



333-201 Business Finance

Dr Cesario MATEUS

PhD in Finance

Senior Lecturer in Finance and Banking

Room 219 A – Economics & Commerce Building

8344 – 8061

c.mateus@greenwich.ac.uk



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Lecture 17:

Capital Budgeting / Project Evaluation 4

Capital Budgeting IV

- the weighted average cost of capital
- Estimate the weighted average cost of capital
- Use the weighted average cost of capital in capital budgeting
- Examine the limitations of the weighted average cost of capital

The Weighted Average Cost of Capital

- The weighted average cost of capital (WACC or k_0) is the benchmark required rate of return used by a firm to evaluate its investment opportunities
 - The discount rate used to evaluate projects of **similar risk to the firm**
- It takes into account **how** a firm finances its investments
 - How much debt versus equity does the firm employ?
- The WACC depends on...
 - Qualitative factors
 - The market values of the alternative sources of funds
 - The market costs associated with these sources of funds

Estimating the WACC

- The main steps involved in the estimation of the WACC are...
 - Identify the financing components
 - Estimate the current (or market) values of the financing components
 - Estimate the cost of each financing component
 - Estimate the WACC
- We will consider each step for typical financing components

Identify the Financing Components

- Debt

- Identify all externally supplied debt items
- Do not include creditors and accruals as these costs are already included in net cash flows

- Ordinary shares

- Obtain number of issued shares from the balance sheet
- Do not include reserves and retained earnings

- Preference shares

- Obtain number of issued shares from the balance sheet

Valuing the Financing Components

- Use market values and **not** book values
- Value coupon paying debt using the following pricing relation (see Lecture 3)

$$P_0 = \frac{C_1}{(1+k_d)} + \frac{C_2}{(1+k_d)^2} + \dots + \frac{C_n}{(1+k_d)^n} + \frac{F_n}{(1+k_d)^n}$$

$$P_0 = \sum_{t=1}^n \frac{C_t}{(1+k_d)^t} + \frac{F_n}{(1+k_d)^n}$$

where P_0 = Market price of the debt security
 C_t = Periodic interest payment on debt in period t
 k_d = Required rate of return on debt

Valuing Long Term Debt

Example: BLD Ltd has 10,000 bonds outstanding and each bond has a face value of \$1,000 with two years remaining to maturity. The bonds pay coupons (or interest) at a rate of 10% p.a. every six months. If the market interest rate appropriate for the bond is 15% p.a., what is the current price of each bond? What is the total market value of debt in BLD Ltd's capital structure?

Valuing Long Term Debt

- Coupon (or interest) payments are made every six months
- Number of payments, $n = 4$, semi-annual payments
- Annual interest payments = $0.10(1000) = \$100.00$
 - So, semi-annual interest payments = $\$50.00$
- Repayment of principal at the end of year 2 = $\$1000.00$
- Required return on debt, $k_d = 15\%$ p.a.
- So, semi-annual required return on debt, $k_d = 7.5\%$

Valuing Long Term Debt

The price of the bond is...

$$P_0 = \frac{50}{(1.075)^1} + \frac{50}{(1.075)^2} + \frac{50}{(1.075)^3} + \frac{1050}{(1.075)^4}$$

$$P_0 = \$916.27$$

- So, total value of debt = $10000(916.27) = \$9,162,700$
- **Note:** As the coupon rate is lower than the market rate, the price is less than the face value, that is, the bond is selling at a **discount** to face value
 - If the coupon rate is greater than the market rate, the price would be at a **premium** to face value

Valuing Ordinary Shares

- **Example:** ABC Ltd has 300,000 shares on issue which each have a par value of \$1.00. If the shares are currently trading at \$3.50 each what is the total market value of ABC's ordinary shares?
- There are 300,000 shares on issue with a market value of \$3.50 per share
- Market value of equity = $300000 \times 3.50 = \$1,050,000$
 - The par (or book) value of shares is **not** relevant here

Valuing Preference Shares

- Preference shares pay a fixed dividend at regular intervals
- If the shares are non-redeemable, then the cash flows represent a perpetuity and the market value can be computed as...

- $P_0 = D_p / k_p$

Where

P_0 = The current market price

D_p = Value of the periodic dividend

k_p = Required return on preference shares

Valuing Preference Shares

- Example: Assume the preference shares of XYZ Ltd pay a dividend of \$0.40 p.a. and the cost of preference shares is 10% p.a. What is the price of the preference shares? If XYZ Ltd has 500,000 preference shares outstanding, what is the market value of these shares?
- The cash flows from the preference shares are...
 - $D_p = \$0.40$ per share
 - So, $P_0 = 0.40/0.10 = \$4.00$
 - Market value of shares = $500000 \times 4.00 = \$2,000,000$

Estimating the Costs of Capital

- The costs of a firm's financing instruments can be obtained as follows...
 - Use observable market rates - may need to be estimated
 - Use effective annual rates
 - For the cost of debt use the market yield
- Focus here is on the costs of debt, ordinary shares and preference shares
 - **Note:** We ignore the complications of flotation costs and franking credits associated with dividends (sections 15.5.3 and 15.5.5 of the text)

Cost of Debt

- **Example:** The bonds of ABD Ltd have a face value of \$1,000 with one year remaining to maturity. The bonds pay coupons at the rate of 10 percent p.a. If the current market price of the bonds is \$1,018.50, what is the firm's cost of debt?
- The annual interest (coupon) paid on the debt is...
 - $1000 \times 0.10 = \$100$
- So, $1018.50 = (1000 + 100)/(1 + k_d)$
- $k_d = (1100/1018.50) - 1 = 8.0\%$

Cost of Ordinary Shares

It is common to use CAPM to estimate the cost of equity capital, where the cost of equity is...

$$k_e = r_f + [E(r_m) - r_f]\beta_e$$

where $E(r_m) - r_f$ = Expected market risk premium

r_f = Risk free rate

β_e = Equity beta

- Note that the equity beta is the estimate of the firm's relative “risk” compared to movements in the market portfolio
 - The market risk premium is typically estimated using historical market data
 - The riskfree rate is typically based on the long term government bond rate

Cost of Ordinary Shares

Example: Assume that the risk free rate is 6 percent, the expected market risk premium is 8 percent and the equity beta of XYW Ltd's equity is 1.2. What is the firm's cost of equity capital?

Using the CAPM, we have...

$$\begin{aligned} \diamond k_e &= r_f + [E(r_m) - r_f]\beta_e \\ \diamond k_e &= 0.06 + 0.08 \times 1.2 = 15.6\% \end{aligned}$$

Note: Can also use the dividend discount models covered in Lecture 4 (but not commonly used by managers...)

$$\begin{aligned} \diamond P_0 &= D_1 / (k_e - g) \\ \diamond \text{So, } k_e &= D_1 / P_0 + g \end{aligned}$$

Cost of Preference Shares

- Recall that, $P_0 = D_p/k_p$
- Thus, $k_p = D_p/P_0$
- **Example:** The preference shares of DBB Ltd pay a dividend of \$0.50 p.a. If the preference shares are currently selling for \$4.00 per share, what is the cost of these shares to the firm?
- The cost of preference shares is given as...
$$k_p = D_p/P_0$$

$$\text{So, } k_p = 0.50/4.00 = 12.5\%$$

Weighted Average Cost of Capital

The weighted average cost of capital (k_o) uses the cost of each component of the firm's capital structure and weights these according to their relative market values

Assuming that only debt and equity are used, we have...

$$k_o = k_d(D/V) + k_e(E/V)$$

where k_d = Cost of debt

k_e = Cost of equity

D = Market value of debt

E = Market value of equity

$V = D + E$

Weighted Average Cost of Capital

Assuming that preference shares are used as well as debt and equity...

$$k_o = k_d(D/V) + k_e(E/V) + k_p(P/V)$$

where P = Market value of preference shares

k_p = Cost of preference shares

$V = D + E + P$

- Be careful of rounding errors in initial calculations
- Be careful to work in consistent terms
 - Calculations in percentages versus decimals
- Check your answers with some common sense logic...

$$\diamond k_e > k_p > k_d > k_d(1 - t_c) \text{ (Why?)}$$

Taxes and the WACC

- Under the classical tax system...
 - Interest on debt is tax deductible
 - Dividends have no tax effect for the firm
- The after-tax cost of debt, $k'_d = (1 - t_c) k_d$
where t_c corporate tax rate
- The cost of equity (k_e) is unaffected
- The after-tax WACC is defined as...

$$k_o = k_d(1 - t_c)(D/V) + k_e(E/V) \quad \text{and}$$

$$k_o = k_d(1 - t_c)(D/V) + k_e(E/V) + k_p(P/V)$$

Calculating and Using the WACC

Example: You are given the following information for BCA Ltd. Note that book values are obtained from the firm's balance sheet while market values are based on market data.

The firm's marginal tax rate is 30%. Estimate the firm's before-tax and after-tax weighted average costs of capital

	Book values	Market values	Market costs
Bonds	\$30,000,000	\$50,000,000	8.0%
Preference shares	\$10,000,000	\$20,000,000	10.0%
Ordinary shares	\$60,000,000	\$80,000,000	14.0%
Total	\$100,000,000	\$150,000,000	

Calculating and Using the WACC

- Before-tax weighted average cost of capital
 - WACC weights are based on market values so book values are not relevant

$$k_o = k_d(D/V) + k_e(E/V) + k_p(P/V)$$
$$V = D + E + P$$

	Market values	Weights	Market costs	Weights×Costs
Bonds	\$50,000,000	0.333	8.0%	2.67%
Preference shares	\$20,000,000	0.133	10.0%	1.33%
Ordinary shares	\$80,000,000	0.533	14.0%	7.47%
Total	\$150,000,000	1.000		11.47%

Note: Weight in bonds, $D/V = 50/150 = 0.333$, and so on

- Before-tax cost of capital = **11.47%**

Calculating and Using the WACC

The after-tax cost of capital requires the after tax cost of debt

$$k'_d = k_d (1 - t_c)$$

$$k'_d = 0.08(1 - 0.30) = 5.6\%$$

	Market values	Weights	After tax market costs	Weights×Costs
Bonds	\$50,000,000	0.333	5.6%	1.87%
Preference shares	\$20,000,000	0.133	10.0%	1.33%
Ordinary shares	\$80,000,000	0.533	14.0%	7.47%
Total	\$150,000,000	1.000		10.67%

- **Note:** Weight in bonds, $D/V = 50/150 = 0.333$, and so on
 - After-tax cost of capital = 10.67%

Calculating and Using the WACC

Example: Assume that a firm is financed by 60 percent equity, 10 percent preference shares and the remainder by debt. The corporate tax rate is 30 percent. The costs of capital for debt, preference and equity capital are 10 percent, 12 percent and 15 percent, respectively. What is the firm's after-tax weighted average cost of capital? If the firm is considering three independent projects with IRRs of 10%, 12% and 14% which of these projects should it accept?

Calculating and Using the WACC

$$k_o = k_d(1 - t_c)(D/V) + k_p(P/V) + k_e(E/V)$$

The debt ratio is...

$$D/V = 1 - 0.60 - 0.10 = 0.30$$

$$k_o = [0.10 \times (1 - 0.30) \times 0.30] + (0.12 \times 0.10) + (0.15 \times 0.60)$$

$$k_o = 12.3\%$$

- The firm should accept all projects with an IRR greater than the cost of capital (why?)
 - Accept the project with an IRR of 14%
 - Reject the projects with IRRs of 10% and 12%

Calculating and Using the WACC

- **Example:** ASL Ltd has a debt-to-equity ratio of 25%. The cost of debt is 8 percent and the corporate tax rate is 30 percent. If the after-tax weighted average cost of capital is 20 percent, what is the firm's cost of equity?
- The cost of equity can be obtained using the weighted average cost of capital relationship...

$$k_o = k_d(1 - t_c)(D/V) + k_e(E/V)$$

- Note that we're given a D/E ratio of 0.25
 - We need the $D/V = D/(D + E)$ ratio

Calculating and Using the WACC

$D/E = 0.25$ implies...

$$D = 0.25(E)$$

$$\text{So, } D/(D + E) = 0.25(E)/[0.25(E) + E] = 0.25(E)/1.25(E)$$

$$D/(D + E) = 0.20 \text{ and } E/(D + E) = 1 - 0.20 = 0.80$$

The weighted average cost of capital is...

$$k_0 = 0.20 = 0.08(1 - 0.30)(0.20) + k_e(0.80)$$

$$\text{So, } k_e = [0.20 - 0.08(1 - 0.30)(0.20)]/(0.80)$$

$$k_e = 23.6\%$$

Limitations on Using the WACC

- **Recall:** The weighted average cost of capital is the discount rate that is used to evaluate projects of similar risk to the firm
- The WACC cannot be used in the following situations...
 - If the project alters the operational (or business) risk of the firm
 - If the project alters the financial risk of the firm by dramatically altering its capital structure
- Examples of risk altering projects?
- What should the firm do if the WACC cannot be used?

Key Concepts

- The weighted average cost of capital is the discount rate that is used to evaluate projects of similar risk to the firm
- There are four main steps involved in the estimation of the weighted average cost of capital
 - Identify the financing instruments
 - Estimate the current (or market) values of the financing components
 - Estimate the cost of each financing component
 - Estimate the weighted average cost of capital
- The WACC cannot be used to evaluate projects that alter the business or financial risks of the firm

Key Relationships/Formula Sheet

Price of debt: $P_0 = \sum_{t=1}^n \frac{C_t}{(1 + k_d)^t} + \frac{F_n}{(1 + k_d)^n}$

Price of preference shares: $P_0 = D_p/k_p$

Cost of equity: $k_e = r_f + [E(r_m) - r_f]\beta_e$

Cost of preference shares: $k_p = D_p/P_0$

Before-tax weighted average cost of capital

❖ $k_o = k_d(D/V) + k_e(E/V)$

❖ $k_o = k_d(D/V) + k_e(E/V) + k_p(P/V)$

After-tax weighted average cost of capital

❖ $k_o = k_d(1 - t_c)(D/V) + k_e(E/V)$

❖ $k_o = k_d(1 - t_c)(D/V) + k_e(E/V) + k_p(P/V)$