Capital Budgeting with Leverage

Lesson Outline

- The weighted average cost of capital (WACC) method
- The adjusted present value (APV) method
- The flow-to-equity (FTE) method
- Project-based cost of capital

Overview

- Objective: To put together our understanding of risk, return, and the firm's choice of capital structure in capital budgeting.
- WACC: We discount the unlevered FCF using the after-tax WACC. This method incorporates the tax benefit of debt implicitly through cost of capital.
- APV: We explicitly add the value of interest tax shields to project's (firm's) unlevered value.
- FTE: We value the firm's equity based on the total payouts to shareholders instead of valuing the firm based on its FCF.

Overview (Con't)

- We will apply each method to a single example under the following simplifying assumptions:
  - The market risk of the project is equivalent to the overall market risk of the firm, so the project's cost of capital can be assessed based on the risk of the firm.
  - The firm adjusts its leverage to maintain a constant debt-equity ratio in terms of market values, so the firm's WACC will not fluctuate due to leverage changes.
  - Corporate taxes are the only imperfection, so the main effect of leverage on valuation is due to the corporate tax shield.

The WACC

- The WACC incorporates the tax savings from debt by using the firm's after-tax cost of capital for debt:

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1 - \tau_c)$$

I

E: market value of equity	RE: equity cost of capital
D: market value of debt	RD: debt cost of capital
Tc: marginal cost of debt	

- Given a constant debt-equity ratio, the WACC remains constant over time. Thus, the levered value of an investment is obtained by discounting its FCF using WACC.

$$V_0^L = \frac{FCF_1}{1 + r_{wacc}} + \frac{FCF_2}{(1 + r_{wacc})^2} + \frac{FCF_3}{(1 + r_{wacc})^3} \cdots$$

Example 1: Valuing a Project with WACC

- Assume Avco is considering introducing a new line of packaging, the RFX Series.
  - Avco expects the technology used in these products to become obsolete after four years. However, the marketing group expects annual sales of $60 million per year over the next four years for this product line.
  - Manufacturing costs and operating expenses are expected to be $25M and $9M, respectively, per year.
  - Developing the product will require upfront R&D and marketing expenses of $6.67 million, together with a $24 million investment in equipment. The equipment will be obsolete in four years and will be depreciated completely via the straight-line method over that period.
  - Avco expects no net working capital requirements for the project and pays a corporate tax rate of 40%.

Example 1 (Con't)

	Year	0	1	2	3	4
Incremental Earnings Forecast ($ million)						
1	Sales	—	60.00	60.00	60.00	60.00
2	Cost of Goods Sold	—	(25.00)	(25.00)	(25.00)	(25.00)
3	**Gross Profit**	—	35.00	35.00	35.00	35.00
4	Operating Expenses	(6.67)	(9.00)	(9.00)	(9.00)	(9.00)
5	Depreciation	—	(6.00)	(6.00)	(6.00)	(6.00)
6	**EBIT**	(6.67)	20.00	20.00	20.00	20.00
7	Income Tax at 40%	2.67	(8.00)	(8.00)	(8.00)	(8.00)
8	**Unlevered Net Income**	(4.00)	12.00	12.00	12.00	12.00
Free Cash Flow						
9	Plus: Depreciation	—	6.00	6.00	6.00	6.00
10	Less: Capital Expenditures	(24.00)	—	—	—	—
11	Less: Increases in NWC	—	—	—	—	—
12	**Free Cash Flow**	**(28.00)**	**18.00**	**18.00**	**18.00**	**18.00**

Example 1 (Con't)

- Now, Avco's existing asset has market value of $600M, and the market value of equity and debt are both $300M, respectively. Its debt and equity cost of capital are 6% and 10%, respectively.
- Avco intends to maintain a similar debt-equity ratio for the foreseeable future, including any financing related to the RFX project. Thus, Avco's WACC is:

$$
\begin{aligned}
r_{wacc} &= \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-\tau_c) \\
&= 0.5 \times 10\% + 0.5 \times 6\% \times (1-0.4) \\
&= 6.8\%
\end{aligned}
$$

Example 1 (Con't)

- The value of the project, including tax shield from debt, is calculated as the PV of its FCF:

$$V_0^L = \frac{18}{1.068} + \frac{18}{1.068^2} + \frac{18}{1.068^3} + \frac{18}{1.068^4} = 61.25$$

- The NPV of the project is 61.25 - 28 = 33.25 M.

WACC: Summary

- The key steps in WACC valuation method:
  - Determine the FCF of the investment.
  - Compute the (after-tax) weighted average cost of capital.
  - Compute the value of the investment, including the tax benefit of leverage, by discounting the FCF of the investment using the WACC.
- The WACC can be used for new investments that are of comparable risk to the rest of the firm and that will not alter the firm's debt-equity ratio.

Constant Debt-Equity Ratio

- Using WACC does not require knowing how the constant debt-equity ratio is implemented. However, such leverage policy has implications for how the firm's total debt will change with new investment.
- By undertaking the RFX project, Avco adds new assets to the firm with initial market value $61.25M. Therefore, to maintain its debt-to-value ratio, Avco must add $30.625 million in new debt. (50% 61.25 = $30.625)

Constant Debt-Equity Ratio (Con't)

- How is this debt to equity ratio achieved?
  - The project raises the equity value by $33.25M, the NPV of the project.
  - The company raises $30.625M worth of debt, invests $28M in the project, pays the remaining $2.625M (30.625 - 28 = 2.625) to shareholders through a dividend.
  - Since $2.625M leaves the firm, the equity value drops by the same amount. Thus the market value of Avco's equity increases ultimately by $30.625M.

Constant Debt-Equity Ratio (Con't)

- After the initial financing of the project, Avco also needs to change its leverage level periodically to maintain the constant debt-equity ratio.
- The amount of debt at a particular date that is required to maintain the firm's target debt-to-value ratio is called the debt capacity.

Constant Debt-Equity Ratio (Con't)

- The debt capacity at date t is calculated as:

$$D_t = d \times V_t^L$$

where d is the firm's target debt-to-value ratio and V_t^L *is the levered continuation value on date t.*

- The levered continuation value, V_t^L, is the levered value of the firm's FCF after date t.

$$V_t^L = \frac{FCF_{t+1}}{1 + r_{wacc}} + \frac{FCF_{t+2}}{(1 + r_{wacc})^2} + \frac{FCF_{t+3}}{(1 + r_{wacc})^3} \cdots$$

Constant Debt-Equity Ratio (Con't)

- Working backward, the levered continuation value can be recursively calculated as follows:

$$V_t^L = \frac{FCF_{t+1} + V_{t+1}^L}{1 + r_{wacc}}$$

where V_{t+1}^L is equal to the PV (as of t+1) of FCF in year t+2 and beyond.

- The continuation value and debt capacity of the RFX project over time is given by the following table

	Year	0	1	2	3	4
Project Debt Capacity ($ million)						
1	**Free Cash Flow**	(28.00)	18.00	18.00	18.00	18.00
2	Levered Value, V^L (at r_{wacc} = 6.8%)	61.25	47.41	32.63	16.85	—
3	**Debt Capacity (at d = 50%)**	**30.62**	**23.71**	**16.32**	**8.43**	—

The Adjusted Present Value (APV)

- The Adjusted Present Value (APV) method determines the levered value of an investment by first calculating its unlevered value and then adding the value of the interest tax shield.

$$V_L = \text{APV} = V_U + \text{PV(Interest Tax Shield)}$$

- The unlevered value of a project is obtained by discounting its FCF using the project's cost of capital if it were financed without leverage.
- To value the interest tax shield, we need to determine the future interest payments and its risk level.

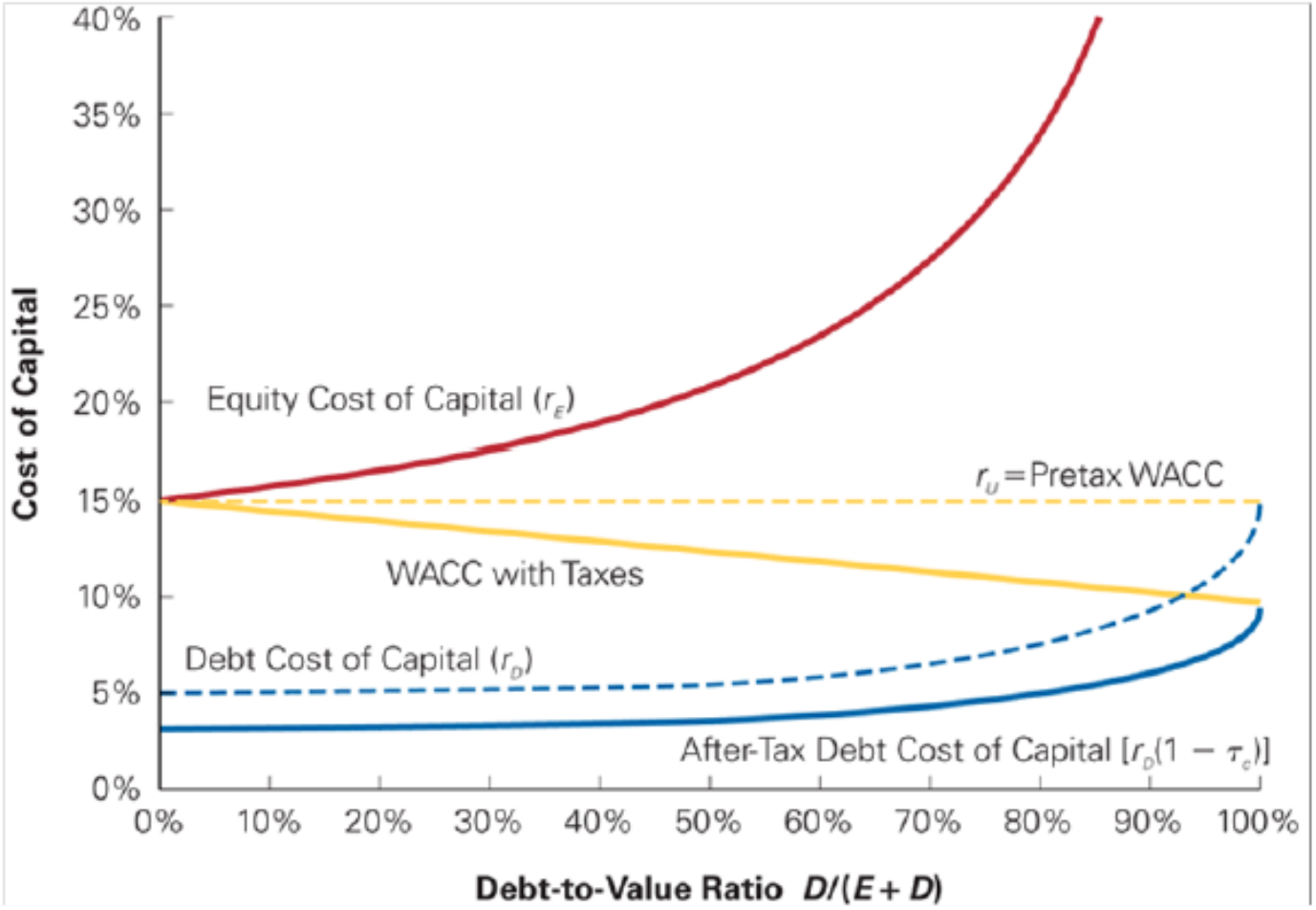
The Unlevered Value of the Project

- The RFX project has an upfront cost of $28 million, and it generates $18 million per year in free cash flow for the next four years. To determine the unlevered value of the project, we need to discount the FCF using the project's unlevered cost of capital.
- Because the project has similar risk to Avco's other investments, its unlevered cost of capital is the same as for the firms as whole.
- The firm's unlevered cost of capital can be estimated as the weighted average cost of capital computed without taking into account taxes (pre-tax WACC).

$$r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = \text{Pretax WACC} \quad (2)$$

Recall

The WACC with and without Corporate Taxes



Pretax WACC

- The firm's pretax WACC represents investors' required return for holding the entire firm (equity and debt). Thus, it will depend only on the firm's overall risk.
- As long as the firm's leverage choice does not change the overall risk of the firm, the pretax WACC must be the same whether the firm is levered or unlevered.

Pretax WACC (Con't)

- The assumption that the overall risk of the firm is independent of the choice of leverage holds in a perfect market. It will also hold in a world with taxes whenever the risk of the tax shield is the same as the risk of the firm, so the size of the tax shield will not change the overall riskiness of the firm.
- We learned (and will see again later) that the tax shield will have the same risk as the firm if the firm maintains a target leverage ratio.
  - The firm adjusts its debt proportionally to the project's value
  - A special case is a constant debt-equity ratio.

Project's Unlevered Value

- Applying **2** to Avco, we find its unlevered cost of capital to be $r_U = 0.5 \times 10\% + 0.5 \times 6\% = 8\%$
- The project's value without leverage is:

$$V_0^U = \frac{18}{1.08} + \frac{18}{1.08^2} + \frac{18}{1.08^3} + \frac{18}{1.08^4} = 59.62$$

- Comparing the calculation of the project's levered and unlevered value, we see:
  - The unlevered cost of capital r_U is more than the after-tax WACC r_{WACC}.
  - The unlevered value of \$59.62M is less than the levered value of \$61.25M.
  - The difference of \$1.63M is due to the value of interest tax shield, which we will calculate directly next.

Valuing the Interest Tax Shield

- To determine the interest tax shield, we need to find the interest payment in each year. The interest paid in year t is estimated based on the amount of debt outstanding at the end of the prior year:

$$\text{Interest paid in year } t = r_D \times D_{t-1}$$

Valuing the Interest Tax Shield

- To compute the PV of the interest tax shield, we need to find the appropriate cost of capital.
  - Because Avco maintains a constant debt-equity ratio, if the project does well (poorly), its value will be higher (lower), it will support more (less) debt, and the interest tax shield will be higher (lower).
  - Thus, the tax shield will fluctuate with, and therefore share the risk of the project itself.
  - When the firm maintains a target leverage ratio, its future interest tax shields have similar risk to the project's cash flows, so they should be discounted at the project's unlevered cost of capital.

Valuing the Interest Tax Shield (Con't)

- The project's interest tax shield is estimated:

	Year	0	1	2	3	4
Interest Tax Shield ($ million)						
1	**Debt Capacity, D_t**	30.62	23.71	16.32	8.43	—
2	Interest Paid (at $r_D = 6\%$)		1.84	1.42	0.98	0.51
3	**Interest Tax Shield (at $\tau_c = 40\%$)**		**0.73**	**0.57**	**0.39**	**0.20**

- The PV of the interest tax shield:

$$\text{PV(Interest Tax Shield)} = \frac{0.73}{1.08} + \frac{0.57}{1.08^2} + \frac{0.39}{1.08^3} + \frac{0.20}{1.08^4} = 1.63$$

- The levered value of the project is thus equal to the sum of the value of the interest tax shield and the value of the unlevered project.

$$V_L = V_U + \text{PV(Interest Tax Shield)} = 59.62 + 1.63 = 61.25$$

- which is exactly the same value found using the WACC approach.

APV: Summary

- The key steps in the APV valuation method:
  - Determine the investment's value without leverage.
  - Determine the PV of the interest tax shield.
    - Determine the expected interest tax shield.
    - Discount the interest tax shield.
    - Add the unlevered value to the PV of the interest tax shield to determine the value of the investment with leverage.

APV Summary (Con't)

- The APV method is more complicated than the WACC method because we must compute both the unlevered value of the project and the value of the interest tax shield. But the APV method also has advantages in some situations.
  - It can be easier to apply than the WACC method when the firm does not maintain a constant debt-equity ratio.
  - The APV approach also explicitly values market imperfections (e.g. taxes) and therefore allows managers to measure their contribution to value.

The Flow-To-Equity (FTE)

- In the WACC and APV methods, we value a project based on its FCF, which is computed ignoring interest and debt payments.
- In the flow-to-equity (FTE) valuation method, we explicitly calculate the FCF available to equity holders (free cash flow to equity, FCFE) after taking into account all payments to and from debt holders.
  - The adjustment includes interest payments, debt issuance and debt repayments.
- The CF to equity holders are then discounted using the equity cost of capital
- The FTE method calculates the gain to shareholders from the project, while the WACC and APV methods calculate the total value of the project.

Example: FTE to Value a Project

- The expected FCFE from Avco's RFX project is laid out in the following table:

	Year	0	1	2	3	4
Incremental Earnings Forecast ($ million)						
1	Sales	—	60.00	60.00	60.00	60.00
2	Cost of Goods Sold	—	(25.00)	(25.00)	(25.00)	(25.00)
3	**Gross Profit**	—	35.00	35.00	35.00	35.00
4	Operating Expenses	(6.67)	(9.00)	(9.00)	(9.00)	(9.00)
5	Depreciation	—	(6.00)	(6.00)	(6.00)	(6.00)
6	**EBIT**	(6.67)	20.00	20.00	20.00	20.00
7	Interest Expense	—	(1.84)	(1.42)	(0.98)	(0.51)
8	**Pretax Income**	(6.67)	18.16	18.58	19.02	19.49
9	Income Tax at 40%	2.67	(7.27)	(7.43)	(7.61)	(7.80)
10	**Net Income**	(4.00)	10.90	11.15	11.41	11.70
Free Cash Flow to Equity						
11	Plus: Depreciation	—	6.00	6.00	6.00	6.00
12	Less: Capital Expenditures	(24.00)	—	—	—	—
13	Less: Increases in NWC	—	—	—	—	—
14	Plus: Net Borrowing	30.62	(6.92)	(7.39)	(7.89)	(8.43)
15	**Free Cash Flow to Equity**	**2.62**	**9.98**	**9.76**	**9.52**	**9.27**

Calculating FCFE

- Note two changes in the calculation of the FCF
  - Interest expense are deducted before taxes
  - The proceeds from the firm's net borrowing activity are added in.
    - Net borrowing at date t = $D_t - D_{t-1}$
    - These proceeds are positive when the firm issues debt and negative when the firm repays principal
- The FCFE can also be calculated using FCF as

$$\begin{aligned}\text{FCFE} &= \text{FCF} + \tau_c \times \text{Interest Payments} - \text{Interest Payments} + \text{Net Borrowing} \\ &= \text{FCF} - \underbrace{(1-\tau_c) \times (\text{Interest Payments})}_{\text{After-tax interest expense}} + \text{Net Borrowing}\end{aligned}$$

	Year	0	1	2	3	4
Free Cash Flow to Equity ($ million)						
1	Free Cash Flow	(28.00)	18.00	18.00	18.00	18.00
2	After-tax Interest Expense	–	(1.10)	(0.85)	(0.59)	(0.30)
3	Net Borrowing	30.62	(6.92)	(7.39)	(7.89)	(8.43)
4	Free Cash Flow to Equity	2.62	9.98	9.76	9.52	9.27

Discounting FCFE

- Because the FCFE represent payments to equity holders, they should be discounted at the project's equity cost of capital.
- Given that the risk and leverage of the RFX project are the same as for Avco overall, we can use Avco's equity cost of capital of 10% for discounting.

$$\text{NPV}(FCFE) = 2.62 + \frac{9.98}{1.10} + \frac{9.76}{1.10^2} + \frac{9.52}{1.10^3} + \frac{9.27}{1.10^4} = 33.25$$

Discounting FCFE (Con't)

- The value of the project's FCFE represents the gain to shareholders from the project and it is identical to the NPV computed using the WACC and APV methods.
  - Shareholders receive $2.62 M at t = 0 as a dividend paid out of the debt financing. Excluding this amount, the value of equity is $30.63M, which accounts for half of the total value of the project.
- The value of the debt:

$$\frac{8.76}{1.06} + \frac{8.81}{1.06^2} + \frac{8.87}{1.06^3} + \frac{8.93}{1.06^4} = 30.62$$

FTE: Summary

- The key steps:
  - Determine the FCFE of the investment.
  - Determine the equity cost of capital.
  - Compute the equity value by discounting the FCFE using the equity cost of capital.

FTE: Summary (Con't)

- Advantages of FTE:
  - It may be simpler to use when calculating the value of equity for the entire firm, if the firm's capital structure is complex and the market values of other securities in the firm's capital structure are not known.
  - It may be viewed as a more transparent method for discussing a project's benefit to shareholders by emphasizing a project's implication for equity.
- FTE has the same disadvantage as APV
  - We must compute the project's debt capacity to determine the interest and net borrowing before capital budgeting decisions can be made.

Project-based Costs of Capital

- Recall that we made some assumptions in the previous example.
  - The project has average risk, so the project's cost of capital can be assessed based on the risk of the firm.
  - The firm maintains a constant debt-equity ratio, so a new project is financed by the same proportion of leverage as the firm's existing asset.
  - Corporate taxes are the only imperfection.
- In the real world, a specific project may have different market risk than the average project for the firm.
  - We cannot use the risk of the firm to assess the project's cost of capital.

Project-based Costs of Capital (Con't)

- In addition, different projects may vary in the amount of leverage they will support.
  - The project's leverage may be different from the leverage of the firm as a whole. Thus, the project's cost of capital is different from that of the firm.
- To calculate the project-based cost of capital, we use the comparable-firms approach and take into account the project's own financing structure.

Example: Project-based Cost of Capital

- Suppose Avco launches a new plastics manufacturing division that faces different market risks than its main packaging business.
- The unlevered cost of capital for the plastics division can be estimated by looking at other single-division plastics firms that have similar business risks.

Example (Con't)

- The characteristics of two such firms are below.

Firm	Equity Cost	Debt Cost	Debt-to-Value Ratio
Comparable #1	12.0%	6.0%	40%
Comparable #2	10.7%	5.5%	25%

- Assuming that both firms maintain a target leverage ratio, the unlevered cost of capital can be estimated by calculating their pretax WACC.

$$r_U^1 = 0.60 \times 12.0\% + 0.40 \times 6.0\% = 9.6\%$$
$$r_U^2 = 0.75 \times 10.7\% + 0.25 \times 5.5\% = 9.4\%$$

- Based on these comparable firms, we estimate an unlevered cost of capital for the plastics division is approximately 9.5%.

Example (Con't)

- To use WACC or FTE method we need to estimate the project's equity cost of capital, which depends on the incremental debt the company will take on as a result of the project.
- A project's equity cost of capital differs from the equity cost of capital for the firm as a whole if the project has a market risk and/or uses a target leverage ratio that is different from the firm's.
- A project's equity cost of capital also differs from that of the comparable firms if the project uses a target leverage ratio that is different from the comparable firms'.

Example (Con't)

- Rearranging terms in **2** to calculate equity cost of capital for the project:

$$r_E = r_U + \frac{D}{E}(r_U - r_D) \quad \textbf{3}$$

where RU is estimated from the average unlevered cost of capital from comparable firms

Example (Con't)

- Now assume that Avco plans to maintain an equal mix of debt and equity financing as it expands into plastics manufacturing, and it expects its borrowing cost to be 6%.
- Given the unlevered cost of capital estimate of 9.5%, the plastics divisions equity cost of capital is estimated to be: $r_E = 9.5\% + \frac{0.5}{0.5}(9.5\% - 6\%) = 13\%$
- Using I we can estimate the division's (after-tax) WACC to be:

$$r_{wacc} = 0.5 \times 13\% + 0.5 \times 6\% \times (1 - 0.4) = 8.3\%$$

- Avco should use a WACC of 8.3% for the plastics division, compared to the WACC of 6.8% for the packaging division that we calculated before.

Project-based WACC: Summary

- Key steps:
  - Calculate the project's unlevered cost of capital. This step is called unlevering the WACC. If the project's market risk if different from the risk of the firm as a whole, we need to look to comparable firms. $r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D$
  - Calculate the project's cost of equity at its target debt-equity ratio. $r_E^{proj} = r_U + \left(\frac{D}{E}\right)^{proj} (r_U - r_D^{proj})$
  - Recalculate the WACC at the project's target capital structure. This step is called re-levering the WACC. $r_{wacc}^{proj} = \left(\frac{E}{E+D}\right)^{proj} r_E^{proj} + \left(\frac{D}{E+D}\right)^{proj} r_D^{proj} (1 - \tau_c)$

Project-based WACC: Summary (Con't)

- Note that the same procedure applies if we want to calculate a firm's WACC at different capital structures. Read the textbook about a common mistake on re-levering the WACC on Page 329.

Lesson Summary

- The weighted average cost of capital (WACC) method
- The adjusted present value (APV) method
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- Project-based cost of capital

End of Lesson