WACC:

$$WACC = \left(\frac{E}{E+P+D+L}\right) r_E + \left(\frac{P}{E+P+D+L}\right) r_P + \left(\frac{D}{E+P+D+L}\right) r_D(1-T) + \left(\frac{L}{E+P+D+L}\right) r_L(1-T)$$

- r_E = cost of COMMON STOCK $\xrightarrow{\text{CAPM}}$ $E[R] = r_f + \beta(E(r_m) - r_f)$, β is the "raw" beta on Bloomberg Terminal
- r_P = cost of PREFERRED STOCK = annual preferred dividend yield ÷ preferred shares outstanding
- T = marginal corporate tax rate
- r_D = cost of debt = weighted-avg. Short Term, Medium Term, Long Term (based on YTM on corporate bond) and bank loan rate
- $r_D(1-T)$ = after-tax cost of debt*
- r_L = IMPLIED INTEREST ON OPERATING LEASES (see SHW spreadsheet)
- $r_L(1-T)$ = AFTER-TAX IMPLIED INTEREST ON OPERATING LEASES*
- E = the firm's market capitalization = share price * shares outstanding (replace market cap w/ firm's target iff revealed in 10k — insofar that you believe in the firm's ability to hit it's target cap structure...)

*debt interest payments and rent are tax deductible

WACC USE CASES: (1) WACC as discount rate in NPV or DCF formula
(2) pursue project if IRR > WACC

W/ preferred stock

4. (18 points) An analyst builds a DCF model for a chemical company. She forecasts financial statements out 6 years to the CV period of 2028. Use the information provided to estimate the appropriate weighted average cost of capital (WACC) to value the firm under the enterprise DCF approach. The firm has a Baa2 debt rating from Moody's.

Bloomberg Raw Beta	**1.48**	Effective Tax Rate	17%
Bloomberg Adjusted Beta	1.32	**Marginal Tax Rate**	**23%**
1-yr. T-Bill yield	5.00%	Balance Sheet Values (mil.)	
6-yr. T-Note yield	4.30%	Short-Term Debt (< 1 yr.)	$618
30-yr. T-Bond yield	**3.90%**	Long-Term Debt	$9,289
Expected S&P 500 Return	**9.40%**	Preferred Stock	$1,546
Baa2 Default Spread (1-yr.)	0.70%	Common Equity	$7,208
Baa2 Default Spread (6-yr.)	1.60%	Common Stock Price	$26.20
Baa2 Default Spread (30-yr.)	**2.50%**	Common Shares Outstanding	405
Annual Preferred Dividend	$1.82	Preferred Stock Price	$24.10
Annual Common Dividend	$0.94	Preferred Shares Outstanding	20

Cost of Equity:	
Risk-Free Rate (30-year)	3.90%
Beta (raw beta)	1.48
Equity Risk Premium (9.40-3.90)	5.50%
	12.0400%
Cost of Preferred:	
Annual Dividend	$1.82
÷ Preferred Stock Price	$24.10
After-Tax Lease Cost	**7.5519%**
Cost of Debt (long-term):	
Risk-Free Rate	3.90%
Long-Term Default Premium	2.50%
Pre-Tax Cost of Debt	**6.40%**
Marginal Tax Rate	23%
After-Tax Debt Cost	**4.9280%**

Market Values:		
Equity (shares*price = $26.20*405)	$10,611	**50.5286%**
Preferred stock ($24.10*20)	482	**2.2952%**
Leases	0	**0.0%**
Debt (BV of ST and LT = 618 + 9289)	9,907	**47.1762%**
Market Value of Firm	21,000	**100.00%**

WACC **8.5818%**

WACC = 12.04*(0.505286) + 7.5519*(0.022952) + 4.9280*(0.471762)
= 6.0836% + 0.1733% + 2.3248% = 8.5818%

w/ operating leases

4. **(15 points)** An analyst builds a DCF model for an industrial chemical company. She projected financial statements out to 2024 (CV year). Use the following information to estimate the weighted average cost of capital (WACC) that would be most appropriate for the analyst to value the firm's equity under the enterprise DCF approach. The firm's S&P debt rating is A-, on bonds it issued last week. (**Please use 4 decimal places for rounding accuracy.)**

Bloomberg Raw Beta	1.42	Common Stock Price	$12.50
Bloomberg Adjusted Beta	1.28	Common Shares Outstanding	3,200
3-mo. T-Bill yield	0.42%	PV of Lease Obligations	$8,000
5-yr. T-Note yield	0.56%	Marginal Tax Rate (2019A)	20%
25-yr. T-Bond yield	1.22%	Effective Tax Rate (2019A)	12%
Expected S&P500 Return:	7.52%	Balance Sheet Values:	
A- Default Spread (1-yr)	1.18%	Short-Term Debt (1-yr)	$2,650
A- Default Spread (5-yr)	1.84%	Long-Term Debt (25-yr)	$9,350
A- Default Spread (25-yr)	2.98%	Leases	$8,000
Lease Contract Yield (IRR)	3.80%	Common Equity	$12,000

Cost of Equity:	
Risk-Free Rate (25-year)	1.22%
Beta (raw beta)	1.42
Equity Risk Premium (7.52-1.22)	6.30%
	10.166%
Cost of Leases:	
Pre-Tax Cost	**3.80%**
Marginal Tax Rate	20%
After-Tax Lease Cost	3.04%
Cost of Debt (long-term):	
Risk-Free Rate	1.22%
Long-Term Default Premium	2.98%
Pre-Tax Cost of Debt	**4.20%**
Marginal Tax Rate	20%
After-Tax Debt Cost	3.36%

Market Values:		
Equity (# shares*price = $12.50*3200)	$40,000	**66.67%**
Leases	8,000	**13.33%**
Debt (BV of ST and LT)	12,000	**20.00%**
Market Value of Firm	60,000	**100.00%**

WACC **7.8546%**

WACC = 10.166*(0.6667) + 3.04*(0.1333) + 3.36*(0.20)
= 6.7773 + 0.4053 + 0.6720 = 7.8546%

FCF:

What is FCF?

Cash flow from **operating** activities available for distribution to **all** claimholders (debt and equity holders) i.e., available to increase shareholder value

FCF is cash flow remaining

- after tax are paid
- after all reinvestment needs have been met
- ***before*** interest payments are subtracted

FCF = NOPAT = EBIT*(1-T)
+ "Depreciation and Amortization" ex. Amortization*
− CapEx
− Δ non-cash Working Capital

- EBIT = operating income
- T = marginal corporate tax rate
- CapEx = Δ Invested Capital (see SHW.xlxs \ Drivers tab)
- Δ non-cash WC includes "normal cash"* = $\min_t(\text{cash}_t, \min_{1:T}(\text{cash \% sales})*\text{sales}_t)$ + [Curr **Operating** Assets − Curr **Operating** Liab.]

* Depreciation and Amortization are part of COGS on I/S and typically reported as a single line item on the CF statement; so, there's some extra work to "back out" just depreciation

* "excess cash" gets added back in later... see SHW.xlxs \ DCF_EP tab

★ NOTE: IGNORE TAX SHIELD IN FCF BECAUSE ALREADY ACCOUNTED FOR IN WACC

EXAMPLE: SHW.xlxs \ Drivers tab

- DCF and EP models
- used to estimate the value of a project from both debtholder & equity holder perspective

FCF:

- not unusual for analysts to keep all or none of cash in the WC formula as opposed to separating "normal" cash from "excess" cash

- alternative method for calculating FCF (will give you th exact same value):

	NET INCOME
(plus)	depreciation
(minus)	CapEx
(minus)	Δ NCWC
(plus)	Interest Expense * (1-T)
	FCF

- Enterprise FCF represents the cash available to all claim holders (debt, equity, etc.) after capital investment decisions.

FCF = gross CF – gross investment
= (NOPLAT + depreciation) –
(increase in WC + capital expenditures)
= NOPLAT - CapEx

FCFt = NOPLATt – Δ Invested Capitalt,t-1

NOPLAT and Invested Capital are defined more specifically in Ch. 9.

★ - EBIT(1-T) subsets actual tax liab. b/c interest is tax deductible. When EBIT(1-T) – actual tax liab. > 1 we call the differential a "tax shield". Why don't we account for interest tax shield in FCF? Its because we've already account for it in WACC: $r_D(1-T)$. Don't want to "double count".

DCF:

TWO EQUIVALENT VERSIONS OF DCF TO CALC. V_{OPER}:

(1) see SHW.xlxs\DCF_EP tab\DCF Model (rows 13:32)

(2) see SHW.xlxs\DCF_EP tab\ EP Model (rows 34:56)

should always run both, then for a sanity check $V_{OPER}^{EP} = V_{OPER}^{DDM}$

ONE ADDITIONAL VERSION WHICH IS NOT EQUIVALENT:

(3) see SHW.xlxs\DDM tab

ALL TOGETHER: (1), (2), AND (3) ESTABLISH THE TARGET PRICE RANGE

Table 1. Valuation Methodologies

Calculate "Intrinsic Value" of core operating income		Calculate Equity Value
DISCOUNTED CASH FLOW (DCF) MODEL	ECONOMIC PROFIT (EP) MODEL	DIVIDEND DISCOUNT MODEL (DDM)
• denominator: $(1+WACC)^n$ • numerator: FCF	• denominator: $(1+WACC)^n$ • numerator: EP	• denominator: $(1+r_E)^n$ • numerator: EPS
!!! see SHW.xlxs for the proper "operating adjustments" made to each respective valuation !!!		

Why is it appropriate to hold WACC constant in DCF firm valuation, but problematic to hold YTM constant in PV bond valuation? After all, a firms cost of raising capital fluctuates just as interest rates do! This is likely just a simplifying assumption...

↑ The reason is b/c: no matter what, you'll eventually hit a perpetual, "steady state" growth rate which means you'd only ever let WACC vary across accounting periods during the "high growth period". And to do it accurately, you must layer-in quantitative stochastic models to forecast R_m, R_f, etc. as well as estimate the firm's unique elasticities w.r.t. each macroeconomic variable. Since the terminal value drives >97% of a long-term DCF equity valuation, it's a ton of work for almost nothing... much better off focusing on accurately approximating terminal growth!

see vid1_multiples saved on T7Shield drive

see vid2_multiples saved on T7Shield drive

see vid3_multiples saved on T7Shield drive

Multiples:

- multiples — such as: P/E, P/B, P/S, EV/EBIT, EV/EBITDA — are financial ratios designated to capture the key enterprise value drivers

- used for **relative valuation** (aka: "Comparable Companies Ananalysis" - CCA) i.e., multiples are standardized rel. to whichever denominator

step 1 Peer Selection: aim for "pure plays" (which are rare!)

- same industry (ideally, exalt same fundamental operations)
- similar size (market capitalization)
- **KEY ASSUMPTIONS: (1) *on avg*, peers are not over- nor undervalued by the market; (2) choice of comparables/peers is good**

step 2 Compare to avg: $\left(\frac{P}{E}\right)_i < \left(\frac{P}{E}\right)^{AVG.} \Rightarrow i$ is "cheap" | $\left(\frac{P}{E}\right)_i > \left(\frac{P}{E}\right)^{AVG.} \Rightarrow i$ is "expensive"

- take the arithmetic avg. multiple or weighted avg. of peer group ex. *your* company
- similar size (market capitalization)

step 3 Target Price $= \left(\frac{P}{E}\right)^{AVG} * E_i$, E is EPS | "$i$ is trading $\left[\left(\frac{P}{E}\right)_i\right]$ x earnings"

OR: $\left(\frac{EV}{EBITDA}\right)^{AVG} * EBITDA_i =$ $EV_{TGT} + CASH - DEBT = V_E \div SHARES$

- of two identical companies, you want to long the one with the lowest P/E
- value stocks typically have **low** P/E and growth typically have **high** P/E
- a "quality growth stock" is one with a relatively low P/E

Caveats and pitfalls:

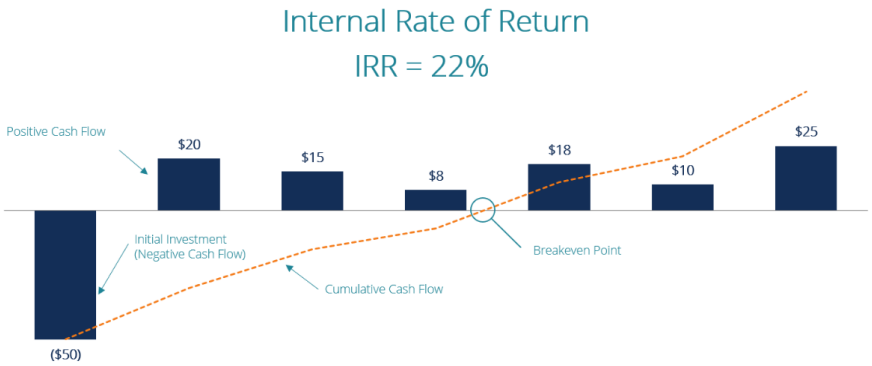
(1) numerator must be a market value, denominator must a "financial"
↳ typically, the "financial" comes from the I/S
↳ obviously both numerator & denominator must be expressed in the same units e.g. $P/S = \frac{\text{Price per share}}{\text{Sales per share}}$ ✓ $\neq \frac{\text{Price per share}}{\text{Total Sales}}$ ✗

(2) Just because P/E is higher for x than y doesn't mean x is more valuable than y — it means that the market has higher growth **expectations** for x than for y (since the numerator, P, is controlled by market expectations)

(3) P/E alone cannot tell you if the firm is over- or undervalued

Internal Rate of Return (IRR)

In the example below, an initial investment of $50 has a 22% IRR. That is equal to earning a 22% compound annual growth rate.



In reality, there are many other quantitative and qualitative factors that are considered in an investment decision.) If the IRR is lower than the hurdle rate, then it would be rejected.

What is the IRR Formula?

The IRR formula is as follows:

$$0 = CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \ldots + \frac{CF_n}{(1+IRR)^n}$$

Or

$$0 = NPV = \sum_{n=0}^{N} \frac{CF_n}{(1+IRR)^n}$$

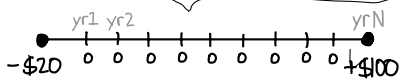
Where:
CF_0 = Initial Investment / Outlay
$CF_1, CF_2, CF_3 \ldots CF_n$ = Cash flows
n = Each Period
N = Holding Period
NPV = Net Present Value
IRR = Internal Rate of Return

Calculating the internal rate of return can be done in three ways:

1. Using the IRR or XIRR function in Excel or other spreadsheet programs (see example below)
2. Using a financial calculator
3. Using an iterative process where the analyst tries different discount rates until the NPV equals zero (Goal Seek in Excel can be used to do this)

Source: CFI

note: if exactly one outflow (@purchase) & exactly one inflow (@exit) w/o any CF in-between (i.e., a 100% "cash sweep" is in place) then IRR formula simplifies to:



$$IRR = \left(\frac{V_E \text{ @ exit}}{V_E \text{ @ purchase}} \right)^{1/N} - 1$$

(N ← #yrs)

Practical Example

Here is an example of how to calculate the Internal Rate of Return.

A company is deciding whether to purchase new equipment that costs $500,000. Management estimates the life of the new asset to be four years and expects it to generate an additional $160,000 of annual profits. In the fifth year, the company plans to sell the equipment for its salvage value of $50,000.

Meanwhile, another similar investment option can generate a 10% return. This is higher than the company's current hurdle rate of 8%. The goal is to make sure the company is making the best use of its cash.

To make a decision, the IRR for investing in the new equipment is calculated below.

Excel was used to calculate the IRR of 13%, using the function, *=IRR()*. From a financial standpoint, the company should make the purchase because the IRR is both greater than the hurdle rate and the IRR for the alternative investment.

Year	Cash Flows	PV of Cash Flows
0	-$500,000	-$500,000
1	$160,000	$141,247
2	$160,000	$124,692
3	$160,000	$110,077
4	$160,000	$97,176
5	$50,000	$26,808

NPV	**0**
IRR	**13%**

source: CFI

Adjusted Present Value (APV):

- APV is either an alternative to WACC or combined w/ WACC. For example, APV method may be used for short-term cash flows when capital structure is expected to change and WACC method for terminal value.

- APV values the firm as if it were unlevered; adds in r_D separately

step 1 calculate FCF as usual

step 2 calculate the unlevered cost of capital:

$$r_u = r_f + \beta_u (r_m - r_f) = \frac{E}{V} R_E + \frac{D}{V} R_D$$

step 3 discount FCF at the unlevered cost of capital to obtain intrinsic unlevered firm value

step 4 adjust unlevered firm value for the costs & benefits of debt:

EV_u − PV of debt + PV of cash = Intrinsic firm value ...

÷ shares outstanding = target price

Examples available on T7Shield/.../APVMethod.pptx

Levered vs Unlevered Beta

BETA:

$$R_E \overset{CAPM}{=\!=} R_f + \beta \underbrace{(R_M - R_f)}_{MRP}, \quad \beta = \beta_\ell$$

Beta

- A firm's beta captures its systematic risk or market risk. This is risk that cannot be diversified away simply by holding more assets in your portfolio.
- In practice, the beta of a firm is estimated as the covariance between the stock return on that firm and the return on a diversified market portfolio like the S&P 500
- Betas of publicly traded firms are easily available
- However, there are times when a firm's beta is not available or has been rendered incorrect due to a corporate action*

* scenarios that nullify historical beta (i.e., historical beta is no longer accurate) are recent (within 5 years), fundamental changes to the firm's business operations or capital structure

(1) privately held businesses (market prices simply unavailable...)

(2) divestiture or M&A (e.g. Leveraged Buyout, LBO)

(3) material change in capital structure (i.e., more debt ⇒ more default risk for equity holders, since debtholders lay first claim to assets)

"equity beta" LEVERED BETA: β_ℓ CAPTURES BOTH BUSINESS RISK(2) AND FINANCIAL RISK(3)

$$\beta_\ell = \underbrace{\beta_u}_{\text{BUSINESS RISK}} + \underbrace{\beta_u \left[\frac{D}{E}(1-T)\right]}_{\text{FINACIAL RISK}} = \beta_u \left[1 + \frac{D}{E}(1-T)\right]$$

"asset beta" UNLEVERED BETA: β_u ONLY CAPTURES BUSINESS RISK(2)

$$\beta_\ell(\beta_u, \bullet) \Rightarrow \beta_u = \beta_\ell \div \left[1 + \frac{D}{E}(1-T)\right]$$

NOTE: IF FIRM HAS NO DEBT AT ALL, THEN $\beta_\ell = \beta_u$