WACC and APV

The Big Picture: Part II - Valuation

A. Valuation: Free Cash Flow and Risk
- April 1 Lecture: Valuation of Free Cash Flows
- April 3 Case: Ameritrade

B. Valuation: WACC and APV
- April 8 Lecture: WACC and APV
- April 10 Case: Dixon Corporation
- April 15 Case: Diamond Chemicals

C. Project and Company Valuation
- April 17 Lecture: Real Options
- April 24 Case: MW Petroleum Corporation
- April 29 Lecture: Valuing a Company
- May 1 Case: Cooper Industries, Inc.
- May 6 Case: The Southland Corporation

What Next?

- We need to incorporate the effects of financial policy into our valuation models.

⇒ Question: How do we incorporate debt tax shields (if any) into our valuation?

Two Approaches:

- **Weighted Average Cost of Capital (WACC):**
  → Discount the FCF using the weighted average of after-tax debt costs and equity costs

$$WACC = k_D(1-t)\frac{D}{D+E} + k_E\frac{E}{D+E}$$

- **Adjusted Present Value (APV):**
  → Value the project as if it were all-equity financed
  → Add the PV of the **tax shield** of debt and other side effects

Recall: ***Free Cash Flows*** are cash flows available to be paid to all capital suppliers ignoring interest rate tax shields (i.e., as if the project were 100% equity financed).

WACC

Weighted Average Cost of Capital (WACC)

- Step 1: Generate the Free Cash Flows (FCFs)
- Step 2: Discount the FCFs using the WACC

$$WACC = k_D(1-t)\frac{D}{D+E} + k_E\frac{E}{D+E}$$

WARNING!!!

- The common intuition for using WACC is:
  - → "To be valuable, a project should return more than what it costs us to raise the necessary financing, i.e., our WACC"
  - → This intuition is wrong.

- Using WACC this way is OK sometimes... but "by accident".
- Most of the time, it is plain wrong:
  - → conceptually, i.e., the logic is flawed
  - → practically, i.e. gives you a result far off the mark

Discount rates and hence the WACC are project specific!

Weighted Average Cost of Capital (WACC)

- **Discount rates are project-specific**

==> Imagine the project is a stand alone, financed as a separate firm.
==> The WACC inputs should be project-specific as well:

$$WACC = k_D(1-t)\frac{D}{D+E} + k_E\frac{E}{D+E}$$

- Let's look at each WACC input in turn:

Leverage Ratio D/(D+E)

- D/(D+E) should be the target capital structure (in market values) for the particular project under consideration.
- Common mistake 1:
  - → Using a priori D/(D+E) of the firm undertaking the project.
- Common mistake 2:
  - → Use D/(D+E) of the project's financing
  - → Example: Using 100% if project is all debt financed.

Caveat: We will assume that the target for A+B is the result of combining target for A and target for B. It's OK most of the time.

Leverage Ratio (cont.)

- So how do we get that "target leverage ratio"?
- Use comparables to the project:
  - → "Pure plays" in the same business as the project
  - → Trade-off: Number vs. "quality" of comps
- Use the firm undertaking the project if the project is very much like the rest of the firm (i.e. if the firm is a comp for the project).
- Introspection, improved by checklist,...

Important Remark:

- If the project maintains a relatively stable D/V over time, then WACC is also stable over time.
- If not, then WACC should vary over time as well and we should compute a different WACC for each year.
- In practice, firms tend to use a constant WACC.
- So, in practice, the WACC method does not work well when the capital structure is expected to vary substantially over time.

Cost of Debt Capital: k_D (cont.)

- Can often look it up: Should be close to the interest rate that lenders would charge to finance the project with the chosen capital structure.
- Caveat: Cannot use the interest rate as an estimate of k_D when:
  - → Debt is very risky. We would need default probabilities to estimate expected cash flows.
  - → If there are different layers of debt. We would need to calculate the average interest rate.

Marginal Tax Rate: t

- It's the marginal tax rate of the firm undertaking the project (or to be more precise, of the firm including the project).
- Note that this is the rate that is going to determine the tax savings associated with debt.
- We need to use the marginal as opposed to average tax rate t.
  - → In practice, the marginal rate is often not easily observable.

Cost of Equity Capital: k_E

- Cannot look it up directly.
- Need to estimate k_E from comparables to the project:
  - → "Pure Plays", i.e. firms operating only in the project's industry.
  - → If the firm undertaking the project is itself a pure play in the project's industry, can simply use the k_E of the firm.
- Problem:
  - → A firm's capital structure has an impact on k_E
  - → Unless we have comparables with same capital structure, we need to work on their k_E before using it.

Using CAPM to Estimate k_E

1) Finds comps for the project under consideration.

2) **Unlever** each comp's β_E (**using the comp's D/(D+E)**) to estimate its β_A. When its debt is not too risky (and its D/V is stable), we can use:

$$\beta_A = \beta_E \frac{E}{E+D}$$

3) Use the comps' β_A to estimate the project's β_A (e.g. take the average).

4) **Relever** the project's estimated β_A (**using the project's D/(D+E)** to estimate its β_E under the assumed capital structure. When the project's debt is not too risky (and provided its D/V is stable), we can use:

$$\beta_E = \frac{E+D}{E}\beta_A = \left[1+\frac{D}{E}\right]\beta_A$$

5) Use the estimated β_E to calculate the project's cost of equity k_E:

$$k_E = r_f + \beta_E * \text{Market Risk Premium}$$

Remarks on Unlevering and Relevering:

- Formulas:
  → Relevering formulas are reversed unlevering formulas.
- Procedure:
  → Unlever each comp, i.e., one unlevering per comp.
  → Estimate one β_A by taking the average over all comps' β_A possibly putting more weight on those we like best.
  → This is our estimate of the project's β_A.
  → Relever that β_A.
- In the course, we use mostly the formula for a constant D/(D+E).

More on Business Risk and Financial Risk

$$\beta_A = \beta_E \frac{E}{E+D} \quad \Leftrightarrow \quad \beta_E = \left(1 + \frac{D}{E}\right) \times \beta_A \quad \Leftrightarrow \quad \beta_E - \beta_A = \frac{D}{E} \times \beta_A$$

- Comparable firms have similar **Business Risk**

==> Similar asset beta β_A and, consequently, similar unlevered cost of capital k_A

- Comparable firms can have different **Financial Risk** (different β_E- β_A) if they have different capital structures

==> Different equity beta β_E and thus different required return on equity k_E

- In general, equity beta β_E increases with D/E
  - $\rightarrow$ Consequently the cost of equity k_E increases with leverage.

Business Risk and Financial Risk: Intuition

- Consider a project with β_A>0
- Its cash flows can be decomposed into:
  - $\rightarrow$ Safe cash-flows
  - $\rightarrow$ Risky cash-flows that are positively correlated with the market.
- As the level of debt increases (but remains relatively safe):
  - $\rightarrow$ A larger part of the safe cash-flows goes to debtholders;
  - $\rightarrow$ The residual left to equityholders is increasingly correlated with the market.

Note: If cash-flows were negatively correlated with the market (β_A<0), increasing debt would make equity more negatively correlated with the market and would reduce the required return on equity.

WACC – A simple example:

You are evaluating a new project. The project requires an initial outlay of $100 million and you forecast before-tax profits of $25 million in perpetuity. The marginal tax rate is 40%, the project has a target debt-to-value ratio of 25%, the interest rate on the project's debt is 7%, and the cost of equity is 12%.

After-tax CFs = $25 $\times$ 0.60 = $15 million

After-tax WACC = $D/V * (1–t) * r_d + E/V * r_e$

$= 0.25 \times 0.60 \times 0.07 + 0.75 \times 0.12 = 10.05\%$

NPV = -100 + 15 / 0.1005 = $49.25 million

How Firms Tend to Use WACC:

They calculate their WACC using:

- Their current cost of debt k_D
- Their own current capital structure D/(D+E)
- Their own current cost of equity capital k_E
- The marginal tax rate they are facing

They discount all future FCF with:

- this (single) discount rate
- maybe adjusted for other things (e.g., project's "strategic value")

$\Rightarrow$ This practical approach can be very misleading, especially if the new project is very different from the firm undertaking it.

Selected Industry Capital Structures, Betas, and WACCs

Industry	Debt ratio (%)	Equity beta	Asset beta	WACC (%)
Electric and Gas	43.2	0.58	0.33	8.1%
Food production	22.90	0.85	0.66	11.0%
Paper and plastic	30.40	1.03	0.72	11.4%
Equipment	19.10	1.02	0.83	12.4%
Retailers	21.70	1.19	0.93	13.2%
Chemicals	17.30	1.34	1.11	14.7%
Computer software	3.50	1.33	1.28	16.2%
Average of all industries	21.50	1.04	0.82	12.3%
Assumptions: Risk-free rate 6%; market risk premium 8%; cost of debt 7.5%; tax rate 35%				

APV

Adjusted Present Value

- Separates the effects of financial structure on value from the estimation of asset values.
- **Step 1:** Value the project or firm as if it were 100% equity financed.
- **Step 2:** Add the value of the tax shield of debt.

Note:

- This is simply applying MM-Theorem with taxes
- APV = Valuation by Components = ANPV

Step 1: Value as if 100% Equity Financed

- Cash-flows: Free Cash Flows are exactly what you need.
- You need the rate that would be appropriate to discount the firm's cash flows if the firm were 100% equity financed.
- This rate is the expected return on equity if the firm were 100% equity financed.
- To get it, you need to:
  - → Find comps, i.e., publicly traded firms in same business.
  - → Estimate their expected return on equity if they were 100% equity financed.

Step1: Value if 100% Equity Financed (cont.)

- Unlever each comp's β_E to estimate its asset beta (or all equity or unlevered beta) β_A using the appropriate unlevering formula

$$\beta_A = \beta_E \frac{E}{E+D} \quad \text{or} \quad \beta_A = \beta_E \frac{E}{E+(1-t)D}$$

- Use the comps' β_A to estimate the project's β_A (e.g. average).
- Use the estimated β_A to calculate the all-equity cost of capital k_A

$$k_A = r_f + \beta_A * \text{Market Risk Premium}$$

- Use k_A to discount the project's FCF

Step 2: Add PV(Tax Shield of Debt)

- Cash-flow: The expected tax saving is tk_DD where k_D is the cost of debt capital (discussed earlier).
- If D is expected to remain stable, then discount tk_DD using k_D

$$PVTS = tk_DD/\ k_D = tD$$

- If D/V is expected to remain stable, then discount tk_DD using k_A

$$PVTS = tk_DD/\ k_A$$

- Intuition:
  - → If D/V is constant, D (tk_DD) and thus moves up/down with V
  - → The risk of tk_DD is similar to that of the firm's assets: use k_A

Step 2: Add PVTS (cont.)

- For many projects, neither D nor D/V is expected to be stable.
- For instance, LBO debt levels are expected to decline.
- In general you can estimate debt levels using:
  → repayment schedule if one is available,
  → financial forecasting
  and discount by a rate between k_D and k_A.

Extending the APV Method

- One good feature of the APV method is that it is easy to extend to take other effects of financing into account.
- For instance, one can value an interest rate subsidy separately as the PV of interest savings.

APV= NPV(all-equity) + PV(Tax Shield) + PV(other stuff)

WACC vs. APV

Pros of WACC: Most widely used

- Less computations needed (important before computers).
- More literal, easier to understand and explain (?)

Cons of WACC:

- Mixes up effects of assets and liabilities. Errors/approximations in effect of liabilities contaminate the whole valuation.
- Not very flexible: What if debt is risky? Cost of hybrid securities (e.g., convertibles)? Other effects of financing (e.g., costs of distress)? Non-constant debt ratios? Personal taxes?

Note: For non-constant debt ratios, could use different WACC for each year (see appendix) but this is heavy and defeats the purpose.

WACC vs. APV (cont.)

Advantages of APV:

- No contamination.
- Clearer: Easier to track down where value comes from.
- More flexible: Just add other effects as separate terms.

Cons of APV:

- Almost nobody uses it.

Overall:

- For complex, changing or highly leveraged capital structure (e.g., LBO), APV is much better.
- Otherwise, it doesn't matter much which method you use.

Appendix I - Relation to MM Theorem

Relation to MM Theorem

- Without taxes, WACC is independent of leverage.
- Indeed, for simplicity, think in terms of CAPM (although the result does not rely on CAPM being true).

$$\begin{aligned} WACC &= k_D \frac{D}{D+E} + k_E \frac{E}{D+E} \\ &= \left[r_f + \beta_D \cdot \text{Mkt Prem.} \right] \frac{D}{D+E} + \left[r_f + \beta_E \cdot \text{Mkt Prem.} \right] \frac{E}{D+E} \\ &= r_f + \left[\beta_D \frac{D}{D+E} + \beta_E \frac{E}{D+E} \right] \cdot \text{Mkt Prem.} \\ &= r_f + \beta_A \cdot \text{Mkt Prem.} \end{aligned}$$

- The last expressions does not contain leverage – WACC does not depend on it.

The WACC Fallacy (Revisited)

- The cost of debt is lower than the cost of equity (true).
- Does this mean that projects should be financed with debt?

$$WACC = k_D \frac{D}{D+E} + k_E \frac{E}{D+E}$$

- No: WACC is independent
- As you are tapping into cheap debt, you are increasing the cost of equity (its financial risk increases).

Without taxes, WACC is independent of leverage: