Chapter 13
The Weighted-Average Cost of Capital and Company Valuation

Financial Management (MGCM10018)

Preview

- If a firm is financed wholly by common stock, the company cost of capital is the return required by the stockholders.
  - However, most companies are financed by a mixture of securities.
    - Common stock, Bonds, Preferred stock, and others.
- The required rate of return on a firm's projects can be calculated using the weighted-average cost of capital (WACC).
  - The WACC is the after-tax return the company needs to earn in order to satisfy all its security holders.

Outline

- Geothermal's Cost of Capital
- The Weighted-Average Cost of Capital
- Measuring Capital Structure
- Calculating the WACC
- Interpreting the WACC
- Valuing Entire Businesses

Geothermal's Cost of Capital (13.1)

- Suppose we are the chief financial analyst of Geothermal Corporation, which produce electricity from geothermal energy.
  - Because oil shock in recent years, the firm's rate of return on book assets is about 25% per year.
- The CEO asks us to evaluate a project with cost of $30 million and perpetual after-tax cash flow of $4.5 million annually.
  - That is, the project rate of return was 15%.
  - This is much less than the profitability of existing assets.

Geothermal's Cost of Capital (con'd)

- How will we present our analysis in this project?
- We should know that 15% was not necessarily a bad return.
  - It might still exceed Geothermal's cost of capital.
  - How to calculate the cost of capital for companies that used only common stock financing?
    - Value of business = value of stock
    - Risk of business = risk of stock
    - Rate of return on business = rate of return on stock
    - Investors' required return from business = investors' required return from stock

Geothermal's Cost of Capital (con'd)

- However, Geothermal had borrowed a substantial amount of money.
- We now have to look at Geothermal's capital structure to consider rate of return by debt.

Assets		Liabilities and Shareholders' Equity		
Market value of assets = value of Geothermal's existing business	$647	Market value of debt	$194	(30%)
		Market value of equity	453	(70%)
Total value	$647	Total value	$647	(100%)

  - Suppose debt's yielding 8% and equity investors want 14%. With tax rate of 35%,

Geothermal's Cost of Capital (con'd)

- Thus, we can define the company cost of capital as the opportunity cost of capital for the firm's existing assets.
  - It is the minimum acceptable rate of return when the firm expands by investing in average-risk projects.
  - We use it to value new assets that have the same risk as the old ones.
- Note that the capital structure is the mix of long-term debt and equity financing.

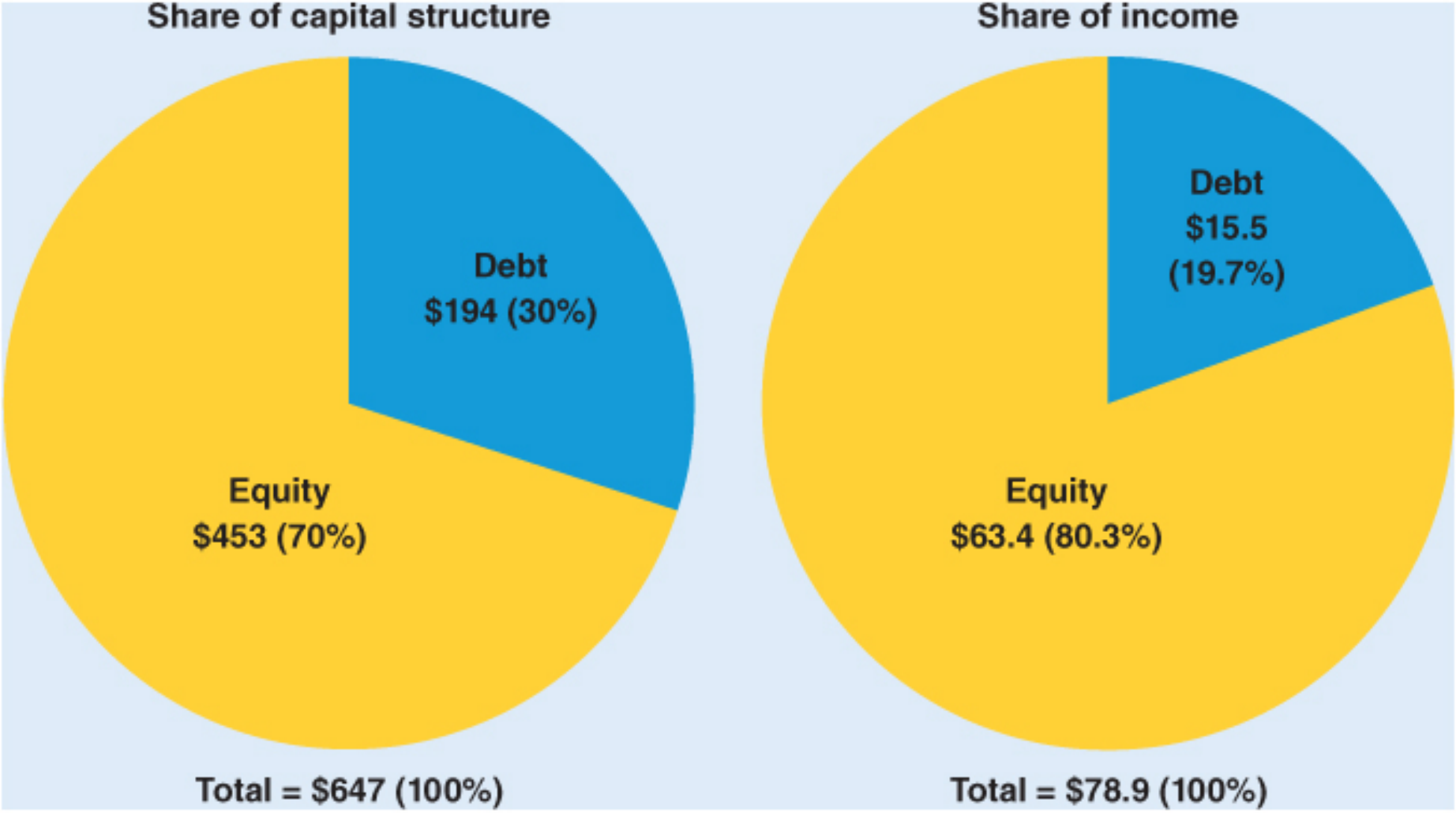
The Weighted-Average Cost of Capital, WACC (13.2)

- The company cost of capital is the opportunity cost of capital for the company as a whole.
- The weighted-average cost of capital (WACC) helps to measure the company cost of capital when the firm has raised different types of debt and equity financing.
  - WACC also adjust the cost for the tax deductibility of interest payments.

The WACC (continued)

- When only common stock is outstanding, calculating the company cost of capital is straightforward.
  - For example, a financial manager could estimate beta and find shareholders' required rate of return using the CAPM.
- When debt is involved, the company cost of capital is a weighted average of the returns demanded by debt and equity investors.
  - The weighted average is the expected rate of return investors would demand on a portfolio of all the firm's outstanding securities.

Example of Geothermal



The WACC (continued)

- The bottom line is
  - Company cost of capital = weighted average of debt and equity returns
  - We ignore taxes for now.

The WACC (continued)

$$r_{assets} = \frac{D}{V} * r_{debt} + \frac{E}{V} * r_{equity}$$

Where:

D = **Market value** of outstanding debt

E = **Market value** of outstanding equity

V = Total **market value** of firm (D + E = V)

r_{debt} = Required return on a firm's debt

r_{equity} = Required return on a firm's equity

r_{assets} = Required return on all of a firm's assets

Example

Macrosoft, Inc. has issued long-term bonds with a present value of $25 million and a yield of 8%. It currently has 12 million shares outstanding, trading at $20 each, offering an expected return of 14%. What is the firm's cost of capital?

$$D = \$25\ million \qquad E = (12{,}000{,}000 * \$20) = \$240\ million$$

$$V = D + E = \$265\ million$$

The WACC (continued)

- The cost of capital must be based on what investors are actually willing to pay for the company's outstanding securities.
  - That is, based on the securities' market values.
- For proper valuation we must value the firm's after-tax cash flows.
  - Recall that in Chapter 9, we discount the cash flow after tax assuming the project is equity-financed.
  - Now consider debt, the interest payments on debt are deducted from income before tax is calculated.

The WACC (continued)

Thus, the WACC provides a firm's after-tax cost of capital.

$$WACC = \left[\frac{D}{V} \times (1 - T_c) r_{debt}\right] + \left[\frac{E}{V} \times r_{equity}\right]$$

Where:

T_c = The firm's tax rate

The WACC (continued)

- A firm's WACC is calculated in 3 steps:
  1. Calculate the value of each security as a proportion of firm value.
  2. Determine the required rate of return on each security.
  3. Calculate a weighted average of the after-tax return on the debt and return on the equity.

WACC: Example

What is the WACC for a firm with $30 million in outstanding debt with a required return of 8%, 8 million in equity shares outstanding trading at $15 each with a required return of 12%, and a tax rate of 35%?

1. $D = \$30\ million \quad E = \$120\ million \quad V = \$150\ million$

2. $r_{debt} = 8\% \quad r_{equity} = 12\% \quad T_c = 35\%$

The WACC (continued)

- If there are 3 (or more) sources of financing, simply calculate the weighted-average after-tax return of each security type.
- For example, if the firm issues preferred stock:

$$WACC = \left[\frac{D}{V} \times (1 - T_c) r_{debt}\right] + \left[\frac{E}{V} \times r_{equity}\right] + \left[\frac{P}{V} \times r_{Preferred}\right]$$

WACC: Example

Consider a firm with \$8 million in outstanding bonds, \$15 million worth of outstanding common stock, and \$5 million worth of outstanding preferred stock. Assume required returns of 8%, 12%, and 10%, respectively, and a 35% tax rate.

1. $D = \$8\,million \qquad E = \$15\,million \qquad P = \$5\,million$

$$V = D + E + P = \$28\,million$$

2. $r_{debt} = 8\% \qquad r_{equity} = 12\% \qquad r_{preferred} = 10\%$

WACC and NPV

- In our previous example, we calculated the firm's WACC to be 9.7%
- Would NPV be positive or negative if:
  - We invested in a project offering a 9% return?
  - We invested in a project offering a 10% return?
  - We invested in a project offering a 9.7% return?

Geothermal Example

- We find the WACC as 11.4% in the Geothermal example.
- Assume a cash-flow worksheet as below:

Revenue	$10.00 million
– Operating expenses	– 3.08
= Pretax operating cash flow	6.92
– Tax at 35%	– 2.42
After-tax cash flow	$ 4.50 million

  - The interest tax shields generated by the project's debt financing is in fact reflected in the WACC.

Measuring Capital Structure (13.3)

- When estimating WACC, the first step is to work out the capital structure.
  - We use market values, not book values.
- Market value of debt
  - Present value of all coupons and principal, discounted at the current YTM.
- Market value of equity
  - Market price per share multiplied by the number of shares outstanding.

Measuring Capital Structure: Example

If a firm's bonds pay a 5% coupon and mature in 3 years, what is their market value, assuming a 7% yield to maturity? Assume the bond has a $1,000 par value.

Capital Structure: Example

- Below table shows the debt and equity issued by Big Oil.

Bank debt	$200	25.0%
Long-term bonds (12-year maturity, 8% coupon)	200	25.0
Common stock (100 million shares, par value $1)	100	12.5
Retained earnings	300	37.5
Total	$800	100.0%

  - The book value of bank debt should be similar with the market value since the interest rate is highly correlated with the discount rate.

Capital Structure: Example

- For long-term bonds,
  - assuming the current interest rate is 9%,
  - The PV of bonds should be

$$PV = \frac{16}{1.09} + \frac{16}{1.09^2} + \cdots + \frac{216}{1.09^{12}} = 185.7$$

- For equity,
  - The $400 million measures the cash raised for shareholders in the past or has retained and invested on their behalf.
  - This is not what investors are willing to pay for the firm's common stocks.

Capital Structure: Example

- For equity,
  - what investors are willing to pay for the firm's common stocks depends on:
    - If Big Oil has found projects that are worth more than they originally cost.
    - If value of assets has increased with inflation.
    - If investors see great future investment opportunities for the company.
  - Assuming market price of $12 a share, the market value of common stock is 100 × $12 = $1,200 million.

Capital Structure: Example

- Thus, below table shows the market values of Big Oil's capital structure:

Bank debt	$ 200.0	12.6%
Long-term bonds	185.7	11.7
Total debt	385.7	24.3
Common stock (100 million shares at $12)	1,200.0	75.7
Total	$1,585.7	100.0%

  - We can see that the debt and equity account for 24.3% and 75.7%, respectively.
    - By book value, the two each accounted for 50%.

Calculating the WACC (13.4)

- To calculate the WACC, we must calculate the rates of return that investors expect from each security.
  - Expected returns on bonds
    - The risk of bankruptcy aside, the yield to maturity (YTM) represents an investor's expected return on a firm's bonds.
  - Expected returns on common stock
  - Expected returns on preferred stock

Calculating the WACC (continued)

- The expected returns on common stock can be obtain by two methods
- Estimating r_{equity} using CAPM:

$$r_{equity} = r_f + \beta(r_m - r_f)$$

  - Example: A firm's beta is 1.5, Treasury bills currently yield 4%, and the long-run market risk premium is 8%. What is the firm's cost of equity?

Calculating the WACC (continued)

- Estimating r_{equity} using dividend discount model (DDM):

$$r_{equity} = \frac{DIV_1}{P_0} + g$$

  - Example: A firm's shares are trading for $45 per share. The firm is expected to pay a $2 per share dividend annually. What is its expected return on equity assuming a 9% constant growth rate?

Calculating the WACC (continued)

- A preferred stock that pays a fixed annual dividend is no more than a simple perpetuity.

$$r_{preferred} = \frac{dividend}{preferred\ share\ price}$$

  - Example: If a share of preferred stock sells for $40 and it pays a dividend of $3 per share, what is the expected return on that share of stock:

Big Oil Example

- Thus, below table shows the data of Big Oil needed to calculate the expected returns:

Security Type	Capital Structure		Required Rate of Return
Debt	$D = \$ 385.7$	$D/V = .243$	$r_{debt} = .09$, or 9%
Common stock	$E = \$1{,}200.0$	$E/V = .757$	$r_{equity} = .12$, or 12%
Total	$V = \$1{,}585.7$		

$$WACC = \left[\frac{D}{V} \times (1 - T_c) r_{debt}\right] + \left(\frac{E}{V} \times r_{equity}\right)$$

Real-company WACCs

	Expected Return on Equity, %	Interest Rate on Debt, %	Proportion of Equity (*E*/*V*)	Proportion of Debt (*D*/*V*)	WACC, %
Dow Chemical	19.0	6.30	.61	.39	13.2
Starbucks	12.5	6.30	.97	.03	12.3
Dell	12.3	4.60	.88	.12	11.2
Boeing	12.0	4.60	.79	.21	10.1
Disney	11.1	4.60	.86	.14	9.9
Microsoft	9.8	3.50	.98	.02	9.7
Ford	20.7	7.25	.21	.79	8.0
IBM	8.3	4.55	.88	.12	7.7
McDonald's	7.3	4.65	.87	.13	6.8
Newmont Mining	7.1	6.25	.85	.15	6.7
Johnson & Johnson	7.0	3.50	.92	.08	6.6
Heinz	7.3	6.25	.74	.26	6.4
Pfizer	7.8	4.55	.70	.30	6.4
ExxonMobil	5.9	3.50	.98	.02	5.8
Campbell Soup	5.6	4.60	.85	.15	5.2
Consolidated Edison	5.2	6.20	.55	.45	4.7
Walmart	4.7	4.20	.84	.16	4.4

Interpreting the WACC (13.5)

- The WACC is the rate of return that the firm must expect to earn on its average-risk investments.
  - It is appropriate only for projects that have the same risk as the firm's existing business.
  - It can be used as a companywide benchmark discount rate;
    - the benchmark is adjusted upward for unusually risky projects and downward for unusually safe ones.

Interpreting the WACC (continued)

- A common mistake.
  - In the Big Oil case, we see its WACC as 10.5% with only 24.3% of debt.
    - One might say that the firm has good credit rating, it could push up the debt ratio to 50%.
      - Given 9% YTM, the WACC would be [0.5*0.65*0.09] + (0.5*0.12) = 8.9%.
    - Thus, with discount rate of 8.9%, we can justify a lot more investments.
  - This is a mistake because when the firm increases its borrowing, the lenders would demand a higher rate of interest on the debt.
    - Consequently, the risk of common stock would also increase, and investors would demand higher return.

Interpreting the WACC (continued)

- There are two costs of debt financing.
  - The explicit cost is the rate of interest that bondholders demand.
  - The implicit cost is the increase of required return on equity due to additional borrowing.
- When capital structure is altered due to change in debt ratio, the explicit cost is sometimes changed.
  - The implicit cost may or may not change depending on the magnitude of change in debt ratio.

Altering Capital Structure: Example

What is the WACC for a firm with $100 million in debt requiring a 6% return and $400 million in equity requiring a 10% return? Assume a tax rate of 35%.

What if the firm borrows an additional $150 million to retire some of its shares, but investors now demand 12% on the debt?

Valuing Entire Business (13.6)

- We can treat entire companies (or division of business) like giant projects and value them using the WACC.
  - Recall that we need to find the free cash flow.
    - Free cash flow: cash flow that is not required for investment in fixed assets or working capital and is therefore available to investors.
- Suppose we want to buy Establishing Industry's concatenator manufacturing operation.
  - Next table shows the forecasts of operating cash flow and investment for the dividsion.

Concatenator Manufacturing Division
(thousands of dollar)

	Year					
	1	2	3	4	5	6
1. Sales	1,189	1,421	1,700	2,020	2,391	2,510
2. Costs	1,070	1,279	1,530	1,818	2,152	2,260
3. Earnings before interest, taxes, depreciation, and amortization (EBITDA) = 1 − 2	119	142	170	202	239	250
4. Depreciation	45	59	76	99	128	136
5. Profit before tax = 3 − 4	74	83	94	103	111	114
6. Tax at 35%	25.9	29.1	32.9	36.1	38.9	39.9
7. Profit after tax = 5 − 6	48.1	54.0	61.1	67.0	72.2	74.1
8. Operating cash flow = 4 + 7	93.1	113.0	137.1	166.0	200.2	210.1
9. Investment in plant and working capital	166.7	200.0	240.0	200.0	160.0	130.6
10. Free cash flow = 8 − 9	−73.6	−87.1	−102.9	−34.1	40.2	79.5

Valuing Entire Business (continued)

- Note that the forecast cash flow in the table did not include a deduction for debt interest.
  - We know that acquisition of the business will support additional debt.
  - We will recognize the fact by discounting the cash flows with WACC,
    - which reflects both the firm's capital structure and the tax deductibility of its interest payment.

Valuing Entire Business (continued)

- Suppose the capital structure of the operation is 60% equity and 40% debt.
  - Assume the required rate of return on equity is 12%, and the business borrow at an interest rate of 5%.
  - The WACC = [.4 × (1 – 0.35)5%] + (.6 × 12%) = 8.5%
- We can see that the business has rapid expansion in early year, and when the growth slows down, the FCF turns positive.
  - The value of the operation is the PVs of both cash flows before horizon and of the horizon value.

Valuing Entire Business (continued)

$$PV_{firm} = \frac{FCF_1}{(1+WACC)^1} + \frac{FCF_2}{(1+WACC)^2} + \ldots + \frac{FCF_H}{(1+WACC)^H} + \frac{PV_H}{(1+WACC)^H}$$

$PV_{free\ cash\ flow}$

$PV_{horizon\ value}$

$$Horizon\ Value = \frac{FCF\ in\ year\ (H+1)}{r-g}$$

Valuing Entire Business (continued)

- Horizon years are often chosen arbitrarily.
  - Sometimes the boss tells everyone to use 10 years because it's a nice round number.
  - In this example, we use year 5 because the business is expected to settle down to steady growth of 5% a year from then on.
  - Thus, based on the constant-growth formula (from Chapter 7) the horizon value should be:

Valuing Entire Business (continued)

- The NPV of the business would be:

$$PV = -\frac{73.6}{1.085} - \frac{87.1}{1.085^2} - \frac{102.9}{1.085^3} - \frac{34.1}{1.085^4} + \frac{40.2}{1.085^5} + \frac{2{,}271.4}{1.085^5} = \$1{,}290.4$$

  - Thus, the positive NPV suggests the business is a good investment opportunity.

Valuing Entire Businesses: Example

Use the following information to calculate the value of a business that your firm is considering acquiring.

Firm's WACC: 12.5%

Firm's Cash Flows

- $1 million FCF, years 1-4
- $1.05 million FCF, year 5
- 5% growth after 4 years

Valuing Entire Businesses: Example

$$PV_{firm} = \frac{FCF_1}{(1+WACC)^1} + \frac{FCF_2}{(1+WACC)^2} + \ldots + \frac{FCF_H}{(1+WACC)^H} + \frac{PV_H}{(1+WACC)^H}$$