Handout 16: Examples of Capital Budgeting with Leverage

Corporate Finance, Sections 001 and 002

We have shown that, under corporate taxes and no costs of financial distress, the value of the firm is the value if the firm were all equity financed, plus the present value of the tax shield. This principle also applies to calculating net present value. Here, we can say that the NPV of a project is the NPV if the project is all equity financed, plus the present value of the tax shield resulting from the project.

In practice, the adjustment to NPV is often made by adjusting the discount rate to take the tax shield into account. This is done using the weighted average cost of capital adjusted for taxes. Let T_C denote the corporate tax rate. Then

$$r_{\text{WACC}} = \frac{D}{D + E}(1 - T_C)r_D + \frac{E}{D + E}r_E$$

Intuitively, we reduce the cost of debt by $1 - T_C$, because the interest on the debt is tax-deductible for the corporation. In effect, the government "pays" a fraction T_C of the cost of debt.

- Example 1 – Using WACC

  Consider a project that costs $1 million and generates $95,000 each year in perpetuity. The riskiness of the project is the same as for the assets of the firm undertaking it. Suppose the equity beta $\beta_E = 0.75$, the riskfree rate $R_f = 0.05$, and the expected return on the market $\bar{R}_M = 0.15$. Suppose the debt of the firm is risk free so $r_D = 0.05$.

  Assume the firm is 40% debt and 60% equity. Assume debt is perpetual and the corporate tax rate $T_C = 25\%$. Should the firm do the project?

  Solution

  To take into account the tax shield, we discount at the WACC, adjusted for taxes. Note that because debt is riskfree, there are no costs of financial distress

associated with doing the project. We first need to find r_E. Using the CAPM

$$r_E = 0.05 + 0.75(0.15 - 0.05) = 0.125$$

Using the formula above,

$$r_{\text{WACC}} = (1 - 0.25)(0.05)(0.4) + (0.125)(0.6) = 0.09$$

Therefore
$$NPV = -1,000,000 + \frac{95,000}{0.09} = 55,555$$

so the firm should do the project.

Recall that in the case of no taxes and bankruptcy costs, capital structure was irrelevant in determining NPV. Once we incorporate taxes and bankruptcy costs, we can see this is no longer true. What would happen, for example, if the firm in the example above were financed with equity?

To solve this second problem, we need one more formula. In the case of no taxes and bankruptcy costs, r_E is related to the cost of capital if the firm were all-equity financed by the equation:

$$r_0 = \frac{E}{D+E} r_E + \frac{D}{D+E} r_D$$

where r_0 is the cost of capital if the firm were all-equity financed.

With taxes (assume for now that the firm has issued sufficiently little debt so there are no costs of financial distress), this formula becomes

$$r_0 = \frac{E}{(1-T_C)D+E} r_E + \frac{(1-T_C)D}{(1-T_C)D+E} r_D$$

A similar formula holds for beta

$$\beta_0 = \frac{E}{(1-T_C)D+E} \beta_E + \frac{(1-T_C)D}{(1-T_C)D+E} \beta_D$$

This is shown in footnote 18 of RWJ (page 412). We can use this formula to answer the question of what would happen if the firm were financed entirely with equity.

- Example 2 – <u>Unlevering Beta</u>

  Suppose the same numbers as above. Assume the riskiness of the project is the same as the riskiness of the firm overall, and that the firm is financed entirely with equity. Should the firm do the project?

  <u>Solution</u> We find the cost of capital if the firm is financed entirely with equity. Because debt is riskless, $\beta_D = 0$. Therefore,

  $$
  \begin{aligned}
  \beta_0 &= \frac{E}{(1 - T_C)D + E}\beta_E \\
  &= \frac{E}{(1 - T_C)D + E}\beta_E \\
  &= \frac{1}{(1 - T_C)(D/E + 1)}\beta_E \\
  &= \frac{1}{(1 - 0.25)(0.4/0.6 + 1)}(0.75) = 0.5
  \end{aligned}
  $$

  Using the CAPM,

  $$r_0 = 0.05 + 0.5(0.15 - 0.05) = .10$$

  Under all-equity financing:

  $$NPV = -1,000,000 + \frac{95,000}{0.10} = -50,000$$

  Therefore the firm should not undertake the project. Note: to find the cost of capital for the firm if it were all-equity, we found the β for the firm if it were all-equity. This is sometimes called "unlevering beta".