Week 9: FNCE10002 Principles of Finance

POSTERA CRESCAM LAUDE

THE UNIVERSITY OF MELBOURNE

Capital Budgeting II

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9. Capital Budgeting II

1. Examine various issues related to the capital budgeting decision
2. Define and estimate the weighted average cost of capital
3. Use the weighted average cost of capital in capital budgeting
4. Examine the limitations of the weighted average cost of capital

Required Readings: Weeks 9 – 10

- *Week 9*
  - GRAH, Ch. 10 and Ch. 11
- *Week 10*
  - GRAH, Ch. 13 (Sec 13.1 – 13.3)

9.1 Issues in Cash Flow Estimation

- Timing of cash flows
  - The exact timing of project cash flows can affect the valuation of a project
  - The simplifying assumption made is that the net cash flows occur at the *end of a period*
- Financing charges
  - Cash flows relating to *how* the project is to be financed are *excluded* from the analysis
  - A project's evaluation should be made *independently* of how it will be financed
  - Note that the required rate of return (or hurdle rate) used to evaluate the project represents the rate of return required by shareholders, debtholders and other securityholders and should reflect these financing costs
  - *Does this make sense?*

Issues in Cash Flow Estimation

- Incremental cash flows
  - Only cash flows that *change* if the project is accepted are relevant in evaluating a project
  - Need to be careful with sunk costs and fixed overhead costs
- Sunk costs
  - These costs are *not* included as they have been incurred in the past and will *not* be affected by the project's acceptance or rejection
- Fixed overhead costs
  - Overhead costs are typically allocated by management to firm's divisions. For example, administrative costs incurred by the head office and allocated to divisions
  - If the costs do *not* vary with the decision to take the project they should be ignored

Issues in Cash Flow Estimation

- Net working capital (*NWC*)
  - *NWC* = Current assets – Current liabilities
  - *NWC* = Cash + Inventory + Account receivables – Account payables
- The *change* in net working capital is defined as...
  - $\Delta NWC = NWC_t - NWC_{t-1}$
- An *increase* in net working capital is a cash *outflow* and is an *incremental cost* associated with the project (e.g., an increase in inventory or a reduction in accounts payable that are being paid off by the company)
- A *decrease* in net working capital is a cash *inflow* associated with the project (e.g., sale of inventory or a loan from suppliers)

Issues in Cash Flow Estimation

- Taxes and tax effects
  - Taxes need to be included where they have an effect on the net cash flows generated by a project
  - Taxes have *three* main effects on net cash flows
    - Corporate income taxes
    - Depreciation tax shield
    - Taxes on disposal of assets
- Corporate income taxes
  - Corporate taxes should be included as a cash outflow
  - After-tax cash flow = Before-tax cash flow × $(1 - t_c)$
  - t_c = The effective corporate tax rate (*Note:* The text uses T_c)

Issues in Cash Flow Estimation

- Depreciation tax savings or depreciation tax shield
  - Depreciation itself is *not* an operating expense and is excluded from the net cash flows
  - However, depreciation affects net cash flows as it *decreases* the taxes payable due to the depreciation tax shield
  - Depreciation tax savings (or shield) = t_c × Depreciation expense

Issues in Cash Flow Estimation

- Salvage (or scrap) value of assets
  - The salvage (or scrap) value of assets needs to be taken into account *after taxes*
  - Taxes are payable when an asset is sold for *more* than its book value
  - There is a tax saving when an asset is sold for *less* than its book value as the loss can be offset against the firm's taxable income
  - Book value = Acquisition cost – Accumulated depreciation
  - Gain (or loss) = Disposal value – Book value
    - Taxes payable of gain = $t_c \times$ Gain on sale
    - Tax saving on loss = $t_c \times$ Loss on sale

Issues in Cash Flow Estimation

- The incremental net after-tax cash flows (or free cash flows) are defined as…
- C_{t} =Operating revenues in time t, R_t

  minus

  Operating costs in time t, OC_t

  minus

  Taxes paid in time t, $(R_t - OC_t - D_t)t_{\text{c}}$

  - *Note:* D_{t} = Depreciation expense in time t
- We also need to take into account…
  - The initial and future investment outlays, I_0 and I_{t}
  - Changes in net working capital, ΔNWC_0 and/or ΔNWC_{t}
  - After-tax salvage (or scrap) value, SV_{t}

Issues in Cash Flow Estimation

- The net after-tax cash flows from a project are…
- $C_{\mathrm{t}} = R_t - OC_t - Taxes_{\mathrm{t}}$
- $C_{\mathrm{t}} = R_t - OC_t - (R_t - OC_t - D_t)t_{\mathrm{c}}$
- $C_{\mathrm{t}} = (R_t - OC_t)(1 - t_{\mathrm{c}}) - (-D_t)t_{\mathrm{c}}$
- $C_{\mathrm{t}} = (R_t - OC_t)(1 - t_{\mathrm{c}}) + t_{\mathrm{c}}D_t$
- *Note:* Depreciation expense is not an operating expense but it affects the net cash flows via the depreciation tax shield, $t_{\mathrm{c}}D_t$

Issues in Cash Flow Estimation

- Alternatively, we can start with the net operating income [that is, $(R_t - OC_t - D_t)(1 - t_c)$] and add back depreciation (which is a non-operating expense) to get the net after-tax cash flows as…
- $C_t = (R_t - OC_t - D_t)(1 - t_c) + D_t$
- $C_t = (R_t - OC_t)(1 - t_c) - D_t(1 - t_c) + D_t$
- $C_t = (R_t - OC_t)(1 - t_c) - D_t - (-D_t t_c) + D_t$
- $C_t = (R_t - OC_t)(1 - t_c) + t_c D_t$

Issues in Cash Flow Estimation

	Year 0	*Years 1 – n*	*Year n*
Incremental earnings			
Sales revenues		R_t	
Operating costs*		OC_t	
Depreciation		D_t	
EBIT*		$R_t - OC_t - D_t$	
Taxes (at t_c)		$t_c(R_t - OC_t - D_t)$	
Net income or EAT		$(R_t - OC_t - D_t)(1 - t_c)$	
Net after-tax cash flows			
Plus: Depreciation		$+D_t$	
Less: Capital expenditures	$-I_0$	$-I_t$	
Less: Increase in *NWC*	$-\Delta NWC_0$	$-\Delta NWC_t$	
Plus: After-tax *SV*			$+SV_t$

*Operating costs typically include cost of goods sold, general, sales and administrative expenses and R&D expenses. EBIT is earnings before interest and taxes

Issues in Cash Flow Estimation

- *Example:* A project requires an initial investment in equipment and machinery of \$10 million. The equipment is expected to have a five-year life with no salvage value and will be depreciated on a straight line basis. The project is expected to generate revenues of \$6 million each year for the five years and have operating expenses (excluding depreciation) amounting to one-third of revenues. If the company's tax rate is 30%, calculate the net cash flows from this project using the two methods outlined earlier
- Depreciation, D_t = 10000000/5 = \$2 million per year
- Operating costs = 6000000(1/3) = \$2 million per year

Issues in Cash Flow Estimation

	Method 1
Revenues, R_t	$6,000,000
Operating costs, OC_t	$2,000,000
Depreciation, D_t	$2,000,000
Income before taxes	$2,000,000
Taxes (30%)	$600,000
Net cash flows, C_t	$3,400,000

$C_t = R_t - OC_t - Taxes_t$

$Taxes_t = (R_t - OC_t - D_t)t_c$

	Method 2
Revenues, R_t	$6,000,000
Operating costs, OC_t	$2,000,000
Depreciation, D_t	$2,000,000
Income before taxes	$2,000,000
Taxes (30%)	$600,000
Income after taxes	$1,400,000
Add back depreciation, D_t	$2,000,000
Net cash flows, C_t	$3,400,000

$C_t = (R_t - OC_t - D_t)(1 - t_c) + D_t$

Case Study 1: Costco in Melbourne

- Costco Wholesale (*Nasdaq:* COST) currently has four wholesale stores in Melbourne and management is considering building a fifth store to service the outer suburbs. The company already owns the land for this store, which currently has an abandoned warehouse located on it. The marketing department has spent $250,000 on market research to determine the extent of customer demand for the new store. Costco is now in the process of deciding whether or not to build the new store. Which of the following should be included as part of the incremental cash flows associated with the proposed new store and why?

Case Study 1: Costco in Melbourne

1. The cost of the land where the store will be located
2. The cost of demolishing the abandoned warehouse and clearing the area
3. The loss of sales in its existing outlets, if customers who previously drove across town to shop at those outlets become customers of the new store instead
4. The $250,000 in market research spent to evaluate customer demand
5. The construction cost for the new store
6. The interest expense on the funds borrowed to pay for the construction costs

Case Study 2: The Curry Shack

- The Curry Shack, Melbourne's third-largest Indian restaurant, has recently purchased a new computer system that fully automates its ordering and delivery systems. The computer system costs $12,000, has a useful life of 6 years and will be depreciated on a straight-line basis over that period. It is expected that as a result of this new system the restaurant will generate additional before-tax operating cash flows (that is, operating revenues minus operating costs) of $6,000 per year over its useful life. Assume that at the end of year 4 the firm sells the computer system for $5,000. If the firm's effective corporate tax rate is 30% what is the net after-tax cash flow in year 4 of the computer system's life?

Case Study 2: The Curry Shack

- The net after-tax cash inflows in year 4 are…

$$(R_4 - OC_4)(1 - t_c) = 6000(1 - 0.3) = \$4,200$$

- The depreciation expense per year = 12000/6 = $2,000
- So, the depreciation tax saving in year 4 is…

$$t_c D_4 = 0.3 \times 2000 = \$600$$

- In addition to the above cash flows we need to consider the gain/loss on the computer system in year 4

Case Study 2: The Curry Shack

- To calculate the gain/loss on the computer system we first need its book value in year 4

End of Year	*Depreciation*	*Accumulated Depreciation*	*Book Value*
0			\$12,000
1	\$2,000	\$2,000	\$10,000
2	\$2,000	\$4,000	\$8,000
3	\$2,000	\$6,000	\$6,000
4	\$2,000	\$8,000	\$4,000

Case Study 2: The Curry Shack

- Before-tax proceeds from the sale of the system = \$5,000
- The taxes on proceeds from sale of the system are…
  - Total gain = Disposal value – Book value
  - Total gain = 5000 – 4000 = \$1,000
  - Taxes payable on gain = 0.3×1000 = \$300
- The net after-tax salvage (or scrap) value is…
  - $SV_4 = 5000 - 300 = \$4{,}700$
- What would happen if the proceeds from the sale of the computer system were \$3,000 and not \$5,000?

Case Study 2: The Curry Shack

- The total after-tax net cash flow in year 4 is…

$$C_4 = (R_4 - OC_4)(1 - t_c) + t_c D_4 + SV_4$$

After-tax net cash inflow	\$4,200	$(R_4 - OC_4)(1 - t_c)$
Depreciation tax saving	\$600	$t_c D_4$
Proceeds from sale	\$5,000	SV_4
Taxes payable on gains	-\$300	
Total after-tax net cash flow	\$9,500	

Issues in Cash Flow Estimation

- Not all projects have a clearly defined end date
  - *Examples:* Mining projects, corporate acquisitions, etc.
- Recall Week 8's case study examining Microsoft's acquisition of LinkedIn in 2016. In acquiring LinkedIn for US$26.2 billion, Microsoft would have had to forecast LinkedIn's cash flows well into the future!
- In such cases, it is typical to forecast the cash flows from a target company over several years and then assume that the cash flows will grow at some constant rate forever
- The valuation problem is…
  - Calculate the present value of projected cash flows
  - Calculate the *terminal value* of the investment
  - Calculate the present value of all cash flows

Case Study 3: LinkedIn's Terminal Value

- Assume that Microsoft had projected the following cash flows associated with its LinkedIn acquisition in 2016

End of Year	*Cash Flow*
1	\$5.0*b*
2	\$4.5*b*
3	\$4.0*b*
4	\$4.0*b*
5	\$2.0*b*

- Assume also that from year 5 onwards Microsoft expected the cash flows to grow at a rate of 2% p.a. forever and that it used a discount rate of 12% to value this acquisition. What was LinkedIn's estimated value to Microsoft?

Case Study 3: LinkedIn's Terminal Value

- Terminal value calculations…
- $C_6 = C_5(1 + g) = 2.0(1 + 0.02) = \$2.04b$
- $PV_5 = C_6/(r - g) = 2.04/(0.12 - 0.02) = \$20.4b$
- Present value of all cash flows…
- $PV_0 = 5/(1.12)^1 + 4.5/(1.12)^2 + 4.0/(1.12)^3 + 4.0/(1.12)^4 + (2.0 + 20.4)/(1.12)^5$
- $PV_0 = \$26.2b$

Inflation and Capital Budgeting

- It is important to be consistent in the treatment of inflation
  - For *nominal* cash flows use the *nominal* discount rate
  - For *real* cash flows use the *real* discount rate
- From the Fisher relationship we have…
  - $(1 + r) = (1 + r_r)(1 + i)$ *or*
  - $(1 + r_r) = (1 + r)/(1 + i)$
  - r = Nominal rate of return (or nominal interest rate) per annum
  - r_r = Real rate of return (or real interest rate) per annum
  - i = Expected inflation rate per annum
- Don't mix these up!
  - Real cash flows discounted using the nominal discount rate
  - Nominal cash flows discounted using the real discount rate

Inflation and Capital Budgeting

- *Example:* Victoria Pedia, the finance manager of OLO Ltd, has obtained the following data and notes relating to an investment proposal

Estimated life of the proposal	2 years
Initial outlay	\$300,000
Net operating cash flows per year (real, before tax)	\$220,000
Salvage (scrap) value in year 2 (real, before tax)	\$25,000
Corporate tax rate	30%
Discount rate (nominal, after tax)	8.15% p.a.
Expected inflation rate	3.00% p.a.

Notes: The tax payable on salvage (or scrap) value is \$7,500. The corporate tax rate is assumed to remain unchanged over the next two years, as is the expected inflation rate.

Inflation and Capital Budgeting

- Vicky has estimated the *NPV* of this investment proposal as follows…
- $C_1 = 220000(1 - 0.3) = \$154{,}000$
- $C_2 = 220000(1 - 0.3) = \$154{,}000$
- $NPV = 154000/1.0815 + (154000 + 25000)/(1.0815)^2 - 300000$
- $NPV = -\$4{,}567$
- Vicky has asked you to check her calculations and report back to her if you find any errors. Indicate what errors, if any, she has made and, if required, re-estimate the *NPV* of the proposal

Inflation and Capital Budgeting

- Vicky used the *real* after-tax cash flows in years 1 and 2 and the *real* before-tax salvage value and discounted these at the *nominal* discount rate
  - She should have discounted the *real* after-tax cash flows at the *real* discount rate
  - She should have considered the salvage value on an after-tax basis
- Real discount rate = 1.0815/1.03 – 1 = 5%
- After-tax salvage value = 25000 – 7500 = $17,500
- *Correct NPV* = $154000/1.05 + (154000 + 17500)/(1.05)^2$
  $– 300000$
- *Correct NPV* = $2,222

Inflation and Capital Budgeting

- Note that she could have calculated the *nominal* cash flows and discounted those at the *nominal* discount rate
- C_1 (nominal, after-tax) = 220000 × 1.03 × (1 – 0.3) = $158,620
- C_2 (nominal, after-tax) = 220000 × $(1.03)^2$ × (1 – 0.3) = $163,379
- SV_2 (nominal, after-tax) = 17500 × $(1.03)^2$ = $18,566
- *Correct NPV* = 158620/1.0815 + (163379 + 18566)/$(1.0815)^2$ – 300000
- *Correct NPV* = $2,222

Projects With Different Lives

- *Example:* Consider the following two mutually exclusive projects which have lives of 3 and 2 years, respectively. At a 10% p.a. discount rate which project should the firm choose?

End of Year	*Project A*	*Project B*
0	–$300,000	–$300,000
1	$120,000	$180,000
2	$130,000	$180,000
3	$130,000	–
NPV (at 10%)	$14,200	$12,397

- Can we directly compare the *NPV*s of the projects?

Projects With Different Lives

- We assume that both projects can be invested in with *identical* projects until they achieve a common duration (or life)
  - This is called the constant chain of replacement assumption
- The constant chain of replacement assumption can be applied using two different, but consistent, methods…
  - The lowest common multiple method
  - The perpetuity method
  - *Note that both methods will give the same decision*

Projects With Different Lives

- Constant chain of replacement using the lowest common multiple method
  - Invest in the projects until they achieve the same "lives"
  - A 2-year versus a 3-year project – invest in the 2-year project 3 times and in the 3-year project 2 times (common life = 6 years)
  - A 2-year versus a 4-year project – invest in the 2-year project 2 times and in the 4-year project one time (common life = 4 years)
  - A 4-year versus a 5-year project – invest in the 4-year project 5 times and in the 5-year project 4 times (common life = 20 years)
- In our example…
  - Invest in project A ($n = 3$) 2 times and in project B ($n = 2$) 3 times for a common life of 6 years (see next slide)

Projects With Different Lives

End of Year	*Project A*	*Project B*
0	–$300,000	–$300,000
1	$120,000	$180,000
2	$130,000	$180,000 – $300,000
3	$130,000 – $300,000	$180,000
4	$120,000	$180,000 – $300,000
5	$130,000	$180,000
6	$130,000	$180,000
NPV (at 10%)	$24,868	$31,109

- Note that project A has the *lower NPV* than project B so project B would be preferred over project A

Projects With Different Lives

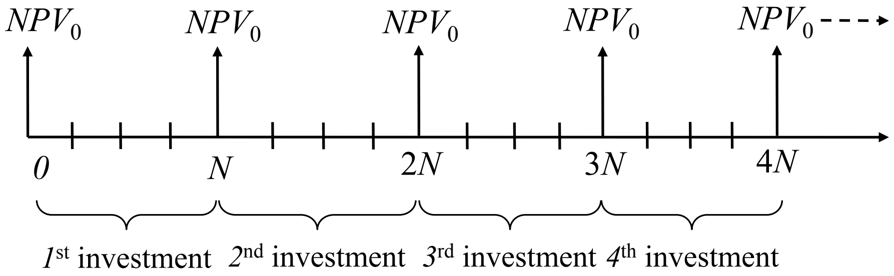
- *NPV* of project A
  - $NPV = -300000 + 120000/1.10 + 130000/1.10^2 + (130000 - \$300000)/1.10^3 + 120000/1.10^4 + 130000/1.10^5 + 130000/1.10^6$
  - $NPV = \$24{,}868$
- *NPV* of project B
  - $NPV = -300000 + 180000/1.10 + (180000 - 300000)/1.10^2 + 180000/1.10^3 + (180000 - 300000)/1.10^4 + 180000/1.10^5 + 180000/1.10^6$
  - $NPV = \$31{,}109$
- Project A has the *lower NPV* than project B so project B would be preferred over project A

Projects With Different Lives

- The lowest common multiple method can be cumbersome to use when considering projects with "long" unmatched lives
- *Example:* Two projects with lives of 10 and 13 years require present value calculations over 130 (= 10 × 13) years! The first project is assumed to be invested in 13 times and the second 10 times
- Constant chain of replacement in perpetuity method assumes that both projects are invested in *forever*
  - The chains of cash flows are of "equal length" because they are both of *infinite* length
  - The method is generally easier to implement

Projects With Different Lives

- Consider a project with a life of N years and a required rate of return of r% p.a. Its net present value is NPV_0
- The project, when invested in forever, will have the following profile of NPVs



Projects With Different Lives

- The net present value of the infinite chain of *NPV*s is…

$$NPV_{\infty} = NPV_{0} + \frac{NPV_{0}}{(1+r)^{N}} + \frac{NPV_{0}}{(1+r)^{2N}} + \ldots + \frac{NPV_{0}}{(1+r)^{\infty}}$$

$$NPV_{\infty} = NPV_{0}\left[1 + \frac{1}{(1+r)^{N}} + \frac{1}{(1+r)^{2N}} + \ldots + \frac{1}{(1+r)^{\infty}}\right]$$

$$NPV_{\infty} = NPV_{0}\left[\frac{1}{1 - \frac{1}{(1+r)^{N}}}\right] = NPV_{0}\frac{(1+r)^{N}}{(1+r)^{N} - 1}$$

Projects With Different Lives

- *Example (continued):* Consider the previous two mutually exclusive projects and assume the same 10% p.a. discount rate. Reevaluate the two machines using the constant chain of replacement in perpetuity method

End of Year	*Project A*	*Project B*
0	–$300,000	–$300,000
1	$120,000	$180,000
2	$130,000	$180,000
3	$130,000	–
NPV (at 10%)	$14,200	$12,397

Projects With Different Lives

- The net present values of the machines are given as…
  - NPV_0 for project A = \$14,200
  - NPV_0 for project B = \$12,397
- The net present value of the infinite chain (NPV_∞) is…

$$NPV_\infty = NPV_0 \frac{(1+r)^N}{(1+r)^N - 1}$$

$$NPV_\infty^A = 14200 \frac{(1.10)^3}{(1.10)^3 - 1} = \$57,100$$

$$NPV_\infty^B = 12397 \frac{(1.10)^2}{(1.10)^2 - 1} = \$71,429$$

Projects With Different Lives

- A variant to the constant chain of replacement in perpetuity method is the *equivalent annuity value (EAV) method* which involves the following steps…
- *Step 1:* Calculate the *NPV*s of the projects
  - *NPV* for project A = \$14,200
  - *NPV* for project B = \$12,397
- *Step 2:* Convert these *NPV*s to an equivalent annual value (*EAV*) series by dividing the *NPV*s by the present value of an ordinary annuity factor, $[1 - (1/(1 + r))^n]/r$
  - *EAV* for project A = $14200 \Big/ \left(\frac{1}{0.10}\right)\left(1-\frac{1}{(1+0.10)^3}\right) = \$5,710$
  - *EAV* for project B = $12397 \Big/ \left(\frac{1}{0.10}\right)\left(1-\frac{1}{(1+0.10)^2}\right) = \$7,143$

Projects With Different Lives

- *Step 3:* Because the *EAV*s in Step 2 are assumed to be *perpetuities*, their present values can be calculated by dividing them by the discount rate as follows
  - *NPV* of project A = EAV/r = 5710 /0.10 = $57,100
  - *NPV* of project B = EAV/r = 7143/0.10 = $71,430
- *Note 1:* $NPV_{\infty} = EAV/r$
- *Note 2:* The above analyses also implies that we can evaluate the projects using just their *EAV*s

9.2 The Weighted Average Cost of Capital

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

Estimating and Using the WACC

- The main steps involved in the estimation of the WACC are…
  - Identify the financing components
  - Estimate the current (that is, 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

Valuing the Financing Components

- Debt (Bonds)
  - Identify all externally supplied debt
  - Obtain the number of bonds on issue from the balance sheet and use the market price to get the total market value of bonds
- Ordinary shares
  - Obtain number of issued shares on issue from the balance sheet and use the market price to get the total market value of ordinary shares
- Preference shares
  - Obtain number of issued shares on issue from the balance sheet and use the market price to get the total market value of preference shares

Estimating the Costs of Financing Components

- Debt (Bonds)
  - The cost of bonds is measured as the yield to maturity of the bonds, r_D (not the coupon rate!) – Note that this assumes that the bonds are *default risk free*
- Ordinary shares
  - The cost of ordinary shares is measured as the required rate of return on the shares, r_E
  - Can get r_E from the CAPM (common) or one of the dividend growth models (not as common)
- Preference shares
  - The cost of preference shares is measured as the required rate of return on the shares, r_P

Estimating the Cost of Capital

- The before-tax weighted average cost of capital (WACC or r_O) uses the cost of each component of the firm's capital structure and weights these according to their relative market values
- $r_O = r_D(D/V) + r_E(E/V) + r_P(P/V)$

where r_D = Cost of debt (bonds)

r_E = Cost of equity (ordinary shares)

r_P = Cost of preference shares

D = Market value of debt

E = Market value of equity (ordinary shares)

P = Market value of preference shares

V = Market value of the firm ($= D + E + P$)

Estimating the Cost of Capital

- Be careful of rounding errors in initial calculations
- Be careful to work in consistent terms
  - Calculations in percentages versus decimals
- Check your answers against some common sense logic…
  - $r_E > r_P > r_D > r_D(1 - t_c)$

Taxes and the Cost of Capital

- 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, $r'_D = (1 - t_c)r_D$
  - t_c = Effective corporate tax rate (*Note:* The text uses T_c)
- The cost of equity (r_E) is unaffected
- The after-tax WACC is defined as…
- $r'_O = r_D(1 - t_c)(D/V) + r_E(E/V) + r_P(P/V)$
- *Note:* The text uses WACC for both the before- and after-tax weighted average cost of capital

9.3 Using the Cost of Capital

- *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	

Using the Cost of Capital

- Before-tax weighted average cost of capital
  - WACC weights are based on market values so book values are *not* relevant
  - $r_O = r_D(D/V) + r_E(E/V) + r_P(P/V)$
  - $V = D + E + P$

	Market values	*Weights*	*Market costs*	*Weights×Costs*
Bonds	\$50,000,000	0.333	8.0%	2.664%
Preference shares	\$20,000,000	0.133	10.0%	1.330%
Ordinary shares	\$80,000,000	0.534	14.0%	7.476%
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, $r_O = 11.47\%$

Using the Cost of Capital

- The after-tax cost of capital requires the after-tax cost of debt
  - $r'_D = r_D\,(1 - t_c)$
  - $r'_D = 0.08(1 - 0.30) = 5.6\%$

	Market values	*Weights*	*After-tax market costs*	*Weights×Costs*
Bonds	\$50,000,000	0.333	5.6%	1.865%
Preference shares	\$20,000,000	0.133	10.0%	1.330%
Ordinary shares	\$80,000,000	0.534	14.0%	7.476%
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, $r'_O = 10.67\%$

Using the Cost of Capital

- *Example:* ASL Ltd has a debt-to-assets 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 10 percent, what is the firm's cost of equity?
- The cost of equity can be obtained using the after-tax weighted average cost of capital relation, which is…
  - $r'_O = r_D(1 - t_c)(D/V) + r_E(E/V)$
- $r'_O = 0.10 = 0.08(1 - 0.30)(0.25) + r_E(0.75)$
- So, $r_E = [0.10 - 0.08(1 - 0.30)(0.25)]/(0.75)$
- $r_E = 11.47\%$

Using the Cost of Capital

- *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 after-tax weighted average cost of capital relation, which is…
  - $r'_O = r_D(1 - t_c)(D/V) + r_E(E/V)$
- *Note:* We're given a D/E ratio of 0.25 but we need the $D/V = D/(D + E)$ ratio!

Using the Cost of Capital

- $D/E = 0.25$ implies $D = 0.25(E)$
  - That is, the market value of debt is 25% the market value of equity
- Substituting the above expression in the debt-to-assets ratio, we get…
  - $D/(D + E) = 0.25(E)/[0.25(E) + E] = 0.25(E)/1.25(E)$
  - $D/(D + E) = 0.25/1.25 = 0.20$
  - $E/(D + E) = 1 – 0.20 = 0.80$
- The after-tax weighted average cost of capital is…
  - $r'_O = 0.20 = 0.08(1 – 0.30)(0.20) + r_E(0.80)$
  - So, $r_E = [0.20 – 0.08(1 – 0.30)(0.20)]/(0.80)$
  - $r_E = 23.6\%$

9.4 Limitations on Using the Cost of Capital

- *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?*

- Note that we have not covered sensitivity analysis, scenario analysis and real options here – These topics are covered in detail in FNCE20005 Corporate Financial Decision Making

Key Concepts

- The *NPV* method is recommended for investment evaluation because it is consistent with the maximization of shareholder wealth
- The *NPV* method requires a careful analysis of which incremental cash flows are included in the analysis
- Inflation can distort *NPV* analysis and it is important to evaluate real (nominal) net cash flows using the real (nominal) discount rate
- The constant chain of replacement assumption can be used to evaluate and compare projects of differing lives
- The weighted average cost of capital is the discount rate that is used to evaluate projects of similar risk to the firm

Key Concepts

- 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

Formula Sheet

- Net after-tax cash flows from a project
  - $C_t = (R_t - OC_t)(1 - t_c) + t_c D_t$
- Fisher relationship: $(1 + r) = (1 + r_r)(1 + i)$
- Net present value (constant chain replacement method in perpetuity)

$$NPV_\infty = NPV_0 \frac{(1+r)^N}{(1+r)^N - 1}$$

- Before-tax weighted average cost of capital
  - $r_O = r_D(D/V) + r_E(E/V) + r_P(P/V)$
- After-tax weighted average cost of capital
  - $r'_O = r_D(1 - t_c)(D/V) + r_E(E/V) + r_P(P/V)$

(*Note:* The formula sheet on the final exam will contain all the formulas covered in lectures but *without* the descriptions)