MICHIGAN ROSS

Winter 2025

FIN 623: Venture Capital Finance

Valuation Part II

ROSS

Road Map

Characteristics Correlated to Value

- How large is the opportunity?
- What level of risk does the opportunity entail?

The "Sweet Spot" Method

- How much **cash** does the company need to accomplish the next milestone?
- How much **ownership** is required to exert appropriate control without undermining the founders' incentives?

The VC Method

- At time of exit, how **large** is the market, how **profitable** will the company be, and what investors pay per dollar of profit?
- What is the **probability** of a successful exit?

Modified DCF

- How much cash will the company generate during the **early years**?
- How much cash will the company generate at **maturity**?

Qualitative Approach | **Objective Valuation** | **Subjective Valuation**

Least Data-Driven
Based on Market Demand

Most Data-Driven
Based on Performance Expectations

Plan for today

Part I: What Drives a Company's Value?

Part II: The DCF Method

Part III: Multiples Valuation

Part I: What Drives a Company's Value?

Overview

- What Drives a Company's Value?

  - Key Value Drivers

  - Dynamic Model of Value Creation
    - ROIC
    - Growth

What are the Key Value Drivers?

- **Starting Point:** Gordon Growth Model
  - Suppose cash flows **grow** by a constant rate g **FOREVER** ➡ **Growing Perpetuity**
  - Using the Discounted Cash Flow Method, the value of the company is equal to:

$$\text{Value}_0 = \frac{\text{CF}_1}{(1+\text{R})^1} + \frac{\text{CF}_2}{(1+\text{R})^2} + \ldots + \frac{\text{CF}_t}{(1+\text{R})^t} + \ldots =$$

$$= \frac{\text{CF}_0 \times (1+\text{g})}{(1+\text{R})^1} + \frac{\text{CF}_0 \times (1+\text{g})^2}{(1+\text{R})^2} + \ldots + \frac{\text{CF}_0 \times (1+\text{g})^t}{(1+\text{R})^t} + \ldots$$

$$\boxed{\text{Value}_0 = \frac{\text{CF}_0(1+\text{g})}{\text{R}-\text{g}} = \frac{\text{CF}_1}{\text{R}-\text{g}}}$$

How Do We Estimate Cash Flows?

Cash Flow = Operating Profit – (Capital Expenditures + ΔNWC - Depreciation)

Net After-Tax Operating Profit (NOPAT)
NOPAT = EBIT x (1 – Tax Rate)

Net Investment (NI)

- **Investment Rate (IR) =** Net Investment (NI)/NOPAT
- **Return on Investment Capital (ROIC) =** Change in Profit Per Dollar of Net Investment (NI)

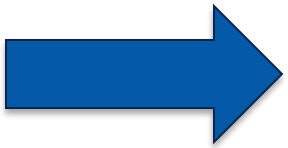
Cash Flow = NOPAT x (1 - IR)

$$\text{ROIC} = \frac{\text{NOPAT}}{\text{Invested Capital}} = \frac{\text{NOPAT}}{\text{Revenues}} \times \frac{\text{Revenues}}{\text{NI}} = \text{Profit Margin} \times \text{Invested Capital Turnover}$$

How Do We Estimate Cash Flows?

	Year 1	Year 2
Net After-Tax Operating Profit (NOPAT)	100.0	103.0
Net Investment (NI)	(30.0)	(30.9)
Cash Flow	70.0	72.1

- Investment Rate (IR) = 30.0/100.0 = 30%
- ROIC = (103.0 - 100.0)/30 = 10%
- Cash Flow Growth = (72.1-70.0)/70.0 = 3%



Cash Flow Growth = **IR x ROIC** = 30% x 10% = 3%

What are the Key Value Drivers?

$$\mathrm{ROIC}_{t\text{-}1} = \frac{\mathrm{NOPAT}_t - \mathrm{NOPAT}_{t\text{-}1}}{\mathrm{NI}_{t\text{-}1}} = \frac{\mathrm{NOPAT}_t - \mathrm{NOPAT}_{t\text{-}1}}{\mathrm{NOPAT}_{t\text{-}1} \times \mathrm{IR}_{t\text{-}1}}$$

$$\mathrm{ROIC}_{t\text{-}1} \times \mathrm{IR}_{t\text{-}1} = \frac{\mathrm{NOPAT}_t - \mathrm{NOPAT}_{t\text{-}1}}{\mathrm{NOPAT}_{t\text{-}1}} = \frac{\mathrm{CF}_t - \mathrm{CF}_{t\text{-}1}}{\mathrm{CF}_{t\text{-}1}}$$

$$\mathrm{ROIC}_{t\text{-}1} \times \mathrm{IR}_{t\text{-}1} = \mathrm{g}_t$$

- **Achieve Higher Growth by:**
  - Earning a Higher Return on Invested Capital
  - Reinvesting a Larger Fraction of the Profits

Key Value Driver Formula

"The Zen of Corporate Finance"

$$\text{Value} = \frac{\text{CF}}{\text{R} - \text{g}} = \frac{\text{Profit} \times (1 - \text{IR})}{\text{R} - \text{g}} = \frac{\text{Profit} \times (1 - \frac{\text{g}}{\text{ROIC}})}{\text{R} - \text{g}}$$

Gordon Growth | **CF = Profit x (1 - IR)** | **Growth Rate (g) - IR x ROIC**

- Increase in Profit → Increase in Value
- Increase in ROIC → Increase in Value
- Increase in Cost of Capital → Decrease in Value
- Increase in Growth Rate → **Let's See!**

Key Value Driver Formula

$$\text{Value} = \frac{\text{CF}}{\text{R} - \text{g}} = \frac{\text{Profit} \times (1 - \text{IR})}{\text{R} - \text{g}} = \frac{\text{Profit} \times (1 - \frac{\text{g}}{\text{ROIC}})}{\text{R} - \text{g}}$$

The market value of a company, with a profit of $100M and a 10% cost of capital is as follows:

		ROIC			
		7.5%	10.0%	12.5%	15.0%
Growth	2%				
	4%				
	6%				

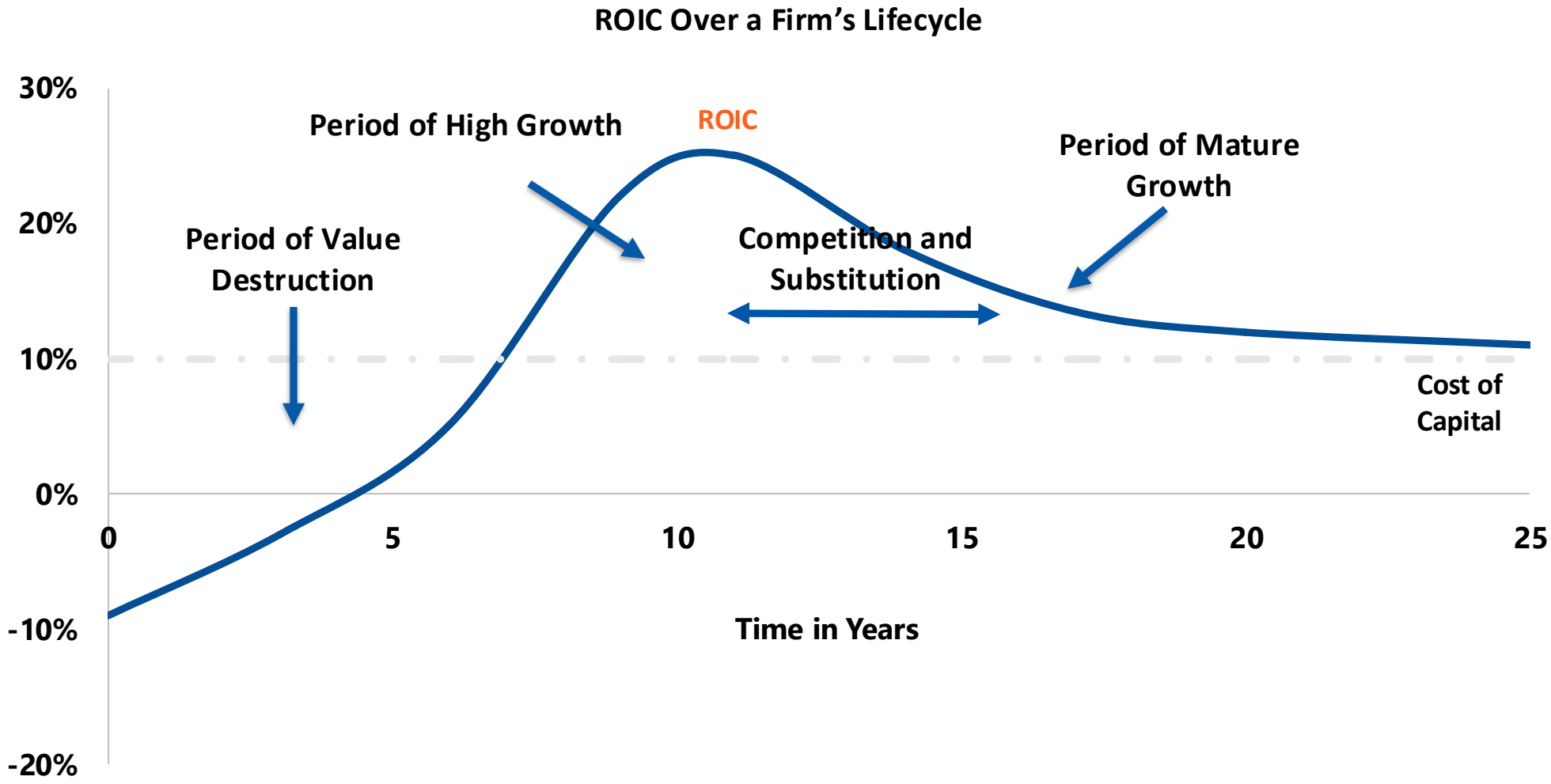
Key Value Driver Formula

- **ROIC > Cost of Capital: Increase in growth creates value**
  - The greater the increase in growth rate, the greater the increase in value

- **ROIC = Cost of Capital : Firm creates NO value through growth**
  - The firm is growing by investing in projects with NPV = 0!

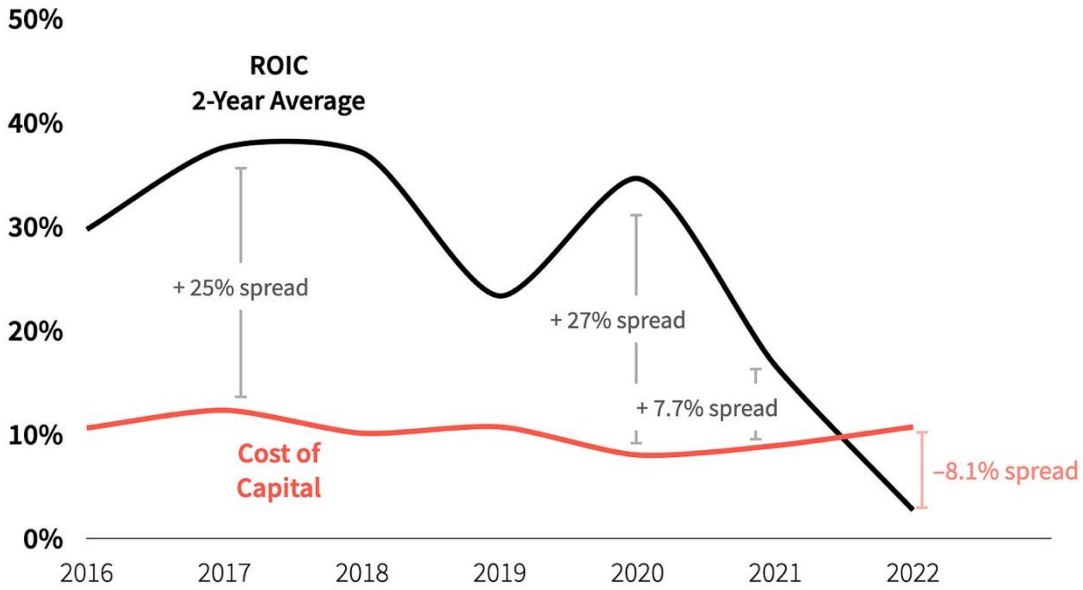
- **ROIC < Cost of Capital : Firm destroys value by investing in projects**
  - If a firm is unable to earn the necessary return on new investments, an increase in growth leads to a decline in market value

Dynamic Value Driver Framework: ROIC

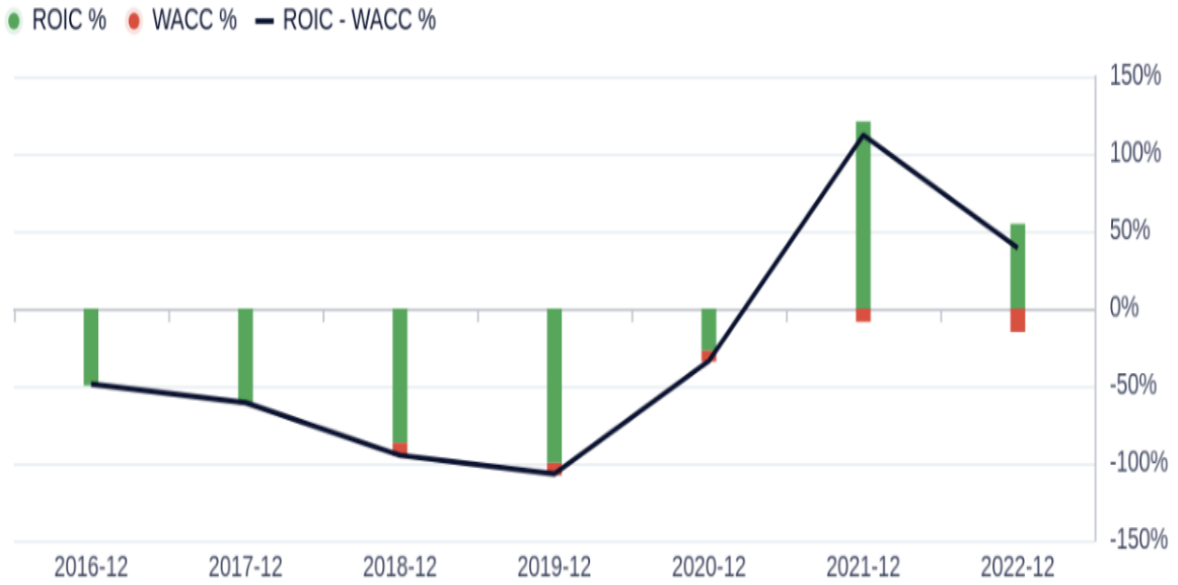


Examples

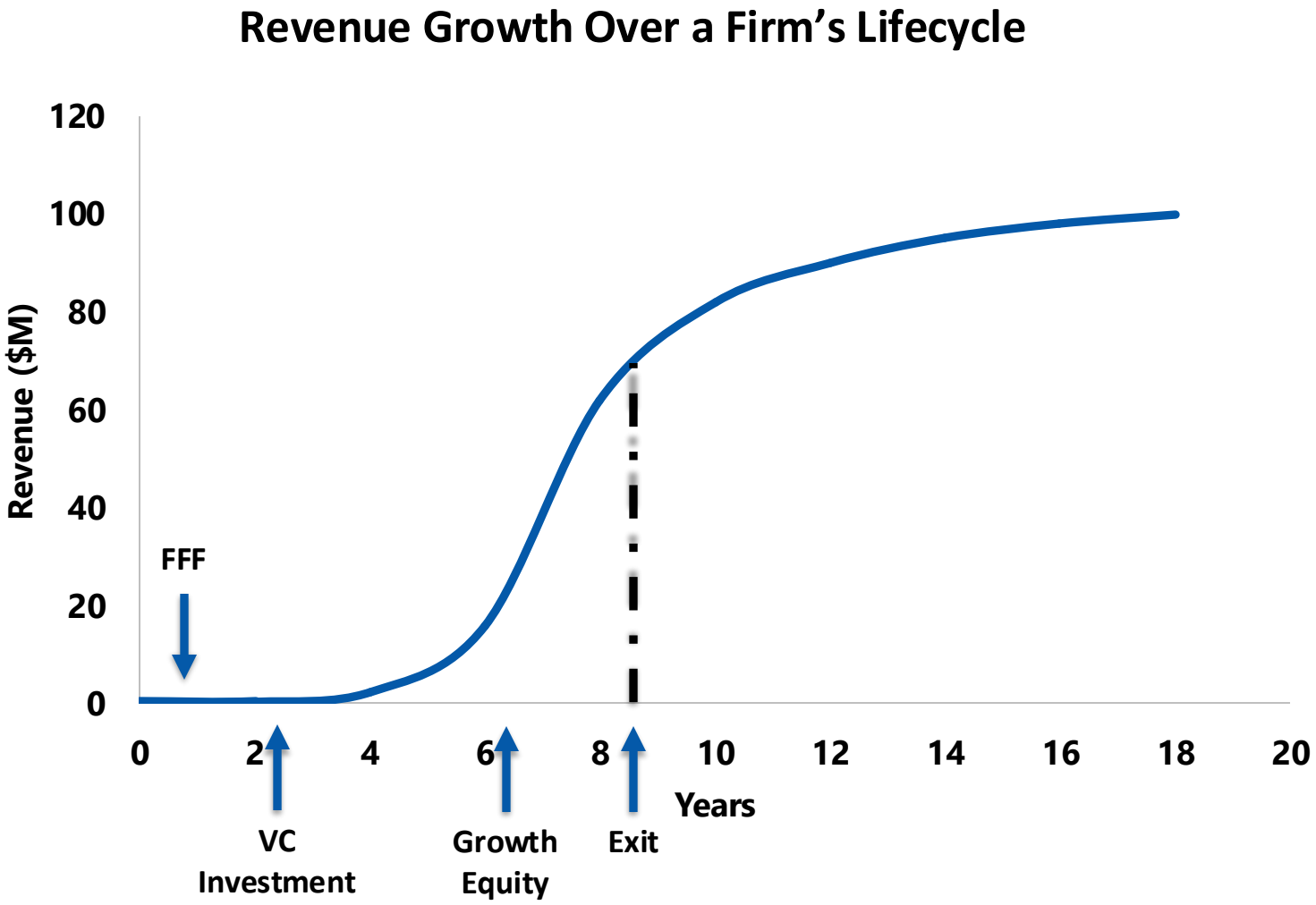
TradeDesk ROIC-Cost of Capital Spread



Moderna ROIC-Cost of Capital Spread



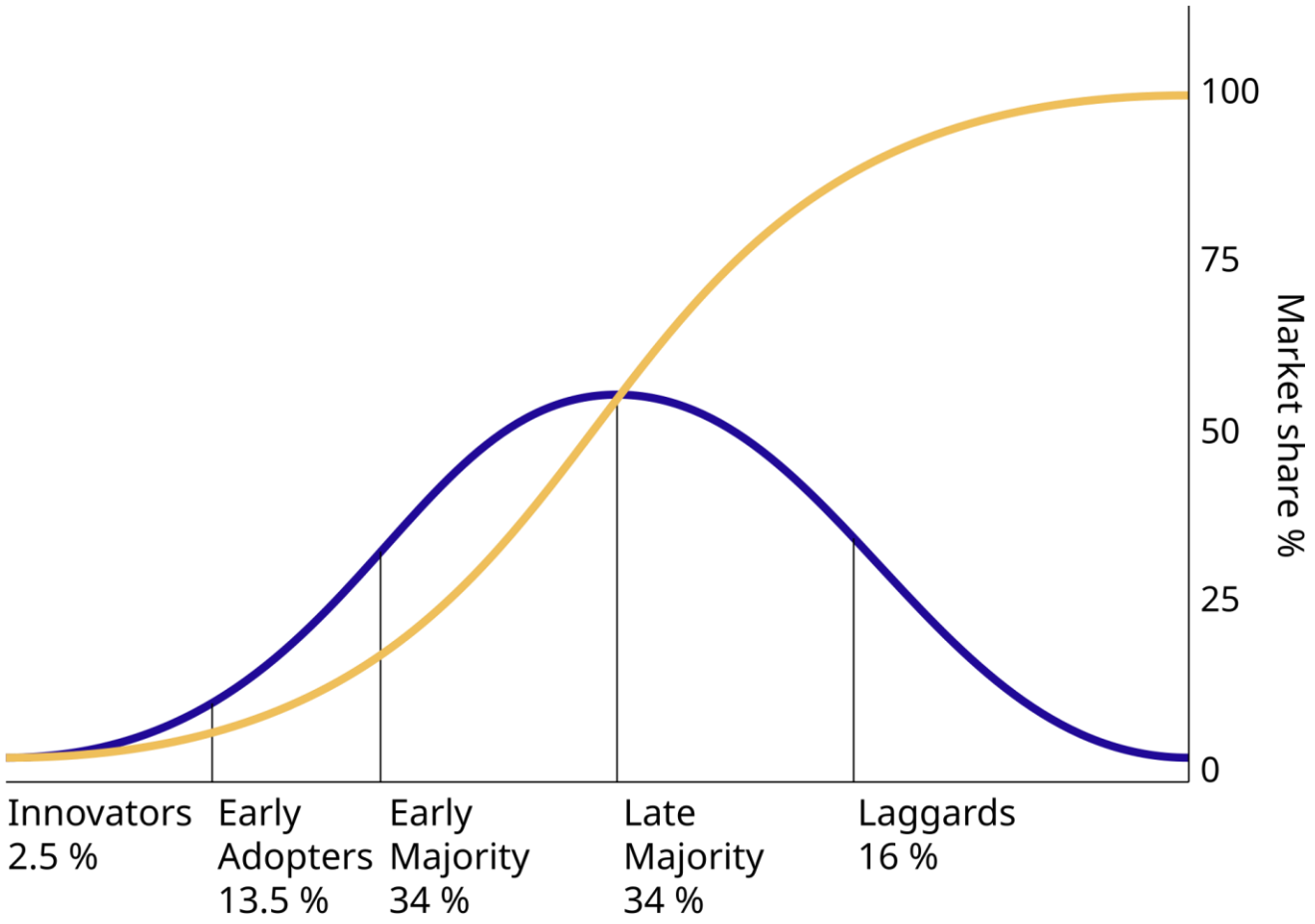
Dynamic Value Driver Framework: Growth



- To value a new opportunity, size the addressable market and forecast adoption rates
- Market sizing using top-down (through filters) or bottom-up (through channel aggregation)

Dynamic Value Driver Framework: Growth

Diffusion of Innovation Theory



- To value a new opportunity, size the addressable market and forecast adoption rates
- Market sizing through Everett Rogers' "Diffusion of Innovation Theory"

Dynamic Value Driver Framework: Growth

- **Everett Rogers' Innovation ACCORD Model, which examines the product or service from the customer's perspective:**

  Advantage Relative to What the Product Replaces

  Compatibility with Current Behaviors/Systems

  Complexity of Communicating the Benefits

  Observability of the Product's Benefits

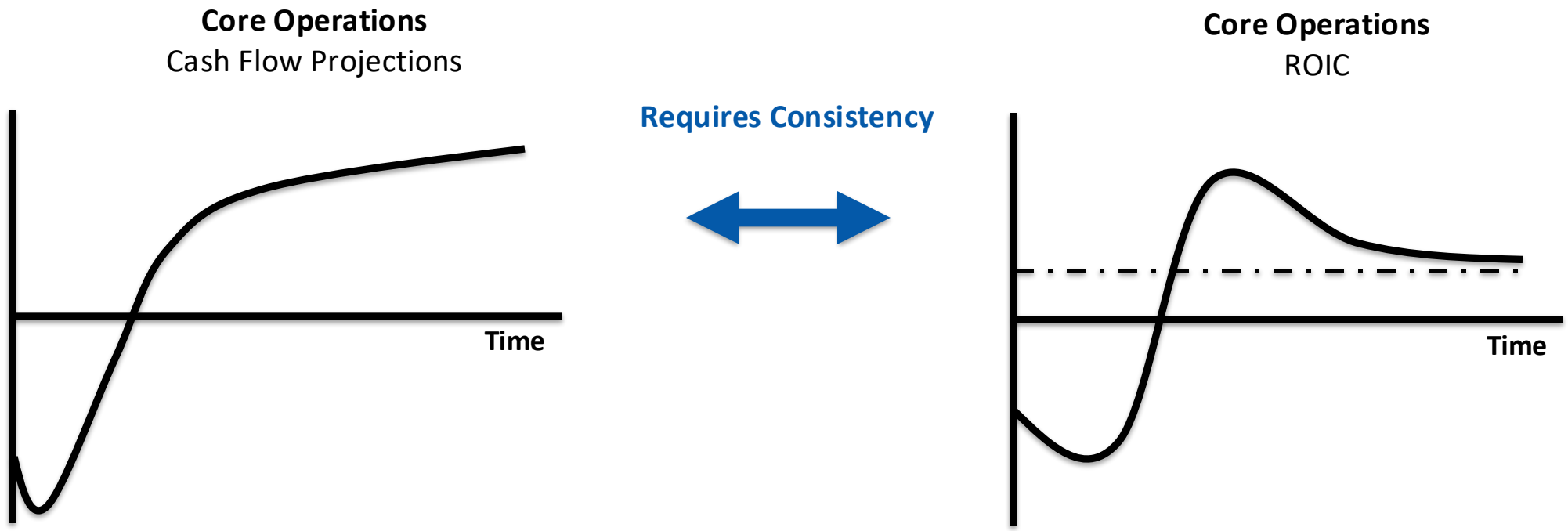
  Risk of Product Failure

  Divisibility or Trialability

Dynamic Value Driver Framework: Summary

- The Dynamic Value Driver framework allows you to create a link between **cash flows** and **corporate strategy**, **competitive positioning**, **barriers to entry** etc.

- Imposes discipline on DCF Model:



Part II: DCF Valuation

Road Map

Characteristics Correlated to Value	The "Sweet Spot" Method	The VC Method	Modified DCF
❑ How large is the opportunity? ❑ What level of risk does the opportunity entail?	❑ How much **cash** does the company need to accomplish the next milestone? ❑ How much **ownership** is required to exert appropriate control without undermining the founders' incentives?	❑ At time of exit, how **large** is the market, how **profitable** will the company be, and what investors pay per dollar of profit? ❑ What is the **probability** of a successful exit?	❑ How much cash will the company generate during the **early years**? ❑ How much cash will the company generate at **maturity**?
Qualitative Approach	**Objective Valuation**	**Subjective Valuation**	

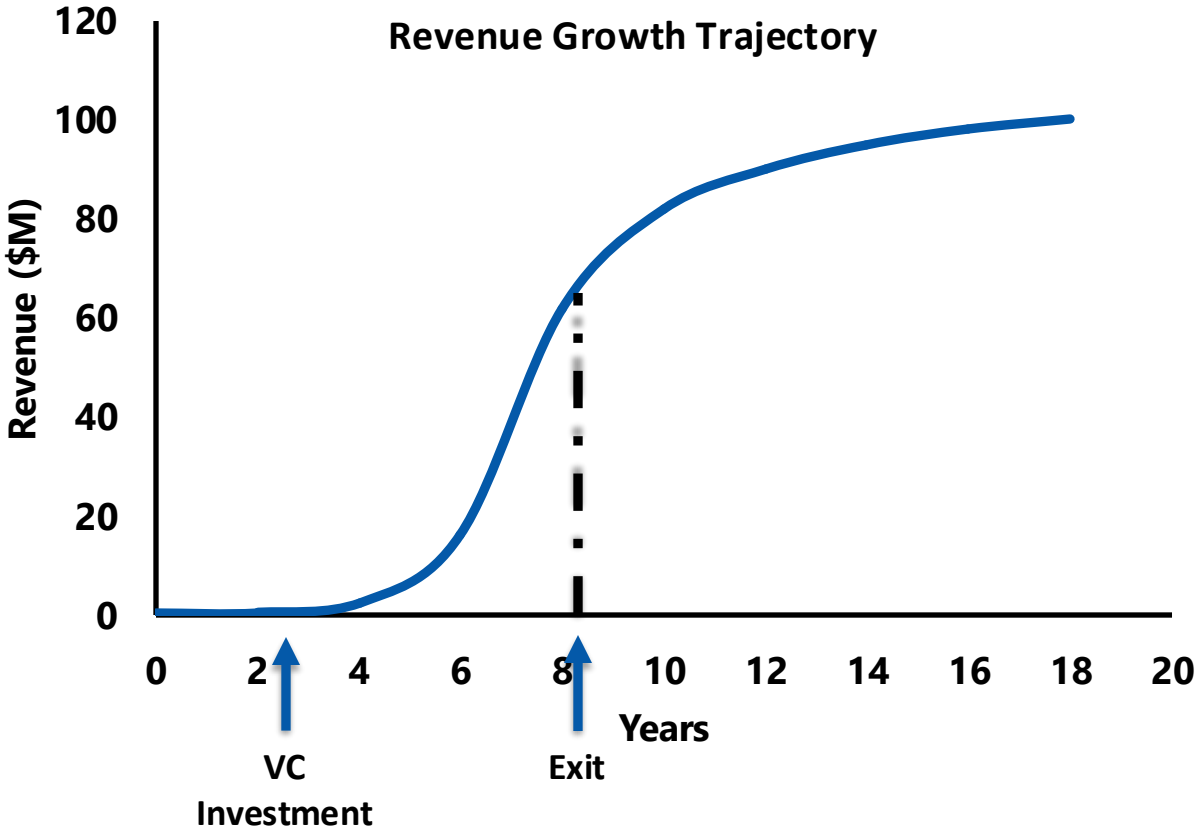
Least Data-Driven
Based on Market Demand

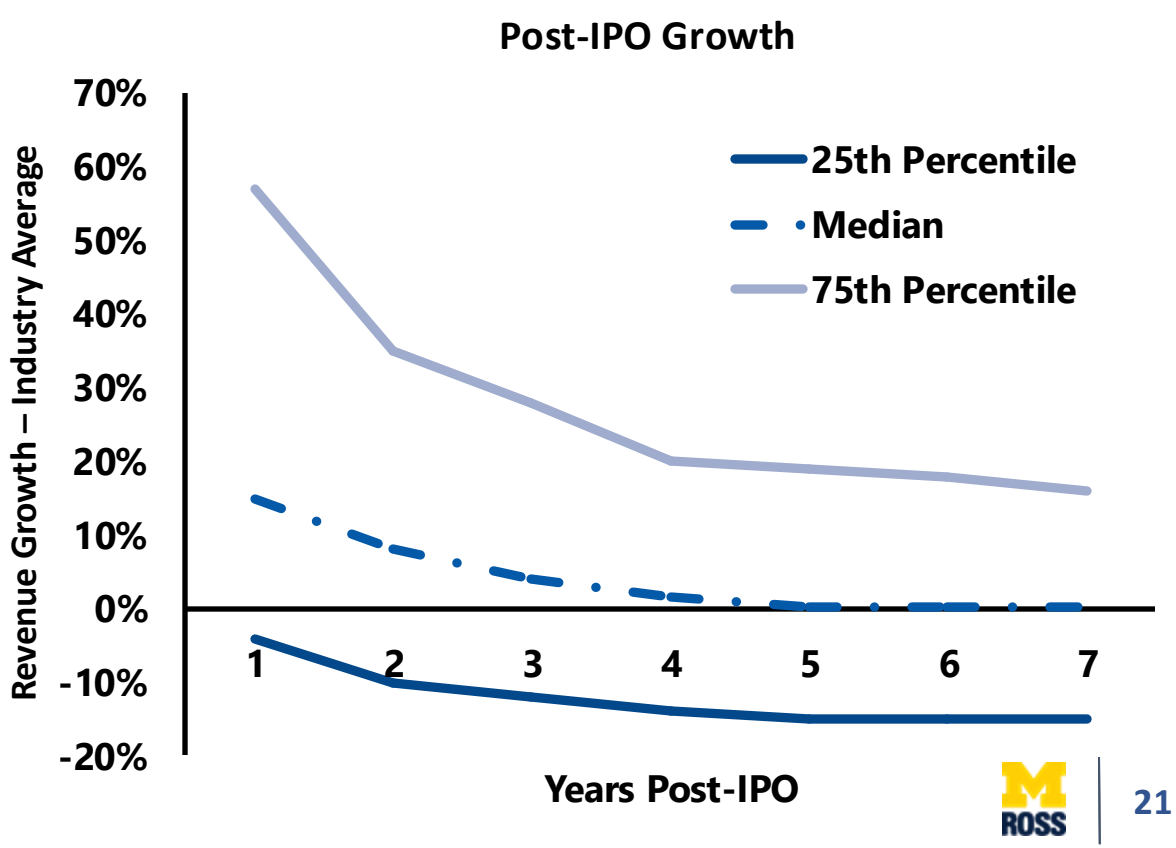
Most Data-Driven
Based on Performance Expectations

Company Growth

- The **"Zen of Corporate Finance"** formula relies on a **perpetuity**, which assumes the company has reached a **steady state**

- For startups and high-growth companies, **neither growth rates nor margins are stable**





Phases of Growth

- **Venture Period:** Beginning with Initial VC Investment and Ending with IPO or Acquisition
- **High-Growth Period:** Company Grows Rapidly and Ends with Approaching Industry Averages
- **Stable-Growth Period:** Company Grows at a Stable Rate

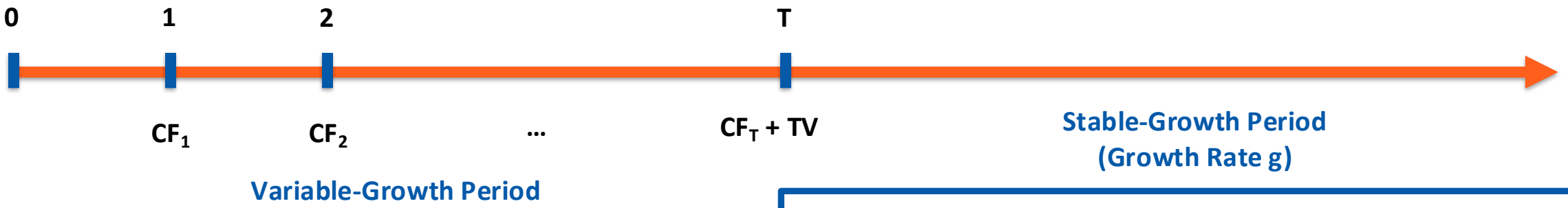
Discounted Cash Flow: Inputs

- The Discounted Cash Flow (DCF) Method Estimates a Company's Value as the **Sum** of the **Present Values** of the **Expected Cash Flows** Generated by the Company:

$$\text{Value}_0 = \sum_{t=1}^{N} \text{PV}(\text{Expected Cash Flow}_t) = \sum_{t=1}^{N} \frac{\text{E}(\text{CF}_t)}{(1+\text{r})^t}$$

- **Inputs:**
  - **Cash Flows:** Forecasted for a Period Typically >= 5 Years
    - Capture the Amount of Cash Generated by the Company's Operations After Considering Operating Expenses and Capital Expenditures
  - **Discount Rate (r):** To Convert the Forecasted Cash Flows to Present Values
  - **Stable-Growth Rate:** To Estimate Terminal Value (TV) at Graduation

Discounted Cash Flow: Steps



$$\text{Value}_0 = \frac{\text{CF}_1}{(1+\text{r})^1} + \frac{\text{CF}_2}{(1+\text{r})^2} + \ldots + \frac{\text{CF}_\text{T} + \text{TV}_\text{T}}{(1+\text{r})^\text{T}}$$

❑ Steps:

1. **Estimate Cash Flows for the Variable Growth Period (Period 1 to T)**
   - Based on Accounting Information from Financial Statements and Estimated Using the Free Cash Flow (FCF) Formula
2. **Estimate the Terminal Value (TV) for the Stable-Growth Period at Period T**
   - Using the Growing Perpetuity Formula Based on a Growth Rate g
   - Alternatively, Use an "Intermediate" or "Steady-State" Competitor Multiple
3. **Use Discount Rate to Convert Cash Flows and Terminal Value to Present Values at t = 0**
4. **Sum Present Values to Estimate the Value of the Company**

Free Cash Flows (FCFs)

- VC-funded companies **rarely** use any **debt**
  - **Assumption:** VC-funded companies are **all-equity financed**
  - Supported by empirical evidence as the average (median) leverage right after IPO for VC-funded companies is 4.7% (1.2%)

Free Cash Flow (FCF) = EBIT x (1 – Tax Rate) + Depreciation - CapEx+ ΔNWC

- **EBIT =** Earnings Before Interest and Taxes (or Operating Income)
- **Depreciation** is a Non-Cash Expense
- **CapEx =** Capital Expenditures = ΔNet Fixed Assets + Depreciation
  - Amount of Cash Invested for the Acquisition, Upgrade, or Maintain Fixed Assets
- **ΔNWC =** Change in Net Working Capital

Free Cash Flow Formula

Free Cash Flow (FCF) = EBIT x (1 – Tax Rate) + Depreciation - CapEx+ ΔNWC

- **EBIT =** Revenues - COGS - Operating Expenses - Depreciation
- **COGS** is Cost of Goods Sold
  - Representing Production Costs
- **Operating Expenses =** SG&A Expenses + R&D Expenses
  - SG&A Expenses is Selling, General and Administrative Expenses (Overhead)
  - R&D Expenses is Expenses for Research and Development
- No **Amortization**
  - Primarily Related to Acquisitions and Goodwill
- **Capital Expenditure** (CapEx) is an Important Value Driver for a Company's Growth
- **ΔNet Working Capital** (NWC) = **ΔCurrent Assets - ΔCurrent Liabilities**
  - Tends to Grow for VC-Funded Companies

Free Cash Flows (FCFs)

	Historical Financials		Forecast Period		Terminal Value
	2023	2024	2025E	2026E	
Revenues					
(-) Cost of Goods Sold (COGS)					
Gross Profit					
(-) Selling, General and Administrative Expenses (SG&A) and R&D					
Earnings Before Interest, Taxes Depreciation, and Amortization (EBITDA)					
(-) Depreciation and Amortization					
Earnings Before Interest and Taxes (EBIT)					
(-) Taxes [or (x) (1 - Tax Rate)]					
(+) Depreciation and Amortization					
(-) Capital Expenditures (CapEx)					
(-) Increases in Net Working Capital					
Free Cash Flow (FCF)					

Discount Rate and Terminal Value

- Use the **Cost of Capital** for the Company
  - Estimation Relies on Cash Flows Generated by the Company
  - Use Industry-Specific Comparables in the Market
- Contrasts with the VC Method that Relies on the **VC Fund's Cost of Capital**
  - Focuses on Cash Flows to the VC Fund
- The Terminal Value Represents the Value of the Firm at the **Start** of the **Stable-Growth Period**
  - Relies on the Growing Perpetuity Formula Based on the Stable Growth Rate g
  - Alternatively, Use an "Intermediate" or "Steady-State" Competitor Multiple
  - For the Stable Growth Rate g, Consider the Long-Run Growth Rate of Economy or Industry or Estimate Using **ROIC x IR**

$$TV_T = \frac{CF_T \times (1+g)}{(r-g)}$$

DCF Valuation

Value of Company at t = 0

$$\text{Value}_0 = \frac{\text{CF}_1}{(1+\text{r})^1} + \frac{\text{CF}_2}{(1+\text{r})^2} + \ldots + \frac{\text{CF}_\text{T} + \text{TV}_\text{T}}{(1+\text{r})^\text{T}}$$

- **Discounted Cash Flow Method:**
  - The Value of the Company at t = 0 is Equal to the Present Value of the Expected Cash Flows Generated by the Company in Perpetuity

- Rely on DCF to Estimate **Exit Valuation** for the VC Method
  - Forecast Post-Exit Cash Flows

DCF Valuation in High-Growth Companies

	Historical Financials		Forecast Period		Terminal Value
	2023	2024	2025E	2026E	
Revenues					
(-) Cost of Goods Sold (COGS)					
Gross Profit					
(-) Selling, General and Administrative Expenses (SG&A) and R&D					
Earnings Before Interest, Taxes Depreciation, and Amortization (EBITDA)	??		High-Growth Period		Stable-Growth Period
(-) Depreciation and Amortization					
Earnings Before Interest and Taxes (EBIT)					
(-) Taxes [or (x) (1 - Tax Rate)]					
(+) Depreciation and Amortization					
(-) Capital Expenditures (CapEx)					
(-) Increases in Net Working Capital					
Free Cash Flow (FCF)					

Valuing High-Growth Companies

1. Start from the Future

- Identify Length of High-Growth Period and Point in Time of Stable Growth
- Size the Market and Estimate Potential Market Share the Company Likely to Capture
- Estimate Level of Sustainable Operating Margin
- Evaluate Capital Investments Necessary to Achieve Scale

2. Link Future Performance to Current Performance

- Assess the Speed of Transition from Current Performance to Future Long-Term Performance
- Be Consistent with Economic Principles and Industry Characteristics
- Rely on Historical Progression for Prior Companies in the Industry
- Evaluate Capital Investments Necessary to Achieve Scale

3. Develop Probability-Weighted Scenarios

Quantifying Value Drivers

Quantify **Key Value Drivers**

- **Revenue Growth:** How Large is the Addressable Market? What Is the Market's Growth Rate? How Fast Is the Company Able to Capture Estimated Market Share?
- **Operating Margin:** What Are the Operating Margins at Established Companies in the Industry? How Soon Are We Able to Get There?
- **Required Investment:** What is the Amount of Capital Investment Required to Grow the Company and Achieve Estimated Market Share?
- **Discount Rate:** Determine the Appropriate Discount Rate Using CAPM or Multi-Factor Models, NOT Arbitrary Rates!
- **Terminal Value:** What is the Appropriate Growth Rate for the Stable-Growth Period? Alternatively, What is the Appropriate Terminal Value Multiple?

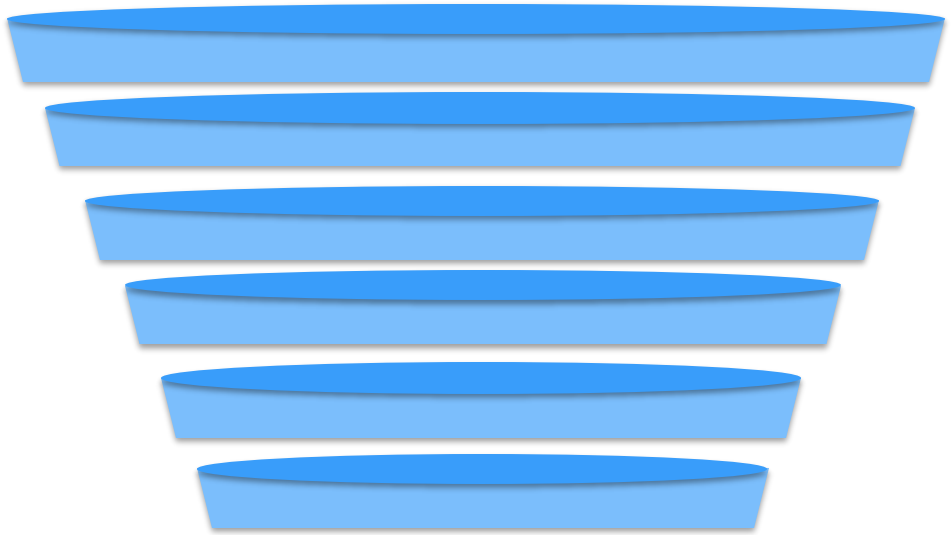
Revenue Forecasts

Critical Aspect of Valuing a Venture Opportunity:

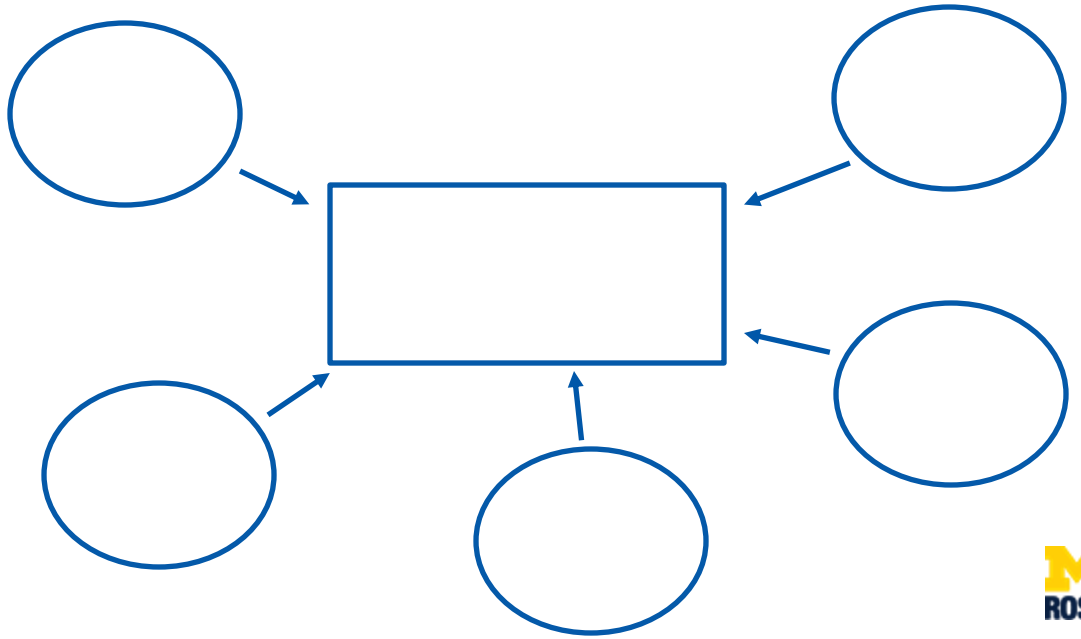
Sizing Relevant Market

- A **top-down** approach starts with the **global population** and **narrows** the **market size** by relevant filters
- A **bottom-up** approach estimates value of potential customers segment-by-segment or source-by-source

Top-Down



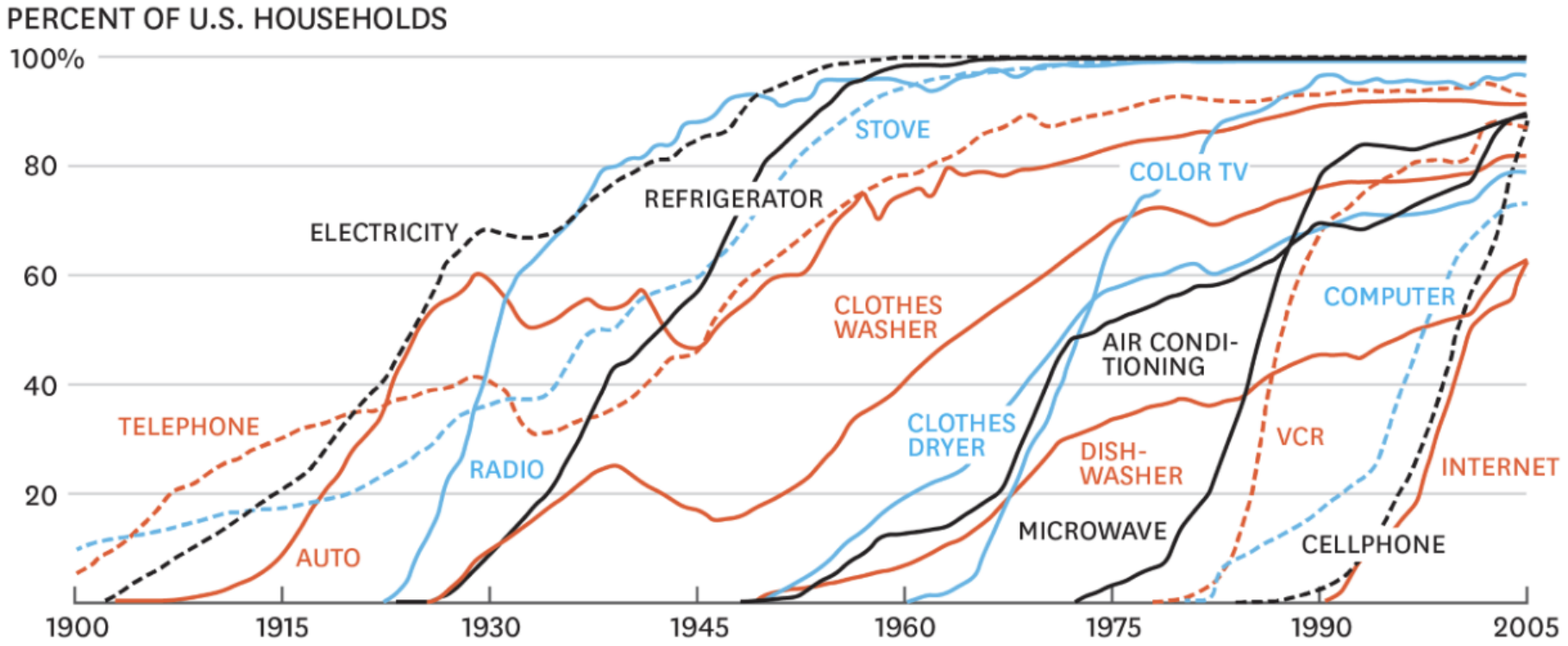
Bottom-Up



Market Growth

With advances in **distribution channels** and the improved availability of **external funding**, time to full penetration has decreased.

- Dishwasher achieved 60% penetration in 60 years, whereas Internet achieved 60% in only 15 years.



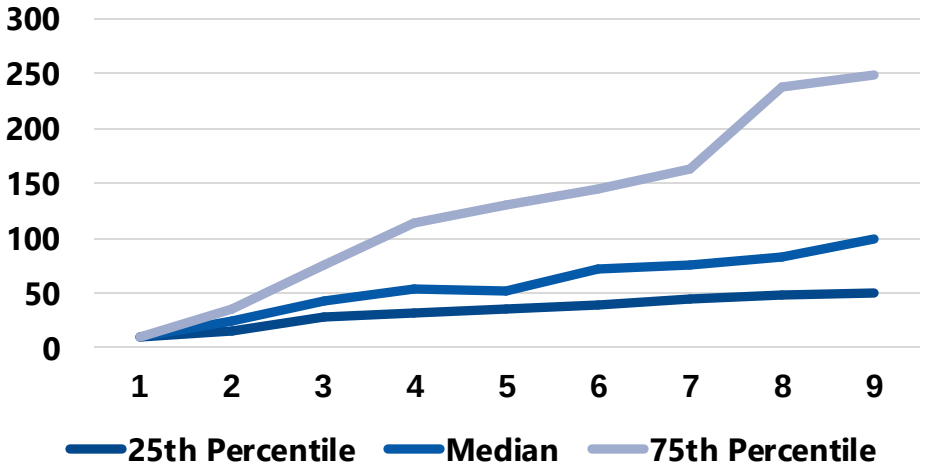
Source: Nicholas Felton, The New York Times

Competitive Landscape

Estimate Potential **Market Share**:

Revenue for Public Technology Start-Ups after Reaching the $10 million Threshold

- What is **Growth Rate** of the Market? What Was the Historical Growth Rate of the Market Entrants?
- Which Companies Are the Primary **Competitors**?
- Which Companies are Experiencing **Increases** or **Declines** in **Market Share**? What Are the Underlying Factors?



Average Growth Rates By Period

	Years 1-4	Years 5-8	Total
Upper Quartile	89.0%	17.8%	49.3%
Median	52.5%	16.3%	33.1%
Lower Quartile	32.0%	13.8%	22.6%

Unit Economics

- **Unit Economics:** Method for estimating a company's profitability by analyzing the direct revenues and costs on a **per-unit basis**, where a unit is any quantifiable item that provides value to the company (e.g., Customer)
- **Unit Economics Metrics:**
  - **Lifetime Value (LTV):** Average Amount of Money Earned Per Unit (Customer) Over Lifetime of Relationship with the Company
  - **Cost Acquisition Cost (CAC):** Total Amount Spent to Sales and Marketing to Acquire a Customer
  - **Retention Rate** or **Churn Rate**
  - **Average Customer Lifetime**
  - **Number of Transactions Per Unit**
  - **Total Unit Revenue**
  - **Average Order Value Per Unit**

Example: OpenTable

OpenTable is an online restaurant-reservation company founded in 1998 and based in San Francisco that was subsequently acquired by Priceline for $2.6B in June 2014

Step 1: What Are OpenTable's Revenue Streams?

- One-Time $800 Computer Installation Fee
- $250/Month Subscription Fee
- Fee Per Diner: $1 If Used OpenTable's Website, $0.25 Otherwise

Step 2: Market Size

- Total Market: Number of Restaurants in the U.S.
- Addressable Market: Number of Reservations-Accepting Restaurants

Step 3: How Fast Is OpenTable Able to Acquire Market Share?

- 30% of Addressable Market in 2008
- **Upper Bound:** 60% (Current Penetration in SF)
- Assume 60% Penetration Achieved in 10 Years

Step 4: International Growth

- Assume International Growth Equal to U.S. Delayed by 6 Years

Step 5: Compute Revenues

- Installation and Subscription Revenues = Number of Restaurants x Fee Per Restaurant

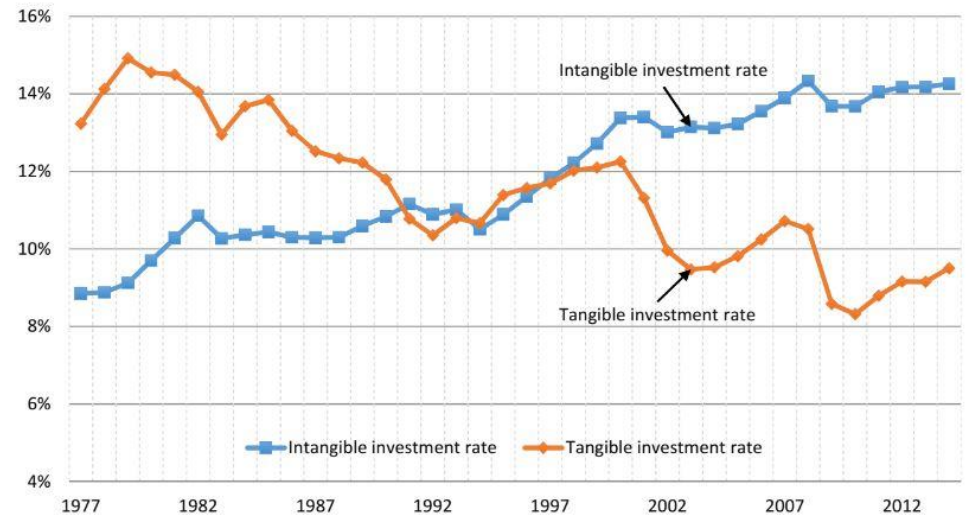
Quantifying Value Drivers

Critical Aspect of Valuing a Venture Opportunity:

Developing a Perspective on Margins

- Transitioning from **Accounting** to **Economic** Profits
  - Accounting Earnings Are Becoming Practically Irrelevant for **Digital Companies**
  - **Intangible Investments** Surpassed Investments in Fixed Assets (Property, Plant, and Equipment) as the Primary Source of Value Creation

Figure 8.1: The Intangibles Revolution
US private sector investment in tangible and intangible capital (relative to gross value added), 1977-2014



From: Lev and Gu, "The End of Accounting and the Path Forward for Investors and Managers," 2016.

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The Rise of Intangible Capitalism

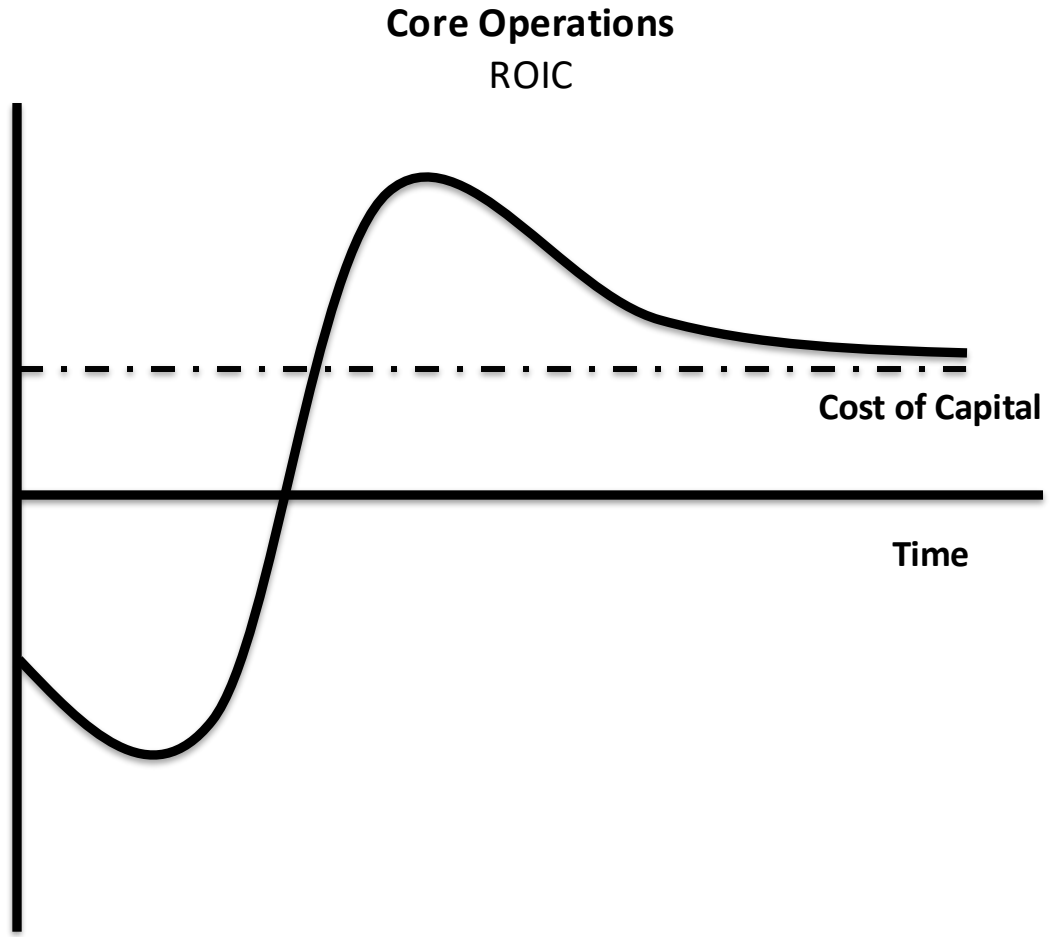
Nov 12, 2021 | **ERIC HAZAN**, **JONATHAN HASKEL**, and **STIAN WESTLAKE**

The digitized, dematerialized, knowledge-based economy is already here and spreading, and offers huge potential value. The challenge for firms and policymakers is to manage the transition in a way that benefits the many and not just the few.

PARIS – In a 2014 book, the Nobel laureate economist Joseph E. Stiglitz and Bruce C. Greenwald argued that the most important societal endowment is the ability to learn. Today, it is increasingly evident that the "learning society" has not only been created, but is starting to drive our economies.

Forecasting Long-Run Profits

- In the long run, the Return on Invested Capital (ROIC) is equal to the Cost of Capital
- How to Measure Capital Effectively?
- **Problem:** Investments in R&D, Branding, and Distribution Are **Expensed on the Income Statement BUT NOT Capitalized in the Balance Sheet**
- **Example:** A Company Investing Heavily in Branding Appears to Have **Low Earnings** Despite Large Investments in Intangible Assets



Defining Invested Capital

Invested Capital = OA - OL = D + E - NOA

	Assets	Liabilities	
Receivables Inventories Fixed Assets	Operating Assets (OA)	Operating Liabilities (OL)	Receivables Inventories Fixed Assets
Goodwill		Debt and Debt Equivalents (D)	Receivables Inventories Fixed Assets
Excess Cash Short-Term Investments Strategic Investments	Non-Operating Assets (NOA)	Equity and Equity Equivalents (E)	Common Stock Retained Earnings

Estimating Intangible Assets

How Do We Account for Investment in Intangible Assets?

Step 1: "Knowledge Capital" = G_t = Accumulated Prior R&D Expenses

- $G_t = G_{t-1} \times (1 - d_G) + R\&D_t$
- d_G = Industry-Specific R&D Depreciation Rates from BEA's Website

Step 2: "Organizational Capital" = S_t = 30% of Accumulated Prior SG&A Expenses

- $S_t = S_{t-1} \times (1 - d_S) + 0.3 \times SG\&A_t$
- d_S = 20% Per Year Depreciation
- **Assumption:** 30% of SG&A Expenses Represent Investment in Intangible Capital Including Branding, Distribution Systems, Employee Training

Step 3: Internally Developed Intangible Capital = Knowledge Capital + Organizational Capital

Step 4: Add Externally Acquired "Intangibles" from Balance Sheet

Intangibles in DCF

	Intangibles
Accounting Financial Statements	❑ Treat R&D and SG&A as Operating Expenses ❑ Use the Standard Balance Sheet
Economic Financial Statements	❑ Remove R&D and Part of SG&A from Operating Expenses ❑ Instead Add to CapEx and Adjust Taxes ❑ Add Capitalized R&D and SG&A to Balance Sheet

Why is DCF not always used in venture practice?

- DCF/APV analysis requires to take a stand on expected future FCF
  - Explicit modeling of idiosyncratic uncertainty is particularly important
  - Take expected value of cash flows over various scenarios

- Details matter but are not easy to nail down.
  - Defining free cash flow carefully
  - CAPM discount rates
  - Unlevering beta
  - Tax-loss / interest expense carry forward

- Multiples/Comparables often replace DCF in early-stage or high-uncertainty scenarios

Part III: Multiples Valuation

Overview

- Multiples (Comparables) Definition and Computation
- What Drives Differences in Multiples Across Companies?
- Which Multiple Is Appropriate and Why?
- How Can We Use Non-Financial Information?
- Is There a Better Way?

Taxonomy of Earnings

		Spyros Corp. (in $M)
1	**Revenues**	100
2	(-) Cost of Goods Sold (COGS)	40
3	**Gross Profit (1-2)**	60
4	(-) Selling, General and Administrative Expenses (SG&A) and R&D	20
5	**Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA) (3-4)**	40
6	(-) Depreciation	10
7	**Earnings Before Interest, Taxes, and Amortization (EBITA) (5-6)**	30
8	(-) Amortization	5
9	**Earnings Before Interest and Taxes (EBIT) or Operating Profit (7-8)**	25
10	(-) Net Interest Expense	5
11	**Earnings Before Taxes (EBT) (9-10)**	20
12	(-) Taxes (Tax Rate x 9)	8
13	**Net Income (11-12)**	12

What Are Multiples?

- Multiples are used to compare companies by “size-adjusting” market values using revenues, profits, book values, or non-financial statistics
- Multiples is a **Relative Valuation** Method

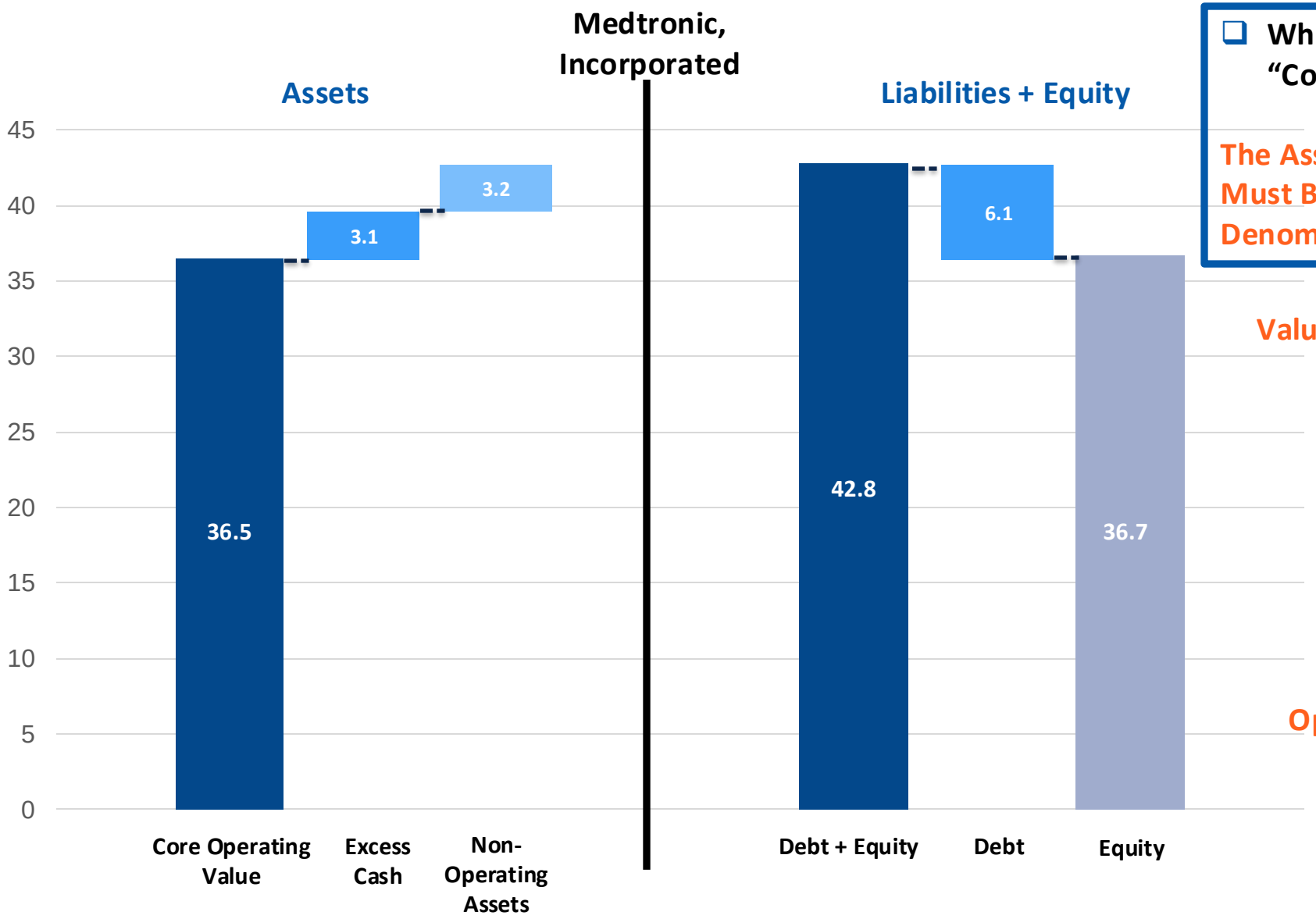
Company	Enterprise Value	Market Capitalization	Net Debt	ROIC	EV/Revenue	EV/EBITDA	EV/EBIT
Boston Scientific (NYS: BSX)	65,509,194	57,997,194	7,805,000	5.84%	5.8	66.1	1,213.0
Zimmer Biomet (NYS: ZBH)	33,813,646	27,214,446	7,321,300	0.08%	5.6	37.3	1,287.4
Medtronic (NYS: MDT)	169,027,981	153,905,981	15,572,000	5.70%	6.9	31.2	55.3
Electromed (ASE: ELMD)	91,427	102,407	(11,889)	7.35%	2.6	19.3	22.5
Johnson & Johnson (NYS: JNJ)	424,774,338	421,847,338	10,081,000	15.73%	5.2	16.1	22.1
Becton, Dickinson and Co. (NYS: BDX)	84,749,405	69,432,405	15,315,000	5.23%	4.3	17.7	32.9
				Mean	5.1	31.3	438.8
				Median	5.4	25.2	44.1
				Std Dev./Mean	29%	56%	131%

Multiple Analysis

- Derive the (Exit or Terminal) Value of a Company from Comparable Firms or Transactions
  - Comparable Firms Based on **Market Information**
  - Comparable Transactions Based on Similar **Deals**
- **Steps:**
  1. Identify Comparables
     - VC Funds Invest in **Young**, **High-Growth** Firms
     - Rely on **Industry** and **Growth Trajectory**
  2. Choose Relevant Multiples
  3. Compute the Mean/Median Value of the Comparable Sample
  4. Apply the Result to the Company's Characteristic

Step 1: Compute the Multiple

EBITDA is Forecasted to Be $5.3B Next Period



- What Constitutes a "Consistent" Multiple?

The Assets in the Numerator Must Be What Generates the Denominator!

Value of Operating Assets

$$\frac{\text{Value}}{\text{EBITDA}}$$

Profits from Operating Assets

Step 2: Use Multiple to Determine Terminal Value

- To Determine the Terminal Value, Multiply the **Forecasted EBITDA** by the **Enterprise Value Multiple**
- **Forward** or **Trailing** Multiple:
  - Timing of Estimation Matters
- **Underlying Assumption:**

Startup Under Consideration for Investment

At Time of Terminal Value

≈

Established Companies

Today

"Is Comparable to"

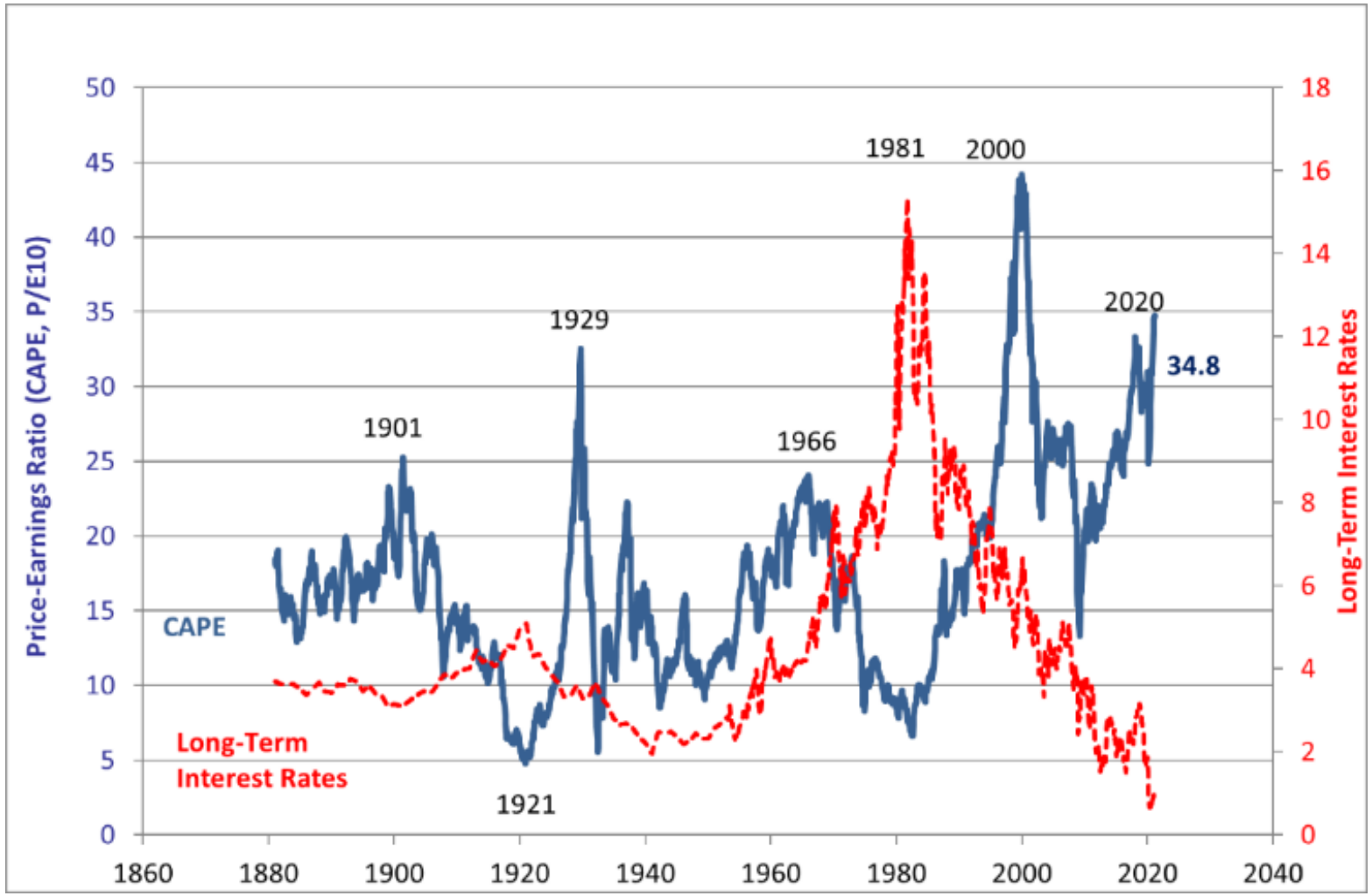
Finding Multiples

- Industry Cycles
  - Young industries might have high multiples for firms that enter the market today, since they have first mover advantage and high growth
- Mean Reversion
  - High multiples for firms that enter the market during a “hot” market need not apply for firms that go public in a few years
  - How well can you “market time”?
- IPOs Underperform
  - IPO multiples overstate gains due to long term under-performance

Choose your multiples wisely!

Multiples Mean-Revert

CAPE Ratio: Cyclically-Adjusted Price-Earnings Ratio for U.S. Firms



What Drives Multiples?

- Start with the Key Value Driver Formula

$$\text{Value} = \frac{\text{Profit} \times (1 - \frac{g}{\text{ROIC}})}{R - g}$$

- After-Tax Profits = EBITA x (1-T)

$$\text{Value} = \frac{\text{EBITA} \times (1 - T) \times (1 - \frac{g}{\text{ROIC}})}{R - g}$$

- Divide Both Sides by EBITA

$$\frac{\text{Value}}{\text{EBITA}} = \frac{(1 - T) \times (1 - \frac{g}{\text{ROIC}})}{R - g}$$

ROIC and Growth Drive EBITA Multiples

Enterprise Value to EBITDA → **Increasing ROIC**
Return On Invested Capital →

Long-Term Growth Rate	6%	9%	15%	20%	25%
4.0%	4.7	7.8	10.3	11.2	11.8
4.5%	3.9	7.8	10.9	12.1	12.8
5.0%	2.9	7.8	11.7	13.1	14.0
5.5%	1.7	7.8	12.7	14.5	15.6
6.0%	N/A	7.8	14.0	16.3	17.7

Different Combinations of Growth and ROIC Lead to SAME Multiple!

When ROIC > Cost of Capital, Higher Growth Leads to Higher EV/EBITA Ratio

How to Choose Comparable Companies?

- Criteria Depend on the Multiple Under Consideration
- Incorrect Comparables → Incorrect Valuation
- **Example:** Comparable Company Inputs
  - **ROIC** = 16%
  - **Tax Rate** = 40%
  - **Cost of Capital** = 8%
  - **g** = 3%

$$\frac{\text{Value}}{\text{EBITA}} = \frac{(1 - \text{T}) \times (1 - \frac{\text{g}}{\text{ROIC}})}{\text{R} - \text{g}} = \frac{(1 - 0.4) \times (1 - \frac{0.03}{0.16})}{0.08 - 0.03} = 9.75$$

- If Company Valued has ROIC = 5% → Value/EBITA = 4.5

Which Multiple?

- **EV/EBIT:** Enterprise Value Relative to EBIT
  - EBIT as a measure of Free Cash Flow
- **EV/EBITDA:** Enterprise Value Relative to EBITDA
  - Closely resembles forward-looking Free Cash Flow compared to EBIT, which is net of Depreciation and Amortization that are sunk
  - Particularly useful in industries with wide variation in depreciation practices
- **EV/EBITA:** Enterprise Value Relative to EBITA
  - Although prior investment (which drive current depreciation) are sunk, future investments (which drive future depreciation) are not
- **EV/Revenue:** Enterprise Value Relative to Revenue
  - Can be used for high-growth companies with negative earnings
  - However, imposes the additional restriction of similar operating margins

Enterprise Value Multiples

- **Price/Earnings:** Equity Price Relative to Earnings Per Share
- **Price/Book:** Equity Price Relative to Book Value Per Share

Equity Multiples

When EBITDA Is Better Than EBIT

Consider three identical companies that only differ in size. Prior to M&A activity, all three companies trade at the **same multiple**. If B purchases C and **impairs "intangibles"** over five years, what happens to the EBIT multiple?

	Pre- Acquisition			B Acquires C	
$M	**Company A**	**Company B**	**Company C**	**Company A**	**Company B+C**
Revenues	500	375	125	500	500
Operating Costs	(200)	(150)	(50)	(200)	(200)
Depreciation	(100)	(75)	(25)	(100)	(100)
Amortization	0	0	0	0	(25)
Operating Profit	200	150	50	200	175
Book Capital	1,000	750	250	1,500	1,000
Market Value	1,500	1,125	375	1,500	1,500
EV/EBITDA	5.0	5.0	5.0	5.0	5.0
EV/EBIT	7.5	7.5	7.5	7.5	8.6

When EBITDA Is Better Than EBIT

EBITDA multiples have their own drawbacks. To see this, consider two companies that differ only in outsourcing policies. Because they produce identical products at the same costs, their valuations are identical ($150).

Company A Manufactures Product Using Own Equipment

Incurs Depreciation Cost Directly

$M	Company A	Company B
Revenues	100	100
Raw Materials	(10)	(35)
Operating Costs	(40)	(40)
EBITDA	50	25
Depreciation	(30)	(5)
EBITA	20	20

Company B Outsources Manufacturing

Incurs Depreciation Cost Indirectly Through an Increase in the Cost of Raw Materials

Multiples As A Validation Tool for DCF

You are trying to value a well-established medical devices company. You have generated a DCF model that implicitly leads to a **15x forward-looking EBITDA multiple**. What do the following comparables tell you about your work?

Company	Price	Market Capitalization	Net Debt	Enterprise Value	EV/Revenue	EV/EBITDA	EV/EBITA	EV/EBIT
Becton, Dickinson and Company	70.64	16,933.2	124.1	17,057.3	2.4	7.9	8.5	10.2
Boston Scientific Corporation	8.66	13,003.02	6,737.0	19,740.2	2.4	8.0	10.9	13.0
Covidien Limited	38.13	19,213.4	1,770.0	20,983.4	2.1	7.9	8.3	9.4
Medtronic, Incorporated	32.81	36,689.0	5,343.0	42,032.0	2.9	7.9	8.2	9.0
St. Jude Medical, Inc.	38.28	13,175.3	966.5	14,141.8	3.0	9.5	10.0	11.4
Stryker Corporation	43.19	17,437.3	(2,934.0)	15,043.3	2.2	7.4	8.3	9.1
Zimmer Holdings, Inc.	41.06	9,220.9	(362.1)	8,858.8	2.2	5.9	6.1	7.6
				Mean	2.4	7.8	8.6	10.0
				Median	2.4	7.9	8.3	9.4
				Std Dev./Mean	14.6%	13.7%	17.7%	17.8%

The Revenue Multiple

- Enterprise Value Divided By Revenue Decomposition Into Ratios:

$$\frac{\text{Value}}{\text{Revenues}} = \frac{\text{EBITA}}{\text{Revenues}} \times \frac{\text{Value}}{\text{EBITA}}$$

- EBITA/Revenues Is Equal to Pre-Tax Profit Margin. Thus, the Value-to-Revenue Multiple Equals the Pre-Tax Profit Margin x Enterprise Value-to-EBITA Multiple

$$\frac{\text{Value}}{\text{Revenues}} = \text{Pre-Tax Profit Margin} \times \frac{(1 - \text{T}) \times (1 - \frac{\text{g}}{\text{ROIC}})}{\text{R} - \text{g}}$$

Revenue Multiples: Software Companies

- Revenue Multiples are typically used to value **high-growth start-ups**, including software companies
- Note how EBIT multiples below have the tightest distribution.

Company	Price	Market Capitalization	Net Debt	Enterprise Value	EV/Revenue	EV/EBITDA	EV/EBITA	EV/EBIT
Adobe Systems Incorporated	21.10	11,057.2	(1,669.2)	9,387.9	2.8	6.4	7.6	7.7
BMC Software Incorporated	29.66	5,561.4	(1,338.4)	4,223.0	2.2	5.6	6.6	7.0
CA, Incorporated	18.65	9,676.9	(214.0)	9,462.9	2.2	6.4	8.9	7.2
Intuit, Incorporated	22.97	7,351.8	171.7	7,533.5	2.3	7.4	7.7	8.1
Microsoft Corporation	19.09	169,720.8	(23,662.0)	146,058.8	2.4	6.1	6.1	6.7
Oracle Corporation	17.72	89,418.3	193.0	89,611.3	3.8	7.8	8.4	8.4
SAP AG	37.12	44,071.2	(4,192.7)	39,878.5	2.5	9.0	9.2	9.8
				Mean	2.6	6.9	7.8	7.8
				Median	2.4	6.4	7.7	7.7
				Std Dev./Mean	21.1%	16.7%	14.5%	13.5%

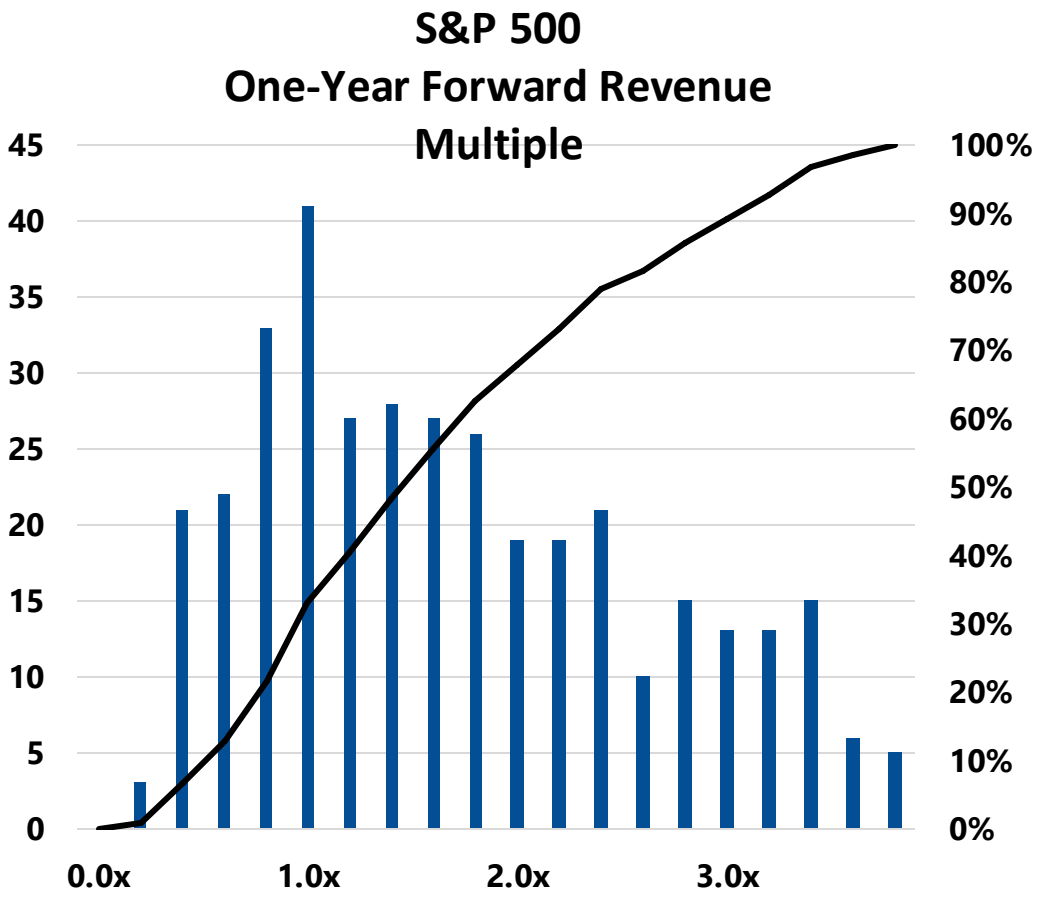
Revenue Multiples: Software Companies

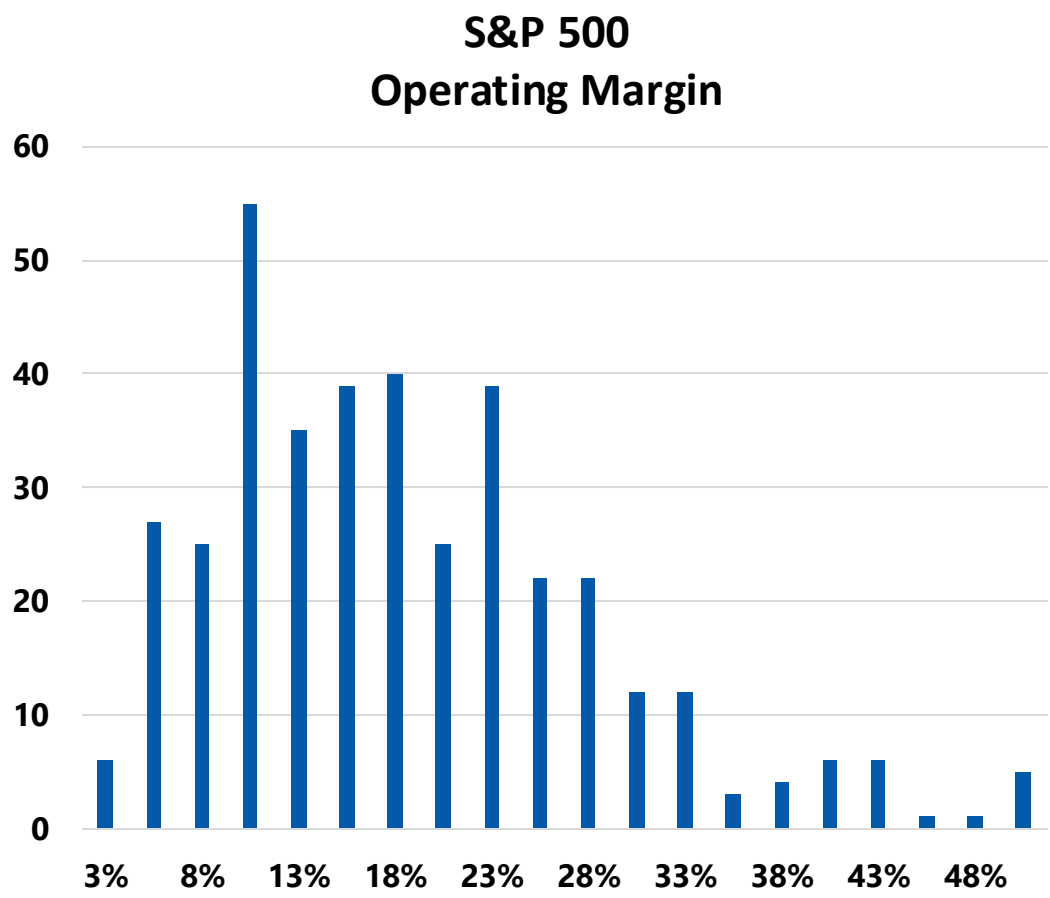
- The **Revenue Multiple** fails to normalize for the **Operating Margin**
- Using **EBITDA** to control for the **Operating Margin**, both companies trade at about the same multiple.
- Do NOT Use Revenue Multiple When "Comparables" Have Different Margins

Company	EV/Revenue	EV/EBITDA	EV/EBITA	Pre-Tax Operating Margin	Projected Three-Year Growth
Adobe Systems Incorporated	2.8	6.4	7.6	37.2%	3.9%
BMC Software Incorporated	2.2	5.6	6.6	32.1%	3.5%
CA, Incorporated	2.2	6.4	8.9	30.7%	1.7%
Intuit, Incorporated	2.3	7.4	7.7	28.4%	5.5%
Microsoft Corporation	2.4	6.1	6.1	35.5%	2.9%
Oracle Corporation	3.8	7.8	8.4	44.9%	4.4%
SAP AG	2.5	9.0	9.2	25.9%	5.7%

Distribution of Revenue Multiples

- Unlike the EBITDA Multiple, **Revenue Multiples** for the S&P 500 exhibit a wide distribution, mirroring the wide distribution for S&P 500 **Operating Margins**





Non-Financial Multiples

- **Valuing an industry with limited historical information is extremely difficult. How do you justify extraordinary prices as the following?**
  - Yahoo! had a P/E Multiple of 580 at peak
  - E-Bay had a P/E Multiple of 1,945 at peak
  - Amazon traded at a Revenue Multiple of 13.5 at peak
- **When current financials fail to predict long-term value, include non-financial multiples based on following information:**
  - Number of Customers
  - Number of Downloads
  - Number of Transactions
  - Number of Webpage Views
  - Number of Employees
  - Total Book Capital = Physical Capital (PP&E) + Intangible Capital

Non-Financial Multiples

- Firm Value Divided By Number of Customers Decomposition:

$$\frac{\text{Value}}{\#\ \text{Customers}} = \frac{\text{Revenues}}{\#\ \text{Customers}} \times \frac{\text{Value}}{\text{Revenues}}$$

- Implying that Comparables Have the Same Revenues/Customer:

$$\frac{\text{Value}}{\#\ \text{Customers}} = \frac{\text{Revenues}}{\text{Customer}} \times \text{Pre-Tax Profit Margin} \times \frac{(1 - \text{T}) \times (1 - \frac{\text{g}}{\text{ROIC}})}{\text{R} - \text{g}}$$

Is There a Better Way?

Goal: Estimate V(j) = Value of Company j, Given Earnings E(j) and Data on Other Companies' V and E

	Current Practice	Regression Interpretation
Step 1: Estimate Statistical Model	Compute Average V/E Ratio in Industry = β	Run Regression V(i) = β x E(i) + e(i) Regression Slope β ≈ Industry Average V/R
Step 2: Apply Model to Company j	To Value Company j, V(j) = β x E(j)	To Value Company j, V(j) = β x E(j)

Observation: When You Are Using Comparables, You Are Basically Using a Linear Regression

Problems: Why Assume that Valuations Depend Only on Earnings? What About Number of Customers or Webpage Views or Transactions? What if Comparables Have Different Fundamentals (e.g., Profit Margin, Growth Rate)? Can We Learn Anything from Firms Outside the Industry?

Solution: Run Regressions with As Many Variables As you want on Right-Hand Side (e.g., Earnings, Size, Margins). Feel free to Include Companies Outside the Industry, BUT Include Industry Fixed Effects

Next: VC Firms and Funds