Chapter 18

Valuation and Capital Budgeting for the Levered Firm

McGraw-Hill/Irwin

Key Concepts and Skills

- Understand the effects of leverage on the value created by a project
- Be able to apply the Adjusted Present Value (APV) method, the Flows to Equity (FTE) method, and the WACC method to value projects with leverage
- Be able to apply the above methods to projects with different levels of risk and/or debt financing
- Be able to estimate the cost of capital (and the beta) using the Pure-Play Method

Chapter Outline

18.1 Adjusted Present Value (APV) Approach

18.2 Flows to Equity (FTE) Approach

18.3 Weighted Average Cost of Capital (WACC) Method

18.4 A Comparison of the APV, FTE, and WACC Approaches

18.5 Capital Budgeting When the Discount Rate Must Be Estimated – The Pure-Play Approach

18.6 Advanced APV Analysis (Separate Handout)

18.7 Beta and Leverage

Key Question

- Why might the capital budgeting decision change if a firm has debt in its capital structure?
  - The interaction between financing and investment decisions!
  - Three methods –
    - Adjusted Present Value (APV)
    - Flow to Equity (FTE)
    - Weighted Average Cost of Capital (WACC)

18.1 Adjusted Present Value (APV)

$$APV = NPV + NPVF$$

- The value of a project to the firm can be thought of as the value of the project to an unlevered firm (*NPV*), i.e., discounting UCFs with R_o, plus the present value of the financing side effects (*NPVF*).
- There are four side effects of financing:
  - The Tax Subsidy to Debt
  - The (Flotation) Costs of Issuing New Securities
  - The Costs of Financial Distress
  - Subsidies to Debt Financing

APV Example

- Assume
  - Sales of $650,000/year for indefinite future;
  - Cash costs of 75% of sales;
  - Initial investment of $700,000;
  - Corporate tax rate of 34%;
  - Cost of equity for an all-equity firm, Ro = 16%.
- Calculate the <u>unlevered cash flow (UCF)</u>

APV Example - NPV of all-equity project

- **UCF**
  - $650,000
  - - $487,500 (Cash Costs=0.75*$650,000)
  - = $162,500 i.e., EBIT
  - - $55,250 (Taxes=0.34*$162,500)
  - = **$107,250 i.e., UCF**
- PV of project
  - $107,250 / 0.16 = $670,312.50
- NPV of project (APV Method)
  - $670,312.50 – $700,000 = -$29,687.50

APV Example – NPVF and APV

- APV = NPV + NPVF
  - Where NPVF is T_c*B, i.e., assume perpetual debt, in this example!

- Assume firm uses **$183,145.50*** of debt to finance project (i.e., 25% debt ratio)

  *   Derivation of B in class!!! <Read lecture notes!>

  ➔ -$29,687.50 + 0.34*($183,145.50) = **$32,582**!

  - **This is the APV!**

18.2 Flow to Equity (FTE)

- Discount the levered cash flows (LCFs) from the project to the equity holders of the levered firm at the cost of levered equity capital, R_S.
  - LCF is the residual CF to equity holders after interest has been deducted.

- There are three steps in the FTE method:
  - Step One: Calculate the levered cash flows (LCFs)
  - Step Two: Calculate R_S.
  - Step Three: Discount levered cash flows at R_S to calculate the value of the project to equity holders.

FTE Example - Step 1: Levered CF

- Calculate levered cash flow to equity holders,
  - Assume interest rate of 10% (i.e., R_B)
    - $650,000
    - <u>- $487,500</u>
    - $162,500
    - <u>- $18,315</u> (Interest Exp.=0.10*$183,145.50)
    - $144,185
    - <u>- $49,023</u> (Taxes=0.34*$144,185)
    - $95,162.40 i.e., LCF

FTE Example -Step 2: Calculate R_S

- R_s = 0.16 + (1/3)*(1-0.34)*(0.16-0.10) = 0.1732
  - Recall: $R_s = R_0 + (B/S_L)*(1-T_c)*(R_0 – R_B)$
    - Reference: M&M Proposition II with Corporate Taxes
  - Given that the firm has a target debt ratio of 25%, its debt-to-equity ratio, i.e., B/S_L, is 1/3.

FTE Example - Step 3: Valuation

- LCF / R_s = $95,162.40 / 0.1732 = $549,436.50
  - Valuation of the project's benefits that belong to equity holders

- Subtract the debt portion of the initial investment to get the contributions of equity holders to the project;
  - ➔$(700,000 – 183,145.50) = $516,854.50

- Value of the project to equity holders
  - $(549,436.50 – 516,854.50)= **$32,582**!

18.3 WACC Method

$$R_{WACC} = \frac{S_L}{S_L + B} R_S + \frac{B}{S_L + B} R_B (1 - T_C)$$

- To find the value of the project, discount the unlevered cash flows (UCFs) at the weighted average cost of capital (WACC).

Example – WACC Method

- Calculate WACC
  - 0.10*0.25*(1-0.34) + 0.75*0.1732 = 0.1464

- Discount unlevered cash flows (UCF);
  - UCF = $107,250 (from Slide #6)
  - $107,250 / 0.1464 = $732,582

- NPV = $(732,582 – 700,000) = **$32,582**!

18.4 A Comparison of the APV, FTE, and WACC Methods

- All three methods attempt the same task: valuation in the presence of debt financing.
- Guidelines:
  - Use *WACC* or *FTE* if the firm's (constant) target debt-to-value ***ratio*** applies to the project over the life of the project.
  - Use the *APV* if the project's (constant) ***level*** of debt is known over the life of the project.
- In the real world, the *WACC* method is, by far, the most widely used, and the FTE method is a good choice for a highly levered firm. But the APV method offers a flexible platform for analyzing complicated financing effects!

Summary: APV, FTE, and WACC

	APV	WACC	FTE
Initial Investment	All	All	Equity Portion
Cash Flows	*UCF*	*UCF*	*LCF*
Discount Rates	R_0	R_{WACC}	R_S
PV of financing effects	Yes	No	No

18.5 Capital Budgeting When the Discount Rate Must Be Estimated

- A *scale-enhancing* project is one where the project is similar to those of the existing firm.
- In the real world, executives would make the assumption that the business risk of the non-scale-enhancing project would be about equal to the business risk of firms already in the business.
- No exact formula exists for this. Some executives might arbitrarily elect a discount rate slightly higher on the assumption that the new project is somewhat riskier since it is a new entrant.

The **Pure-Play Method** for Discount Rate Estimation

- **Select the comparable**
  - Determine comparable firm(s) with similar business risk
- **Estimate comparable firm's (equity) beta and hence its Rsc**
  - Estimate the equity beta of each comparable firm
- **Unlever the comparable firm's equity beta (➔ asset beta) and hence Ro**
  - Unlever the equity beta of each comparable, i.e., removing the financial risk component and hence reflecting only the business risk component of the equity beta
- **Lever the beta for the project's financial risk & Rs**
  - Lever the asset beta of the project by adjusting the asset beta for the financial risk of the project

Example – Discount rate estimation w/ M&M equations and the Pure-Play Method

- WWE – conglomerate firm
  - Seeking to invest in widget business
  - Will finance projects with 25% debt to 75% equity
  - Borrowing cost is 10%
- Challenge – estimate the cost of capital for widget business

Example – Discount rate estimation w/ M&M equations and the Pure-Play Method

- AW – a single product widget firm (i.e., c)
  - Capital structure is 40% debt and 60% equity
  - Beta is 1.5
  - Cost of debt is 12%

Market Information

- Corporate tax rate is 21%
- Market risk premium (MRP) is 8.5%
- Risk-free interest rate (Rf) is 8%

Calculate discount rate for widget venture (the Pure-Play Method)

- Steps:
  1. Calculate AW's cost of equity, Rsc
  2. Unlever this cost of equity for Ro
  3. Lever it back up, using WWE's debt/equity ratio, cost of debt and tax rate
  4. Calculate R_S and WACC for WWE

Step 1 - Calculate cost of equity for AW

- $R_s = R_f$ + beta*(MRP) i.e., CAPM
- Apply for AW (the single product widget firm, c)
  - 0.08 + 1.5*(0.085) = 0.2075, i.e., Rsc

Step 2 - Unlever

Calculate AW's cost of equity (with leverage) and then unlever it.

- $R_S = R_O + B/S_L * (R_O - R_B) * (1 - T_C)$
  - ➔ $0.2075 = R_o + (0.4/0.6)*(R_o - 0.12)*(1-0.21)$
  - ➔ $\mathbf{R_o} = 0.1773$

The APV method stops here because Ro is the choice of the discount rate for unlevered cash flows in calculating the project value (ref. slide #15)!

Step 3 - Relever

- Calculate the cost of levered equity, at WWE's debt level;

- $R_S = R_O + B/S_L * (R_O - R_B) * (1 - T_C)$

$R_S = 0.1825 + (0.25/0.75)*(0.1825-0.10)*(1-0.4)$

Hence, $\mathbf{R_S} = 0.1990$

Note: This is WWE's levered cost of equity, R_S!

Step 4 – R_S and WACC

- The relevered cost of equity, R_S, is used in the Flow to Equity (FTE) method to discount levered cash flows in calculating project value.
- Use the relevered cost of equity for WWE in the WACC equation, and use the relevered WACC to discount unlevered cash flows in calculating project value.
- Reference: Slide #15!

Pure Play Method - Example

XY, Inc. plans to expand its manufacturing facilities and start producing a new type of artificial stone for outdoor patios. The project will have a debt-to-equity ratio of .40 and a pre-tax cost of debt of 8%. ABC, the sole firm producing this product now, has a pre-tax cost of debt of 7.5%, a debt-to-value ratio of .20, and a beta of 1.4. Both firms have a 35% tax rate. The risk-free rate of return is 4.5% and the market rate of return is 12%.

What is ABC's cost of equity capital?

What is the hypothetical all-equity cost of capital?

What is XY's cost of equity capital?

What is XY's weighted average cost of capital?

Pure Play Method - Example

ABC's cost of equity capital:

$$R_S = R_F + \beta \times (\bar{R}_M - R_F)$$
$$= .045 + 1.4(.12 - .045)$$
$$= .1500$$
$$= 15\%$$

Hypothetical all-equity cost of capital:

$$R_S = R_0 + \frac{B}{S}(1 - t_c)(R_0 - R_B)$$
$$.15 = R_0 + \frac{.20}{1 - .20}(1 - .35)(R_0 - .075)$$
$$.15 = R_0 + .1625R_0 - .0121875$$
$$.1621875 = 1.1625R_0$$
$$R_0 = .139516$$
$$R_0 = 13.95\%$$

Pure Play Method - Example

XY's cost of equity capital:

$$R_S = R_0 + \frac{B}{S}(1 - t_c)(R_0 - R_B)$$

$$R_S = .1395 + \frac{.40}{1}(1 - .35)(.1395 - .08)$$

$$R_S = .1395 + .01547$$

$$R_S = .15497$$

$$R_S = 15.50\%$$

XY's weighted average cost of capital:

$$R_{WACC} = \frac{B}{S+B} R_B (1 - t_c) + \frac{S}{S+B} R_S$$

$$= \frac{.4}{1.4}(.08)(1 - .35) + \frac{1}{1.4}(.155)$$

$$= .01486 + .11071$$

$$= .12557$$

$$= 12.56\%$$

18.7 Beta and Leverage

- Recall that an asset beta would be of the form:

$$\beta_{\text{Asset}} = \frac{Cov(UCF, Market)}{\sigma^2_{\text{Market}}}$$

Beta and Leverage: NO Corporate Taxes

- In a world without corporate taxes, and with **riskless** corporate debt ($\beta_{Debt} = 0$), it can be shown that the relationship between the beta of the unlevered firm and the beta of levered equity is:

$$\beta_{Asset} = \frac{\text{Equity}}{\text{Asset}} \times \beta_{Equity}$$

- In a world without corporate taxes, and with **risky** corporate debt, it can be shown that the relationship between the beta of the unlevered firm and the beta of levered equity is:

$$\beta_{Asset} = \frac{\text{Debt}}{\text{Asset}} \times \beta_{Debt} + \frac{\text{Equity}}{\text{Asset}} \times \beta_{Equity}$$

Beta and Leverage: With Corporate Taxes

- In a world with corporate taxes, and riskless debt, it can be shown that the relationship between the beta of the unlevered firm and the beta of levered equity is:

$$\beta_{\text{Equity}} = \left(1 + \frac{\text{Debt}}{\text{Equity}} \times (1 - T_C)\right) * \beta_{\text{Unlevered firm}}$$

- Since $\left(1 + \frac{\text{Debt}}{\text{Equity}} \times (1 - T_C)\right)$ must be greater than 1 for a

levered firm, it follows that $\beta_{\text{Equity}} > \beta_{\text{Unlevered firm}}$

Example

- Suppose the equity beta for a pure play firm is equal to 2, debt/equity ratio is .5, and the firm's tax rate is 34%.

- Unlever this beta
  - ➔ $\beta_u = \beta_L \ / \ (1 + B/S_L * (1\text{-}Tc))$
  - ➔ $\beta_u = 2 \ / \ (1 + 0.5*(0.66)) = 1.5038$

- Relever it for a firm with 50% debt.
  - ➔ $\beta_L = 1.5038*(1+1*(1-0.34)) = 2.50$

Beta and Leverage: With Corporate Taxes and Risky Debt

- If the debt beta is non-zero, then:

$$\beta_{\text{Equity}} = \beta_{\text{Unlevered firm}} + (1 - T_C) * (\beta_{\text{Unlevered firm}} - \beta_{\text{Debt}}) \times \frac{B}{S_L}$$

- Note that this is the general case while slides 29 and 30 represent special cases:
  - Slide 29: Both tax rate and debt beta are zero,
    - i.e., Tc=0 and β_{Debt} =0!
  - Slide 30: Debt beta is zero, i.e., β_{Debt} =0!

Beta and Leverage - Example

- Company A is considering expanding its operations. Currently, the market value of the firm's equity is $116 million while the market value of debt is $72 million. The equity has a beat of 1.8 and the debt is riskless. The risk free rate is 5.5%. The expected return on the market is 13.7% and the tax rate is 34%.
- What is the beta of a hypothetical all-equity firm given the information on Company A? Given that beta, what discount rate should be applied to the expansion project?

Beta and Leverage - Example

$$
\begin{aligned}
B_{\text{Unlevered firm}} &= \frac{\text{Equity}}{\text{Equity} + (1 - t_c) \times \text{Debt}} \times B_{\text{Equity}} \\
&= \frac{\$116 \text{ million}}{\$116 \text{ million} + (1 - .34) \times \$72 \text{ million}} \times 1.8 \\
&= \frac{\$116 \text{ million}}{\$163.52 \text{ million}} \times 1.8 \\
&= 1.28
\end{aligned}
$$

$$
\begin{aligned}
R_S &= R_F + \beta \times [R_M - R_F] \\
&= .055 + 1.28 \times (.137 - .055) \\
&= .15996 \\
&= 16.00\%
\end{aligned}
$$

Summary

The APV formula can be written as:

$$APV = \sum_{t=1}^{\infty} \frac{UCF_t}{(1+R_0)^t} + \begin{matrix}\text{Additional} \\ \text{effects of} \\ \text{debt}\end{matrix} - \begin{matrix}\text{Initial} \\ \text{investment}\end{matrix}$$

The FTE formula can be written as:

$$FTE = \sum_{t=1}^{\infty} \frac{LCF_t}{(1+R_S)^t} - \left(\begin{matrix}\text{Initial} \\ \text{investment}\end{matrix} - \begin{matrix}\text{Amount} \\ \text{borrowed}\end{matrix} \right)$$

The WACC formula can be written as:

$$NPV_{WACC} = \sum_{t=1}^{\infty} \frac{UCF_t}{(1+R_{WACC})^t} - \begin{matrix}\text{Initial} \\ \text{investment}\end{matrix}$$

Summary

- Use the WACC or FTE if the firm's target debt to value ratio applies to the project over its life.
  - WACC is the most commonly used by far.
  - FTE has appeal for a firm deeply in debt.
- The APV method is used if the level of debt is known over the project's life.
  - The APV method is frequently used for special situations like interest subsidies, LBOs, and leases.
- The beta of the equity of the firm is positively related to the leverage of the firm.

Quick Quiz

- Explain how leverage impacts the value created by a potential project.
- Identify when it is appropriate to use the APV method? The FTE approach? The WACC approach?

Additional APV Example
(Finite Term Bond)

Consider a project of the Pearson Company. The timing and size of the ***incremental after-tax cash flows*** for an all-equity firm, i.e., **UCFs**, are:

0	1	2	3	4
–\$1,000	\$125	\$250	\$375	\$500

The unlevered cost of equity is $\boldsymbol{R_0}$ = 10%:

$$NPV_{10\%} = -\$1{,}000 + \frac{\$125}{(1.10)} + \frac{\$250}{(1.10)^2} + \frac{\$375}{(1.10)^3} + \frac{\$500}{(1.10)^4}$$

$$NPV_{10\%} = -\$56.50$$

The project would be rejected by an all-equity firm: $NPV < 0$.

Additional APV Example

- Now, imagine that the firm finances the project with \$600 of debt at R_B = 8%.
- Pearson's tax rate is 40%, so they have an interest tax shield of $T_C * B * R_B$ = 0.40×\$600×0.08 = \$19.20 each year.

- The net present value of the project under leverage is:

$$APV = NPV + NPV_{\text{debt tax shield}}$$

$$APV = -\$56.50 + \sum_{t=1}^{4} \frac{\$19.20}{(1.08)^t}$$

$$APV = -\$56.50 + 63.59 = \$7.09$$

- So, Pearson should accept the project *with debt*.

Additional FTE Example - Step One: Levered Cash Flows (LCFs)

- Since Pearson Company is using \$600 of debt, the equity holders only have to provide \$400 of the initial \$1,000 investment.
  - Thus, Equity holders' CF_0 = –\$400

- Each period, the equity holders must pay interest expense. The annual *after-tax interest expense* is:

$$B \times R_B \times (1 - T_C) = \$600 \times 0.08 \times (1 - 0.40) = \$28.80$$

Step One: Levered Cash Flows (LCFs)

$LCF_4 = \$(500–28.80) – \$600$

$LCF_3 = \$(375–28.80)$

$LCF_2 = \$(250–28.80)$

$LCF_1 = \$(125–28.80)$

0	1	2	3	4
–\$400	\$96.20	\$221.20	\$346.20	–\$128.80

Step Two: Calculate R_S

$$R_S = R_0 + \frac{B}{S_L} * (1 - T_C) * (R_0 - R_B)$$

To calculate the debt to equity ratio, $\frac{B}{S_L}$, start with $\frac{B}{V_L}$

$$V_L = \frac{\$125}{(1.10)} + \frac{\$250}{(1.10)^2} + \frac{\$375}{(1.10)^3} + \frac{\$500}{(1.10)^4} + \sum_{t=1}^{4} \frac{19.20}{(1.08)^t}$$

➔ $V_L = \$943.50 + \$63.59 = \$1{,}007.09$

Given $B = \$600$ and $V_L = \$1{,}007.09$, $S_L = \$407.09$.

$$R_S = 0.10 + \frac{\$600.0}{\$407.09} * (1 - 0.40) * (0.10 - 0.08) = 0.1177$$

Step Three: Valuation

- Discount the cash flows to equity holders at R_S = 11.77%

–$400	$96.20	$221.20	$346.20	–$128.80
0	*1*	*2*	*3*	*4*

$$NPV = -\$400 + \frac{\$96.20}{(1.1177)} + \frac{\$221.20}{(1.1177)^2} + \frac{\$346.20}{(1.1177)^3} - \frac{\$128.80}{(1.1177)^4}$$

$$NPV = \$28.56$$

- **Note:** If we use Rs=11.8% (see slide 42 footnote), value of the project to equity holders will be $28.32!

Additional WACC Example

Suppose Pearson's target debt to equity ratio is 1.50 (reference slides 38 & 39!)

$$R_{WACC} = 0.40 \times 0.1177 + 0.60 \times 0.08 \times (1 - .40)$$
$$R_{WACC} = 0.0758$$

Note: If we use Rs=11.8% (see slide 42 footnote), WACC = 0.0760!

Additional WACC Example

- To find the value of the project, discount the unlevered cash flows (UCFs; slide 38) at the weighted average cost of capital (WACC) –

$$NPV = -\$1{,}000 + \frac{\$125}{(1.0758)} + \frac{\$250}{(1.0758)^2} + \frac{\$375}{(1.0758)^3} + \frac{\$500}{(1.0758)^4}$$

$$NPV_{7.58\%} = \$6.68$$

- Note: If we use WACC=7.60%, NPV = $6.14!