



YALE  
UNDERGRADUATE  
DIVERSIFIED  
INVESTMENTS

MEETING # 3

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DISCOUNTED CASH FLOW ANALYSIS

OCTOBER 15

9 PM

# GOALS OF MEETING # 3

- 1) Definition
- 2) Use
- 3) Major Parts
- 4) Combining Parts
- 5) Valuation & Sensitivity

# Discounted Cash Flow Analysis

- Intrinsic Value of the Company
- Sum of all future cash flows available to the company
- Discounting these Cash Flows to TODAY
- Value higher than cost of ownership today - could be attractive investment!

# Discounted Cash Flow Analysis

- Major valuation methodology to determine intrinsic value of a company
- DCF model is only as good as its projections & assumptions

# Discounted Cash Flow Analysis

1. **Cash each year**
2. **A % to discount that cash**
3. **A way to summarize cash flows toward infinity**

# Discounted Cash Flow Analysis

1. **Unlevered Free Cash Flow**
2. **WACC (Weighted Average Cost of Capital)**
3. **Terminal EBITDA Multiple & Perpetuity Growth Rate**

# MAJOR PARTS

## **1. Unlevered Free Cash Flow**

# UNLEVERED FREE CASH FLOW

- How much cash there is at the end of each year
- Use Accounting Statements to get from Revenue to Unlevered Free Cash Flow each year
- Assumptions on growth affect each line item year to year

## **Short Hand:**

Unlevered Free Cash Flow = **Operating Cash Flow - CapEX + interest(1-tax%)**



# UNLEVERED FREE CASH FLOW

Example DCF			Historical			
	Historical Year 1	Historical Year 2	Historical Year 3	Historical Year 4	Historical Year 5	
Revenue:	\$ 2,644	\$ 3,892	\$ 4,049	\$ 4,721	\$ 5,152	
Revenue Growth Rate		47.20%	4.03%	16.60%	9.13%	

# UNLEVERED FREE CASH FLOW

Example DCF				Historical			
	Historical Year		Historical Year		Historical	Historical	Historical
	1	2	Year 3	Year 4	Year 5		
<b>Revenue:</b>	\$ 2,644	\$ 3,892	\$ 4,049	\$ 4,721	\$ 5,152		
<i>Revenue Growth Rate</i>		47.20%	4.03%	16.60%	9.13%		
<b>(COGS):</b>	1500	1400	1300	1200	1100		
<i>COGS Growth Rate</i>		-7%	-7%	-8%	-8%		
<b>(SG&amp;A):</b>	300	400	500	600	700		
<i>SG&amp;A Growth Rate</i>		33.33%	25.00%	20.00%	16.67%		
<b>(D&amp;A)</b>	100	145	167	183	199		
<i>% of Revenue</i>	3.78%	3.73%	4.12%	3.88%	3.86%		
<b>(Stock Based Compensation)</b>	12	13	18	19	20		
<i>% of Revenue</i>	0.45%	0.33%	0.44%	0.40%	0.39%		
<b>(Other Expenses &amp; Intangibles)</b>	0	0	0	0	0		
<i>% of Revenue</i>	0.00%	0.00%	0.00%	0.00%	0.00%		
<b>Operating Income: (EBIT)</b>	732	1934	2064	2719	3133		
<i>EBIT Margin Growth Rate</i>		164.21%	7%	32%	15%		
<b>(Taxes):</b>		256	677	722	952	1097	
<i>Tax Rate</i>	35%						
<b>NOPAT</b>	476	1257	1342	1767	2036		
<b>D&amp;A</b>	100	145	167	183	199		
<i>% of Revenue</i>	3.78%	3.73%	4.12%	3.88%	3.86%		
<b>Stock Based Compensation</b>	12	13	18	19	20		
<i>% of Revenue</i>	0.45%	0.33%	0.44%	0.40%	0.39%		
<b>Change in Operating A &amp; L</b>	-23	77	-99	-21	-22		
<i>% of Revenue</i>	-0.87%	1.98%	-2.45%	-0.44%	-0.43%		
<b>Change in CapEx</b>	-63	-115	-129	-134	-139		
<i>% of Revenue</i>	-2.38%	-2.95%	-3.19%	-2.84%	-2.70%		
<b>Unlevered FCF:</b>	502	1377	1299	1814	2094		

# UNLEVERED FREE CASH FLOW

Example DCF			Projected		
	Forward Year 1	Forward Year 2	Forward Year 3	Forward Year 4	Forward Year 5
<b>Revenue:</b>	6143	7325	8735	10415	12419
<i>Revenue Growth Rate</i>	19.24%	19.24%	19.24%	19.24%	19.24%
<b>(COGS):</b>	1018	942	872	807	747
<i>COGS Growth Rate</i>	-7.46%	-7.46%	-7.46%	-7.46%	-7.46%
<b>(SG&amp;A):</b>	866	1072	1327	1642	2032
<i>SG&amp;A Growth Rate</i>	23.75%	23.75%	23.75%	23.75%	23.75%
<b>(D&amp;A)</b>	238	283	338	403	481
<i>% of Revenue</i>	3.87%	3.87%	3.87%	3.87%	3.87%
<b>(Stock Based Compensation)</b>	25	29	35	42	50
<i>% of Revenue</i>	0.40%	0.40%	0.40%	0.40%	0.40%
<b>(Other Expenses &amp; Intangibles)</b>	0	0	0	0	0
<i>% of Revenue</i>	0.00%	0.00%	0.00%	0.00%	0.00%
<b>Operating Income: (EBIT)</b>	3997	4998	6163	7522	9111
<i>EBIT Margin Growth Rate</i>	na	na	na	na	na
<b>(Taxes):</b>	1399	1749	2157	2633	3189
<i>Tax Rate</i>	35%				
<b>NOPAT</b>	2598	3249	4006	4889	5922
<b>D&amp;A</b>	238	283	338	403	481
<i>% of Revenue</i>	3.87%	3.87%	3.87%	3.87%	3.87%
<b>Stock Based Compensation</b>	25	29	35	42	50
<i>% of Revenue</i>	0.40%	0.40%	0.40%	0.40%	0.40%
<b>Change in Operating A &amp; L</b>	-27	-32	-38	-46	-55
<i>% of Revenue</i>	-0.44%	-0.44%	-0.44%	-0.44%	-0.44%
<b>Change in CapEx</b>	-173	-206	-245	-293	-349
<i>% of Revenue</i>	-2.81%	-2.81%	-2.81%	-2.81%	-2.81%
<b>Unlevered FCF:</b>	2661	3324	4095	4996	6049

# MAJOR PARTS

## **2. Weighted Average Cost of Capital**

# WACC

- Weighted Average Cost of Capital
- We have the Cash Flows from each year - **now we need to discount these cash flows!**
- Cost of Capital for the company - riskier companies have higher WACC's
- Represents the **average rate or return** a company expects to compensate all its different investors.
  - Debt - “cost of debt” as interest on debt
  - Equity - “cost of equity” as the amount the company needs to make for investors not to sell the stock and find a better alternative (opportunity cost)

# WACC

- $WACC = [E/(E+D)]Re + [D/(E+D)]Rd*(1-t\%)$
- E = Market Value of Equity
- D = Market Value of Debt
- Re = Cost of Equity (calculated in a few min)
- Rd = Cost of Debt

Let's go step by step and find these variables!

## Market Value of Equity

- **Public Company** - their Equity Value
- **Private Company** - We do not know this value
  - Instead we look at public comparable companies as a proxy
  - Use median D/E ratio in WACC calculation

## Market Value of Debt

- **Public Company** - value of debt issued
- **Private Company** - We do not know this value
  - Instead we look at public comparable companies as a proxy
  - Use median D/E ratio in WACC calculation



## Cost of Equity

- Represents the compensation that the market demands in exchange for ownership of the asset and bearing the risk of ownership
- Has to essentially match the opportunity cost of other investments of equal or lower risk
- **Capital Asset Pricing Model (CAPM)**
  - $Re = Rf + Ba(Rm - Rf)$
- $Re$  = Cost of Equity
- $Rf$  = Risk Free Rate (10 year treasury, for example)
- $Ba$  = levered beta (how correlated the stock is to the market)
- $Rm$  = Expected Market Return
- $(Rm - Rf)$  = Market Premium

## Cost of Debt

- Interest rate on debt issued (what investors expect to receive on their investment in the company's debt)
- If no debt, no cost of debt.

## Public Company

**1. E = Market Value of Equity**

- \$ per share \* Shares Outstanding

**2. D = Market Value of Debt**

- Value of Bonds

**3. Re = Cost of Equity**

- Company's public, levered beta
- Everything else is accessed online

**4. Rd = Cost of Debt**

- Interest rate on debt

## Private Company

### 1. **E = Market Value of Equity**

- We don't know company's equity so we need to find median D/E from comparable

### 2. **D = Market Value of Debt**

- We don't know company's equity so we need to find median D/E from comparable

### 3. **Re = Cost of Equity**

- We use the median of the unlevered betas (calculation to come) to calculate levered beta of company
- Everything else is accessed online

### 4. **Rd = Cost of Debt**

- Interest rate on debt

# Private Company

Discount Rate Calculation - Assumptions	
Risk-Free Rate (Rf)	2.3%
Equity Risk Premium (Rm-Rf)	4.7%
Interest Rate on Debt (Rd)	4.0%

**E & D = Market Value of Equity & Debt**

**Re = Cost of Equity**

**Rd = Cost of Debt**

Comparable Companies - Unlevered Beta Calculation				(\$ in millions)			
Name	Ticker	Historical Levered Bet	Debt	Equity Value	Tax Rate	Unlevered Beta	Debt / Equity
Company 1	-	0.7	\$52.1	\$451.3	35%	0.6	11.5%
Company 2	-	1.1	40.0	493.6	35%	1.0	8.1%
Company 3	-	0.2	35.0	371.4	35%	0.2	9.4%
Company 4	-	0.5	24.8	120.4	35%	0.5	20.6%
Company 5	-	2.3	22.0	128.4	35%	2.0	17.1%
Company 6	-	1.9	4.1	161.0	35%	1.8	2.5%
Company 7	-	1.9	46.0	245.5	35%	1.7	18.7%
<b>Median</b>						<b>1.01</b>	<b>11.5%</b>

- **Unlevered Beta:**  $\text{Levered Beta} / [1 + (1 - \text{tax}\%) * (D/E)]$

(\$ in millions)					
Historical Levered Bet	Debt	Equity Value	Tax Rate	Unlevered Beta	Debt / Equity
0.7	\$52.1	\$451.3	35%	0.6	11.5%
1.1	40.0	493.6	35%	1.0	8.1%
0.2	35.0	371.4	35%	0.2	9.4%
0.5	24.8	120.4	35%	0.5	20.6%
2.3	22.0	128.4	35%	2.0	17.1%
1.9	4.1	161.0	35%	1.8	2.5%
1.9	46.0	245.5	35%	1.7	18.7%
<b>Median</b>				<b>1.01</b>	<b>11.5%</b>

- **Why?** - so we can compare betas regardless of capital structure

- **Now we have:**
  1. Median D/E ratio from comparable
  2. Risk Free Rate
  3. Equity Risk Premium ( $R_m - R_f$ )
  4. Interest Rate on Debt
  5. Median unlevered beta from comparable

# WACC

- **Refer back to the equation:**
- $WACC = [E/(E+D)]R_e + [D/(E+D)]R_d*(1-t\%)$
- E = Market Value of Equity
- D = Market Value of Debt
- $R_e$  = Cost of Equity
- $R_d$  = Cost of Debt
- $WACC = (9/10)R_e + (1/10)*4%*(1-.35\%)$



<i>Median</i>	<b>1.01</b>	<b>11.5%</b>
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- **Levered Beta:**  $\text{Unlevered Beta} * [1 + (1 - \text{tax}\%) * (D/E)]$ 
  - **Answer: 1.08**

**We need Levered Beta not Unlevered Beta to account for company capital structure!**

Discount Rate Calculation - Assumptions	
Risk-Free Rate	2.3%
Equity Risk Premium	4.7%
Interest Rate on Debt	4.0%

- **Cost of Equity**
  - $Re = Rf + Ba(Rm - Rf)$
  - $Re = 2.3\% + 1.08(4.7\%)$
  - $Re = 7.38\% + \text{size premium } (5.3\%)$
  - **$Re = 12.68\%$**

- **Refer back to the equation:**
- $WACC = [E/(E+D)]Re + [D/(E+D)]Rd*(1-t\%)$
- E = Market Value of Equity
- D = Market Value of Debt
- Re = Cost of Equity
- Rd = Cost of Debt
- $WACC = (9/10)*12.68\% + (1/10)*4%*(1-.35\%)$

**Weighted Average Cost of Capital = 11.6%**

## 3. Terminal EBITDA Multiple & Perpetuity Growth Rate

# TERMINAL EBITDA & PERPETUITY

- Terminal EBITDA Multiple & Perpetuity Growth Rate
- We have the Cash Flows from each year and we now know how to discount these cash flows.
- **We can't predict future cash flows forever, so we have to summarize!**

## Terminal EBITDA Multiple

- EV/EBITDA
  - Used in public comparable company analysis (content for next lecture)
  - These multiples are used to see how much a company is being currently valued on the market.
  - For example - some companies may be valued at 8x EBITDA meaning their EV is 8x the size of the EBITDA.

## Terminal EBITDA Multiple

- Look at the Median EV/EBITDA multiple for public comparable companies if looking at a private company (like in our example)
- Assume that this median is **9.5x EBITDA**. This means that we could potentially sell our company at 9.5x EBITDA in the final year of our DCF projection, receiving cash!

**We would apply this 9.5x EBITDA multiple to the EBITDA of the final year projection to get a lump sum!**

# UNLEVERED FREE CASH FLOW

Example DCF	
	Forward Year 5
<b>Revenue:</b>	12419
Revenue Growth Rate	19.24%
<b>(COGS):</b>	747
COGS Growth Rate	-7.46%
<b>(SG&amp;A):</b>	2032
SG&A Growth Rate	23.75%
<b>(D&amp;A)</b>	481
% of Revenue	3.87%
<b>(Stock Based Compensation)</b>	50
% of Revenue	0.40%
<b>(Other Expenses &amp; Intangibles)</b>	0
% of Revenue	0.00%
<b>Operating Income: (EBIT)</b>	9111
EBIT Margin Growth Rate	na
<b>(Taxes):</b>	3189
Tax Rate	35%
<b>NOPAT</b>	5922
<b>D&amp;A</b>	481
% of Revenue	3.87%
<b>Stock Based Compensation</b>	50
% of Revenue	0.40%
<b>Change in Operating A &amp; L</b>	-55
% of Revenue	-0.44%
<b>Change in CapEx</b>	-349
% of Revenue	-2.81%
<b>Unlevered FCF:</b>	6049

- Find EBITDA in Year 5 projection
  - Take EBIT and add back D&A
  - $9111 + 481 = 9592$

We multiple this terminal year EBITDA by our EBITDA multiple of 9.5x to get **\$91,124 terminal value.**



## Perpetuity Growth Method

- **Growing Perpetuity**
  - Receiving cash forever that is growing at a specific % each year.
  - As long as this % is less than our WACC, eventually the PV of those cash flows will converge to 0.
  - To find the % growth we can look at different things
    - In this example, let's assume we take the average growth rate of the S&P 500 compensating for inflation, etc. at **6.5%**

# TERMINAL EBITDA & PERPETUITY

Example DCF	
	Forward Year 5
<b>Revenue:</b>	12419
Revenue Growth Rate	19.24%
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% of Revenue	-2.81%
<b>Unlevered FCF:</b>	6049

- Take the Unlevered FCF for the final projected year (Year 5)
- Equation for Growing Perpetuity:

$$\text{Unlevered FCF} * (1+g) / (\text{WACC}-g)$$

$$6049 * (1.065) / (.116 - .065) =$$

**\$126,317 terminal value**

## COMBINING PARTS

### We Now Have:

#### 1. Unlevered Free Cash Flow for 5 projected years

Example DCF	Projected				
	Forward Year 1	Forward Year 2	Forward Year 3	Forward Year 4	Forward Year 5
Unlevered FCF:	2661	3324	4095	4996	6049

#### 2. Weighted Average Cost of Capital

$$\text{WACC} = 11.6\%$$

#### 3. Terminal EBITDA Multiple & Perpetuity Growth %

$$\text{Terminal Multiple} = 9.5x$$

$$\text{Perpetuity Growth} = 6.5\%$$

# COMBINING PARTS

Cash Flow Projections		2016P	2017P	2018P	2019P	2020P
Unlevered Free Cashflow		\$2,661.0	\$3,324.0	\$4,095.0	\$4,996.0	\$6,049.0
Terminal Value EBITDA Mult.						\$91,124.0
Terminal Value Perpetuity						\$126,317.4
Projection Discount Period		1.00	2.00	3.00	4.00	5.00
PV of Unlevered Free Cashflows		\$2,384.4	\$2,668.9	\$2,946.2	\$3,220.8	\$3,494.3
PV of Terminal Value EBITDA Mult.	\$52,640					
PV of Terminal Value Perpetuity	\$72,970					
NPV of Company Ownership						
Terminal Value EBITDA Multiple	\$67,354					
NPV of Company Ownership						
Terminal Value Perpetuity	\$87,684					

# VALUATION & SENSITIVITY

## Valuation Sensitivity - Terminal Value EBITDA Multiple vs. Discount Rate

		Discount Rate (WACC)				
		9.5%	10.5%	11.5%	12.5%	13.5%
Terminal Value EBITDA Multiple	8x	\$64,384	\$61,767	\$59,284	\$56,927	\$54,687
	9x	\$70,477	\$67,589	\$64,850	\$62,249	\$59,780
	10x	\$73,523	\$70,500	\$67,633	\$64,911	\$62,326
	11x	\$82,663	\$79,234	\$75,982	\$72,895	\$69,965
	12x	\$88,756	\$85,056	\$81,547	\$78,218	\$75,057

## Valuation Sensitivity - Perpetuity Growth Rate vs. Discount Rate

		Discount Rate (WACC)				
		9.5%	10.5%	11.5%	12.5%	13.5%
Perpetuity Growth Rate	5.5%	\$116,985	\$92,662	\$76,475	\$64,935	\$56,299
	6.0%	\$132,012	\$101,678	\$82,404	\$69,085	\$59,336
	6.5%	\$152,047	\$112,948	\$89,520	\$73,926	\$62,808
	7.0%	\$180,098	\$127,439	\$98,217	\$79,648	\$66,813
	7.5%	\$222,173	\$146,759	\$109,088	\$86,514	\$71,486