15  
Capital Structure: Basic Concepts

The Capital-Structure Question and The Pie Theory

The value of a firm is defined to be the sum of the value of its debt and the firm's equity.

\[ V = B + S \]

If the goal of the management of the firm is to make the firm as valuable as possible, the the firm should pick the debt-equity ratio that makes the pie as big as possible.

The Capital-Structure Question

There are really two important questions:

1. Why should the stockholders care about maximizing firm value? Perhaps they should be interested in strategies that maximize shareholder value.
2. What is the ratio of debt-to-equity that maximizes the shareholder's value?

As it turns out, changes in capital structure benefit the stockholders if and only if the value of the firm increases.

Financial Leverage, EPS, and ROE

Consider an all-equity firm that is considering going into debt. (Maybe some of the original shareholders want to cash out.)

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Debt</td>
<td>$0</td>
<td>$8,000</td>
</tr>
<tr>
<td>Equity</td>
<td>$20,000</td>
<td>$12,000</td>
</tr>
<tr>
<td>Debt/Equity ratio</td>
<td>0.00</td>
<td>2/3</td>
</tr>
<tr>
<td>Interest rate</td>
<td>n/a</td>
<td>8%</td>
</tr>
<tr>
<td>Shares outstanding</td>
<td>400</td>
<td>240</td>
</tr>
<tr>
<td>Share price</td>
<td>$50</td>
<td>$50</td>
</tr>
</tbody>
</table>

EPS and ROE Under Current Capital Structure

<table>
<thead>
<tr>
<th></th>
<th>Recession</th>
<th>Expected</th>
<th>Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$1,000</td>
<td>$2,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Interest</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net income</td>
<td>$1,000</td>
<td>$2,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>EPS</td>
<td>$2.50</td>
<td>$5.00</td>
<td>$7.50</td>
</tr>
<tr>
<td>ROA</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>ROE</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Current Shares Outstanding = 400 shares
### EPS and ROE Under Proposed Capital Structure

<table>
<thead>
<tr>
<th></th>
<th>Recession</th>
<th>Expected</th>
<th>Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$1,000</td>
<td>$2,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Interest</td>
<td>640</td>
<td>640</td>
<td>640</td>
</tr>
<tr>
<td>Net income</td>
<td>$360</td>
<td>$1,360</td>
<td>$2,360</td>
</tr>
<tr>
<td>EPS</td>
<td>$1.50</td>
<td>$5.67</td>
<td>$9.83</td>
</tr>
<tr>
<td>ROA</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>ROE</td>
<td>3%</td>
<td>11%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Proposed Shares Outstanding = 240 shares

### EPS and ROE Under Both Capital Structures

<table>
<thead>
<tr>
<th></th>
<th>All-Equity (Expected)</th>
<th>Expected</th>
<th>Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$1,000</td>
<td>$2,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Interest</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net income</td>
<td>$000</td>
<td>$1,360</td>
<td>$2,360</td>
</tr>
<tr>
<td>EPS</td>
<td>$2.50</td>
<td>$5.67</td>
<td>$9.83</td>
</tr>
<tr>
<td>ROA</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>ROE</td>
<td>3%</td>
<td>11%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Current Shares Outstanding = 400 shares

### Financial Leverage and EPS

- **Proposition I**: Firm value is not affected by leverage
  \[ V_L = V_U \]

- **Proposition II**: Leverage increases the risk and return to stockholders
  \[ r_s = r_0 + \left( \frac{B}{S_L} \right) \left( r_d - r_0 \right) \]
  - \( r_s \) is the interest rate (cost of debt)
  - \( r_d \) is the return on (levered) equity (cost of equity)
  - \( r_0 \) is the return on unlevered equity (cost of capital)
  - \( B \) is the value of debt
  - \( S_L \) is the value of levered equity

### Assumptions of the Modigliani-Miller Model

- Homogeneous Expectations
- Homogeneous Business Risk Classes
- Perpetual Cash Flows
- Perfect Capital Markets:
  - Perfect competition
  - Firms and investors can borrow/lend at the same rate
  - Equal access to all relevant information
  - No transaction costs
  - No taxes

### The MM Proposition I (No Taxes)

The derivation is straightforward:
- Shareholders in a levered firm receive
  \[ EBIT - r_d B \]
- Bondholders receive \( r_s B \)
- Thus, the total cash flow to all stakeholders is
  \[ (EBIT - r_d B) + r_s B \]

The present value of this stream of cash flows is \( V_L \)

Clearly
\[ (EBIT - r_d B) + r_s B = EBIT \]

The present value of this stream of cash flows is \( V_L \)

\[ V_L = V_U \]
The MM Proposition II (No Taxes)

The derivation is straightforward:

\[
\text{WACC} = \frac{B}{B+S} r_B + \frac{S}{B+S} r_S
\]

Then set \( r_{\text{WACC}} = r_0 \)

\[
\frac{B}{B+S} r_B + \frac{S}{B+S} r_S = r_0
\]

by sides both multiply

\[
\frac{B}{S} r_B + \frac{S}{S} r_S = r_0
\]

\[
\frac{B}{S} r_B + r_S = r_0 + (\frac{S}{S} - \frac{B}{S}) (r_0 - r_2)
\]

The Cost of Equity, the Cost of Debt, and the Weighted Average Cost of Capital: MM Proposition II with No Corporate Taxes

The MM Proposition I & II (with Corporate Taxes)

Proposition I (with Corporate Taxes)
- Firm value increases with leverage
  \( V_L = V_U + TC \) \( B \)

Proposition II (with Corporate Taxes)
- Some of the increase in equity risk and return is offset by interest tax shield

\[
r_2 = r_0 + (\frac{B}{S} - 1)(r_0 - r_B)
\]

\[
r_0 = \text{return on unlevered equity (cost of capital)}
\]

\[
r_B = \text{the interest rate (cost of debt)}
\]

\[
r_S = \text{return on equity (cost of equity)}
\]

\[
B = \text{the value of debt}
\]

\[
S = \text{the value of levered equity}
\]

The MM Proposition II (Corp. Taxes)

Start with M&M Proposition I with taxes:

\[
V'_L = V'_U + T_c B
\]

Since

\[
V'_U = S + B \Rightarrow S + B = V'_U + T_c B
\]

The cash flows from each side of the balance sheet must equal:

\[
S_T + B_T = V'_U + T_c B
\]

Divide both sides by \( S \)

\[
\frac{S_T}{S} = \frac{V'_U}{S} + \frac{B_T}{S} + \frac{T_c}{S} B
\]

Which quickly reduces to

\[
r_2 = \frac{B}{S} r_B + \frac{S}{S} r_2 = r_0 + (\frac{S}{S} - \frac{B}{S})(r_0 - r_2)
\]

The Effect of Financial Leverage on the Cost of Debt and Equity Capital with Corporate Taxes
Total Cash Flow to Investors Under Each Capital Structure with Corp. Taxes

All-equity firm

Leveled firm

The sum of the debt plus the equity of the levered firm is greater than the equity of the unlevered firm.

This is how cutting the pie differently can make the pie larger: the government takes a smaller slice of the pie!

Summary: No Taxes

In a world of no taxes, the value of the firm is unaffected by capital structure.

This is M&M Proposition I:

\[ V_L = V_U \]

Prop I holds because shareholders can achieve any pattern of payouts they desire with homemade leverage.

In a world of no taxes, M&M Proposition II states that leverage increases the risk and return to stockholders

\[ r_E = r_U + \frac{B}{S_L} \times (1 - T_c) \times (r_D - r_E) \]

Summary: Taxes

In a world of taxes, but no bankruptcy costs, the value of the firm increases with leverage.

This is M&M Proposition I:

\[ V_L = V_U + TC_B \]

Prop I holds because shareholders can achieve any pattern of payouts they desire with homemade leverage.

In a world of taxes, M&M Proposition II states that leverage increases the risk and return to stockholders

\[ r_E = r_U + \frac{B}{S_L} \times (1 - T_c) \times (r_D - r_E) \]

Prospectus: Bankruptcy Costs

So far, we have seen M&M suggest that financial leverage does not matter, or imply that taxes cause the optimal financial structure to be 100% debt.

In the real world, most executives do not like a capital structure of 100% debt because that is a state known as “bankruptcy”.

In the next chapter we will introduce the notion of a limit on the use of debt: financial distress.

The important use of this chapter is to get comfortable with “M&M algebra”.

4