precise debt/equity ratio that maximizes the value of the firm. However, if the firm's cost of new debt suddenly becomes much more expensive, it's probably true that the firm is too highly leveraged.
8. It's called leverage (or "gearing" in the UK) because it magnifies gains or losses.
9. Homemade leverage refers to the use of borrowing on the personal level as opposed to the corporate level.
10. The basic goal is to minimize the value of non-marketed claims.

Solutions to Questions and Problems

NOTE: All end-of-chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.

Basic

1. a. A table outlining the income statement for the three possible states of the economy is shown below. The EPS is the net income divided by the 2,500 shares outstanding. The last row shows the percentage change in EPS the company will experience in a recession or an expansion economy.

	<u>Recession</u>	<u>Normal</u>	<u>Expansion</u>
EBIT	\$5,600	\$14,000	\$18,200
Interest	<u>0</u>	<u>0</u>	<u>0</u>
NI	<u>\$5,600</u>	<u>\$14,000</u>	<u>\$18,200</u>
EPS	\$ 2.24	\$ 5.60	\$ 7.28
%ΔEPS	-60	—	+30

- b. If the company undergoes the proposed recapitalization, it will repurchase:

Share price = Equity / Shares outstanding

Share price = \$150,000/2,500

Share price = \$60

Shares repurchased = Debt issued / Share price

Shares repurchased = \$60,000/\$60

Shares repurchased = 1,000

The interest payment each year under all three scenarios will be:

Interest payment = \$60,000(.05) = \$3,000

The last row shows the percentage change in EPS the company will experience in a recession or an expansion economy under the proposed recapitalization.

	<u>Recession</u>	<u>Normal</u>	<u>Expansion</u>
EBIT	\$5,600	\$14,000	\$18,200
Interest	<u>3,000</u>	<u>3,000</u>	<u>3,000</u>
NI	<u>\$2,600</u>	<u>\$11,000</u>	<u>\$15,200</u>
EPS	\$1.73	\$ 7.33	\$10.13
%ΔEPS	-76.36	—	+38.18

2. a. A table outlining the income statement with taxes for the three possible states of the economy is shown below. The share price is still \$60, and there are still 2,500 shares outstanding. The last row shows the percentage change in EPS the company will experience in a recession or an expansion economy.

	<u>Recession</u>	<u>Normal</u>	<u>Expansion</u>
EBIT	\$5,600	\$14,000	\$18,200
Interest	0	0	0
Taxes	<u>1,960</u>	<u>4,900</u>	<u>6,370</u>
NI	<u>\$3,640</u>	<u>\$9,100</u>	<u>\$11,830</u>
EPS	\$1.46	\$3.64	\$4.73
%ΔEPS	-60	—	+30

- b. A table outlining the income statement with taxes for the three possible states of the economy and assuming the company undertakes the proposed capitalization is shown below. The interest payment and shares repurchased are the same as in part *b* of Problem 1.

	<u>Recession</u>	<u>Normal</u>	<u>Expansion</u>
EBIT	\$5,600	\$14,000	\$18,200
Interest	3,000	3,000	3,000
Taxes	<u>910</u>	<u>3,850</u>	<u>5,320</u>
NI	<u>\$1,690</u>	<u>\$7,150</u>	<u>\$9,880</u>
EPS	\$1.13	\$4.77	\$6.59
%ΔEPS	-76.36	—	+38.18

Notice that the percentage change in EPS is the same both with and without taxes.

3. a. Since the company has a market-to-book ratio of 1.0, the total equity of the firm is equal to the market value of equity. Using the equation for ROE:

$$\text{ROE} = \text{NI}/\$150,000$$

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The ROE for each state of the economy under the current capital structure and no taxes is:

	<u>Recession</u>	<u>Normal</u>	<u>Expansion</u>
ROE	.0373	.0933	.1213
%ΔROE	-60	—	+30

The second row shows the percentage change in ROE from the normal economy.

- b. If the company undertakes the proposed recapitalization, the new equity value will be:

$$\text{Equity} = \$150,000 - 60,000$$

$$\text{Equity} = \$90,000$$

So, the ROE for each state of the economy is:

$$\text{ROE} = \text{NI}/\$90,000$$

	<u>Recession</u>	<u>Normal</u>	<u>Expansion</u>
ROE	.0222	.1156	.1622
%ΔROE	-76.36	—	+38.18

- c. If there are corporate taxes and the company maintains its current capital structure, the ROE is:

ROE	.0243	.0607	.0789
%ΔROE	-60	—	+30

If the company undertakes the proposed recapitalization, and there are corporate taxes, the ROE for each state of the economy is:

ROE	.0144	.0751	.1054
%ΔROE	-76.36	—	+38.18

Notice that the percentage change in ROE is the same as the percentage change in EPS. The percentage change in ROE is also the same with or without taxes.

4. a. Under Plan I, the unlevered company, net income is the same as EBIT with no corporate tax. The EPS under this capitalization will be:

$$\text{EPS} = \$200,000/150,000 \text{ shares}$$

$$\text{EPS} = \$1.33$$

Under Plan II, the levered company, EBIT will be reduced by the interest payment. The interest payment is the amount of debt times the interest rate, so:

$$\text{NI} = \$200,000 - .10(\$1,500,000)$$

$$\text{NI} = \$50,000$$

And the EPS will be:

$$\begin{aligned} \text{EPS} &= \$50,000/60,000 \text{ shares} \\ \text{EPS} &= \$0.83 \end{aligned}$$

Plan I has the higher EPS when EBIT is \$200,000.

- b. Under Plan I, the net income is \$700,000 and the EPS is:

$$\begin{aligned} \text{EPS} &= \$700,000/150,000 \text{ shares} \\ \text{EPS} &= \$4.67 \end{aligned}$$

Under Plan II, the net income is:

$$\begin{aligned} \text{NI} &= \$700,000 - .10(\$1,500,000) \\ \text{NI} &= \$550,000 \end{aligned}$$

And the EPS is:

$$\begin{aligned} \text{EPS} &= \$550,000/60,000 \text{ shares} \\ \text{EPS} &= \$9.17 \end{aligned}$$

Plan II has the higher EPS when EBIT is \$700,000.

- c. To find the breakeven EBIT for two different capital structures, we simply set the equations for EPS equal to each other and solve for EBIT. The breakeven EBIT is:

$$\begin{aligned} \text{EBIT}/150,000 &= [\text{EBIT} - .10(\$1,500,000)]/60,000 \\ \text{EBIT} &= \$250,000 \end{aligned}$$

5. We can find the price per share by dividing the amount of debt used to repurchase shares by the number of shares repurchased. Doing so, we find the share price is:

$$\begin{aligned} \text{Share price} &= \$1,500,000/(150,000 - 60,000) \\ \text{Share price} &= \$16.67 \text{ per share} \end{aligned}$$

The value of the company under the all-equity plan is:

$$V = \$16.67(150,000 \text{ shares}) = \$2,500,000$$

And the value of the company under the levered plan is:

$$V = \$16.67(60,000 \text{ shares}) + \$1,500,000 \text{ debt} = \$2,500,000$$

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6. a. The income statement for each capitalization plan is:

	<u>I</u>	<u>II</u>	<u>All-equity</u>
EBIT	\$10,000	\$10,000	\$10,000
Interest	<u>1,650</u>	<u>2,750</u>	<u>0</u>
NI	<u>\$8,350</u>	<u>\$7,250</u>	<u>\$10,000</u>
EPS	\$7.59	\$ 8.06	\$ 7.14

Plan II has the highest EPS; the all-equity plan has the lowest EPS.

- b. The breakeven level of EBIT occurs when the capitalization plans result in the same EPS. The EPS is calculated as:

$$\text{EPS} = (\text{EBIT} - R_D D) / \text{Shares outstanding}$$

This equation calculates the interest payment ($R_D D$) and subtracts it from the EBIT, which results in the net income. Dividing by the shares outstanding gives us the EPS. For the all-equity capital structure, the interest paid is zero. To find the breakeven EBIT for two different capital structures, we simply set the equations equal to each other and solve for EBIT. The breakeven EBIT between the all-equity capital structure and Plan I is:

$$\begin{aligned} \text{EBIT}/1,400 &= [\text{EBIT} - .10(\$16,500)]/1,100 \\ \text{EBIT} &= \$7,700 \end{aligned}$$

And the breakeven EBIT between the all-equity capital structure and Plan II is:

$$\begin{aligned} \text{EBIT}/1,400 &= [\text{EBIT} - .10(\$27,500)]/900 \\ \text{EBIT} &= \$7,700 \end{aligned}$$

The break-even levels of EBIT are the same because of M&M Proposition I.

- c. Setting the equations for EPS from Plan I and Plan II equal to each other and solving for EBIT, we get:

$$\begin{aligned} [\text{EBIT} - .10(\$16,500)]/1,100 &= [\text{EBIT} - .10(\$27,500)]/900 \\ \text{EBIT} &= \$7,700 \end{aligned}$$

This break-even level of EBIT is the same as in part *b* again because of M&M Proposition I.

d. The income statement for each capitalization plan with corporate income taxes is:

	<u>I</u>	<u>II</u>	<u>All-equity</u>
EBIT	\$10,000	\$10,000	\$10,000
Interest	1,650	2,750	0
Taxes	<u>3,340</u>	<u>2,900</u>	<u>4,000</u>
NI	<u>\$5,010</u>	<u>\$4,350</u>	<u>\$6,000</u>
EPS	\$4.55	\$ 4.83	\$ 4.29

Plan II still has the highest EPS; the all-equity plan still has the lowest EPS.

We can calculate the EPS as:

$$\text{EPS} = [(\text{EBIT} - R_D D)(1 - t_C)] / \text{Shares outstanding}$$

This is similar to the equation we used before, except that now we need to account for taxes. Again, the interest expense term is zero in the all-equity capital structure. So, the breakeven EBIT between the all-equity plan and Plan I is:

$$\begin{aligned} \text{EBIT}(1 - .40)/1,400 &= [\text{EBIT} - .10(\$16,500)](1 - .40)/1,100 \\ \text{EBIT} &= \$7,700 \end{aligned}$$

The breakeven EBIT between the all-equity plan and Plan II is:

$$\begin{aligned} \text{EBIT}(1 - .40)/1,400 &= [\text{EBIT} - .10(\$27,500)](1 - .40)/900 \\ \text{EBIT} &= \$7,700 \end{aligned}$$

And the breakeven between Plan I and Plan II is:

$$\begin{aligned} [\text{EBIT} - .10(\$16,500)](1 - .40)/1,100 &= [\text{EBIT} - .10(\$27,500)](1 - .40)/900 \\ \text{EBIT} &= \$7,700 \end{aligned}$$

The break-even levels of EBIT do not change because the addition of taxes reduces the income of all three plans by the same percentage; therefore, they do not change relative to one another.

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7. To find the value per share of the stock under each capitalization plan, we can calculate the price as the value of shares repurchased divided by the number of shares repurchased. So, under Plan I, the value per share is:

$$P = \$11,000/200 \text{ shares}$$

$$P = \$55 \text{ per share}$$

And under Plan II, the value per share is:

$$P = \$27,500/500 \text{ shares}$$

$$P = \$55 \text{ per share}$$

This shows that when there are no corporate taxes, the stockholder does not care about the capital structure decision of the firm. This is M&M Proposition I without taxes.

8. a. The earnings per share are:

$$\text{EPS} = \$16,000/2,000 \text{ shares}$$

$$\text{EPS} = \$8.00$$

So, the cash flow for the company is:

$$\text{Cash flow} = \$8.00(100 \text{ shares})$$

$$\text{Cash flow} = \$800$$

- b. To determine the cash flow to the shareholder, we need to determine the EPS of the firm under the proposed capital structure. The market value of the firm is:

$$V = \$70(2,000)$$

$$V = \$140,000$$

Under the proposed capital structure, the firm will raise new debt in the amount of:

$$D = 0.40(\$140,000)$$

$$D = \$56,000$$

This means the number of shares repurchased will be:

$$\text{Shares repurchased} = \$56,000/\$70$$

$$\text{Shares repurchased} = 800$$

Under the new capital structure, the company will have to make an interest payment on the new debt. The net income with the interest payment will be:

$$\text{NI} = \$16,000 - .08(\$56,000)$$

$$\text{NI} = \$11,520$$

This means the EPS under the new capital structure will be:

$$\text{EPS} = \$11,520/1,200 \text{ shares}$$

$$\text{EPS} = \$9.60$$

Since all earnings are paid as dividends, the shareholder will receive:

$$\text{Shareholder cash flow} = \$9.60(100 \text{ shares})$$

$$\text{Shareholder cash flow} = \$960$$

- c. To replicate the proposed capital structure, the shareholder should sell 40 percent of their shares, or 40 shares, and lend the proceeds at 8 percent. The shareholder will have an interest cash flow of:

$$\text{Interest cash flow} = 40(\$70)(.08)$$

$$\text{Interest cash flow} = \$224$$

The shareholder will receive dividend payments on the remaining 60 shares, so the dividends received will be:

$$\text{Dividends received} = \$9.60(60 \text{ shares})$$

$$\text{Dividends received} = \$576$$

The total cash flow for the shareholder under these assumptions will be:

$$\text{Total cash flow} = \$224 + 576$$

$$\text{Total cash flow} = \$800$$

This is the same cash flow we calculated in part *a*.

- d. The capital structure is irrelevant because shareholders can create their own leverage or unlever the stock to create the payoff they desire, regardless of the capital structure the firm actually chooses.
9. a. The rate of return earned will be the dividend yield. The company has debt, so it must make an interest payment. The net income for the company is:

$$\text{NI} = \$73,000 - .10(\$300,000)$$

$$\text{NI} = \$43,000$$

The investor will receive dividends in proportion to the percentage of the company's share they own. The total dividends received by the shareholder will be:

$$\text{Dividends received} = \$43,000(\$30,000/\$300,000)$$

$$\text{Dividends received} = \$4,300$$

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So the return the shareholder expects is:

$$R = \$4,300/\$30,000$$
$$R = .1433 \text{ or } 14.33\%$$

- b. To generate exactly the same cash flows in the other company, the shareholder needs to match the capital structure of ABC. The shareholder should sell all shares in XYZ. This will net \$30,000. The shareholder should then borrow \$30,000. This will create an interest cash flow of:

$$\text{Interest cash flow} = .10(-\$30,000)$$
$$\text{Interest cash flow} = -\$3,000$$

The investor should then use the proceeds of the stock sale and the loan to buy shares in ABC. The investor will receive dividends in proportion to the percentage of the company's share they own. The total dividends received by the shareholder will be:

$$\text{Dividends received} = \$73,000(\$60,000/\$600,000)$$
$$\text{Dividends received} = \$7,300$$

The total cash flow for the shareholder will be:

$$\text{Total cash flow} = \$7,300 - 3,000$$
$$\text{Total cash flow} = \$4,300$$

The shareholders return in this case will be:

$$R = \$4,300/\$30,000$$
$$R = .1433 \text{ or } 14.33\%$$

- c. ABC is an all equity company, so:

$$R_E = R_A = \$73,000/\$600,000$$
$$R_E = .1217 \text{ or } 12.17\%$$

To find the cost of equity for XYZ, we need to use M&M Proposition II, so:

$$R_E = R_A + (R_A - R_D)(D/E)(1 - t_C)$$
$$R_E = .1217 + (.1217 - .10)(1)(1)$$
$$R_E = .1433 \text{ or } 14.33\%$$

- d. To find the WACC for each company, we need to use the WACC equation:

$$\text{WACC} = (E/V)R_E + (D/V)R_D(1 - t_c)$$

So, for ABC, the WACC is:

$$\text{WACC} = (1)(.1217) + (0)(.10)$$

$$\text{WACC} = .1217 \text{ or } 12.17\%$$

And for XYZ, the WACC is:

$$\text{WACC} = (1/2)(.1433) + (1/2)(.10)$$

$$\text{WACC} = .1217 \text{ or } 12.17\%$$

When there are no corporate taxes, the cost of capital for the firm is unaffected by the capital structure; this is M&M Proposition II without taxes.

10. With no taxes, the value of an unlevered firm is the interest rate divided by the unlevered cost of equity, so:

$$V = \text{EBIT}/\text{WACC}$$

$$\$35,000,000 = \text{EBIT}/.13$$

$$\text{EBIT} = .13(\$35,000,000)$$

$$\text{EBIT} = \$4,550,000$$

11. If there are corporate taxes, the value of an unlevered firm is:

$$V_U = \text{EBIT}(1 - t_c)/R_U$$

Using this relationship, we can find EBIT as:

$$\$35,000,000 = \text{EBIT}(1 - .35)/.13$$

$$\text{EBIT} = \$7,000,000$$

The WACC remains at 13 percent. Due to taxes, EBIT for an all-equity firm would have to be higher for the firm to still be worth \$35 million.

12. a. With the information provided, we can use the equation for calculating WACC to find the cost of equity. The equation for WACC is:

$$\text{WACC} = (E/V)R_E + (D/V)R_D(1 - t_c)$$

The company has a debt-equity ratio of 1.5, which implies the weight of debt is 1.5/2.5, and the weight of equity is 1/2.5, so

$$\text{WACC} = .12 = (1/2.5)R_E + (1.5/2.5)(.12)(1 - .35)$$

$$R_E = .1830 \text{ or } 18.30\%$$

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- b. To find the unlevered cost of equity, we need to use M&M Proposition II with taxes, so:

$$\begin{aligned} R_E &= R_0 + (R_0 - R_D)(D/E)(1 - t_C) \\ .1830 &= R_0 + (R_0 - .12)(1.5)(1 - .35) \\ R_0 &= .1519 \text{ or } 15.19\% \end{aligned}$$

- c. To find the cost of equity under different capital structures, we can again use M&M Proposition II with taxes. With a debt-equity ratio of 2, the cost of equity is:

$$\begin{aligned} R_E &= R_0 + (R_0 - R_D)(D/E)(1 - t_C) \\ R_E &= .1519 + (.1519 - .12)(2)(1 - .35) \\ R_E &= .1934 \text{ or } 19.34\% \end{aligned}$$

With a debt-equity ratio of 1.0, the cost of equity is:

$$\begin{aligned} R_E &= .1519 + (.1519 - .12)(1)(1 - .35) \\ R_E &= .1726 \text{ or } 17.26\% \end{aligned}$$

And with a debt-equity ratio of 0, the cost of equity is:

$$\begin{aligned} R_E &= .1519 + (.1519 - .12)(0)(1 - .35) \\ R_E &= R_0 = .1519 \text{ or } 15.19\% \end{aligned}$$

13. a. For an all-equity financed company:

$$WACC = R_0 = R_E = .12 \text{ or } 12\%$$

- b. To find the cost of equity for the company with leverage, we need to use M&M Proposition II with taxes, so:

$$\begin{aligned} R_E &= R_0 + (R_0 - R_D)(D/E)(1 - t_C) \\ R_E &= .12 + (.12 - .08)(.25/.75)(1 - .35) \\ R_E &= .1287 \text{ or } 12.87\% \end{aligned}$$

- c. Using M&M Proposition II with taxes again, we get:

$$\begin{aligned} R_E &= R_0 + (R_0 - R_D)(D/E)(1 - t_C) \\ R_E &= .12 + (.12 - .08)(.50/.50)(1 - .35) \\ R_E &= .1460 \text{ or } 14.60\% \end{aligned}$$

d. The WACC with 25 percent debt is:

$$\begin{aligned} \text{WACC} &= (E/V)R_E + (D/V)R_D(1 - t_C) \\ \text{WACC} &= .75(.1287) + .25(.08)(1 - .35) \\ \text{WACC} &= .1095 \text{ or } 10.95\% \end{aligned}$$

And the WACC with 50 percent debt is:

$$\begin{aligned} \text{WACC} &= (E/V)R_E + (D/V)R_D(1 - t_C) \\ \text{WACC} &= .50(.1460) + .50(.08)(1 - .35) \\ \text{WACC} &= .0990 \text{ or } 9.90\% \end{aligned}$$

14. a. The value of the unlevered firm is:

$$\begin{aligned} V &= \text{EBIT}(1 - t_C)/R_0 \\ V &= \$95,000(1 - .35)/.22 \\ V &= \$280,681.82 \end{aligned}$$

b. The value of the levered firm is:

$$\begin{aligned} V &= V_U + t_C B \\ V &= \$280,681.82 + .35(\$60,000) \\ V &= \$301,681.82 \end{aligned}$$

15. We can find the cost of equity using M&M Proposition II with taxes. First, we need to find the market value of equity, which is:

$$\begin{aligned} V &= D + E \\ \$301,681.82 &= \$600,000 + E \\ E &= \$241,681.82 \end{aligned}$$

Now we can find the cost of equity, which is:

$$\begin{aligned} R_E &= R_0 + (R_0 - R_D)(D/E)(1 - t) \\ R_E &= .22 + (.22 - .11)(\$60,000/\$241,681.82)(1 - .35) \\ R_E &= .2378 \text{ or } 23.78\% \end{aligned}$$

Using this cost of equity, the WACC for the firm after recapitalization is:

$$\begin{aligned} \text{WACC} &= (E/V)R_E + (D/V)R_D(1 - t_C) \\ \text{WACC} &= (\$241,681.82/\$301,681.82)(.2378) + (\$60,000/\$301,681.82).11(1 - .35) \\ \text{WACC} &= .2047 \text{ or } 20.47\% \end{aligned}$$

When there are corporate taxes, the overall cost of capital for the firm declines the more highly leveraged is the firm's capital structure. This is M&M Proposition I with taxes.

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16. Since Unlevered is an all-equity firm, its value is equal to the market value of its outstanding shares. Unlevered has 10 million shares of common stock outstanding, worth \$80 per share. Therefore, the value of Unlevered:

$$V_U = 10,000,000(\$80) = \$800,000,000$$

Modigliani-Miller Proposition I states that, in the absence of taxes, the value of a levered firm equals the value of an otherwise identical unlevered firm. Since Levered is identical to Unlevered in every way except its capital structure and neither firm pays taxes, the value of the two firms should be equal. Therefore, the market value of Levered, Inc., *should be* \$800 million also. Since Levered has 4.5 million outstanding shares, worth \$100 per share, the market value of Levered's equity is:

$$E_L = 4,500,000(\$100) = \$450,000,000$$

The market value of Levered's debt is \$275 million. The value of a levered firm equals the market value of its debt plus the market value of its equity. Therefore, the current market value of Levered is:

$$V_L = B + S$$

$$V_L = \$275,000,000 + 450,000,000$$

$$V_L = \$725,000,000$$

The market value of Levered's equity needs to be \$525 million, \$75 million higher than its current market value of \$450 million, for MM Proposition I to hold. Since Levered's market value is less than Unlevered's market value, Levered is relatively underpriced and an investor should buy shares of the firm's stock.

Intermediate

17. To find the value of the levered firm, we first need to find the value of an unlevered firm. So, the value of the unlevered firm is:

$$V_U = \text{EBIT}(1 - t_c)/R_0$$

$$V_U = (\$35,000)(1 - .35)/.14$$

$$V_U = \$162,500$$

Now we can find the value of the levered firm as:

$$V_L = V_U + t_c B$$

$$V_L = \$162,500 + .35(\$70,000)$$

$$V_L = \$187,000$$

Applying M&M Proposition I with taxes, the firm has increased its value by issuing debt. As long as M&M Proposition I holds, that is, there are no bankruptcy costs and so forth, then the company should continue to increase its debt/equity ratio to maximize the value of the firm.

18. With no debt, we are finding the value of an unlevered firm, so:

$$\begin{aligned} V &= \text{EBIT}(1 - t_c)/R_0 \\ V &= \$9,000(1 - .35)/.17 \\ V &= \$34,411.76 \end{aligned}$$

With debt, we simply need to use the equation for the value of a levered firm. With 50 percent debt, one-half of the firm value is debt, so the value of the levered firm is:

$$\begin{aligned} V &= V_U + t_c B \\ V &= \$34,411.76 + .35(\$34,411.76/2) \\ V &= \$40,433.82 \end{aligned}$$

And with 100 percent debt, the value of the firm is:

$$\begin{aligned} V &= V_U + t_c B \\ V &= \$34,411.76 + .35(\$34,411.76) \\ V &= \$46,455.88 \end{aligned}$$

19. According to M&M Proposition I with taxes, the increase in the value of the company will be the present value of the interest tax shield. Since the loan will be repaid in equal installments, we need to find the loan interest and the interest tax shield each year. The loan schedule will be:

Year	Loan Balance	Interest	Tax Shield
0	\$1,000,000		
1	500,000	\$80,000	.35(\$80,000) = \$28,000
2	0	40,000	.35(\$40,000) = \$14,000

So, the increase in the value of the company is:

$$\begin{aligned} \text{Value increase} &= \$28,000/1.08 + \$14,000/(1.08)^2 \\ \text{Value increase} &= \$37,928.67 \end{aligned}$$

20. *a.* Since Alpha Corporation is an all-equity firm, its value is equal to the market value of its outstanding shares. Alpha has 5,000 shares of common stock outstanding, worth \$20 per share, so the value of Alpha Corporation is:

$$V_{\text{Alpha}} = 5,000(\$20) = \$100,000$$

- b.* Modigliani-Miller Proposition I states that in the absence of taxes, the value of a levered firm equals the value of an otherwise identical unlevered firm. Since Beta Corporation is identical to Alpha Corporation in every way except its capital structure and neither firm pays taxes, the value of the two firms should be equal. So, the value of Beta Corporation is \$100,000 as well.

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- c. The value of a levered firm equals the market value of its debt plus the market value of its equity. So, the value of Beta's equity is:

$$\begin{aligned}V_L &= B + S \\ \$100,000 &= \$25,000 + S \\ S &= \$75,000\end{aligned}$$

- d. The investor would need to invest 20 percent of the total market value of Alpha's equity, which is:

$$\text{Amount to invest in Alpha} = .20(\$100,000) = \$20,000$$

Beta has less equity outstanding, so to purchase 20 percent of Beta's equity, the investor would need:

$$\text{Amount to invest in Beta} = .20(\$75,000) = \$15,000$$

- e. Alpha has no interest payments, so the dollar return to an investor who owns 20 percent of the company's equity would be:

$$\text{Dollar return on Alpha investment} = .20(\$35,000) = \$7,000$$

Beta Corporation has an interest payment due on its debt in the amount of:

$$\text{Interest on Beta's debt} = .12(\$25,000) = \$3,000$$

So, the investor who owns 20 percent of the company would receive 20 percent of EBIT minus the interest expense, or:

$$\text{Dollar return on Beta investment} = .20(\$35,000 - 3,000) = \$6,400$$

- f. From part d, we know the initial cost of purchasing 20 percent of Alpha Corporation's equity is \$20,000, but the cost to an investor of purchasing 20 percent of Beta Corporation's equity is only \$15,000. In order to purchase \$20,000 worth of Alpha's equity using only \$15,000 of his own money, the investor must borrow \$5,000 to cover the difference. The investor will receive the same dollar return from the Alpha investment, but will pay interest on the amount borrowed, so the net dollar return to the investment is:

$$\text{Net dollar return} = \$7,000 - .12(\$5,000) = \$6,400$$

Notice that this amount exactly matches the dollar return to an investor who purchases 20 percent of Beta's equity.

- g. The equity of Beta Corporation is riskier. Beta must pay off its debt holders before its equity holders receive any of the firm's earnings. If the firm does not do particularly well, all of the firm's earnings may be needed to repay its debt holders, and equity holders will receive nothing.

21. a. A firm's debt-equity ratio is the market value of the firm's debt divided by the market value of a firm's equity. So, the debt-equity ratio of the company is:

$$\begin{aligned}\text{Debt-equity ratio} &= \text{MV of debt} / \text{MV of equity} \\ \text{Debt-equity ratio} &= \$10,000,000 / \$20,000,000 \\ \text{Debt-equity ratio} &= .50\end{aligned}$$

- b. We first need to calculate the cost of equity. To do this, we can use the CAPM, which gives us:

$$\begin{aligned}R_S &= R_F + \beta[E(R_M) - R_F] \\ R_S &= .08 + .90(.18 - .08) \\ R_S &= .1700 \text{ or } 17.00\%\end{aligned}$$

We need to remember that an assumption of the Modigliani-Miller theorem is that the company debt is risk-free, so we can use the Treasury bill rate as the cost of debt for the company. In the absence of taxes, a firm's weighted average cost of capital is equal to:

$$\begin{aligned}R_{WACC} &= [B / (B + S)]R_B + [S / (B + S)]R_S \\ R_{WACC} &= (\$10,000,000/\$30,000,000)(.08) + (\$20,000,000/\$30,000,000)(.17) \\ R_{WACC} &= .1400 \text{ or } 14.00\%\end{aligned}$$

- c. According to Modigliani-Miller Proposition II with no taxes:

$$\begin{aligned}R_S &= R_0 + (B/S)(R_0 - R_B) \\ .17 &= R_0 + (.50)(R_0 - .08) \\ R_0 &= .1400 \text{ or } 14.00\%\end{aligned}$$

This is consistent with Modigliani-Miller's proposition that, in the absence of taxes, the cost of capital for an all-equity firm is equal to the weighted average cost of capital of an otherwise identical levered firm.

22. a. To purchase 5 percent of Knight's equity, the investor would need:

$$\text{Knight investment} = .05(\$1,714,000) = \$85,700$$

And to purchase 5 percent of Veblen without borrowing would require:

$$\text{Veblen investment} = .05(\$2,400,000) = \$120,000$$

In order to compare dollar returns, the initial net cost of both positions should be the same. Therefore, the investor will need to borrow the difference between the two amounts, or:

$$\text{Amount to borrow} = \$120,000 - 85,700 = \$34,300$$

An investor who owns 5 percent of Knight's equity will be entitled to 5 percent of the firm's earnings available to common stock holders at the end of each year. While Knight's expected operating income is \$300,000, it must pay \$60,000 to debt holders before distributing any of its earnings to stockholders. So, the amount available to this shareholder will be:

$$\text{Cash flow from Knight to shareholder} = .05(\$300,000 - 60,000) = \$12,000$$

Veblen will distribute all of its earnings to shareholders, so the shareholder will receive:

$$\text{Cash flow from Veblen to shareholder} = .05(\$300,000) = \$15,000$$

However, to have the same initial cost, the investor has borrowed \$34,300 to invest in Veblen, so interest must be paid on the borrowings. The net cash flow from the investment in Veblen will be:

$$\text{Net cash flow from Veblen investment} = \$15,000 - .06(\$34,300) = \$12,942$$

For the same initial cost, the investment in Veblen produces a higher dollar return.

- b.* Both of the two strategies have the same initial cost. Since the dollar return to the investment in Veblen is higher, all investors will choose to invest in Veblen over Knight. The process of investors purchasing Veblen's equity rather than Knight's will cause the market value of Veblen's equity to rise and/or the market value of Knight's equity to fall. Any differences in the dollar returns to the two strategies will be eliminated, and the process will cease when the total market values of the two firms are equal.
- 23. a.** Before the announcement of the stock repurchase plan, the market value of the outstanding debt is \$7,500,000. Using the debt-equity ratio, we can find that the value of the outstanding equity must be:

$$\text{Debt-equity ratio} = B / S$$

$$.40 = \$7,500,000 / S$$

$$S = \$18,750,000$$

The value of a levered firm is equal to the sum of the market value of the firm's debt and the market value of the firm's equity, so:

$$V_L = B + S$$

$$V_L = \$7,500,000 + 18,750,000$$

$$V_L = \$26,250,000$$

According to MM Proposition I without taxes, changes in a firm's capital structure have no effect on the overall value of the firm. Therefore, the value of the firm will not change after the announcement of the stock repurchase plan

- b. The expected return on a firm's equity is the ratio of annual earnings to the market value of the firm's equity, or return on equity. Before the restructuring, the company was expected to pay interest in the amount of:

$$\text{Interest payment} = .10(\$7,500,000) = \$750,000$$

The return on equity, which is equal to R_S , will be:

$$\begin{aligned} \text{ROE} = R_S &= (\$3,750,000 - 750,000) / \$18,750,000 \\ R_S &= .1600 \text{ or } 16.00\% \end{aligned}$$

- c. According to Modigliani-Miller Proposition II with no taxes:

$$\begin{aligned} R_S &= R_0 + (B/S)(R_0 - R_B) \\ .16 &= R_0 + (.40)(R_0 - .10) \\ R_0 &= .1429 \text{ or } 14.29\% \end{aligned}$$

This problem can also be solved in the following way:

$$R_0 = \text{Earnings before interest} / V_U$$

According to Modigliani-Miller Proposition I, in a world with no taxes, the value of a levered firm equals the value of an otherwise-identical unlevered firm. Since the value of the company as a levered firm is \$26.25 million (= \$7,500,000 + 18,750,000) and since the firm pays no taxes, the value of the company as an unlevered firm is also \$26.25 million. So:

$$\begin{aligned} R_0 &= \$3,750,000 / \$26,250,000 \\ R_0 &= .1429 \text{ or } 14.29\% \end{aligned}$$

- d. In part c, we calculated the cost of an all-equity firm. We can use Modigliani-Miller Proposition II with no taxes again to find the cost of equity for the firm with the new leverage ratio. The cost of equity under the stock repurchase plan will be:

$$\begin{aligned} R_S &= R_0 + (B/S)(R_0 - R_B) \\ R_S &= .1429 + (.50)(.1429 - .10) \\ R_S &= .1643 \text{ or } 16.43\% \end{aligned}$$

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24. a. The expected return on a firm's equity is the ratio of annual aftertax earnings to the market value of the firm's equity. The amount the firm must pay each year in taxes will be:

$$\text{Taxes} = .40(\$1,500,000) = \$600,000$$

So, the return on the unlevered equity will be:

$$R_0 = (\$1,500,000 - 600,000) / \$10,000,000$$

$$R_0 = .0900 \text{ or } 9.00\%$$

Notice that perpetual annual earnings of \$900,000, discounted at 9 percent, yields the market value of the firm's equity

- b. The company's market value balance sheet before the announcement of the debt issue is:

		Debt	—
Assets	<u>\$10,000,000</u>	Equity	<u>\$10,000,000</u>
Total assets	<u>\$10,000,000</u>	Total D&E	<u>\$10,000,000</u>

The price per share is simply the total market value of the stock divided by the shares outstanding, or:

$$\text{Price per share} = \$10,000,000 / 500,000 = \$20.00$$

- c. Modigliani-Miller Proposition I states that in a world with corporate taxes:

$$V_L = V_U + T_C B$$

When Green announces the debt issue, the value of the firm will increase by the present value of the tax shield on the debt. The present value of the tax shield is:

$$\text{PV(Tax Shield)} = T_C B$$

$$\text{PV(Tax Shield)} = .40(\$2,000,000)$$

$$\text{PV(Tax Shield)} = \$800,000$$

Therefore, the value of Green Manufacturing will increase by \$800,000 as a result of the debt issue. The value of Green Manufacturing after the repurchase announcement is:

$$V_L = V_U + T_C B$$

$$V_L = \$10,000,000 + .40(\$2,000,000)$$

$$V_L = \$10,800,000$$

Since the firm has not yet issued any debt, Green's equity is also worth \$10,800,000.

Green's market value balance sheet after the announcement of the debt issue is:

Old assets	\$10,000,000	Debt	—
PV(tax shield)	<u>800,000</u>	Equity	<u>\$108,00,000</u>
Total assets	<u>\$10,800,000</u>	Total D&E	<u>\$10,800,000</u>

d. The share price immediately after the announcement of the debt issue will be:

$$\text{New share price} = \$10,800,000 / 500,000 = \$21.60$$

e. The number of shares repurchase will be the amount of the debt issue divided by the new share price, or:

$$\text{Shares repurchased} = \$2,000,000 / \$21.60 = 92,592.59$$

The number of shares outstanding will be the current number of shares minus the number of shares repurchased, or:

$$\text{New shares outstanding} = 500,000 - 92,592.59 = 407,407.41$$

f. The share price will remain the same after restructuring takes place. The total market value of the outstanding equity in the company will be:

$$\text{Market value of equity} = \$21.60(407,407.41) = \$8,800,000$$

The market-value balance sheet after the restructuring is:

Old assets	\$10,000,000	Debt	\$2,000,000
PV(tax shield)	<u>800,000</u>	Equity	<u>8,800,000</u>
Total assets	<u>\$10,800,000</u>	Total D&E	<u>\$10,800,000</u>

g. According to Modigliani-Miller Proposition II with corporate taxes

$$R_S = R_0 + (B/S)(R_0 - R_B)(1 - t_C)$$

$$R_S = .09 + (\$2,000,000 / \$8,800,000)(.09 - .06)(1 - .40)$$

$$R_S = .0941 \text{ or } 9.41\%$$

25. a. In a world with corporate taxes, a firm's weighted average cost of capital is equal to:

$$R_{WACC} = [B / (B+S)](1 - t_C)R_B + [S / (B+S)]R_S$$

We do not have the company's debt-to-value ratio or the equity-to-value ratio, but we can calculate either from the debt-to-equity ratio. With the given debt-equity ratio, we know the company has 2.5 dollars of debt for every dollar of equity. Since we only need the ratio of debt-to-value and equity-to-value, we can say:

$$B / (B+S) = 2.5 / (2.5 + 1) = .7143$$

$$E / (B+S) = 1 / (2.5 + 1) = .2857$$

We can now use the weighted average cost of capital equation to find the cost of equity, which is:

$$.15 = (.7143)(1 - 0.35)(.10) + (.2857)(R_S)$$

$$R_S = .3625 \text{ or } 36.25\%$$

- b. We can use Modigliani-Miller Proposition II with corporate taxes to find the unlevered cost of equity. Doing so, we find:

$$R_S = R_0 + (B/S)(R_0 - R_B)(1 - t_C)$$

$$.3625 = R_0 + (2.5)(R_0 - .10)(1 - .35)$$

$$R_0 = .2000 \text{ or } 20.00\%$$

- c. We first need to find the debt-to-value ratio and the equity-to-value ratio. We can then use the cost of levered equity equation with taxes, and finally the weighted average cost of capital equation. So:

$$\text{If debt-equity} = .75$$

$$B / (B+S) = .75 / (.75 + 1) = .4286$$

$$S / (B+S) = 1 / (.75 + 1) = .5714$$

The cost of levered equity will be:

$$R_S = R_0 + (B/S)(R_0 - R_B)(1 - t_C)$$

$$R_S = .20 + (.75)(.20 - .10)(1 - .35)$$

$$R_S = .2488 \text{ or } 24.88\%$$

And the weighted average cost of capital will be:

$$R_{WACC} = [B / (B+S)](1 - t_C)R_B + [S / (B+S)]R_S$$

$$R_{WACC} = (.4286)(1 - .35)(.10) + (.5714)(.2488)$$

$$R_{WACC} = .17$$

If debt-equity = 1.50

$$B / (B+S) = 1.50 / (1.50 + 1) = .6000$$

$$E / (B+S) = 1 / (1.50 + 1) = .4000$$

The cost of levered equity will be:

$$R_S = R_0 + (B/S)(R_0 - R_B)(1 - t_c)$$

$$R_S = .20 + (1.50)(.20 - .10)(1 - .35)$$

$$R_S = .2975 \text{ or } 29.75\%$$

And the weighted average cost of capital will be:

$$R_{WACC} = [B / (B+S)](1 - t_c)R_B + [S / (B+S)]R_S$$

$$R_{WACC} = (.6000)(1 - .35)(.10) + (.4000)(.2975)$$

$$R_{WACC} = .1580 \text{ or } 15.80\%$$

Challenge

26. M&M Proposition II states:

$$R_E = R_0 + (R_0 - R_D)(D/E)(1 - t_c)$$

And the equation for WACC is:

$$WACC = (E/V)R_E + (D/V)R_D(1 - t_c)$$

Substituting the M&M Proposition II equation into the equation for WACC, we get:

$$WACC = (E/V)[R_0 + (R_0 - R_D)(D/E)(1 - t_c)] + (D/V)R_D(1 - t_c)$$

Rearranging and reducing the equation, we get:

$$WACC = R_0[(E/V) + (E/V)(D/E)(1 - t_c)] + R_D(1 - t_c)[(D/V) - (E/V)(D/E)]$$

$$WACC = R_0[(E/V) + (D/V)(1 - t_c)]$$

$$WACC = R_0[\{(E+D)/V\} - t_c(D/V)]$$

$$WACC = R_0[1 - t_c(D/V)]$$

27. The return on equity is net income divided by equity. Net income can be expressed as:

$$NI = (EBIT - R_D D)(1 - t_C)$$

So, ROE is:

$$R_E = (EBIT - R_D D)(1 - t_C)/E$$

Now we can rearrange and substitute as follows to arrive at M&M Proposition II with taxes:

$$R_E = [EBIT(1 - t_C)/E] - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A V_U/E - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A(V_L - t_C D)/E - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A(E + D - t_C D)/E - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A + (R_A - R_D)(D/E)(1 - t_C)$$

28. M&M Proposition II, with no taxes is:

$$R_E = R_A + (R_A - R_f)(B/S)$$

Note that we use the risk-free rate as the return on debt. This is an important assumption of M&M Proposition II. The CAPM to calculate the cost of equity is expressed as:

$$R_E = \beta_E(R_M - R_f) + R_f$$

We can rewrite the CAPM to express the return on an unlevered company as:

$$R_A = \beta_A(R_M - R_f) + R_f$$

We can now substitute the CAPM for an unlevered company into M&M Proposition II. Doing so and rearranging the terms we get:

$$R_E = \beta_A(R_M - R_f) + R_f + [\beta_A(R_M - R_f) + R_f - R_f](B/S)$$

$$R_E = \beta_A(R_M - R_f) + R_f + [\beta_A(R_M - R_f)](B/S)$$

$$R_E = (1 + B/S)\beta_A(R_M - R_f) + R_f$$

Now we set this equation equal to the CAPM equation to calculate the cost of equity and reduce:

$$\beta_E(R_M - R_f) + R_f = (1 + B/S)\beta_A(R_M - R_f) + R_f$$

$$\beta_E(R_M - R_f) = (1 + B/S)\beta_A(R_M - R_f)$$

$$\beta_E = \beta_A(1 + B/S)$$

29. Using the equation we derived in Problem 28:

$$\beta_E = \beta_A(1 + D/E)$$

The equity beta for the respective asset betas is:

<u>Debt-equity ratio</u>	<u>Equity beta</u>
0	$1(1 + 0) = 1$
1	$1(1 + 1) = 2$
5	$1(1 + 5) = 6$
20	$1(1 + 20) = 21$

The equity risk to the shareholder is composed of both business and financial risk. Even if the assets of the firm are not very risky, the risk to the shareholder can still be large if the financial leverage is high. These higher levels of risk will be reflected in the shareholder's required rate of return R_E , which will increase with higher debt/equity ratios.

30. We first need to set the cost of capital equation equal to the cost of capital for an all-equity firm, so:

$$\frac{B}{B+S} R_B + \frac{S}{B+S} R_S = R_0$$

Multiplying both sides by $(B+S)/S$ yields:

$$\frac{B}{S} R_B + R_S = \frac{B+S}{S} R_0$$

We can rewrite the right-hand side as:

$$\frac{B}{S} R_B + R_S = \frac{B}{S} R_0 + R_0$$

Moving $(B/S)R_B$ to the right-hand side and rearranging gives us:

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