DISCOUNTED CASH FLOW VALUATION METHODS

DCF Valuation

1. Risk Adjustments: Comparison Method and the Leverage Effect
2. Effects of Corporate Taxation on Valuation
3. Adjusted Present Value (APV) Method
4. Weighted Average Cost of Capital (WACC)
5. Terminal Value Calculations

1. Risk-Adjusted Discounting: Comparison Method and the Leverage Effect

Consider a risky cash flow at a single future date, and, <u>for now, ignore corporate taxes</u>. Our objective is to find the cash flow's PV:

<u>t = 0</u>	<u>t = 1</u>
PV	$\tilde{C}$

- Ideally, would like to apply the "tracking portfolio approach", i.e., find a portfolio of traded assets that will generate the same risky cash flow
- But perfect tracking is not always feasible
- So we typically resort to <u>discounted cash flow valuation</u>: discount the expected cash flow at a <u>cost of capital</u> that matches the expected returns of assets with similar exposures to priced risk factors

$\underline{t = 0}$	$\underline{t = 1}$
PV	$\tilde{C}$

Risk-adjusted discounting using C.A.P.M.:

$$PV = \frac{E(\tilde{C})}{1 + \underbrace{r_f + \beta\left(\overline{r}_M - r_f\right)}_{\text{Project's cost of capital}}}$$

- Alternatively, one can use a multifactor model to compute the cost of capital

- Inputs we need for risk-adjusted discounting:
  - Expected cash flow: Estimate, based on projections, simulations, etc.
  - The risk-free rate: Observable. In theory the short-term T-bill rate, in practice often a higher rate is used (e.g. 10-year Treasury)
  - Market risk premium: Estimate (or guesstimate?). Historically about 7%, possibly much lower going forward (~ 3-4%?)
  - **<u>The Project Beta</u>: How do we compute this?**
    - What we need is a beta that measures the exposure of project returns to market risk
    - Is this the same as <u>our own firm's equity beta</u>?

- In practice "***The Comparison Method"*** is commonly used to compute the project beta:

Use stock returns of comparable businesses to estimate risk of the business

Procedure:

1. Identify a set of companies in the same business (i.e. in the same risk class) – can include own firm <u>if appropriate</u>
   - Why might the firm itself not be a good comp?
     - ➢ Differences in business composition
     - ➢ Differing risks of assets-in-place vs. growth opportunities
2. Obtain companies' equity betas (via regressions of equity returns on market returns)
3. Adjust for <u>leverage</u>
4. Adjust for taxes (we will examine tax adjustments shortly)

- Why do we adjust for leverage?

  - We want the beta of comparable businesses (i.e., project, or asset beta)
  - We observe the beta of one of the claims to those assets (the equity beta)
  - The amount of debt financing (leverage) affects the equity beta

  Hence:

  - We need to adjust the beta of the equity in order to recover the beta of the assets

Example – The leverage effect:

	t = 0	t = 1	t = 2	t = 3	Annual Returns
Asset Value	100	120	80	100	20%, −33%, 25%
Equity Value	100	120	80	100	20%, −33%, 25%
Equity Value	50	70	30	50	40%, −57%, 67%

Scenario 1: All-equity financing

Scenario 2: 50% debt financing

Initially borrow 50 and roll over the debt annually; assume zero interest on the debt

Note how leverage amplifies project returns

- The comparison firm's equity beta will be higher in Scenario 2
- We need to "undo" the leverage effect so that our estimate of the asset risk is not arbitrarily inflated

Let's see the leverage effect on a balance sheet in market values (recall that so far we ignore corporate taxes):

Assets	Liabilities
A	D
	E

Present value of the firm's future cash flows

Market values of debt and equity

Balance sheet identity $\Rightarrow$ $\beta_{\text{Assets}} = \beta_{\text{Liabilities}}$ + Portfolio intuition:

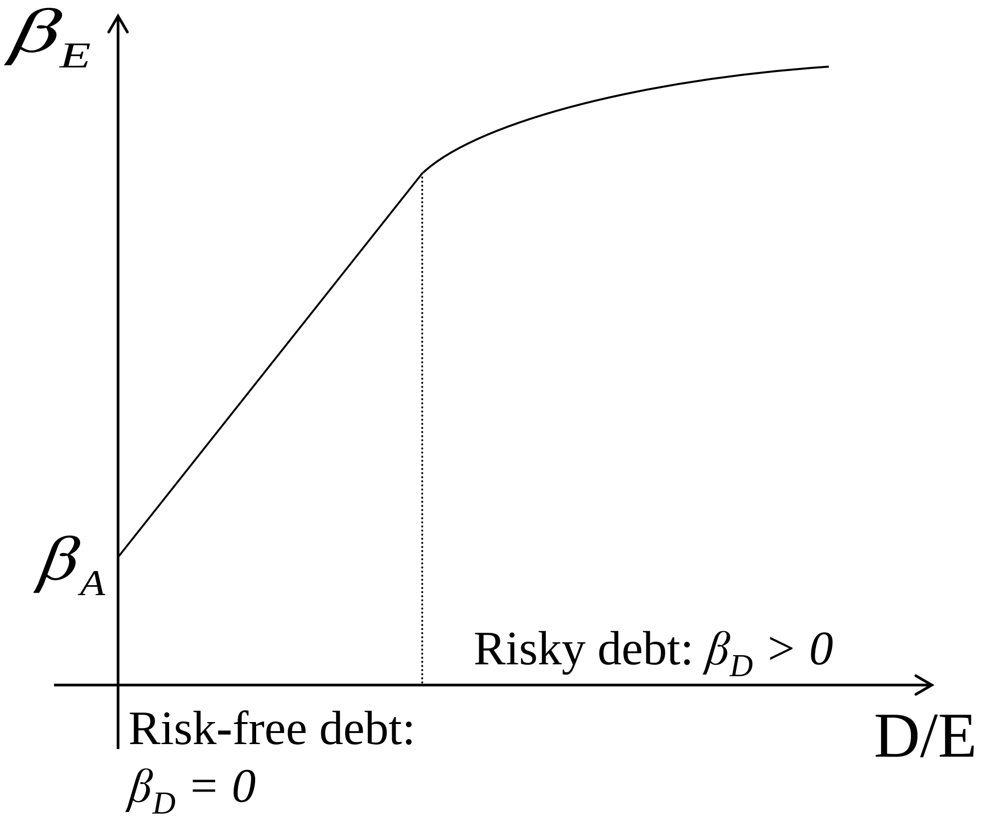
$$\boxed{\beta_A = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E}$$

If debt is risk-free, then $\beta_D = 0$, and so:

$$\boxed{\beta_A = \frac{E}{D+E}\beta_E \quad \Rightarrow \quad \beta_E = \left(1 + \frac{D}{E}\right)\beta_A}$$

$$\boldsymbol{\beta}_A = \frac{D}{D+E}\boldsymbol{\beta}_D + \frac{E}{D+E}\boldsymbol{\beta}_E$$

Graphically:



- We will derive similar formulas later in this note, but ones that take into account corporate tax effects as well

2. Effects of Corporate Taxation on Valuation

(a) Cash flow effects

– A project's value depends on its total cash flows (to be shared between shareholders and debtholders)

– Corporate taxes reduce project's total cash flows

– Since interest payments are treated as an expense, debt financing reduces taxes paid and so increases after-tax total cash flows (tax shields of debt)

– Useful cash flow decomposition:

CF after taxes = Free Cash Flows + Tax shield due to debt

- Recall that FCF is the after-tax cash flow that would be generated by the project if the firm was all-equity financed

- Tax shield is the reduction in the tax bill due to interest expense

- How to compute the FCF and the Tax Shield?
  - Starting with EBIT:

$$FCF = (1 - \text{Tax Rate}) \times EBIT + \left\{ \begin{array}{c} + \text{ Depreciation and Amortization} \\ - \text{ Change in Working Capital} \\ - \text{ Capital Expenditures} \\ + \text{ Sales of Assets} \\ - \text{ Realized Capital Gains} \\ + \text{ Realized Capital Losses} \end{array} \right\}$$

or equivalently,

$$\boxed{FCF = \text{Pretax } CF - \text{Tax Rate} \times EBIT}$$

Then:

$$\boxed{\text{Tax Shield} = \text{Tax Rate} \times EBIT - \text{Actual Tax Paid}}$$

Notice that, for the FCF calculation:

– We ignored interest payments

– We computed taxes on EBIT

- Do not take the effect of financing (e.g. interest) into account at this stage!

- Remember:
  - First, determine the expected cash flows as if the project were 100% equity financed
  - Later, we will adjust for financing

- **If you count financing costs in free cash flows and then adjust, you count them twice!**

(b) Risk effects

– Start with CF decomposition**:**

CF after taxes = FCF + Tax shield

– How risky are these two components?

- FCF reflects “business risk” (e.g., some businesses have higher betas than others)
- How risky is the tax shield? Is it the same as business risk?

– What are the proper discount rates for these two components?

- The riskiness of future tax shields should determine their present value

Let's look at the firm's market-value balance sheet once again:

Real Assets		Assets	Liabilities	Financial Assets
PV of FCF	→	Unlevered assets = UA	D	
PV of Tax Shields	→	Tax Savings = TXA	E	

Again, think of each side of the balance sheet as a portfolio of its components:

$$\beta_{\text{Real Assets}} = \frac{UA}{D+E}\beta_{UA} + \frac{TXA}{D+E}\beta_{TXA} \quad \text{and} \quad \beta_{\text{Financial Assets}} = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D$$

Let T_C be the corporate tax rate. If firm's debt **<u>risk-free</u>** and is **<u>constant over time,</u>** then

$$TXA = \text{ PV of } \left(T_C \times \underbrace{r_D \times D}_{\text{Annual Interest Expense}}\right) = \frac{T_C \times r_D \times D}{r_D} = T_C \times D$$

Using this value for TXA, the balance sheet identity $\beta_{\text{Real Assets}} = \beta_{\text{Financial Assets}}$, and the fact that $\beta_D = \beta_{TXA} = 0$ with risk-free debt, we get

Unlevered Beta <u>Version 1</u>: When D is constant over time

$$\boxed{\beta_{UA} = \frac{\beta_E}{\left[1 + (1 - T_c)\frac{D}{E}\right]}}$$

Other debt policies (i.e., when *D* is not constant over time):

What if the firm changes *D* dynamically to maintain a target D/E ratio?

- Targeting a *D/E* ratio is a more realistic approximation for the evolution of the firm's debt than assuming constant *D*
- With a *D/E* target, future tax shields are as risky as the FCFs:
    - The amount of debt *D* in future years is perfectly correlated with the value of unlevered assets (*UA*)
        - As the value of the project changes over time, *D* will change to keep track
        - E.g., if the business grows faster than initially expected, the firm issues more debt to keep *D/E* at target
    - As *D* changes, so does the interest expense $r_D \times D$, and the tax shield $T_c \times r_D \times D$

– Thus, the tax shields should be discounted approximately* at the same rate as FCF:

$$\beta_{TXA} \approx \beta_{UA} \qquad \text{and} \qquad \bar{r}_{TXA} \approx \bar{r}_{UA}$$

– Assume $\beta_{TXA} = \beta_{UA}$ and derive the formula for unlevered beta again:

Beta of Real Assets = Beta of Financial Assets

$$\boxed{\beta_{\text{Real Assets}} = \frac{UA}{D+E}\beta_{UA} + \frac{TXA}{D+E}\beta_{TXA} = \beta_{UA} = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D}$$

With risk-free debt $\beta_D = 0$, so the formula becomes

$$\boxed{\beta_{UA} = \frac{E}{D+E}\beta_E = \frac{\beta_E}{\left[1+\frac{D}{E}\right]}}$$

* The relation between the risk of tax shields and the risk of FCF is approximate because debt–and hence the tax shield from interest expense–is likely to respond to changes in the value of FCF with some lag. For instance, at *t=0* (i.e., today), the firm knows the current amount of debt, so the interest expense and the tax shield it generates at *t=1* (i.e., next year) are risk-free.

If the firm targets the *D/E* ratio, do not use Version 1 of the unlevered beta formula. Instead use the formula **<u>without the tax rate</u>**:

Unlevered Beta
<u>Version 2</u>: When *D/E* is constant over time

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

- Important: The target *D/E* formula does not ignore the tax shields; it just treats their riskiness differently

- So, which formula do we ultimately use?
  - While the reality is somewhere in-between the two cases, targeting *D/E* is the more realistic assumption for most applications

Why are these formulas useful?

- They allow us to use the **comparison method** in presence of taxes
  - Obtain β_E and D/E for comparison firms, then compute β_{UA}
- β_{UA} reflects the systematic risk of the business we are evaluating
- Using β_{UA} in the C.A.P.M. equation, we get r_{UA}: <u>the unlevered cost of capital</u> for the project that we would apply if the firm were all-equity financed
- r_{UA} = the rate that should be used for discounting FCF
  - Key input for the APV method
  - Also useful in calculating WACC from comparison firms

Example: Unlevered Cost of Capital

Comparison Firms	β_E	**D**	**E**
Church's Chicken	0.75	0.004	0.096
McDonald's	1.00	2.300	7.700
Wendy's	1.08	0.210	0.790

- r_f = 3% and the market risk premium is 6%
- Corporate tax rate = 20%
- Comparison firms' D/E ratios are stable over time

What is the unlevered cost of capital estimated from the above comparison data?

Answer

Step 1. Use $\beta_{UA} = \dfrac{\beta_E}{\left[1 + \dfrac{D}{E}\right]}$ to find unlevered asset betas (stable D/E ⇨ use version 2)

$$\beta_{UA}^{ChCh} = .72 \qquad \beta_{UA}^{McD} = .77 \qquad \beta_{UA}^{Wendy's} = .85$$

Step 2. Compute the average of betas

$$\beta_{UA} = \frac{.72 + .77 + .85}{3} = .78$$

Step 3. Apply C.A.P.M. to compute the unlevered cost of capital:

$$\bar{r}_{UA} = r_f + \beta_{UA}(\bar{r}_m - r_f) = 3\% + .78 \times 6\% = 7.68\%$$

3. Adjusted Present Value (APV) Method

- Valuation by components
- Flexible Approach: Can be used with debt levels or tax rates that change over time

Implementation of APV

Step 1: Separate cash flows into

(a) FCF (as if the firm is all-equity financed)

(b) Tax shields

Step 2: Find the cost of capital (discount rate) for each component

- For FCF, use unlevered cost of capital

- For tax shields, we need a separate discount rate

Step 3: Calculate the PV of each component and add these PVs to obtain the project PV

- To find the tax shields we need to know the debt capacity of the project in dollar terms
  - Debt capacity: Marginal amount by which a firm can increase its debt when it adopts the project
- What determines debt capacity?
  - Depends on the financial policy of the firm
  - For now we take debt capacity as given (we will examine this issue extensively when we focus on capital structure later in the course)
- Debt Capacity is a <u>dynamic</u> concept
  - May change over time and may depend on the profitability of the project
    - Risky R&D venture – low debt now, more debt in the future
    - Leveraged Buyout (LBO) – high debt now, less debt in the future
  - These issues are easier to address within the APV framework than with WACC

Example – APV with Risk-Free Tax Shields:

Consider a project with an unlevered cost of capital of 14% (i.e., if financed entirely with equity). The project is expected to generate the following FCF over the next four years

Free Cash Flows

Year 1	Year 2	Year 3	Year 4
$100	$100	$1,000	$1,000

Financing plan:

- Initial investment is financed with equity in the first two years
- After 2 years, the firm will repurchase some of its equity and borrow $750 in debt at 8% per year (during the last two years of the project)
- The debt is paid off at the end of year 4
- The corporate tax rate is 20%

Find the PV of the project given the financing plan

Answer

Step 1: Compute the present value assuming all equity financing:

$$PV(FCF) = \frac{\$100}{1.14} + \frac{\$100}{1.14^2} + \frac{\$1,000}{1.14^3} + \frac{\$1,000}{1.14^4} = \$1,432$$

Step 2: Compute the PV of debt tax shields:

$$PV(\text{Tax Shields}) = \frac{0.20(0.08 \times \$750)}{1.08^3} + \frac{0.20(0.08 \times \$750)}{1.08^4} = \$18$$

Step 3: Add the two components:

$$APV = \$1,432 + \$18 = \$1,450$$

- What is the proper discount rate for Risky Tax Shields?
  - In practice, tax shields are often discounted at the cost of debt (as we did in the previous example)
  - This can be incorrect, for two different reasons:

    a) Firm targets a *D/E* ratio, so future tax shields are not constant

    - In this case, compute expected tax shields and discount them at the unlevered cost of capital (i.e., the same rate used to discount FCF)

    b) The firm may not be able to utilize full tax shields in future years (i.e., future EBITs may fall below interest expense) – see next example

    - Need to adjust both the expected tax shields and their discount rate
    - Solution: Use the expected return on debt computed via beta of debt (see example on Slide 29)
    - In practice, these adjustment are relevant only for highly levered projects / firms (e.g., LBOs)

Example – Why a firm may not be able to fully utilize its tax shields?

- Consider a firm with $1M in annual interest expense
- Suppose that EBIT turns out to be $500K, $100K, and −$300K over the next three years, and the firm decides to liquidate afterwards

	t=1	t=2	t=3
EBIT:	500K	100K	−300K
Interest Expense:	1M	1M	1M
Taxes Paid (at 35% of profits):	0	0	0
Tax if all-equity (35% of EBIT):	175K	35K	0
Realized Tax Shield:	175K	35K	0
Full Tax Shield (35% of int. exp.):	350K	350K	350K
Tax Shield Utilization Rate:	50%	10%	0%

Example – NPV when Debt Tax Shields are Risky:

Calculate the NPV of the following project:

- C.A.P.M. holds: Expected market return 13% and $r_f = 5\%$
- Initial investment outlay = \$100M
- FCF = \$20M for the next 10 years
- Beta of Unlevered Assets is $\beta_{UA} = 1$
- Corporate tax rate is 30%
- Financing plan
  - Project adds \$80M to the firm's debt capacity during its life
  - Risky firm debt yields 8% and has beta of 0.25
  - On average the company expects to utilize 75% of debt tax shield
- Assume that beta of tax-shield coincides with beta of debt

Answer

1. PV of the FCF:

$$PV_{UA} = \frac{\$20}{1.13} + \frac{\$20}{1.13^2} + ... + \frac{\$20}{1.13^9} + \frac{\$20}{1.13^{10}} = \$108.52 \text{ million}$$

2. PV of the firm's tax shields:

a) Expected tax shield:

$$\text{Expected tax shield per year} = 0.3 \times 0.08 \times \$80\text{M} \times 0.75 = \$1.44\text{M}$$

b) Discount rate from C.A.P.M.:

$$\bar{r}_{TS} = 0.05 + 0.25 \times (0.13 - 0.05) = 0.07$$

c) Compute PV of the firm's tax shields:

$$PV_{TS} = \frac{\$1.44}{1.07} + \frac{\$1.44}{1.07^2} + ... + \frac{\$1.44}{1.07^9} + \frac{\$1.44}{1.07^{10}} = \$10.11 \text{ million}$$

3. Add PVs and subtract the cost of investment to find the NPV:

$$NPV = \$108.52\text{M} + \$10.11\text{M} - \$100\text{M} = \$18.63\text{M}$$

4. Weighted Average Cost of Capital (WACC)

- Alternative method to incorporate taxes into valuation
- Widely used in practice
- Appropriate if the projects evaluated have the same risks and same debt capacity as the firm as a whole
  - WACC is easier to calculate for the whole firm than for a single project
- Procedure
  1. Estimate a project's <u>FCF</u>
  2. Discount FCF at a single rate (i.e., WACC)

What is WACC?

– Weighted average of the after-tax expected return paid by the firm on its debt and equity

$$WACC = \frac{E}{D+E}\bar{r}_E + \frac{D}{D+E}(1-T_C)\bar{r}_D$$

– Why using WACC method may be “reasonable”?

Good projects are those that give superior expected returns to equity holders after paying the after-tax cost of debt

How to calculate WACC

1. Cost of Equity Financing, $\overline{r}_E$

- Can be estimated using historical data from own firm if
  1. Project has the same risk as the firm ***<u>and</u>***
  2. Project's debt capacity is the same as the debt capacity of the firm

- More generally, need to estimate $\overline{r}_E$ from comparables to the project:
  – "Pure Plays", i.e. firms operating only in the project's industry

- Problem

– A firm's capital structure has an impact on $\overline{r}_E$

– Unless we have comparables with same capital structure, we need to adjust their $\overline{r}_E$ before using it

$$\beta_{equity}^{comparable} \xrightarrow{\text{unlever}} \beta_{UA}^{comparable} = \beta_{UA}^{project} \xrightarrow{\text{relever}} \beta_{equity}^{project}$$

Comparison firm's unlevered beta is assumed to provide a good estimate of the project's systematic risk

Example – Unlevering and relevering betas:

- A project will produce \$5 M of FCF next year, growing at 3% per year indefinitely afterwards
- A comparable business has equity beta = 1.2 and D/E = 1.4
- Your firm plans to have D/E = 1.1
- Both firms will keep D/E ratio constant over time
- Corporate tax rate is 35%
- C.A.P.M. holds: Market risk premium = 8%, r_f = 4%

What is the PV of the project?

Answer:

Step 1: Obtain the *unlevered beta* from comparable business ("unlevering"):

$$\beta_{UA} = \frac{\beta_E^{Comp}}{1+\dfrac{D}{E}} = \frac{1.2}{1+1.4} = 0.50$$

Step 2: Obtain the *firm equity beta* from the unlevered beta ("relevering"):

$$\beta_E = \beta_{UA}\left[1+\frac{D}{E}\right] = 0.50[1+1.1] = 1.05$$

Step 3: Get the *expected equity return* from equity beta:

$$r_E = r_f + \beta_E\,(r_M - r_f) = 4\% + 1.05 \times 8\% = 12.4\%$$

Step 4: Calculate *WACC:*

$$WACC = \frac{E}{D+E}\bar{r}_E + \frac{D}{D+E}(1-T_C)\bar{r}_D = \frac{1}{1.1+1}\times 12.4\% + \frac{1.1}{1.1+1}\times(1-0.35)\times 4\% = 7.27\%$$

Step 5: Calculate PV of FCF growing at 3% in perpetuity using WACC:

PV = 5,000,000/(0.0727 – 0.03) = \$117.09M

2. Cost of Debt Financing, $\overline{r}_D$

a) Default-Free Debt

- Use Yield-To-Maturity (YTM)
  - YTM: Discount rate that makes discounted value of promised future bond payments equal to the market price of the bond
- Good estimate if debt is highly-rated and not convertible

b) Risky Debt

- YTM overstates the cost of debt: The "expected return on debt" is lower than the promised yield
  - Using YTM essentially ignores the limited liability of the equity holders in case the firm defaults on its debt – see example on next slide
- In practice, most firms act conservatively and use YTM for $\overline{r}_D$
- When debt is highly risky, this conservative approach may penalize the project "too much"

Why does the yield on risky debt overstate the cost of debt financing?

Example:

- A project requires $100 of investment today, and will pay either $135 or $95 with equal probability a year from now
- The risk-free rate is 7.5%
- The project cost is to be fully financed by a bank loan with a yield of 20%
- Assume that the tax rate is zero, that this is the only project of the firm, and that there is no other form of financing available
- Should the firm (i.e., the equity holders) take the project?

Answer: Should the firm take the project? *Of course*!

- Equity holders contribute $0 to the project financing
- They get $15 after paying the bank if the cash flow is $135 and $0 otherwise
- Hence this is a good deal for them

But see what happens when we use the YTM of debt as the cost of capital:

$$\text{Expected cash flow} = 0.5 \times \$135 + 0.5 \times \$95 = \$115$$

$$PV = \frac{\$115}{1+0.2} = \$95.83 < \$100$$

Clearly this is the wrong answer. The problem is that 20% is just the *promised yield*, not the *expected return* on the debt:

$$\text{Expected return on debt} = 0.5 \times \left(\frac{\$120}{\$100} - 1 \right) + 0.5 \times \left(\frac{\$95}{\$100} - 1 \right) = 7.5\%$$

Using YTM ignores the fact that equity holders have *limited liability* in case if bankruptcy

Cost of Debt Financing, $\bar{r}_D$, risky debt:

- YTM overstates the cost of debt: The "expected return on debt" is lower than the promised yield
  - In practice, most firms act conservatively and use YTM
- Two alternative ways to get the true cost of debt:

1. C.A.P.M. approach: Use the beta of debt to calculate the expected return on debt

» Junk (i.e., speculative-grade) debt betas range from 0.3 to 0.5

or

2. Subtract expected losses from default and recalculate yields

- See example on next slide

Example: Recalculating the yield based on expected losses

- Firm X has outstanding debt that matures in one year
- Debt has 8% coupon rate over \$1 face value, to be paid at the end of the year
- Debt is currently trading for 96 cents on the dollar
- If firm X defaults, bondholders are expected to recover 90 cents on the dollar
- There is a 15% chance of default

Estimate the cost of debt, $\bar{r}_D$

Answer

1. Find YTM (i.e., return with no default):

$$96 = \frac{108}{1+YTM} \Rightarrow YTM = 12.5\%$$

2. Find the return with default:

$$96 = \frac{90}{1+r} \Rightarrow r = -6.25\%$$

3. Cost of debt (i.e., expected return on debt) is the weighted average of returns in the two possible outcomes:

$$\bar{r}_D = 0.85 \times (12.5\%) + 0.15 \times (-6.25\%) = 9.69\%$$

3. Tax Rate T_c

– If the firm is expected to utilize full tax shields in future years (i.e., EBIT > Interest Expense), then $T_c = T_{marginal}$: the tax rate on the next $ of earnings

– If not, need to adjust the tax rate to take into account expected utilization rate

  - In practice, this adjustment is rarely made

– How to adjust the tax rate?

  1. If the average tax shield utilization rate is stable over time:

$$T_c = \frac{Ave.\ Tax\ Shield\ \ Utilization\ Rate\ \times T_{marginal}\ \times YTM}{\overline{r}_D}$$

which gives the "tax savings" component of WACC:

$$\boxed{T_c \times \overline{r}_D = Ave.\ Tax\ Shield\ \ Utilization\ Rate \times T_{marginal} \times YTM}$$

  2. If tax shield utilization rate changes over time:
     – Not clear if the above adjustment over or underestimates the value of tax shields. A precise value is difficult to find
     – More generally, when interest expense is large relative to cash flow and unused tax shields are potentially important, use APV instead of WACC

Example – WACC with risk-free debt:

A 20% debt-80% equity firm borrows at 8% (risk-free)

• CAPM holds: Expected market return = 14% and the beta of equity = 1.2

• Interest is fully tax deductible and corporate tax rate is 34%

Find WACC

Answer

$$\bar{r}_E = 8\% + 1.2 \times (14\% - 8\%) = 15.2\%$$

$$\bar{r}_D (1 - T_C) = 8\% \times (1 - 0.34) = 5.28\%$$

hence

$$WACC = 0.8 \times 15.2\% + 0.2 \times 5.28 = 13.2\%$$

Example continued – WACC with risky debt:

Compute WACC when

- Firm's bonds have a 15% YTM, and a beta of 0.5
- Average tax shield utilization rate is 75%

Answer

We need to compute $(1-T_C)\bar{r}_D = \bar{r}_D - T_C\bar{r}_D$

Now the expected return on debt is (using the debt beta approach):

$$\bar{r}_D = 8\% + 0.5\times(14\% - 8\%) = 11\%$$

The expected tax savings due to leverage are:

$$T_C \times \bar{r}_D = Ave.\ T.S.\ utilization\ rate \times T_{marginal} \times YTM = 0.75\times 0.34\times 15\% = 3.825\%$$

Hence WACC is:

$$WACC = 0.8\times 15.2\% + 0.2\times(11\% - 3.825\%) = 13.595\%$$

Remarks:

1. What are the weights on equity and debt?

D/(D+E): target capital structure (in market values) for the project (i.e., project's <u>debt capacity</u>)

Common mistake 1: Using the *D/(D+E)* of the firm undertaking the project

– Is the debt capacity of the project the same as that of firm's other assets?

Common mistake 2: Using the *D/(D+E)* of the project's immediate financing

– Would the firm finance the project the way it does if it were its only project?

- To get *D/(D+E):*
  - Use project's comparables: "Pure plays" in the same business as the project
  - Use firm's *D/(D+E)* only if the project is similar to the firm's other assets
  - Use intuitions from optimal determination of capital structure
- What if the project's *D/(D+E)* changes over time? Can't use WACC, use APV instead

2. $\bar{r}_E$ and $\bar{r}_D$ are <u>forward-looking</u> expected returns, not the expected returns at the time the firm has raised financing

- ➢ Getting cheap financing does not justify investing in a bad project!

3. One can adjust WACC for more than two sources of financing (e.g., preferred stock)

$$WACC = \frac{D}{V}(1-t)r_D + \frac{E}{V}r_E + \frac{P}{V}r_P$$

4. Project WACC and firm WACC are different

- If project risk differs significantly from the overall firm risk, using the firm's WACC, which is based on the existing projects, will give the wrong answer
  - See the next example
- Think of diversified firms, or mergers/acquisitions that involve firms in different industries
- Even in pure-play firms, not all projects are of the same risk
  - e.g., investing to enter a new market is high risk, investing in plant maintenance is low risk

Example – Project WACC vs. firm WACC:

- Company X spends \$213,333 per year to lease its office space
- X is all-equity financed and has a WACC = r_E = 20%
- X can buy its office space for \$1,000,000
- If it decides to buy the building, X will finance the purchase with a mortgage obtained at r_f = 8% (suppose mortgage is perpetual)
- Marginal tax rate = 25%

Should the company buy the building?

Answer

1. It makes sense to buy if "owning costs" are less than "leasing costs"

Leasing costs = (1 – 0.25) x 213,333 = $160,000 per year
Owning cost = 0.08 (1 – 0.25) x 1,000,000 = $60,000 per year

Clearly it makes sense to buy the building

2. What happens if you use firm's WACC to evaluate project?

$$NPV = \frac{160{,}000}{0.2} - 1{,}000{,}000 = -\$200{,}000$$

But this is wrong!!

3. What is the correct WACC?
   Finding WACC in this case is more complicated than it looks:

a) One may be tempted to say: the project is all-debt financed, therefore,

$$WACC = 0 \times (8\%) + 1 \times (1 - 0.25) \times 8\% = 6\%$$

But this is wrong too. Although the "cost" of the project is paid by issuing debt, this is only part of project's value. Since we know that the project NPV is positive, the PV of the project includes \$1 million debt plus some surplus accruing to equity holders: V = D + E , D = \$1 million, and V > \$1 million, therefore E > 0.

So we should put some weight on equity too in calculating WACC.

But what is the correct weight?

b) Here the calculation has some circularity. We want to find PV. Yet the weight on equity in WACC is a function of PV too:

$$PV = \frac{160,000}{WACC} = \frac{160,000}{\dfrac{PV - 1million}{PV} \times 8\% + \dfrac{1million}{PV} \times (1 - 0.25) \times 8\%}$$

Rearranging this equation gives the following:

$$(PV - 1million) \times 8\% + (1million) \times (1 - 0.25) \times 8\% = 160,000$$

Solving this gives PV = 2,250,000. Now we can plug this into WACC:

$$WACC = \frac{1,250,000}{2,250,000} \times (8\%) + \frac{1,000,000}{2,250,000} \times (1 - 0.25) \times 8\% = 7.11\%$$

Conclusion: When the project risk differs significantly from the overall firm risk and there are no close pure-play comparisons, finding the correct WACC is a non-trivial task

WACC

Pros

- Widely used and intuitive: a project should earn a higher return than its cost of capital
- Facilitates decentralized capital budgeting
  - Lower-level managers can use it easily while evaluating their divisions' projects

Cons

- Mixes up effects of assets and liabilities
  - Errors/approximations in effects of liabilities can 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?

APV

Pros

- More clear: Easier to track down where value comes from
- More flexible; can accommodate changing debt levels
- Can be extended to include other effects of financing (e.g., financing subsidies)

$$APV = PV\ (all\text{-}equity) + PV\ (Tax\ Shield) + PV\ (other\ stuff)$$

Cons

- Not very frequently used

Overall

- For complex, changing or highly leveraged capital structures (e.g. LBOs), APV is much better
- Otherwise, it may not matter much which method you use

5. Terminal Value Calculations

- In valuing long-lived projects or ongoing businesses, we cannot forecast every year of cash flows

- Instead, forecast FCF until it is reasonable to think that the project or company is in "steady state" and estimate a "terminal value"

$$\text{Project Value} = \sum_{t=0}^{N} \frac{FCF_t}{(1+r)^t} + \frac{\text{Terminal Value}_N}{(1+r)^N}$$

- Typically, terminal value is calculated in one of three ways:
  1. Liquidation value
  2. FCF growing as a perpetuity
  3. Based on multiples

1. Terminal Value as Liquidation Value

- Unless liquidation is likely, this method tends to underestimate TV (but useful as a lower bound)
- Liquidation Value depends on Salvage Value and Net Working Capital recovered

a) Salvage Value (SV): CF that the firm receives from liquidating its assets

SV = Liquidation price – Liquidation costs

b) Net Working Capital

- Does firm recoup NWC at project end?
  - If so, last ΔNWC = last NWC

- NWC's actual value can differ from its book value
  - may not recoup the accounts receivable fully
  - inventory may sell above or below book value

2. Terminal Value as Growing Perpetuity

$$\boxed{\mathbf{TV = FCF_{N+1} / (r - g)}}$$

- $FCF = (1-T_C)\times EBIT + \underbrace{\text{Depreciation} - CAPX - \Delta NWC} = (1-T_C)\times EBIT - \underbrace{\Delta NA}$
- Often assumed: $\Delta NA = g \times NA_{\text{prior year}}$
  - Net assets grow at the same rate as earnings
  - ΔNA is a good measure of replacement costs
- Hence: $TV = [\underbrace{(1 - T_C)\times EBIT_{N+1}}_{(1+g)(1-T_C)EBIT_N} - g \times NA_N] / (r - g)$
- **Be careful with the assumed growth rate**

Any business growing faster than the economy must eventually become the economy

3. Using Multiples to get Terminal Value

TV = k × MULTIPLE

- Apply multiple to expected earnings or revenue of last estimated year
- Be aware of the implicit growth rate in the multiple

Example

- Your investment banker suggests a multiple of "*14 times EBITDA*" to calculate TV of an acquisition
- What is the expected growth rate implicit in the proposed EBITDA multiple?
- Assume: 12% cost of capital and, for simplicity, no CAPEX. Ignore taxes

Answer

Compare the TV calculated as growing perpetuity to the proposed multiple:

$$\text{TV} = \frac{FCF_{N+1}}{r-g} = \frac{FCF_N(1+g)}{r-g} = \frac{EBITDA_N(1+g)}{r-g} \quad \Rightarrow \quad \frac{TV}{EBITDA_N} = \frac{1+g}{r-g}$$

$$14 = \frac{1+g}{0.12-g} \quad \Rightarrow \quad g = 4.53\%$$