Chapter 15
Debt and Taxes

15-1. Pelamed Pharmaceuticals has EBIT of $325 million in 2006. In addition, Pelamed has interest expenses of $125 million and a corporate tax rate of 40%.

a. What is Pelamed’s 2006 net income?

b. What is the total of Pelamed’s 2006 net income and interest payments?

c. If Pelamed had no interest expenses, what would its 2006 net income be? How does it compare to your answer in part (b)?

d. What is the amount of Pelamed’s interest tax shield in 2006?

\[
\begin{align*}
\text{Net Income} & = \text{EBIT} - \text{Interest} - \text{Taxes} = (325 - 125) \times (1 - 0.40) = $120 \text{ million.} \\
\text{Net income + Interest} & = 120 + 125 = $245 \text{ million} \\
\text{Net income} & = \text{EBIT} - \text{Taxes} = 325 \times (1 - 0.40) = $195 \text{ million. This is } 245 - 195 = $50 \text{ million lower than part (b).} \\
\text{Interest tax shield} & = 125 \times 40\% = $50 \text{ million}
\end{align*}
\]

15-2. Grommit Engineering expects to have net income next year of $20.75 million and free cash flow of $22.15 million. Grommit’s marginal corporate tax rate is 35%.

a. If Grommit increases leverage so that its interest expense rises by $1 million, how will its net income change?

b. For the same increase in interest expense, how will free cash flow change?

\[
\begin{align*}
\text{a. Net income will fall by the after-tax interest expense to } & \quad 20.750 - 1 \times (1 - 0.35) = $20.10 \text{ million.} \\
\text{b. Free cash flow is not affected by interest expenses.}
\end{align*}
\]

15-3. Suppose the corporate tax rate is 40%. Consider a firm that earns $1000 before interest and taxes each year with no risk. The firm’s capital expenditures equal its depreciation expenses each year, and it will have no changes to its net working capital. The risk-free interest rate is 5%.

a. Suppose the firm has no debt and pays out its net income as a dividend each year. What is the value of the firm’s equity?

b. Suppose instead the firm makes interest payments of $500 per year. What is the value of equity? What is the value of debt?

c. What is the difference between the total value of the firm with leverage and without leverage?

d. The difference in part (c) is equal to what percentage of the value of the debt?
a. Net income \(= 1000 \times (1 - 40\%) = 600\). Thus, equity holders receive dividends of $600 per year with no risk. \(E = \frac{600}{5\%} = 12,000\)

b. Net income \(= (1000 - 500) \times (1 - 0.40) = 300 \Rightarrow E = \frac{300}{5\%} = 6000\). Debt holders receive interest of $500 per year \(\Rightarrow D = 10,000\)

c. With leverage \(= 6000 + 10,000 = 16,000\)
   Without leverage \(= 12,000\)
   Difference \(= 16,000 - 12,000 = 4000\)

d. \(\frac{4,000}{10,000} = 40\% = \) corporate tax rate

15-4. Braxton Enterprises currently has debt outstanding of $35 million and an interest rate of 8%. Braxton plans to reduce its debt by repaying $7 million in principal at the end of each year for the next five years. If Braxton’s marginal corporate tax rate is 40%, what is the interest tax shield from Braxton’s debt in each of the next five years?

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>35</td>
<td>28</td>
<td>21</td>
<td>14</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Interest</td>
<td>2.8</td>
<td>2.24</td>
<td>1.68</td>
<td>1.12</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>Tax Shield</td>
<td>1.12</td>
<td>0.896</td>
<td>0.672</td>
<td>0.448</td>
<td>0.224</td>
<td></td>
</tr>
</tbody>
</table>

15-5. Your firm currently has $100 million in debt outstanding with a 10% interest rate. The terms of the loan require the firm to repay $25 million of the balance each year. Suppose that the marginal corporate tax rate is 40%, and that the interest tax shields have the same risk as the loan. What is the present value of the interest tax shields from this debt?

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>100</td>
<td>75</td>
<td>50</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interest</td>
<td>10</td>
<td>7.5</td>
<td>5</td>
<td>2.5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tax Shield</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>PV Shield</td>
<td>8.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15-6. Arnell Industries has just issued $10 million in debt (at par). The firm will pay interest only on this debt. Arnell’s marginal tax rate is expected to be 35% for the foreseeable future.

a. Suppose Arnell pays interest of 6% per year on its debt. What is its annual interest tax shield?

b. What is the present value of the interest tax shield, assuming its risk is the same as the loan?

c. Suppose instead that the interest rate on the debt is 5%. What is the present value of the interest tax shield in this case?

a. Interest tax shield \(= 10 \times 6\% \times 35\% = 0.21 \) million

b. \(\text{PV(Interest tax shield)} = \frac{0.21}{0.06} = 3.5 \) million
c. Interest tax shield = $10 × 5% × 35% = $0.175 million. \( PV = \frac{0.175}{0.05} = $3.5 \text{ million.} \)

15-7. Ten years have passed since Arnell issued $10 million in perpetual interest only debt with a 6% annual coupon, as in Problem 6. Tax rates have remained the same at 35% but interest rates have dropped so Arnell’s current cost of debt capital is 4%.

a. What is Arnell’s annual interest tax shield?

b. What is the present value of the interest tax shield today?

a. Solution: Interest tax shield = $10 × 6% × 35% = $0.21 million

b. Solution: \( PV(\text{Interest tax shield}) = \frac{0.21}{0.04} = $5.25 \text{ million.} \)

Alternatively, new market value of debt is \( D = \frac{(10 \times 0.06)}{0.04} = $15 \text{ million.} \) \( TC \times D = 35\% \times 15 = $5.25 \text{ million.} \)

15-8. Bay Transport Systems (BTS) currently has $30 million in debt outstanding. In addition to 6.5% interest, it plans to repay 5% of the remaining balance each year. If BTS has a marginal corporate tax rate of 40%, and if the interest tax shields have the same risk as the loan, what is the present value of the interest tax shield from the debt?

Interest tax shield in year 1 = $30 × 6.5% × 40% = $0.78 million. As the outstanding balance declines, so will the interest tax shield. Therefore, we can value the interest tax shield as a growing perpetuity with a growth rate of \( g = -5\% \) and \( r = 6.5\% \):

\[ PV = \frac{0.78}{6.5\% + 5\%} = $6.78 \text{ million} \]

15-9. Safeco Inc. has no debt, and maintains a policy of holding $10 million in excess cash reserves, invested in risk-free Treasury securities. If Safeco pays a corporate tax rate of 35%, what is the cost of permanently maintaining this $10 million reserve? (Hint: what is the present value of the additional taxes that Safeco will pay?)

\( D = -$10 \text{ million (negative debt)} \)

So \( PV(\text{Interest tax shield}) = TC \times D = -$3.5 \text{ million.} \)

This is the present value of the future taxes Safeco will pay on the interest earned on its reserves.

15-10. Rogot Instruments makes fine Violins and cellos. It has $1 million in debt outstanding, equity valued at $2 million, and pays corporate income tax at rate 35%. Its cost of equity is 12% and its cost of debt is 7%.

a. What is Rogot’s pretax WACC?

b. What is Rogot’s (effective after-tax) WACC?

a. \( r_{wacc} = \frac{E}{E + D}r_E + \frac{D}{E + D}r_D(1 - \tau_c) = \frac{2}{3} + \frac{1}{3} = 10.33\% \)

b. \( r_{wacc} = \frac{E}{E + D}r_E + \frac{D}{E + D}r_D(1 - \tau_c) = \frac{2}{3} + \frac{1}{3}(0.65) = 9.52\% \)
15-11. Rumolt Motors has 30 million shares outstanding with a price of $15 per share. In addition, Rumolt has issued bonds with a total current market value of $150 million. Suppose Rumolt’s equity cost of capital is 10%, and its debt cost of capital is 5%.

a. What is Rumolt’s pretax weighted average cost of capital?

b. If Rumolt’s corporate tax rate is 35%, what is its after-tax weighted average cost of capital?

\[ E = $15 \times 30 = $450 \text{ million}, \quad D = $150 \text{ million}. \]

Pretax WACC = \[ \frac{450}{600} \times 10\% + \frac{150}{600} \times 5\% = 8.75\% \]

b. WACC = \[ \frac{450}{600} \times 10\% + \frac{150}{600} \times 5\%(1-35\%) = 8.3125\% \]

15-12. Summit Builders has a market debt-equity ratio of 0.65 and a corporate tax rate of 40%, and it pays 7% interest on its debt. The interest tax shield from its debt lowers Summit’s WACC by what amount?

\[ \frac{D}{E+D} = 0.65 = 0.394. \]

Therefore, WACC = Pretax WACC – 0.394(7\%)(0.40) = Pretax WACC – 1.10% So, it lowers it by 1.1%.

15-13. NatNah, a builder of acoustic accessories, has no debt and an equity cost of capital of 15%. Suppose NatNah decides to increase its leverage and maintain a market debt-to-value ratio of 0.5. Suppose its debt cost of capital is 9% and its corporate tax rate is 35%. If NatNah’s pretax WACC remains constant, what will its (effective after-tax) WACC be with the increase in leverage?

\[ \text{Pretax Wacc} - \frac{D}{E+D} r_D \tau = 15\% - 0.5 \times 0.09 \times 0.35 = 13.425\% \]

15-14. Restex maintains a debt-equity ratio of 0.85, and has an equity cost of capital of 12% and a debt cost of capital of 7%. Restex’s corporate tax rate is 40%, and its market capitalization is $220 million.

a. If Restex’s free cash flow is expected to be $10 million in one year, what constant expected future growth rate is consistent with the firm’s current market value?

b. Estimate the value of Restex’s interest tax shield.

a. \[ WACC = \frac{1}{1.85} \times 12\% + \frac{0.85}{1.85} \times 7\%(1-0.40) = 8.42\% \]

\[ \nu^L = \frac{E + D}{FCC} = \frac{220 \times 1.85}{407} = \frac{10}{0.0842 - g} \]

\[ g = 0.0842 - \frac{10}{407} = 5.96\% \]

b. \[ \text{pretax WACC} = \frac{1}{1.85} \times 12\% + \frac{0.85}{1.85} \times 7\% = 9.70\% \]

\[ \nu^{LT} = \frac{FCF}{\text{pretax WACC} - g} = \frac{10}{0.0970 - 0.0596} = $267 \text{ million} \]

\[ \text{PV (Interest Tax Shield)} = 407 - 267 = $140 \text{ million} \]
15-15. Acme Storage has a market capitalization of $100 million and debt outstanding of $40 million. Acme plans to maintain this same debt-equity ratio in the future. The firm pays an interest rate of 7.5% on its debt and has a corporate tax rate of 35%.

a. If Acme’s free cash flow is expected to be $7 million next year and is expected to grow at a rate of 3% per year, what is Acme’s WACC?

b. What is the value of Acme’s interest tax shield?

15-16. Milton Industries expects free cash flow of $5 million each year. Milton’s corporate tax rate is 35%, and its unlevered cost of capital is 15%. The firm also has outstanding debt of $19.05 million, and it expects to maintain this level of debt permanently.

a. What is the value of Milton Industries without leverage?

b. What is the value of Milton Industries with leverage?

15-17. Suppose Microsoft has 8.75 billion shares outstanding and pays a marginal corporate tax rate of 35%. If Microsoft announces that it will pay out $50 billion in cash to investors through a combination of a special dividend and a share repurchase, and if investors had previously assumed Microsoft would retain this excess cash permanently, by how much will Microsoft’s share price change upon the announcement?

Reducing cash is equivalent to increasing leverage by $50 billion. PV of tax savings = 35% × 50 = $17.5 billion, or 17.5/ 8.75 = $2.00 per share price increase.

15-18. Kurz Manufacturing is currently an all-equity firm with 20 million shares outstanding and a stock price of $7.50 per share. Although investors currently expect Kurz to remain an all-equity firm, Kurz plans to announce that it will borrow $50 million and use the funds to repurchase shares. Kurz will pay interest only on this debt, and it has no further plans to increase or decrease the amount of debt. Kurz is subject to a 40% corporate tax rate.

a. What is the market value of Kurz’s existing assets before the announcement?

b. What is the market value of Kurz’s assets (including any tax shields) just after the debt is issued, but before the shares are repurchased?

c. What is Kurz’s share price just before the share repurchase? How many shares will Kurz repurchase?

d. What are Kurz’s market value balance sheet and share price after the share repurchase?

c. \( E = \text{Assets} - \text{Debt} = 220 - 50 = $170 \text{ million. Share price} = \frac{$170 \text{ million}}{20} = $8.50 \).

Kurz will repurchase \( \frac{50}{8.50} = 5.882 \) million shares.

d. \( \text{Assets} = 150 (\text{existing}) + 40\% \times 50 (\text{tax shield}) = $170 \text{ million}

\( \text{Debt} = $50 \text{ million} \)

\( E = \text{A} - D = 170 - 50 = $120 \text{ million} \)

\( \text{Share price} = \frac{$120 \text{ million}}{20} = $6.00/\text{share} \).

15-19. Rally, Inc., is an all-equity firm with assets worth $25 billion and 10 billion shares outstanding. Rally plans to borrow $10 billion and use these funds to repurchase shares. The firm’s corporate tax rate is 35%, and Rally plans to keep its outstanding debt equal to $10 billion permanently.

a. Without the increase in leverage, what would Rally’s share price be?

b. Suppose Rally offers $2.75 per share to repurchase its shares. Would shareholders sell for this price?

c. Suppose Rally offers $3.00 per share, and shareholders tender their shares at this price. What will Rally’s share price be after the repurchase?

d. What is the lowest price Rally can offer and have shareholders tender their shares? What will its stock price be after the share repurchase in that case?

a. \( \text{Share price} = \frac{25}{10} = $2.50 \) per share

b. Just before the share repurchase:

\( \text{Assets} = 25 (\text{existing}) + 10 (\text{cash}) + 35\% \times 10 (\text{tax shield}) = $38.5 \text{ billion} \)

\( E = 38.5 - 10 = 28.5 \) \( \text{share price} = \frac{28.5}{10} = $2.85/\text{share} \).

Therefore, shareholders will not sell for $2.75 per share.

c. \( \text{Assets} = 25 (\text{existing}) + 35\% \times 10 (\text{tax shield}) = $28.5 \text{ billion} \)

\( E = 28.5 - 10 = 18.5 \) billion

\( \text{Shares} = 10 - \frac{10}{3} = 6.667 \text{ billion. Share price} = \frac{18.5}{6.667} = $2.775 \text{ share} \).

d. From (b), fair value of the shares prior to repurchase is $2.85. At this price, Rally will have \( 10 - \frac{10}{2.85} = 6.49 \) million shares outstanding, which will be worth \( \frac{18.5}{6.49} = $2.85 \) after the repurchase. Therefore, shares will be willing to sell at this price.

15-20. Suppose the corporate tax rate is 40%, and investors pay a tax rate of 15% on income from dividends or capital gains and a tax rate of 33.3% on interest income. Your firm decides to add debt so it will pay an additional $15 million in interest each year. It will pay this interest expense by cutting its dividend.

a. How much will debt holders receive after paying taxes on the interest they earn?

b. By how much will the firm need to cut its dividend each year to pay this interest expense?
c. By how much will this cut in the dividend reduce equity holders’ annual after-tax income?

d. How much less will the government receive in total tax revenues each year?

e. What is the effective tax advantage of debt $\tau^*?$

a. $15 \times (1-.333) = $10 million each year

b. Given a corporate tax rate of 40%, an interest expense of $15 million per year reduces net income by $15(1-.4) = $9 million after corporate taxes.

c. $9 million dividend cut ⇒ $9 \times (1-.15) = $7.65 million per year.

d. Interest taxes = .333 \times 15 = $5 million

Less corporate taxes = .40 \times 15 = $6 million

Less dividend taxes = .15 \times 9 = $1.35 million

⇒ Govt tax revenues change by 5 – 6 – 1.35 = $2.35 million

(Note this equals (a) – (c)).

e. $\tau^* = 1 - \frac{(1-0.40)(1-0.15)}{1-0.333} = 23.5\%$

15-21. Apple Corporation had no debt on its balance sheet in 2008, but paid $2 billion in taxes. Suppose Apple were to issue sufficient debt to reduce its taxes by $1 billion per year permanently. Assume Apple’s marginal corporate tax rate is 35% and its borrowing cost is 7.5%.

a. If Apple’s investors do not pay personal taxes (because they hold their Apple stock in tax-free retirement accounts), how much value would be created (what is the value of the tax shield)?

b. How does your answer change if instead you assume that Apple’s investors pay a 15% tax rate on income from equity and a 35% tax rate on interest income?

a. $1 billion / 7.5\% = $13.33 billion.

b. To reduce taxes by $1 billion, Apple will need to make interest payments of $1 / .35 = $2.857 billion, or issue $2.857 / .075 = $38.1 billion in debt.

$$T \times = 1 - (1 - tc)(1 - te)/(1 - ti) = 1 - (.65)(.85)/.65 = 15\%$$

$$T \times D = 15\% \times $38.1 = $5.71 billion$$

15-22. Markum Enterprises is considering permanently adding $100 million of debt to its capital structure. Markum’s corporate tax rate is 35%.

a. Absent personal taxes, what is the value of the interest tax shield from the new debt?

b. If investors pay a tax rate of 40% on interest income, and a tax rate of 20% on income from dividends and capital gains, what is the value of the interest tax shield from the new debt?

a. $PV = \tau_c D = 35\% \times 100 = $35 million.$

b. $\tau^* = 1 - \frac{(1-0.35)(1-0.20)}{1-0.40} = 13.33\%$

$$PV = \tau_c D = 13.33\% \times 100 = $13.33 million$$

15-23. Garnet Corporation is considering issuing risk-free debt or risk-free preferred stock. The tax rate on interest income is 35%, and the tax rate on dividends or capital gains from preferred
stock is 15%. However, the dividends on preferred stock are not deductible for corporate tax purposes, and the corporate tax rate is 40%.

a. If the risk-free interest rate for debt is 6%, what is cost of capital for risk-free preferred stock?

b. What is the after-tax debt cost of capital for the firm? Which security is cheaper for the firm?

c. Show that the after-tax debt cost of capital is equal to the preferred stock cost of capital multiplied by \((1 - \tau^*)\).

\[
\tau^* = 1 - \frac{(1 - 0.40)(1 - 0.15)}{1 - 0.35} = 21.54\%
\]

\[
4.59\% \times (1 - 0.2154) = 3.60\%
\]

15-24. Suppose the tax rate on interest income is 35%, and the average tax rate on capital gains and dividend income is 10%. How high must the marginal corporate tax rate be for debt to offer a tax advantage?

\[
\tau^* = 1 - \frac{(1 - r_c)(1 - r)}{1 - r} > 0 \quad \text{if and only if} \quad 1 - r_c < \frac{1 - r}{1 - r} \quad \text{or equivalently:}
\]

\[
r_c > 1 - \frac{1 - r}{1 - r} = 1 - \frac{0.65}{0.90} = 27.8\%.
\]

Thus, there is a tax advantage of debt as long as the marginal corporate tax rate is above 27.8%.

15-25. With its current leverage, Impi Corporation will have net income next year of $4.5 million. If Impi’s corporate tax rate is 35% and it pays 8% interest on its debt, how much additional debt can Impi issue this year and still receive the benefit of the interest tax shield next year?

Net income of $4.5 million \(\Rightarrow\) 4.5 \(\frac{1}{1 - 0.35} = \$6.923\) million in taxable income.

Therefore, Arundel can increase its interest expenses by $6.923 million, which corresponds to debt of:

\[
\frac{6.923}{0.08} = \$86.5 \text{ million.}
\]

15-26. Colt Systems will have EBIT this coming year of $15 million. It will also spend $6 million on total capital expenditures and increases in net working capital, and have $3 million in depreciation expenses. Colt is currently an all-equity firm with a corporate tax rate of 35% and a cost of capital of 10%.

a. If Colt is expected to grow by 8.5% per year, what is the market value of its equity today?

b. If the interest rate on its debt is 8%, how much can Colt borrow now and still have nonnegative net income this coming year?

c. Is there a tax incentive for Colt to choose a debt-to-value ratio that exceeds 50%? Explain.
a. \[ FCF = EBIT \times (1 - \tau) + \text{Dep} - \text{Capex} - \Delta NWC = 15 \times (1 - 0.35) + 3 - 6 = 6.75 \]
\[ E = \frac{6.75}{10\% - 8.5\%} = $450 \text{ million} \]

b. Interest expense of $15 million \(\Rightarrow\) debt of \(\frac{15}{0.08} = $187.5 \text{ million}.\)

c. No. The most they should borrow is 187.5 million; there is no interest tax shield from borrowing more.

15-27. PMF, Inc., is equally likely to have EBIT this coming year of $10 million, $15 million, or $20 million. Its corporate tax rate is 35%, and investors pay a 15% tax rate on income from equity and a 35% tax rate on interest income.

a. What is the effective tax advantage of debt if PMF has interest expenses of $8 million this coming year?

b. What is the effective tax advantage of debt for interest expenses in excess of $20 million? (Ignore carryforwards.)

c. What is the expected effective tax advantage of debt for interest expenses between $10 million and $15 million? (Ignore carryforwards.)

d. What level of interest expense provides PMF with the greatest tax benefit?

a. \[ \tau^* = 1 - \frac{(1 - \tau_c)(1 - \tau_i)}{1 - \tau_i} = 1 - \frac{(1 - 0.35)(1 - 0.15)}{1 - 0.35} = 15\% \]

b. For interest expenses over $20 million, net income is negative so \(\tau_c = 0\).

Therefore, \[ \tau^* = 1 - \frac{(1 - \tau_c)(1 - \tau_i)}{1 - \tau_i} = 1 - \frac{(1 - 0)(1 - 0.15)}{1 - 0.35} = -31\% \]

c. For interest expenses between $10 million and $15 million, there is a \(\frac{2}{3}\) chance that net income will be positive. Therefore, the expected corporate tax savings is \(\frac{2}{3} \times 35\% = 23.3\%\). Thus,

\[ \tau^* = 1 - \frac{(1 - \tau_c)(1 - \tau_i)}{1 - \tau_i} = 1 - \frac{(1 - 0.23)(1 - 0.15)}{1 - 0.35} = -0.3\% \]

d. There is a tax advantage up to an interest expense of $10 million.