The Cost of Capital

March 15, 2004
Sources of capital

• Debt
  – Bank loans
  – Bond issues
  – Convertible bonds
  – Delaying payment on accounts payable

• Preferred equity

• Common equity
  – Common stock issues
  – Retained earnings
Effect of taxes on the cost of capital

• Interest payments are a deductible expense, but returns to stockholders (i.e., dividends, retained earnings) are not.

• => For every dollar of return paid on equity, the firm must earn $1/(1-\tau)$ dollars of income before taxes; for every dollar of interest paid, the firm need only earn one dollar of income before taxes.

• The effective ‘after-tax’ cost of debt $= (1-\tau) r_b$

• The after-tax cost of equity is $r_s$

• Question: Why don’t firms rely exclusively on debt to raise capital?
Other questions

• What determines the ‘capital structure’ of the company -- i.e., the proportions of the different types of financing that it uses?

• What other factors affect the relative cost of the different types of financing? For a given type of financing, do all projects and companies have access to capital at the same cost?
The relationship between investment risk and expected returns

- Each class of financing is perceived by investors to be associated with a different level of risk
  - Bonds
  - Preferred stock
  - Common stock

- The required rate of return is the minimum rate of return necessary to induce investors to buy or hold a security
  - For any given security, the required rate of return, \( r \), equals the riskless rate of interest, \( R_F \), plus a risk premium, \( \rho \)
    \[ r = R_F + \rho \]
The relationship between risk and required rate of return

Capital Market Line (CML)

\[ k = R_F + \alpha \sigma \]

= 6.0 + 0.5\sigma

\[ \rho_A = K_A - R_F \]

\[ \rho_B = K_B - R_F \]

\[ K_B = 11.0 \]

\[ K_A = 8.0 \]

\[ R_F = 6.0 \]

\[ \sigma_1 = 4\% \]

\[ \sigma_2 = 10\% \]

Source: Weston and Brigham
The effect of rising interest rate on the required rate of return

Required rate of return (%)

$\text{CML}_2: k = 8.0 + 0.5\sigma$

$\text{CML}_1: k = 6.0 + 0.5\sigma$

$k_{B2} = 13$

$k_{A2} = 10$

$R_{F2} = 8$

$R_{F1} = 6$

Source: Weston and Brigham

Nuclear Energy Economics and Policy analysis
The Effect of Changing Investor Attitudes on the Required Rate of Return

Source: Weston and Brigham

Nuclear Energy Economics and Policy analysis
Sources of risk

• Macroeconomic risks
  – Interest rates
  – Tax policies

• Industry-specific business risks
  – Technological uncertainties
  – Market uncertainties
  – Competitor uncertainties

• Firm-specific business risks
  – Managerial performance

• Financial risks
  – Effect of degree of financial ‘leverage’ (debt-to-equity ratio)
Effect of financial leverage on the cost of capital

Example (from Weston and Brigham):

Consider three firms in the same industry that are identical except for their financial policies.

Firm A: No debt (0% leverage)
Firm B: 50% debt finance
Firm C: 75% debt finance

<table>
<thead>
<tr>
<th>FIRM A</th>
<th>Total debt</th>
<th>Net worth of equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>$200</td>
<td></td>
</tr>
</tbody>
</table>

| Total assets | $200 | Total liabilities | $200 |

<table>
<thead>
<tr>
<th>FIRM B</th>
<th>Total debt (6%)</th>
<th>Net worth of equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$100</td>
<td>$100</td>
<td></td>
</tr>
</tbody>
</table>

| Total assets | $200 | Total liabilities | $200 |

<table>
<thead>
<tr>
<th>FIRM C</th>
<th>Total debt (6%)</th>
<th>Net worth of equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$150</td>
<td>$50</td>
<td></td>
</tr>
</tbody>
</table>

| Total assets | $200 | Total liabilities | $200 |
# Stockholder Returns under Various Leverage and Economic Conditions

**Economic Conditions**

<table>
<thead>
<tr>
<th>Economic Conditions</th>
<th>Very poor</th>
<th>poor</th>
<th>Indifference Level</th>
<th>Normal</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of return on assets before interest and taxes</td>
<td>2%</td>
<td>5%</td>
<td>6%</td>
<td>8%</td>
<td>11%</td>
<td>14%</td>
</tr>
<tr>
<td>Earnings before interest and taxes (EBIT)</td>
<td>$4</td>
<td>$10</td>
<td>$12</td>
<td>$16</td>
<td>$22</td>
<td>$28</td>
</tr>
</tbody>
</table>

**Firm A: Leverage Factor 0%**

<table>
<thead>
<tr>
<th>EBIT</th>
<th>$4</th>
<th>$10</th>
<th>$12</th>
<th>$16</th>
<th>$22</th>
<th>$28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less: Interest expense</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Taxable Income</td>
<td>$4</td>
<td>$10</td>
<td>$12</td>
<td>$16</td>
<td>$22</td>
<td>$28</td>
</tr>
<tr>
<td>Taxes (50%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Available to common stock</td>
<td>$2</td>
<td>$5</td>
<td>$6</td>
<td>$8</td>
<td>$11</td>
<td>$14</td>
</tr>
<tr>
<td>Percent return on net worth</td>
<td>1%</td>
<td>2.5%</td>
<td>3%</td>
<td>4%</td>
<td>5.5%</td>
<td>7%</td>
</tr>
</tbody>
</table>

**Firm B: Leverage Factor 50%**

<table>
<thead>
<tr>
<th>EBIT</th>
<th>$4</th>
<th>$10</th>
<th>$12</th>
<th>$16</th>
<th>$22</th>
<th>$28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less: Interest expense</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Taxable Income</td>
<td>$(2)</td>
<td>$4</td>
<td>$6</td>
<td>$10</td>
<td>$16</td>
<td>$22</td>
</tr>
<tr>
<td>Taxes (50%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(1)</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Available to common stock</td>
<td>$(1)</td>
<td>$2</td>
<td>$3</td>
<td>$5</td>
<td>$8</td>
<td>$11</td>
</tr>
<tr>
<td>Percent return on net worth</td>
<td>-1%</td>
<td>2%</td>
<td>3%</td>
<td>5%</td>
<td>8%</td>
<td>11%</td>
</tr>
</tbody>
</table>

**Firm C: Leverage Factor 75%**

<table>
<thead>
<tr>
<th>EBIT</th>
<th>$4</th>
<th>$10</th>
<th>$12</th>
<th>$16</th>
<th>$22</th>
<th>$28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less: Interest expense</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Taxable Income</td>
<td>$(5)</td>
<td>$1</td>
<td>$3</td>
<td>$7</td>
<td>$13</td>
<td>$19</td>
</tr>
<tr>
<td>Taxes (50%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(2.5)</td>
<td>.5</td>
<td>1.5</td>
<td>3.5</td>
<td>6.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Available to common stock</td>
<td>$(2.5)</td>
<td>$.5</td>
<td>1.5</td>
<td>3.5</td>
<td>6.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Percent return on net worth</td>
<td>-5%</td>
<td>1%</td>
<td>3%</td>
<td>7%</td>
<td>13%</td>
<td>19%</td>
</tr>
</tbody>
</table>

<sup>a</sup>The tax calculation assumes that losses are carried back and result in tax credits
Rate of return on net worth (after corporate income taxes)

Rate of return on assets (before corporate income taxes)

A: Debt/assets = 0 percent

B: Debt/assets = 50 percent

C: Debt/assets = 75 percent

Nuclear Energy Economics and Policy Analysis
The required return on equity increases with the leverage ratio (i.e., debt-to-equity ratio)
There is, in general, a degree of leverage at which the cost of capital is minimized.

Note: the more stable the industry is, the higher the optimal leverage ratio (i.e., the greater the use of debt)
Marginal cost of capital for a given firm*

At each stage, the capital structure is chosen to minimize the cost of capital

Complications:

1. Determination of optimal capital structure/marginal cost of capital curve is complex.
2. Effect of capital rationing. Firms may be unwilling to operate at the intersection:
   • Uncertainties in projections may cause firm to ‘play it safe’
   • Expectation of better investment opportunities in future years may cause firms to stop short of intersection point.