UNIVERSITY OF TORONTO

Fundamentals of Accounting and Finance (JRE 300)
Practical: Finance Lecture 5

1. **Business Cycles, Systematic Risk, and Cost of Equity**

Your firm operates in a procyclical industry — when the economy booms, your sales and earnings rise sharply, but in recessions they fall. The market returns 8% and the risk-free rate is 2%.

You are comparing two capital structures:

- Capital Structure A is 100% equity-financed. Its beta is 1.5.
- Capital Structure B has 50% debt and 50% equity, with interest payments fixed at $20 million per year (corresponding cost of debt is 3%).

Suppose a recession starts, and EBIT falls from $60 million to $30 million.

(a) Under which capital structure does the firm see a larger percentage drop in dividends? Calculate the percent drop in dividends as the economy enters a recession for each capital structure. Explain why this happens.

(b) Explain how this relates to equity beta. Why does adding debt increase the risk of equity?

(c) Use the Miller-Modigliani result to calculate the cost of equity for the firm under Capital Structure B.
Hint: what was the original cost of equity under Capital Structure A?

(d) What is the beta of the equity of the firm under Capital Structure B? Is this in line with your answer to part (b)?

(e) How would the firm's ability to finance future investments using retained earnings differ between Capital Structure A and Capital Structure B across the business cycle (meaning as the economy fluctuates between good times and recessions)?

Solution:

(a) Let's start when there is no recession. And note there are no taxes in this question.

- A: All of EBIT can go to dividends: $60 million.
- B: $40 million remains after interest payments.

When there is a recession:

- A: Now EBIT is only $30 million.
- B: Only $10 million is remaining after interest payments.

So under Capital Structure A the firm has a drop of $\frac{60-30}{60} = 50\%$, while under Capital Structure B the firm has a drop of $\frac{40-10}{40} = 75\%$. This is because when EBIT falls but the firm has debt, the debt must be paid back before shareholders can receive dividends.

(b) Equityholders are more exposed to the risk of a recession when the firm issues debt, as illustrated in the numerical example above in (a).

(c) The cost of equity of firm A can be calculated from the CAPM:

$$r_0 = r_f + \beta(r_m - r_f) = 2\% + 1.5 \times (8\% - 2\%) = 11\%$$

Then we can use the Modigliani-Miller equation:

$$r_E = r_0 + \frac{D}{E}(r_0 - r_D) = 11\% + \frac{1}{1}(11\% - 3\%) = 19\%$$

(d) Solving directly:

$$\begin{aligned} 19\% &= 2\% + \beta_{\text{equity}}(8\% - 2\%) \\ \beta_{\text{equity}} &= 2.83 \end{aligned}$$

This is in line with my answers to part (b): the equity beta is higher when the firm has leverage. As expected, the increased exposure to recession risk increases equity beta.

(e) Capital Structure A retains more earnings in good times and suffers smaller drops in retained earnings in bad times.

This shows that debt financing reduces the firm's ability to retain earnings across the cycle. Since retained earnings are an important source of internal financing (especially when external financing is costly or constrained), this puts Capital Structure B at a disadvantage when it comes to funding new projects, particularly during or after a downturn.

In short: higher leverage amplifies the cyclicality of available internal funds, which can limit flexibility for future investment.

2. **Project Financing and NPV**

A company is evaluating the construction of a new battery plant. The project requires an upfront investment of $300 million and will produce perpetual annual EBIT of $40 million. The corporate tax rate is 30% and the unlevered cost of capital is 10%.

(a) Calculate the NPV of the project under an all-equity financed structure.

The company instead considers financing the project through a capital structure that is equal parts debt and equity. The interest rate on the debt is 5% and the total debt outstanding would be $150 million.

(b) Calculate the new cost of equity under this capital structure.

(c) Compute the WACC under the new capital structure.

(d) Recalculate the NPV of the project under this financing plan using the WACC you calculated in part (c).

(e) Is there a real effect of choosing different financing streams? In finance, we use the term *real* to mean production-based outcomes. Hint: compare your answers to (a) and (d) and the implications for if the battery plant should be built.

Solution:

(a) The unlevered cost of capital is 10%, so using the perpetuity formula the NPV in millions is:

$$\text{NPV} = -300 + \frac{40 \times (1 - 0.30)}{0.10} = -20$$

(b) Under the new capital structure:

$$r_E = r_0 + \frac{D}{E} \times (1 - \tau_c) \times (r_0 - r_D) = 0.10 + \frac{1}{1} \times (1 - 0.30) \times (0.10 - 0.05) = 13.5\%$$

(c) The new WACC is

$$\text{WACC} = \frac{E}{E + D} \times r_E + \frac{D}{E + D} \times r_D(1 - \tau_c) = \frac{1}{2} \times 0.135 + \frac{1}{2} \times 0.05 \times (1 - 0.3) = 8.5\%$$

(d) Using the WACC from part (c), the NPV in millions is:

$$\text{NPV} = -300 + \frac{40 \times (1 - 0.30)}{0.085} = -300 + \frac{28}{0.085} = 29.41$$

(e) Yes, there is a real effect of financing. Under all equity, the project has a negative NPV. But the tax shield of debt creates enough value to make the project overall positive NPV when financed with a capital structure of equal parts debt and equity. The availability of debt financing allows the company to create value, producing batteries after the plant is built.

3. Capital Structure and Equity Beta

An unlevered firm has a beta of 0.9. The expected return on the market is 10% and the risk-free rate is 3%. There are no corporate taxes. The firm is considering levering up to a capital structure of 65% equity and 35% debt. The interest expense on debt is 4%.

(a) Calculate the firm's cost of equity when it is unlevered.

(b) Calculate the firm's new cost of equity under the levered capital structure.

(c) Why has the cost of equity increased? Explain this in terms of accounting fundamentals: what does the debt obligation mean about the likelihood of cash flows to equity holders? Focus especially on *economic downturns*.

(d) Based on your answer to (c), what do you expect to happen to the beta of the firm's equity after the firm levers up its capital structure? Explain in terms of *systematic risk*.

(e) Use the CAPM to calculate the new beta of the firm's equity after it has levered up. Does this align with your expected answer from (d)?

(f) What does the equity beta from your answer in (e) imply about the beta of the firm's debt? Hint: remember that the beta of an overall firm doesn't change as financing changes. Does the firm's debt beta make sense? Explain in terms of *systematic risk* and *financial distress*.

Solution:

(a) Using the CAPM:

$$r_0 = r_f + \beta(r_m - r_f) = 0.03 + 0.9 \times (0.10 - 0.03) = 9.3\%$$

(b) Using the Modigliani-Miller result:

$$r_E = r_0 + \frac{D}{E}(r_0 - r_D) = 0.093 + \frac{0.35}{0.65} \times (0.093 - 0.04) = 12.15\%$$

(c) The cost of equity increases because in an economic downturn, the firm is less likely to have earnings remaining after interest expense and taxes, meaning fewer dividends available to pay out to equity holders. The shareholders are therefore more exposed to systematic risk.

(d) Since the shareholders are more exposed to systematic risk, the beta of the stock should increase.

(e) From the CAPM with the new cost of equity, I confirm my answer from (d).

$$\begin{aligned} r_E &= r_f + \beta(r_m - r_f) \\ 0.1215 &= 0.03 + \beta(0.10 - 0.03) \\ \beta &= 1.31 \end{aligned}$$

(f) The beta of the firm stays constant (at 0.9) as the equity beta increases to 1.31.

$$\beta_{\text{Project}} = 0.65 \times \beta_{\text{equity}} + 0.35 \times \beta_{\text{debt}} \implies \beta_{\text{debt}} = 0.13$$

This is in line with my expectations. Corporate debt is still sensitive to the business cycle, as an economic downturn could lead to financial distress (inability to pay back debts), though I would expect this to be at a lower level (smaller beta) compared to equity.

4. Capital Structure and Equity Risk

A company is 100% equity-financed and its stock has a historical beta of 3.

(a) The president of the country in which the company is headquartered threatens to cause a recession, and the stock market is down 5% as a result. What is the expected change in the return of this company?

(b) What happens to the equity beta if the company decides to lever up to a capital structure of 75% equity, 25% debt? What would the expected change be in the return of the company after the President's announcement?

(c) What happens to the equity beta if the company decides to lever up to a capital structure of 25% equity, 75% debt? What would the expected change be in the return of the company after the President's announcement?

(d) If you were a shareholder in the company, which capital structure do you prefer of (a)-(c)? Hint: don't just look at the downside risk analyzed in (a)-(c).

Solution:

(a) Using the beta of 3:

$$\Delta R = \beta \times \Delta R_m = 3 \times (-5\%) = -15\%$$

The expected return change is **-15%**.

(b) The new equity beta is given by:

$$\beta_{new} = \beta_{old} \times \left(1 + \frac{D}{E}\right) = 3 \times \left(1 + \frac{0.25}{0.75}\right) = 4$$

New return change:

$$\Delta R = 4 \times (-5\%) = -20\%$$

(c) New equity beta:

$$\beta_{new} = 3 \times \left(1 + \frac{0.75}{0.25}\right) = 3 \times 4 = 12$$

New return change:

$$\Delta R = 12 \times (-5\%) = -60\%$$

(d) As a shareholder, the choice of capital structure depends on your risk tolerance and expected return preferences. While the higher debt leads to a higher expected stock price decline in times of economic uncertainty, the higher debt means higher beta, which means higher expected returns (over long horizons).

5. Capital Budgeting and CAPM

Recall the Capital Asset Pricing Model (CAPM):

$$\mathbb{E}[r_i] = r_f + \beta_i \mathbb{E}[r_m - r_f]$$

A company that is 75% equity financed and 25% debt financed. The corporate tax rate is 37.5%. The company's stocks have a β of 1.5, the risk-free rate is 4%, and the expected market risk premium is 6%. The yield on the company's corporate debt is 8%.

Recall that

$$\text{WACC} = \%\text{ equity} \times \text{cost of equity} + \%\text{ debt} \times \text{after-tax cost of debt}$$

(a) Calculate the company's cost of equity.

(b) Calculate the company's (after-tax) cost of debt.

(c) Calculate the company's weighted-average cost of capital (WACC).

The managers of the company are considering investing in a project that would cost \$5.25 million dollars up front, and then would pay back the following cash flows in the following years:

Year	Cash Flow
1	\$1,250,000
2	\$2,500,000
3	\$2,750,000

(d) If the project will be equity-financed, should the managers do the project?

(e) If the project will be debt-financed, should the managers do the project?

(f) If the project will be financed with the same debt-equity ratio as the firm, should the managers do the project?

(g) Explain why the results of how the project should be financed make sense, noting that the IRR of the project is 10.18%. Mention the terms *opportunity cost*, *equity-holders*, and *debt-holders*.

Solution:

(a) From the CAPM:

$$r_E = r_f + \beta \mathbb{E}[r_m - r_f] = 4\% + 1.5 \times 6\% = 13\%$$

(b)

$$\text{After-tax cost of debt} = r_D \times (1 - \tau_c) = 8\% \times (1 - 37.5\%) = 5\%$$

(c)

$$\text{WACC} = \frac{E}{E+D} \times r_E + \frac{D}{E+D} \times r_D(1 - \tau_c) = 75\% \times 13\% + 25\% \times 5\% = 11\%$$

(d)

$$\text{NPV} = 1{,}000{,}000 \times \left(-5.25 + \frac{1.25}{1+0.13} + \frac{2.5}{(1+0.13)^2} + \frac{2.75}{(1+0.13)^3} \right) = -\$247{,}832.44 < 0$$

Do not do the project.

(e)

$$\text{NPV} = 1{,}000{,}000 \times \left(-5.25 + \frac{1.25}{1+0.05} + \frac{2.5}{(1+0.05)^2} + \frac{2.75}{(1+0.05)^3} \right) = \$216{,}475.11 > 0$$

Do the project.

(f)

$$\text{NPV} = 1{,}000{,}000 \times \left(-5.25 + \frac{1.25}{1+0.11} + \frac{2.5}{(1+0.11)^2} + \frac{2.75}{(1+0.11)^3} \right) = -\$75{,}713.06 < 0$$

Do not do the project.

(g) Only the after-tax cost of debt is below the IRR, which means that debt is the only financing method that compensates the debtholders for their opportunity cost. The cost of equity is high (from the high β), so the high cost of equity means unleveraged or leveraged equity financing will not appropriately compensate equityholders for their opportunity cost.

