8. Use the graph to explain to your boss why PCC might want to use some debt.
The use of debt permits a firm to obtain tax savings from the deductibility of interest. So the use of some debt is good; however, the possibility of bankruptcy increases the cost of using debt. At higher and higher levels of debt, the risk of bankruptcy increases, bringing with it costs associated with potential financial distress. Customers reduce purchases, key employees leave, and so on. There is some point, generally well below a debt ratio of 100%, at which problems associated with potential bankruptcy more than offset the tax savings from debt.

Theoretically, the optimal capital structure is found at the point where the marginal tax savings just equal the marginal bankruptcy-related costs. However, analysts cannot identify this point with precision for any given firm, or for firms in general. Analysts can help managers determine an optimal range for their firm’s debt ratios, but the capital structure decision is still more judgmental than based on precise calculations.

9. After speaking with a local investment banker, you obtain the following estimates of the cost of debt at different debt levels (in thousands of dollars):

| Amount Borrowed | Debt/Assets Ratio | Debt/Equity Ratio | Bond Rating | \( r_d \)  
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 0</td>
<td>0.000</td>
<td>0.0000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>250</td>
<td>0.125</td>
<td>0.1429</td>
<td>AA</td>
<td>8.0%</td>
</tr>
<tr>
<td>500</td>
<td>0.250</td>
<td>0.3333</td>
<td>A</td>
<td>9.0</td>
</tr>
<tr>
<td>750</td>
<td>0.375</td>
<td>0.6000</td>
<td>BBB</td>
<td>11.5</td>
</tr>
<tr>
<td>1,000</td>
<td>0.500</td>
<td>1.0000</td>
<td>BB</td>
<td>14.0</td>
</tr>
</tbody>
</table>

Now consider the optimal capital structure for PCC.

10. To begin, define the terms “optimal capital structure” and “target capital structure.”

The optimal capital structure is the capital structure at which the tax-related benefits of leverage are exactly offset by debt’s risk-related costs. At the optimal capital structure, (1) the total value of the firm is maximized, (2) the WACC is minimized, and the price per share is maximized. The target capital structure is the mix of debt, preferred stock, and common equity with which the firm plans to raise capital.

11. Why does PCC’s bond rating and cost of debt depend on the amount of money borrowed?

Financial risk is the additional risk placed on the common stockholders as a result of the decision to finance with debt. Conceptually, stockholders face a certain amount of risk that is inherent in a firm’s operations. If a firm uses debt (financial leverage), this concentrates the business risk on common stockholders.

Financing with debt increases the expected rate of return for an investment, but leverage also increases the probability of a large loss, thus increasing the risk borne by stockholders. As the amount of money borrowed increases, the firm increases its risk so the firm’s bond rating decreases and its cost of debt increases.
12. Assume that shares could be repurchased at the current market price of $25 per share. Calculate PCC’s expected EPS and TIE at debt levels of $0, $250,000, $500,000, $750,000, and $1,000,000. How many shares would remain after recapitalization under each scenario?

The analysis for the debt levels being considered (in thousands of dollars and shares) is shown below:

At $D = 0$:

\[
\text{EPS} = \frac{[\text{EBIT} - r_d(D)](1-T)}{\text{Shares outstanding}} = \frac{[300 - 0](1-0.4)}{80,000} = 3.00.
\]

\[
\text{TIE} = \frac{\text{EBIT}}{\text{Interest}} = \frac{300}{20} = 15x.
\]

At $D = 250,000$:

Shares repurchased = $250,000/$25 = 10,000.

Remaining shares outstanding = 80,000 – 10,000 = 70,000.

(Note: EPS and TIE calculations are in thousands of dollars.)

\[
\text{EPS} = \frac{[400 - 0.09(250)](0.6)}{60} = 3.55.
\]

\[
\text{TIE} = \frac{400}{45} = 8.9x.
\]

At $D = 500,000$:

Shares repurchased = $500,000/$25 = 20,000.

Remaining shares outstanding = 80,000 – 20,000 = 60,000.

(Note: EPS and TIE calculations are in thousands of dollars.)

\[
\text{EPS} = \frac{[400 - 0.09(500)](0.6)}{60} = 3.55.
\]

\[
\text{TIE} = \frac{400}{45} = 8.9x.
\]
At \( D = \$750,000 \):

Shares repurchased = \( \frac{\$750,000}{\$25} = 30,000 \).

Remaining shares outstanding = 80,000 – 30,000 = 50,000.

(Note: EPS and TIE calculations are in thousands of dollars.)

\[
EPS = \frac{[400 - 0.115(750)](0.60)}{50} = 3.77.
\]

\[
TIE = \frac{400}{86.25} = 4.6x.
\]

At \( D = \$1,000,000 \):

Shares repurchased = \( \frac{\$1,000,000}{\$25} = 40,000 \).

Remaining shares outstanding = 80,000 – 40,000 = 40,000.

(Note: EPS and TIE calculations are in thousands of dollars.)

\[
EPS = \frac{[400 - 0.14(1,000)](0.60)}{40} = 3.90.
\]

\[
TIE = \frac{400}{140} = 2.9x.
\]

13. Using the Hamada equation, what is the cost of equity if PCC recapitalizes with \$250,000 of debt? \$500,000? \$750,000? \$1,000,000?

Hamada’s Equation: \( b_L = b_U[1 + (1 - T)(D/E)] \).

\[
r_{RF} = 6.0\% \quad r_M - r_{RF} = 9.0\%
\]

\[
b_U = 1.0 \quad \text{Total assets} = 2,000
\]

Tax rate = 40.0%

<table>
<thead>
<tr>
<th>Amount Borrowed (1,000s)</th>
<th>Debt Ratio</th>
<th>Debt/Equity</th>
<th>Levered Beta</th>
<th>( r_e )</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.00</td>
<td>0.000</td>
<td>0.000</td>
<td>1.00</td>
<td>15.00%</td>
</tr>
<tr>
<td>$250.00</td>
<td>0.125</td>
<td>0.143</td>
<td>1.09</td>
<td>15.77%</td>
</tr>
<tr>
<td>$500.00</td>
<td>0.250</td>
<td>0.333</td>
<td>1.36</td>
<td>18.24%</td>
</tr>
<tr>
<td>$750.00</td>
<td>0.375</td>
<td>0.600</td>
<td>1.60</td>
<td>20.40%</td>
</tr>
<tr>
<td>$1,000.00</td>
<td>0.500</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
14. Considering only the levels of debt discussed, what is the capital structure that minimizes PCC’s WACC?

\[ r_{RF} = 6.0\% \quad r_M - r_{RF} = 9.0\% \]

\[ b_U = 1.0 \quad \text{Total assets} = 2,000 \]

Tax rate = 40.0%

<table>
<thead>
<tr>
<th>Amount Borrowed (1,000s)</th>
<th>Debt Ratio</th>
<th>Debt/ Equity</th>
<th>Levered Beta</th>
<th>( r_e )</th>
<th>( r_d )</th>
<th>( r_d(1 - T) )</th>
<th>WACC</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.00</td>
<td>0.000</td>
<td>0.000</td>
<td>1.00</td>
<td>15.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>15.00%</td>
</tr>
<tr>
<td>$250</td>
<td>0.125</td>
<td>0.143</td>
<td>1.09</td>
<td>15.77%</td>
<td>8.00%</td>
<td>4.80%</td>
<td>14.40%</td>
</tr>
<tr>
<td>$500</td>
<td>0.250</td>
<td>0.333</td>
<td>1.20</td>
<td>16.80%</td>
<td>9.00%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$750</td>
<td>0.375</td>
<td>0.600</td>
<td>1.36</td>
<td>18.24%</td>
<td>11.50%</td>
<td>6.90%</td>
<td>13.99%</td>
</tr>
<tr>
<td>$1,000</td>
<td>0.500</td>
<td>1.000</td>
<td>1.60</td>
<td>20.40%</td>
<td>14.00%</td>
<td>8.40%</td>
<td>14.40%</td>
</tr>
</tbody>
</table>

PCC’s WACC is minimized at a capital structure that consists of 25% debt and 75% equity, or a WACC of 13.95%.

15. What would be the new stock price if PCC recapitalizes with $250,000 of debt? $500,000? $750,000? $1,000,000? Recall that the payout ratio is 100%, so \( g = 0 \).

We can calculate the price of a constant growth stock as \( \text{DPS} \) divided by \( r_s - g \), where \( g \) is the expected growth rate in dividends: \( P_0 = \text{D}_1/(r_s - g) \). Since in this case all earnings are paid out to the stockholders, \( \text{DPS} = \text{EPS} \). Further, because no earnings are plowed back, the firm’s EBIT is not expected to grow, so \( g = 0 \).

Here are the results:

<table>
<thead>
<tr>
<th>Debt Level</th>
<th>Debt Ratio</th>
<th>( r_s )</th>
<th>DPS</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.00</td>
<td>0.000</td>
<td>15.00%</td>
<td>$3.00</td>
<td>$20.00</td>
</tr>
<tr>
<td>$250,000</td>
<td>0.125</td>
<td>15.77%</td>
<td>$3.26</td>
<td>$20.65</td>
</tr>
<tr>
<td>$500,000</td>
<td>0.250</td>
<td>16.80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$750,000</td>
<td>0.375</td>
<td>18.24%</td>
<td>$3.77</td>
<td>$20.64</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>0.500</td>
<td>20.40%</td>
<td>$3.90</td>
<td>$19.12</td>
</tr>
</tbody>
</table>

16. Is EPS maximized at the debt level that maximizes share price? Why or why not?

We have seen that EPS continues to increase beyond the $500,000 optimal level of debt. Therefore, focusing on EPS when making capital structure decisions is not correct—while the EPS does take account of the differential cost of debt, it does not account for the increasing risk that must be borne by the equity holders.
17. Considering only the levels of debt discussed, what is PCC’s optimal capital structure?

A capital structure with $500,000 of debt produces the highest stock price, $26.89; hence, it is the best of those considered.

18. What is the WACC at the optimal capital structure?

Initial debt level:

Debt/Total assets = 0%, so Total assets = Initial equity = $25 \times 80,000 \text{ shares} = $2,000,000.

WACC =

Note: If we had (1) used the equilibrium price for repurchasing shares and (2) used market value weights to calculate WACC, then we could be sure that the WACC at the price-maximizing capital structure would be the minimum. Using a constant $25 purchase price, and book value weights, inconsistencies may creep in.

19. Suppose you discovered that PCC had more business risk than you originally estimated. Describe how this would affect the analysis. What if the firm had less business risk than originally estimated?

If the firm had higher business risk, then, at any debt level, its probability of financial distress would be higher. Investors would recognize this, and both \( r_d \) and \( r_s \) would be higher than originally estimated. It is not shown in this analysis, but the end result would be an optimal capital structure with less debt. Conversely, lower business risk would lead to an optimal capital structure that included more debt.

20. What are some factors a manager should consider when establishing his or her firm’s target capital structure?

Since it is difficult to quantify the capital structure decision, managers consider the following judgmental factors when making capital structure decisions:

1. The average debt ratio for firms in their industry.
2. Pro forma TIE ratios at different capital structures under different scenarios.
3. Lender/rating agency attitudes.
4. Reserve borrowing capacity.
5. Effects of financing on control.
6. Asset structure.
7. Expected tax rate.
8. Management attitudes.


10. Firm’s internal conditions.

11. Firm’s operating leverage.


21. How does the existence of asymmetric information and signaling affect capital structure?

The asymmetric information concept is based on the premise that management’s choice of financing gives signals to investors. Firms with good investment opportunities will not want to share the benefits with new stockholders, so they will tend to finance with debt. Firms with poor prospects, on the other hand, will want to finance with stock. Investors know this, so when a large, mature firm announces a stock offering, investors take this as a signal of bad news, and the stock price declines. Firms know this, so they try to avoid having to sell new common stock. This means maintaining a reserve of borrowing capacity so that when good investments come along, they can be financed with debt.

22. You might expect the price of a mature firm’s stock to decline if it announces a stock offering. Would you expect the same reaction if the issuing firm were a young, rapidly growing company?

If a mature firm sells stock, the price of its stock would probably decline. A mature firm should have other financing alternatives, so a stock issue would signal that its earnings potential is not good. A young, rapidly growing firm, however, may have so many good investment opportunities that it simply cannot raise all the equity it needs as retained earnings, and investors know this. Therefore, the stock price of a young, rapidly growing firm would probably not fall because of a new stock issue, especially if the firm’s managers announce that they are not selling any of their own shares in the offering.
Recapitalization

Green Manufacturing, Inc. plans to announce that it will issue $2 million of perpetual debt and use the proceeds to repurchase common stock. The bonds will have a 6-percent annual coupon rate. Green is currently an all-equity firm worth $10 million with 500,000 shares of common stock outstanding. After the sale of the bonds, Green will maintain the new capital structure indefinitely. Green currently generates annual pretax earnings of $1.5 million. This level of earnings is expected to remain constant in perpetuity. Green is subject to a corporate tax rate of 40 percent.

a. What is the expected return on Green’s equity before the announcement of the debt issue?

The expected return on a firm’s equity is the ratio of annual after-tax earnings to the market value of the firm’s equity.

Green expects $1,500,000 of pre-tax earnings per year. Because the firm is subject to a corporate tax rate of 40%, it must pay $600,000 worth of taxes every year. Since the firm has no debt in its capital structure and makes no interest payments, Green’s annual after-tax expected earnings are $900,000 (= $1,500,000 - $600,000).

The market value of Green’s equity is $10,000,000.

Therefore, the expected return on Green’s unlevered equity is 9% (= $900,000 / $10,000,000).

Notice that perpetual annual earnings of $900,000, discounted at 9%, yields a market value of the firm’s equity of $10,000,000 (= $900,000 / 0.09).

b. Construct Green’s market-value balance sheet before the announcement of the debt issue. What is the price per share of the firm’s equity?

Green is an all-equity firm. The present value of the firm’s after-tax earnings is $10,000,000 (= ($1,500,000 - $600,000) / 0.09).

Green’s market-value balance sheet before the announcement of the debt issue is:

<table>
<thead>
<tr>
<th>Green Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets = $10,000,000</td>
</tr>
<tr>
<td>Debt = $10,000,000</td>
</tr>
<tr>
<td>Equity = $10,000,000</td>
</tr>
<tr>
<td>Total assets = $10,000,000</td>
</tr>
<tr>
<td>Total D + E = $10,000,000</td>
</tr>
</tbody>
</table>

Since the market value of Green’s equity is $10,000,000 and the firm has 500,000 shares of common stock outstanding, the price of Green’s stock is $20 per share (= $10,000,000 / 500,000 shares) before the announcement of the debt issue.
c. Construct Green’s market-value balance sheet immediately after the announcement of the debt issue.

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

\[ V_L = V_U + T_C D \]

where
- \( V_L \) = the value of a levered firm
- \( V_U \) = the value of an unlevered firm
- \( T_C \) = the corporate tax rate
- \( D \) = the value of debt in a firm’s capital structure

When Green announces the debt issue, the value of the firm will increase by the present value of the tax shield on the debt. Since Green plans to issue $2,000,000 of debt and the firm is subject to a corporate tax rate of 40%, the present value of the firm’s tax shield is:

\[
PV(\text{Tax Shield}) = T_C D \\
= (0.40)(2,000,000) \\
= 800,000
\]

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:

\[
V_L = V_U + T_C D \\
= 10,000,000 + (0.40)(2,000,000) \\
= 10,800,000
\]

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:

<table>
<thead>
<tr>
<th>Green Manufacturing</th>
<th>Old Assets = 10,000,000</th>
<th>PV (Tax Shield) = 800,000</th>
<th>Total assets = 10,800,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt =</td>
<td></td>
<td></td>
<td>Total D + E = 10,800,000</td>
</tr>
<tr>
<td>Equity = 10,800,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
d. What is Green’s stock price per share immediately after the repurchase announcement?

Since the market value of Green’s equity after the announcement of the debt issue is $10,800,000 and the firm has 500,000 shares of common stock outstanding, the price of Green’s stock is $21.60 per share (= $10,800,000 / 500,000 shares) after the announcement of the debt issue.

Therefore, immediately after the repurchase announcement, Green’s stock price will rise to $21.60 per share.

e. How many shares will Green repurchase as a result of the debt issue? How many shares of common stock will remain after the restructuring?

Green will issue $2,000,000 worth of debt and use the proceeds to repurchase shares of common stock. Since the price of Green’s stock after the announcement will be $21.60 per share, Green can repurchase 92,592.59 shares (= $2,000,000 / $21.60 per share) as a result of the debt issue.

Green will repurchase 92,592.59 shares with the proceeds from the debt issue.

Since Green had 500,000 shares of common stock outstanding and repurchased 92,592.59 as a result of the debt issue, the firm will have 407,407.41 (= 500,000 – 92,592.59) shares of common stock outstanding after the repurchase.

Green will have 407,407.41 shares of common stock outstanding after the repurchase.

f. Construct Green’s market-value balance sheet after the restructuring. What is the Green’s stock price per share after the restructuring?

After the restructuring has taken place, Green will have $2,000,000 worth of debt in its capital structure. The value of Green after the restructuring is $10,800,000.

The value of a levered firm is equal to the sum of the market value of its debt and the market value of its equity.

That is, the value of a levered firm is:

\[ V_L = E + D \]

Rearranging this equation, the market value of the Green’s levered equity after the announcement of the debt issue is:

\[ E = V_L - D \]

\[ = $10,800,000 - $2,000,000 \]

\[ = $8,800,000 \]

Green’s market-value balance sheet after the restructuring is:
Green Manufacturing

| Old Assets  | $10,000,000 | Debt     | $2,000,000 |
| PV (Tax Shield) | $800,000 | Equity    | $8,800,000 |
| Total assets | $10,800,000 | Total D + E | $10,800,000 |

Since the market value of Green’s equity after the restructuring is $8,800,000 and the firm has 407,407.41 shares of common stock outstanding, the price of Green’s stock will be $21.60 per share (= $8,800,000 / 407,407.41 shares) after the restructuring.

Therefore, Green’s stock price will remain at $21.60 per share after the restructuring has taken place.

g. What is the required return on Green’s equity after the restructuring?

According to Modigliani-Miller Proposition II with corporate taxes

\[ r_E = r_A + \frac{D}{E}(r_A - r_D)(1 - T_C) \]

where

- \( r_A \) = the required return on the equity of an unlevered firm
- \( r_E \) = the required return on the equity of a levered firm
- \( r_D \) = the pre-tax cost of debt for a levered firm
- \( T_C \) = the corporate tax rate
- \( D \) = the market value of the firm’s debt
- \( E \) = the market value of the firm’s equity

In this problem:

- \( r_A = 0.09 \) (see part a)
- \( r_D = 0.06 \)
- \( T_C = 0.40 \)
- \( D = $2,000,000 \)
- \( E = $8,800,000 \)

The required return on Green’s levered equity after the restructuring is:

\[
\begin{align*}
    r_E &= r_A + \frac{D}{E}(r_A - r_D)(1 - T_C) \\
    &= 0.09 + \frac{\$2,000,000}{\$8,800,000}(0.09 - 0.06)(1 - 0.40) \\
    &= 0.09 + \frac{5}{22}(0.09 - 0.06)(1 - 0.40) \\
    &= 0.0941
\end{align*}
\]

Therefore, the required return on Green’s levered equity after the restructuring is 9.41%.