Problem 1

(1) Book Value Debt/Equity Ratio = 2500/2500 = 100%
Market Value of Equity = 50 million * $ 80 = $4,000
Market Value of Debt = .80 * 2500 = $2,000
Debt/Equity Ratio in market value terms = 2000/4000 = 50.00%
(2) Book Value Debt/(Debt+ Equity) = 2500/(2500 + 2500) = 50%
Market Value Debt/(Debt+Equity) = 2000/(2000+4000) = 33.33%
(3) After-tax Cost of Debt = 12% (1-0.4) = 7.20%
(4) Cost of Equity = 8% + 1.2 (5.5%) = 14.60%
(5) Cost of Capital = 14.60% (4000/6000) + 7.20% (2000/6000) = 12.13%

Problem 2

(1) To assess this project from the equity investors' standpoint, we estimate cashflows to equity and the cost of equity.
Initial Equity Investment in Project = 0.6667 (100 million) = $ 66.67 million
Cash Flows to Equity = Net Income + Depreciation = $ 9.60 million + $ 5 million = $ 14.60 million
NPV of CF to Equity = 14.60/1.1460 - 66.67 = $33.33 million
(2) From the firm's standpoint, the cashflows to the firm have to be estimated.
Initial Investment in Project = $100 million
Cash Flows to Firm = EBIT (1 - tax rate) + Deprec'n = $ 20 million (1-0.4) + $ 5 million = $ 17 million
NPV of CF to Firm = $17.1213 - $100 million = $40.15 million
(3) The cost of equity should be used as the discount rate if the cashflows being discounted are cashflows to equity.
(4) The cost of capital should be used as the discount rate if the cashflows being discounted are cashflows to the firm.
(5) Even if this project is financed entirely with debt, it should be analyzed using the same costs of equity and capital as the analysis above.

Problem 3

(1), (2) and (3)
Unlevered Beta = Levered Beta/(1+(1-t)(D/E)) = 1.2/(1+0.6*0.5) = 0.92

<table>
<thead>
<tr>
<th>D/E Ratio</th>
<th>Beta</th>
<th>Cost of Equity</th>
<th>Cost of Debt</th>
<th>WACC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>16.67%</td>
<td>1.02</td>
<td>13.58%</td>
<td>6.60%</td>
</tr>
<tr>
<td>Option 2</td>
<td>100.00%</td>
<td>1.48</td>
<td>16.12%</td>
<td>7.80%</td>
</tr>
<tr>
<td>Option 3</td>
<td>500.00%</td>
<td>3.69</td>
<td>28.31%</td>
<td>10.80%</td>
</tr>
</tbody>
</table>

(4) ..

<table>
<thead>
<tr>
<th>Δ Firm Value</th>
<th>New Firm Value Debt</th>
<th>Equity</th>
<th>Stock Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>($216)</td>
<td>$5,784</td>
<td>$1,000</td>
</tr>
<tr>
<td>Option 2</td>
<td>$86</td>
<td>$6,086</td>
<td>$3,000</td>
</tr>
<tr>
<td>Option 3</td>
<td>($693)</td>
<td>$5,307</td>
<td>$5,000</td>
</tr>
</tbody>
</table>

Note: The change in firm value will mean that the debt ratios computed above will also change.
(5) From a cost of capital standpoint, option 2 is the best one.
(6) If Rubbermaid’s income is more volatile, the firm should be more cautious in adding debt.
(7) If the new debt or equity is used to take projects, the analysis would change for two reasons –
(a) the projects may have a different risk profile than the firm's risk profile.
(b) the NPV of the projects has to be added to the value change calculated.
(c) the firm value itself will increase as the new debt and equity is issued.
(8) I would factor in the firm's need for flexibility into the analysis - the greater the need for flexibility the less likely it is that I would add on debt. Further, I would look at how responsive managers are to stockholders; if they are not, I would be more likely to add debt.
(9) The higher rating in option 1 lowers the cost of debt, but it is accomplished by replacing debt with more expensive equity.
Problem 4

(a) Intuitively, I would expect Rubbermaid to have a higher debt ratio than its competitors because –

(1) its earnings are less volatile than those of its competitors
(2) it has higher cash flows as a percent of firm value than its competitors.
(3) it has a higher tax rate than its competitors
(4) it has a lower need for flexibility; it has lower R&D expenses.

(b) Plugging in the values into the regression,

\[
\text{Predicted Debt/Equity Ratio} = 0.10 - 0.5(0.2) + 2.0(0.25) + 0.4(0.4) + 2.5(0.02) = 71.00\%.
\]

Problem 5

(1) Marginal Tax Benefit from borrowing $100 million = Tax Rate * Debt = 0.46 * $100 million = $46 million
Marginal Cost of Borrowing $100 million
a. Cost of debt increases from 11% to 12.5%

\[
\text{Increase in cost of debt on existing debt} = (0.125 - 0.11) \times 200\text{ million} = 3\text{ million}.
\]
\[
\text{PV of Increase in Cost of Debt} = 3\text{ million} / 0.125 = 24\text{ million}.
\]
b. Cost of Equity increases as well; the beta of the stock goes up

\[
\text{Old Cost of Equity} = 8\% + 1.50 \times 0.055 = 16.25\%.
\]
\[
\text{Unlevered Beta} = 1.50 \times (1 + 0.54 \times \frac{200}{500}) = 1.23.
\]
\[
\text{New Cost of Equity} = 8\% + 1.63 \times 0.055 = 16.97\%.
\]
\[
\text{Increase in cost of equity on existing equity} = (0.1697 - 0.1625) \times 500\text{ million} = 3.60\text{ million}.
\]
\[
\text{PV of Increase in Cost of Equity} = 3.60 / 0.1697 = 21.21\text{ million}.
\]
Marginal benefit of $46 million is higher than the marginal cost of $45.21 million

(2) WACC without the $100 million

\[
\text{Cost of Equity} = 16.25\%.
\]
\[
\text{After-tax Cost of Debt} = 11\% \times (1-0.46) = 5.94\%.
\]
\[
\text{WACC with the $100 million} = 16.25\% \times (\frac{500}{700}) + 5.94\% \times (\frac{200}{700}) = 13.30\%.
\]

Note: This assumes that the $100 million in borrowing is invested in projects and not used to buy back stock.

(3) Change in Firm Value - assuming no growth

\[
\text{Change in Firm Value} = \frac{\text{Old Firm Value}}{\text{New Cost of Capital}} - \text{New Cost of Capital}.
\]
\[
= \frac{700\text{ million}}{0.1330} - 0.1314 = 8.52\text{ million}.
\]
\[
\text{New Price per share} = \frac{50 + 8.52}{10} = 50.85\text{ dollar}.
\]

(4) After-tax Cash Flow to Firm from Project = $20 million (1-0.46) = 10.8 million

\[
\text{NPV of project} = \frac{10.8}{0.1314} - 100 = 35.00\text{ million}.
\]
No. It is not a desirable project.

(5) If this were a certain project, I would discount the cashflows at the riskless rate.

\[
\text{NPV of project} = \frac{10.80}{0.08} - 100 = 35.00\text{ million}.
\]
This is now an acceptable project.

Problem 6

(1) First, we calculate the cost of capital at different levels of debt

<table>
<thead>
<tr>
<th>Add'l Debt</th>
<th>Beta</th>
<th>Cost of Equity</th>
<th>Rating</th>
<th>Cost of Debt</th>
<th>Cost of Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>1.15</td>
<td>12.33%</td>
<td>BBB</td>
<td>6.00%</td>
<td>11.06%</td>
</tr>
<tr>
<td>500000</td>
<td>1.50</td>
<td>13.15%</td>
<td>BB</td>
<td>6.30%</td>
<td>10.87%</td>
</tr>
<tr>
<td>1000000</td>
<td>1.45</td>
<td>13.98%</td>
<td>B</td>
<td>6.90%</td>
<td>10.94%</td>
</tr>
<tr>
<td>1500000</td>
<td>1.60</td>
<td>14.80%</td>
<td>B-</td>
<td>8.10%</td>
<td>11.45%</td>
</tr>
<tr>
<td>2000000</td>
<td>1.75</td>
<td>15.63%</td>
<td>C</td>
<td>9.00%</td>
<td>11.94%</td>
</tr>
</tbody>
</table>
Unlevered Beta = \( \frac{1.15}{1+0.6*(500/2000)} = 1.00 \)

This assumes that the new debt will not be used to buy back stock.

(2) Effect of moving to the optimal on the Stock Price

Increase in Firm Value = \( 2500000 \times (0.1106 \cdot 0.1087) \) = $43,698

Increase in Stock Price = \( \frac{43,698}{100000} = \) $0.44

(3) See above

(4) After-tax Cash Flow to Firm from Project = EBIT \((1-t) + \) Depreciation = $600,000 \((1-0.4) + \) $100,000

NPV of Project = \( \frac{460000}{0.1087} - 3,000,000 \) = $1,231,831

**Problem 7**

(a) Optimal Debt Ratio

<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>Beta</th>
<th>Cost of Equity</th>
<th>AT Cost of Debt</th>
<th>Cost of Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>1.50</td>
<td>17.25%</td>
<td>6.00%</td>
<td>17.25%</td>
</tr>
<tr>
<td>10%</td>
<td>1.60</td>
<td>17.80%</td>
<td>6.30%</td>
<td>16.65%</td>
</tr>
<tr>
<td>20%</td>
<td>1.73</td>
<td>18.49%</td>
<td>6.60%</td>
<td>16.11%</td>
</tr>
<tr>
<td>30%</td>
<td>1.89</td>
<td>19.37%</td>
<td>7.20%</td>
<td>15.72%</td>
</tr>
<tr>
<td>40%</td>
<td>2.10</td>
<td>20.55%</td>
<td>7.80%</td>
<td>15.45%</td>
</tr>
<tr>
<td>50%</td>
<td>2.40</td>
<td>22.20%</td>
<td>8.40%</td>
<td>15.30%</td>
</tr>
<tr>
<td>60%</td>
<td>2.85</td>
<td>24.68%</td>
<td>9.60%</td>
<td>15.63%</td>
</tr>
<tr>
<td>70%</td>
<td>3.60</td>
<td>28.80%</td>
<td>10.80%</td>
<td>16.20%</td>
</tr>
<tr>
<td>80%</td>
<td>5.10</td>
<td>37.05%</td>
<td>12.00%</td>
<td>17.01%</td>
</tr>
<tr>
<td>90%</td>
<td>9.60</td>
<td>61.80%</td>
<td>15.00%</td>
<td>19.68%</td>
</tr>
</tbody>
</table>

The optimal debt ratio is 50%.

(b) Change in Firm Value = \( 20,000,000 \times (0.1725-0.1530)/0.1530 \) = $2,549,020

Increase in Stock Price from going to optimal debt ratio = $2.55

New Stock Price = $22.55

**Problem 8**

(a) Current Cost of Equity = 8% + 1.06 \((5.5\%) = 13.83\%

Current Cost of Debt = 10% \((1-0.4) = 6.00\%

Current Cost of Capital = 13.83\% \((250/275) + 6.00\% \((25/275) = 13.12\%

(b) If the firm borrows $100 million and buys back $100 million of stock

New Debt/Equity Ratio = 125/150 = 0.83333333

Unlevered Beta = \( 1.06/1+0.6\times10 \) = 1.00

New Beta = \( 1 + 0.6\times0.8333 \) = 1.50

Cost of Equity = 8% + 1.50 \((5.5\%) = 16.25\%

Cost of Capital = 16.25\% \((150/275) + 13\% \((1-4) \((125/275) = 12.41\%

**Problem 9**

(a) Current Cost of Equity = 7% + 1.12 \((5.5\%) = 13.16\%

(b) Current pre-tax Cost of Debt = Interest Expense/Book Debt = 10/100 = 10%

After-tax Cost of Debt = 10% \((1-0.4) = 6\%

[The book interest rate can be used since the bonds are trading at par.]

(c) Current Cost of Capital = 13.16\% \((500/600) + 6\% \((100/600) = 11.97\%

(d) If the firm borrows $350 million and buys back stock,

New Debt = $450

New Equity = $150

Unlevered Beta = \( 1.12/1+0.6\times(100/500) \) = 1.00

New Beta = \( 1.00 \(1+0.6\times(450/150) \) = 2.80

New Cost of Equity = 7% + 2.80 \((5.5\%) = 22.40\%

(e) Effective Tax Rate = EBIT/Interest Expense = \( 50/67.50 \times 40\% = 29.63\%
Problem 10

(a) Current Cost of Equity = 6% + 1.25 (5.5%) = 12.88%
(b) Current After-tax Cost of Debt = 11% (1-0.5) = 5.50%
(c) Current Cost of Capital = 12.88% (1800/2700) + 5.50% (900/2700) = 10.42%

[d] Market Value of Equity = PE * Net Income = 9 * 200 = 1800; Market Value of Debt = 0.9* 1000 = 900

(d) After the action,

\[
\begin{align*}
\text{New Equity} &= 2000 \\
\text{New Debt} &= 700 \\
\text{Unlevered Beta} &= 1.25/(1+0.5*(900/1800)) = 1.00 \\
\text{New Levered Beta} &= 1.00 (1+0.5*(700/2000)) = 1.175 \\
\text{New Cost of Equity} &= 6% + 1.175(5.5%) = 12.46% \\
\text{New WACC} &= 12.46% (2000/2700) + 10% (1-.5) (700/2700) = 10.53% \\
\text{Change in Value of Firm} &= (2700 (.1042-.1053)/.1042 = ($28.21) \\
\text{New Firm Value} &= 2700 - 28.21 = $2,672
\end{align*}
\]

Problem 11

a. Market Value of Equity = 40 million * $ 20 = 800

Cost of Equity = 8% + 1.15 (5.5%) = 14.33%
Cost of Capital = 14.33% (0.8) + 10% (1-.4) (0.2) = 12.66%

b. If the firm borrows $ 200 million and buys back stock, Equity will drop to $ 600 million (60%)

\[
\begin{align*}
\text{New Debt/Equity Ratio} &= 400/600 = 0.67 \\
\text{Unlevered Beta} &= 1.15 / (1 + 0.6*0.25) = 1.00 \\
\text{New Beta} &= 1.00 (1+0.6*0.67) = 1.40 \\
\text{New Cost of Equity} &= 8% + 1.40 (5.5%) = 15.70% \\
\text{New Cost of Capital} &= 15.70% (0.6) + 11% (1-0.4) (0.4) = 12.06% \\
\text{Increase in firm value from moving to optimal} &= (0.1266-0.1206)(1000)/.1206 = $49.75 \\
\text{Increase in Stock Price} &= 49.75/40 = $1.24
\end{align*}
\]

d. New Debt after borrowing $ 150 million = 200 + 150 = 350

Expected Dividend Yield next year = (1/20)*2 = 10%
Expected Price Appreciation = 14.33% - 10% = 4.33% ! Cost of Equity - Div. Yield
Expected Value of Equity at end of year = 800 (1.0433) = 834.64
Expected Debt/Equity Ratio = 350/834.64 = 41.93%

Problem 12

a. Current Value of Equity = $ 700 million

Current Value of Convertible Debt = $500

To calculate the straight debt portion of this convertible debt, we estimate the market value of a straight bond with a coupon rate of 8% and a maturity of 10 years, using a market interest rate of 10%.

Value of Straight Bond, coupon rate of 8%, maturity of 10 years = $877
Value of Straight Bond portion of Convertible Debt = $ 877 * 5000000 = $ 438.5 million
Value of Equity Portion of Convertible Debt = $ 500 - $ 438.5 = $ 61.5 million
Current Debt/Equity Ratio = 438.5/(700+61.5) = 57.58%

b. Cost of Equity = 6% + 1.2 (5.5%) = 12.60%
Cost of Capital = 12.60% (761.5/1200) + 10% (1-.4) (438.5/1200) = 10.19%

c. If $ 250 million is borrowed to buy back stock, pay dividends and take a project

\[
\begin{align*}
\text{Equity} &= $ 761.5 - $ 200 + $ 25 = 586.5 \text{! The NPV is accrues to equity.} \\
\text{Debt} &= 438.5 + 250 = 688.5 \\
\text{New Debt/Equity Ratio} &= 688.5/586.5 = 117.39% \\
\text{Unlevered Beta} &= 1.2/(1+0.6*(.5758)) = 0.89
\end{align*}
\]
New Beta = 0.89 (1+0.6*(1.1739)) = 1.52
New Cost of Equity = 6% + 1.52*(5.5%) = 14.36%
d. New Cost of Capital = 14.36% (586.5/1275) + 11% (1-0.4) (688.5/1275) = 10.17%
e. Change in Firm Value from change in WACC=(.1019-.1017) 1200/.1017 = $2.36
  Increase from taking project with NPV of $25 million = $25
  Net Effect of Restructuring = -20.83 + 25 = $27.36 mil
  New Firm Value after the borrowing = 1200 + 50 + 27.36 = $277.36 million

Problem 13
Current Market Value of Equity = 27.5 million * $25 = $687.50 T.Bond Rate = 7%
Current Debt outstanding = $25.00
Current Debt/Equity Ratio = 25/687.5 = 3.64%
Unlevered Beta = 0.70/(1+0.65*0.0364) = 0.6838208
Return on Assets = EBIT (1-t)/(BV of Debt + Equity)
= 63.3 (1-.35) / (25 + 200) = 18.29%
Return on Equity = ROA + D/E (ROA - Interest Rate on Debt (1-t))
a. Cost of Equity, ROE and Differential Return at each level of Debt

<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>D/E Ratio</th>
<th>Beta</th>
<th>Cost of Equity</th>
<th>Interest Rate</th>
<th>ROE</th>
<th>ROE - COE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0.00%</td>
<td>0.68</td>
<td>10.76%</td>
<td>6.70%</td>
<td>18.29%</td>
<td>7.53%</td>
</tr>
<tr>
<td>10%</td>
<td>11.11%</td>
<td>0.73</td>
<td>11.03%</td>
<td>7.00%</td>
<td>19.81%</td>
<td>8.78%</td>
</tr>
<tr>
<td>20%</td>
<td>25.00%</td>
<td>0.79</td>
<td>11.37%</td>
<td>7.50%</td>
<td>21.64%</td>
<td>10.27%</td>
</tr>
<tr>
<td>30%</td>
<td>42.86%</td>
<td>0.87</td>
<td>11.81%</td>
<td>8.00%</td>
<td>23.90%</td>
<td>12.09%</td>
</tr>
<tr>
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<td>66.67%</td>
<td>0.98</td>
<td>12.39%</td>
<td>8.50%</td>
<td>26.79%</td>
<td>14.40%</td>
</tr>
<tr>
<td>50%</td>
<td>100.00%</td>
<td>1.13</td>
<td>13.21%</td>
<td>9.00%</td>
<td>30.72%</td>
<td>17.52%</td>
</tr>
<tr>
<td>60%</td>
<td>150.00%</td>
<td>1.35</td>
<td>14.43%</td>
<td>10.00%</td>
<td>35.97%</td>
<td>21.54%</td>
</tr>
<tr>
<td>70%</td>
<td>233.33%</td>
<td>1.72</td>
<td>16.47%</td>
<td>11.00%</td>
<td>44.27%</td>
<td>27.81%</td>
</tr>
<tr>
<td>80%</td>
<td>400.00%</td>
<td>2.46</td>
<td>20.54%</td>
<td>12.00%</td>
<td>60.23%</td>
<td>39.69%</td>
</tr>
<tr>
<td>90%</td>
<td>900.00%</td>
<td>4.68</td>
<td>32.76%</td>
<td>15.00%</td>
<td>95.12%</td>
<td>62.35%</td>
</tr>
</tbody>
</table>

The differential return is maximized at 90% debt.

Problem 14
a. Cost of Equity = 6.50% + 1.47 (5.5%) = 14.59%

Cost of Capital = 14.59% (24.27/(24.27+ 2.8)) + 6.8% (1-0.4) (2.8/(24.27+2.8)) = 13.50%
b. If Pfizer moves to a 30% debt ratio,

New debt/equity ratio = 30/70 = 42.86%

Unlevered Beta = 1.47/(1+0.6*(2.8/24.27)) = 1.37

New Beta = 1.37 (1+0.6*0.4286) = 1.72

New Cost of Equity = 6.5% + 1.72 (5.5%) = 15.96%

New Cost of Capital = 15.96% (0.7) + 8.5% (1-.4) (0.3) = 12.70%
c. If the savings grow at 6% a year in perpetuity, the change in firm value can be computed as follows –

Savings each year = (.1350-.1270) (24.27 + 2.8) = 0.21656! $216.56 million

PV of Savings with 6% growth = (216.56*1.06)/(1.127-.06) = $3,426! $3.4 billion

Increase in Stock Price = 3426/24270 = 14.12%! Stock Price will increas by 14.12%
d. The need for R&D increases the need for flexibility; therefore, Pfizer may not go to this higher optimal debt ratio, the cost of capital notwithstanding.

Problem 15
a. Estimate of Market Value of Debt

Present Value of Interest Expenses ($55 million) and book value ($664 million) at the cost of debt of 7.5%
Capital Structure Applications

Estimated Market Value of Debt = $700

Market Value of Equity = 173 * $30.75 = $5,320

b. Cost of Equity = 6.50% + 1.17(5.5%) = 12.94%

Cost of Capital = \( \frac{12.94(5320/(5320+700)) + 7.5(1-.36)(700/(5320+700))}{5320+700} \) = 11.99%

c. Increase in value per share = $1.25

Total Increase in firm value = 173 * 1.25 = $216

Solving for x,
\( x = \frac{(6020*.1294)/(6020+216.25)}{6020+216.25} = 12.49\%

The cost of capital at the optimal is 12.49%.

Problem 16

a. Cost of Equity at current debt level = 6.5% + 0.75(5.5%) = 10.63%

Return on Assets = \( \frac{372 (1-.36)}{210+1250} \) = 16.31%

Return on Equity = ROA + D/E (ROA - i (1-t))

\( = 16.31\% + .05(16.31\% - 6.8\%(1-.36)) \) This analysis could also have been done with book value D/E ratios

= 16.91%

Return Differential = 16.91\% - 10.63\% = 6.28%

b. If the debt ratio goes up to 30%,

Unlevered Beta = 0.75/(1+(1-.36)(.05)) = 0.73

New Beta = 0.73 (1+(1-.36) 30/70) = 0.93

New Cost of Equity = 6.5% + 0.93 (5.55) = 11.62%

New Return on Equity = 16.31\% + (30/70) (16.31\% - 8\%(1-.36)) = 21.11%

Return Differential = 21.11\% - 11.62\% = 9.49%

Problem 17

a. Unlevered Firm Value = Current Firm Value - Tax Savings + Exp. Bankruptcy Cost @ existing debt

\( X = 2287 - 190 + (.023)(.3)(2287-190) = \) $2,111

b. At a debt ratio of 50%,

New Levered Firm Value = $2111 + (.36)(.5) (Leveled Firm Value) - (.4661)(.30) (2111)

\( X = 2111 + .18X - (.4661)(.3) (2111) \)

Solving for X,
\( X = (2111 - (.4661)(.3)(2111))/(0.82) = \) $2,214.41

Problem 18

For simplicity, we are assuming that the debt ratios are computed on the unlevered firm value.

<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>Unlevered Firm Value</th>
<th>Tax Savings or Expected Cost of Bankruptcy</th>
<th>Levered Firm Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$2,614</td>
<td>$0</td>
<td>$2,612</td>
</tr>
<tr>
<td>10%</td>
<td>$2,614</td>
<td>$96</td>
<td>$2,708</td>
</tr>
<tr>
<td>20%</td>
<td>$2,614</td>
<td>$191</td>
<td>$2,796</td>
</tr>
<tr>
<td>30%</td>
<td>$2,614</td>
<td>$287</td>
<td>$2,821</td>
</tr>
<tr>
<td>40%</td>
<td>$2,614</td>
<td>$382</td>
<td>$2,874</td>
</tr>
<tr>
<td>50%</td>
<td>$2,614</td>
<td>$478</td>
<td>$2,784</td>
</tr>
<tr>
<td>60%</td>
<td>$2,614</td>
<td>$573</td>
<td>$2,763</td>
</tr>
<tr>
<td>70%</td>
<td>$2,614</td>
<td>$669</td>
<td>$2,760</td>
</tr>
<tr>
<td>80%</td>
<td>$2,614</td>
<td>$765</td>
<td>$2,856</td>
</tr>
<tr>
<td>90%</td>
<td>$2,614</td>
<td>$860</td>
<td>$2,821</td>
</tr>
</tbody>
</table>

Unlevered Firm Value = Current Firm Value - Tax Savings from Existing Debt + Exp. Bankruptcy Cost

\( = (985+40*46.25) - 0.3656(985) + (0.2235)(0.25)(985+40*46.25-0.3656*985) \)
The current debt ratio is 35%; the probability of default is assumed to be 22.35% - interpolating between 12.20% and 32.50%.

Solving for unlevered firm value,
\[ X = 985 + 40 \times 46.25 - 0.365 \times 985 + 0.2235 \times 0.25 \times (985 + 40 \times 46.25 - 0.365 \times 985) = \$2,614 \]

**Problem 19**

a. The optimal debt ratio is so high because Reebok has a high EBIT relative to firm value.

\[ \frac{\text{EBIT}}{\text{Firm Value}} = \frac{420}{3343} = 0.1256 \]

If one adds back depreciation to this return, it is quite clear that at existing levels, Reebok has substantial cash flows to meet any debt payments, which in turn is pushing up the optimal debt ratio.

b. My primary concern with moving towards this optimal would lie in whether these operating cash flows are sustainable, given the volatility of the product market that Reebok serves.

**Problem 20**

**a. Optimal with WACC Approach**

<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>D/E Ratio</th>
<th>Beta</th>
<th>Cost of Equity</th>
<th>Cost of Debt</th>
<th>Cost of Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0%</td>
<td>0.75</td>
<td>12.01%</td>
<td>5.15%</td>
<td>12.01%</td>
</tr>
<tr>
<td>10%</td>
<td>11%</td>
<td>0.80</td>
<td>12.29%</td>
<td>5.15%</td>
<td>11.58%</td>
</tr>
<tr>
<td>20%</td>
<td>25%</td>
<td>0.87</td>
<td>12.65%</td>
<td>5.54%</td>
<td>11.23%</td>
</tr>
<tr>
<td>30%</td>
<td>43%</td>
<td>0.95</td>
<td>13.12%</td>
<td>5.75%</td>
<td>10.91%</td>
</tr>
<tr>
<td>40%</td>
<td>67%</td>
<td>1.07</td>
<td>13.74%</td>
<td>5.91%</td>
<td>10.61%</td>
</tr>
<tr>
<td>50%</td>
<td>100%</td>
<td>1.22</td>
<td>14.60%</td>
<td>6.54%</td>
<td>10.37%</td>
</tr>
<tr>
<td>60%</td>
<td>150%</td>
<td>1.46</td>
<td>15.90%</td>
<td>6.54%</td>
<td>10.28%</td>
</tr>
<tr>
<td>70%</td>
<td>233%</td>
<td>1.85</td>
<td>18.07%</td>
<td>7.48%</td>
<td>10.66%</td>
</tr>
<tr>
<td>80%</td>
<td>400%</td>
<td>2.64</td>
<td>22.40%</td>
<td>8.11%</td>
<td>10.97%</td>
</tr>
<tr>
<td>90%</td>
<td>900%</td>
<td>5.00</td>
<td>35.39%</td>
<td>8.74%</td>
<td>11.41%</td>
</tr>
</tbody>
</table>

Unlevered Beta = \[ \frac{1.26}{1 + (1 - 0.37)(237/11 \times 19.88)} = 0.75 \]

**b. Optimal with Return Differential Approach**

<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>Cost of Equity</th>
<th>ROE</th>
<th>Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>12.01%</td>
<td>11.09%</td>
<td>-0.92%</td>
</tr>
<tr>
<td>10%</td>
<td>12.29%</td>
<td>11.63%</td>
<td>-0.67%</td>
</tr>
<tr>
<td>20%</td>
<td>12.65%</td>
<td>12.01%</td>
<td>-0.64%</td>
</tr>
<tr>
<td>30%</td>
<td>13.12%</td>
<td>12.32%</td>
<td>-0.80%</td>
</tr>
<tr>
<td>40%</td>
<td>13.74%</td>
<td>12.57%</td>
<td>-1.17%</td>
</tr>
<tr>
<td>50%</td>
<td>14.60%</td>
<td>12.60%</td>
<td>-2.00%</td>
</tr>
<tr>
<td>60%</td>
<td>15.90%</td>
<td>12.79%</td>
<td>-3.11%</td>
</tr>
<tr>
<td>70%</td>
<td>18.07%</td>
<td>12.57%</td>
<td>-5.50%</td>
</tr>
<tr>
<td>80%</td>
<td>22.40%</td>
<td>12.41%</td>
<td>-9.99%</td>
</tr>
<tr>
<td>90%</td>
<td>35.39%</td>
<td>12.20%</td>
<td>-23.20%</td>
</tr>
</tbody>
</table>

Return on Assets = \[ 44 \times (1 - 0.37) / 250 = 11.09\% \]

**c. Differences in Optimal**

The two approaches provide different optimal debt ratios, since they are based upon different analyses. The WACC approach attempts to maximize firm value, given its assets. The return differential approach attempts to maximize the return differential to equity investors.

**Problem 21**

a. Market Value of Equity = 12.2 * 210 = \$2,562.00

Market Value of Debt = \$3,000.00

Debt Ratio = \[ \frac{3000}{3000 + 2562} = 53.94\% \]
b. Current Cost of Equity = 6.12% + 1.26 (5.5%) = 13.05%
   Current Cost of Capital = 13.05% (.4606) + 10.12% (1-.35) (.5394) = 9.56%
c. If the debt ratio is 30%,
   Unlevered Beta = 1.26/(1+0.65*(3000/2562)) = 0.72
   New Beta = 0.72 (1+0.65*(30/70)) = 0.92
   New Cost of Equity = 6.12% + 0.92 (5.5%) = 11.18%
   Cost of Capital = 11.18% (0.7) + 8.12% (1-.35) (.3) = 9.41%
   Change in Firm Value (assuming no growth) = (3000+2562)(.0956-.0941)/.0941 = $89
   New Value of Firm = 5562 + 89 = $5,651

d. Assuming that the 1995 operating income is depressed would lead us to conclude that the true optimal debt ratio would be higher than 30%.

Problems

22

a. Current Cost of Equity = 6% + 1.35 (5.5%) = 13.43%
   Cost of Capital = 13.43% (51/52.5) + 6.80% (1-.365) (1.5/52.5) = 13.13%
b. At a 70% debt ratio,
   Dollar value of Debt = 0.7 (52.5 billion) = $36.75
   Interest Expense = 36.75 *0.16 = $5.88
   The interest expense of $ 5.88 billion is greater than the earnings before interest & taxes ($ 3.4 billion)
   Effective tax rate to use in after-tax cost of debt = 3.4/5.88 *36.5% = 21.11%
c. Unlevered Beta = 1.35/(1+(1-.365)(1.5/51)) = 1.32
   Beta at 70% debt = 1.32 (1+(1-.365)(70/30)) = 3.28 ! We could use t=21.11%
   If debt has a beta of 0.6,
   Beta at 70% debt = 1.32(1+(1-.365)(70/30)) - 0.6 (1-.365) (70/30) = 2.39
   Cost of Capital at 70% debt,
   Cost of Equity = 6% + 3.28 (5.5%) = 24.04%
   Cost of Capital = 24.04% (0.3) + 16% (1-.2111) (0.7) = 16.05%
e. If Intel moves to a 70% debt ratio,
   Change in Firm Value = (.1313-.1605) (52.5)/.1605 = ($9.55)
   New Firm Value = 52.5 - 9.55 = $42.95
   High growth firms will have low optimal debt ratios, largely because their cash flows are insufficient to cover debt payments on higher debt ratios.

Problems

23

a. Value of Firm = 12.14 + 20.55 = 32.69 billion
   Unlevered Firm Value = Levered Firm Value - Tax Savings on existing debt + Exp Bankruptcy Cost
   = 32,690 - 12,140 (0.36) + (.0141) (.30) (32690-12140*0.36)
   = $28,439
b. If the debt ratio increases to 50%,
   New Firm Value = $ 28,439 + 0.5 (0.36) (New Firm Value) -(0.023)(0.30)(28439)
   X = 28439 + .18 X - 196
   Solving for X,
   New Firm Value = (28439-196)/.82 = $34,443
c. If NYNEX Plans to enter the entertainment business, which is riskier and more profitable, it might have to use a lower optimal debt ratio to reflect the business risk.

Problems

24

a. Estimated Market Value of Debt:
   Calculate present value of $ 80,000 for 5 years and $ 1 million at end of fifth year at 8.25%.
   PV of Debt = $990,084
Debt/Equity Ratio = 990,084/6,000,000 = 16.50%
Unlevered Beta for comparable firms = 1.05/(1+0.6*.25) = 0.91
Beta based upon D/E ratio of 16.50% = 0.91(1+0.6*.165) = 1.00
Cost of Equity = 7% + 5.5% = 12.5%
Cost of Capital = 12.5% (6000/6990) + 8.25% (1-.4)(990/6990) = 11.43%
b. New D/E Ratio = 1,990,084/6000000 = 0.331666667! Assumes debt is used to take projects
   New Beta = 0.91 (1+0.6*.33) = 1.09
   New Cost of Equity = 7% + 1.09*(5.5%) = 13.00%
   New Cost of Capital = 13% (6000/7990) + 9% (1-.4)(1990/7990) = 11.11%
   Change in Firm Value = (0.1143-0.1111)(6990)/0.1111 = $201
   New Firm Value = 6990 + 1000 + 201 = $8,191
c. Estimated Debt Ratio = 0.15+ 1.05 (500/6990) - 0.10 (1.00) = 12.51%
d. These analyses are based upon the assumption that the only risk is market risk. For a private firm, all risk matters, since the owners of these firms may not be well diversified.

Problem 25
It is true that the return on equity can be increased by borrowing money, since the after-tax cost of debt is likely to be lower than the return on assets (which is currently equal to the return on equity) of 12.75%. Borrowing money will also increase the cost of equity, however. The net effect will determine whether leverage will increase firm value. If the business risk of the firm is high (a high unlevered beta), then the increase in the cost of equity may exceed the increase in return on equity.
(1) Marginal Tax Benefit from borrowing $100 million = Tax Rate * Debt = 0.46 * $100 million = $46 million.

Note: This assumes that the $100 million in borrowing is invested in projects and not used to buy back stock.
Capital Structure Applications

To the degree that this can be accomplished by expropriating wealth from bondholders, this may not maximize firm value. It is also based upon the presumption that the ROA will be unaffected by the changes.