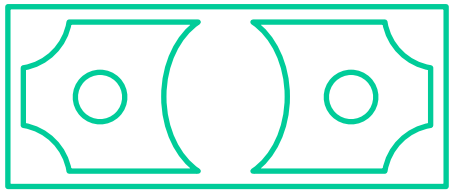
Chapter 8: Cost of Capital



Roadmap

- How much will it cost to raise capital?
- Type of capital and their “costs”:
  1. (Common) Equity
  2. Debt
  3. Preferred Stock
- Objectives:
  4. Estimate the firm’s cost of capital
  5. Customize to meet the specific risk of a new investment
- Put it together ➟ Weighted Average Cost of Capital
- Two components to risk: Operations vs. Financing

Weighted Average Cost of Capital

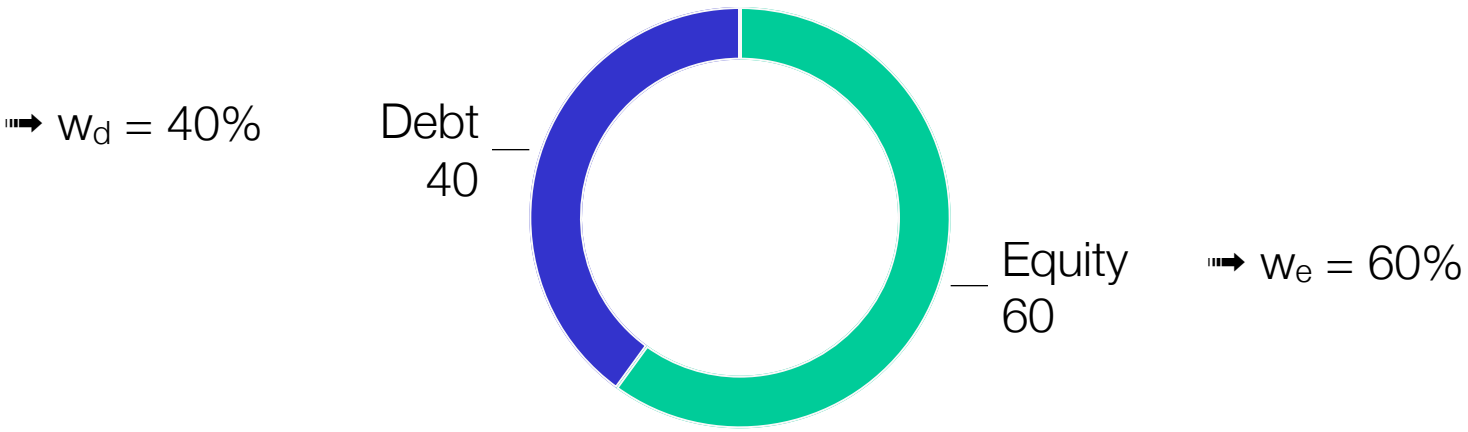
- "Cost of capital" = Required rate of return for capital budgeting

$$\mathbf{WACC = w_{equity}\, r_{equity} + w_{debt}\, r_{debt,after\text{-}tax}}$$

- Useful for cost of projects with the same risk as current operations (e.g., expansion)
- Can't use for projects that have different risk than the firm average.
  - Why? The firm will tend to take on riskier projects (which tend to have a higher expected return than the firm average)

Step 1: Weights

- Consider the firm as a portfolio of equity and debt.
- Use **value weights**:
  - W_e = Value of Equity / Total Value of Capital
  - W_d = Value of Debt / Total Value of Capital



In Practice…

- **Common Equity**: Use market values
- **Debt**: Use book values (easier to pull from balance sheet)
- E = *Price* x *Shares*
- D = Long term debt + Short/current long term debt (Bonds)
- TA = D + E

$$\mathbf{w_e = E / TA}$$

$$\mathbf{w_d = D / TA}$$

Costs of Capital

- Costs of equity and debt
  - Estimated using market data
  - Historical vs. current data
    - Current where possible and sensible
    - Historical if it provides the best estimate

Cost of Equity (Common Stock)

- CAPM: $\mathbb{E}[r_i] = r_f + \beta_i \times (\mathbb{E}[r_m] + r_f)$
- Note: r_e is not ROE!
- Alternative to the CAPM:
  - DDM (for example, constant dividend growth)
  - Fama-French, Arbitrage Pricing Theory (similar to CAPM)

Estimating the Risk-Free Rate

- Should reflect the “average” shareholder's time horizon
- Most shareholder’s are long-term investors (e.g., pensions)
- Standard choice is 10-year Treasury Note

Estimating the Market Risk Premium

- Recall, MRP = r_m - r_f
- Forecast a premium? Requires an estimate of the market!
- Use historical market risk premium as a forecast.
  - What has the risk premium been on average?
  - Assumes future will be similar to the past.
- Historical range: 3% to 9% per year.

Estimating the Beta

- Recall, beta is the regression coefficient ($r_i = a + \beta \times r_m$).
- It measures the "sensitivity" of firm returns to the market return.
- Can estimate from historical return data (e.g., monthly returns of firm and S&P 500).
- Beta estimates are noisy (think Activity 14), and the firm's risk can change over time.
- Trade-off between using more data and using recent data.

Cost of Debt

- Yield-to-Maturity (YTM) on existing debt:
- Measures the actual cost of issuing similar debt.
- What if the project changes the firm's risk?
- Theoretically, YTM is the discount rate that sets the present value of the bond's cash flows to the current price:
  - [PV] = price
  - [FV] = face value
  - [N] = remaining coupons
  - [PMT] = coupon payment
  - [CPT] [I/Y] ➟ YTM (careful—what if its a semiannual bond?)
- In practice, look up on FINRA.org.

Debt Tax Advantage

- Pre-tax cost of debt is r_d, but we get to use pre-tax income to pay bondholders.
- We get to subtract interest payments from our income before calculating tax, reducing the tax bill.
- Without debt, tax bill is EBT x τ
- **With debt**, tax bill is (EBT - D x r_d) x τ
- Thus, after-tax income is D x r_d x τ higher ➟ The cost of debt is D x r_d - D x r_d x τ = D x r_d x (1 - τ) ➟ $r_{d,after\text{-}tax} = r_d (1 - \tau)$

Example

	Unlevered Firm	Levered Firm
EBIT	1000	1000
Interest ($1000 @ 8%)	0	80
Pre-tax Income	1000	920
Tax (@34%)	340	312.80
Net Income	660	607.20
Total Income	0 + 660	80 + 607.20 = 687.20

- The extra $27.20 is 34% of the $80 interest payment.
- The effective tax rate is 8% x (1 - 0.34).

Project-specific Cost of Capital

Beta Decomposition

- Two components of risk:
  - **Operating (Business) Risk**
  - **Financial Risk**
- Business risk is caused by inherent covariance of business with the market.
- Financial risk is caused by leverage.
  - Leverage magnifies ROE mechanically, which leads to a higher covariance.

Beta Decomposition

- Beta is a measure of firm risk, so it must reflect both parts.
- Let β_A be the beta of the firm's capital (i.e., equity *and* debt)—this measures the firm's *overall* risk.
- Let β_e and β_d be the betas of the firm's equity and debt, respectively.
- From the portfolio property of beta we know that

$$\beta_A = w_e\beta_e + w_d\beta_d$$

- Rearrange to find

$$\beta_e = \beta_A + (\beta_A - \beta_d) \times (D/E)$$

Beta Decomposition with Taxes

- With taxes (and $\beta_d = 0$), the equation becomes

$$\beta_e = \beta_A \, (1 + (1 - \tau) \text{ x } D/E)$$

- Setting $\beta_d = 0$ is the standard assumption for this class, but if $\beta_d > 0$, the equation becomes

$$\beta_e = \beta_A + (\beta_A - \beta_d)(1 - \tau)(D/E)$$

Levered and Unlevered Beta

- To add the impact of leverage to the business risk ("levering" beta), use the formula

$$\beta_e = \beta_A \, (1 + (1 - \tau) \times D/E)$$

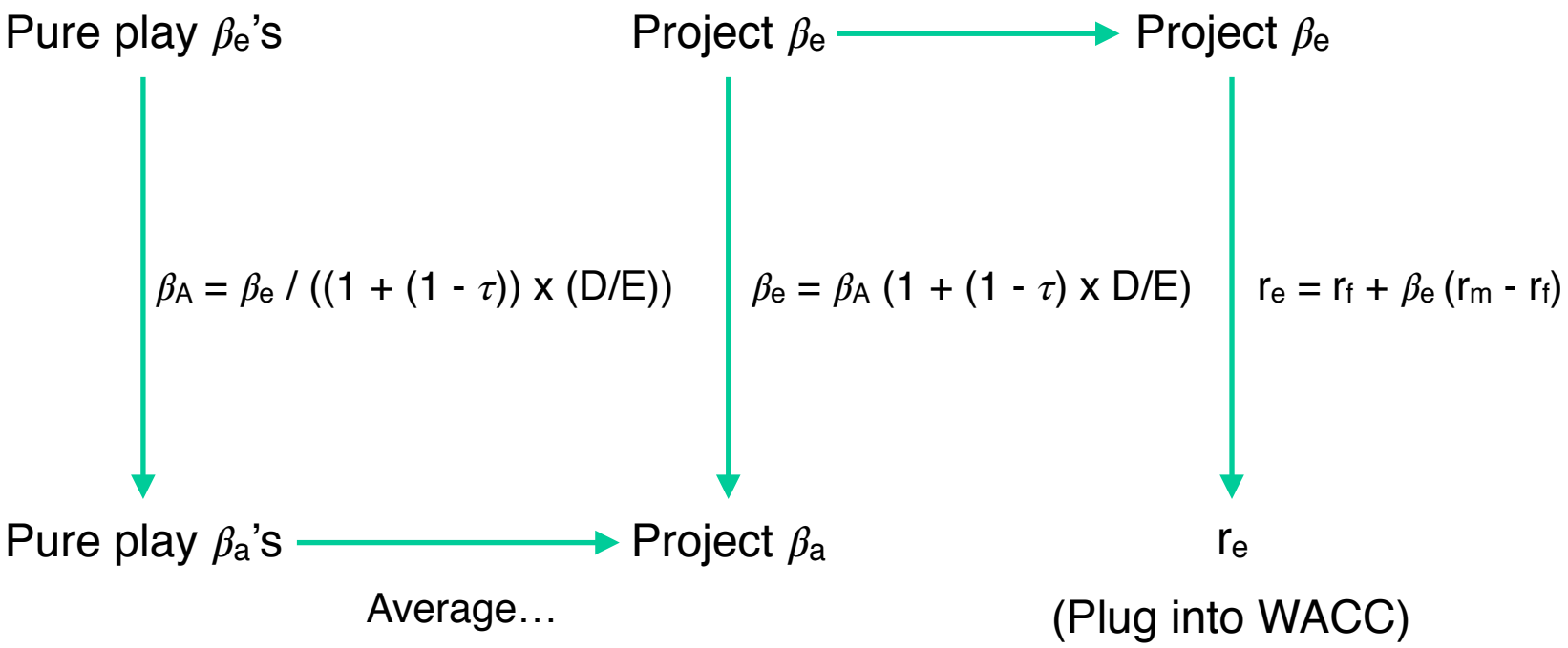
- To find the pure business risk ("unlevering" beta), rearrange

$$\beta_A = \beta_e \, / \, ((1 + (1 - \tau)) \times (D/E))$$

Finding WACC for a Project

- As CFO of Amtrak you are deciding whether to build an airline division. You estimate the new division will return 17% (after-tax) on invested capital. The new division will have the same business risk as other airlines. How to find the project-specific WACC?
- **Basic Steps**:
  1. Find firms that are similar to the proposed division ("pure plays").
  2. Calculate the business risk for each pure play.
  3. Calculate the average business risk across pure plays.
  4. Incorporate the planned project financing (leverage).
  5. Plug into the CAPM to find cost of equity and use to calculate the WACC.

Finding the Project Beta



Using Pure Plays

Comparable Firm	Equity Beta	Leverage (D/E)	Asset Beta
A	1.01	59.1%	0.746
B	0.97	56.3%	0.725
C	0.68	47.8%	0.528
D	0.65	73.8%	0.451
E	0.56	32.8%	0.468
Average			0.584

- (Assume the tax rate is 40%)
- The average unlettered beta of 0.584 is our best guess of the business risk inherent to an airline.

Finding WACC for a Project

- Assume the project will use 20% debt financing.
- The debt-to-equity ratio is 25% (20% / 80%).
- Thus, the levered beta for the project is

$$\beta_e = \beta_A (1 + (1 - \tau) \times D/E) = 0.584(1 + 0.6 \times 0.25) = 0.671$$

- Assume r_f = 6.98% and $r_m - r_f$ = 7% ➟ r_e = 6.98% + 0.671 x 7% = 11.7%.
- Interpretation: “The required return on an airline that is financed with 20% debt is 11.7%.”

Finding WACC for a Project

- Assume Amtrak has debt outstanding with a YTM = 7.74%.
- If the tax rate is 40%, then the after-tax cost of debt is 7.74% (1 - 0.4) = 4.644%.
- Putting it all together:

$$WACC_{project} = 0.80(11.7\%) + 0.20(4.644\%) = 10.3\%$$

- **Decision**: The Airline division has a higher expected return (17%) than its required return (10.3%)—start the airline.