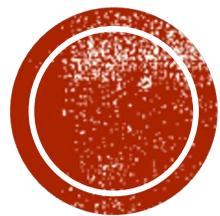


NUMBERS AND NARRATIVE: MODELING, STORY TELLING AND INVESTING

Aswath Damodaran



INTRINSIC VALUATION

101



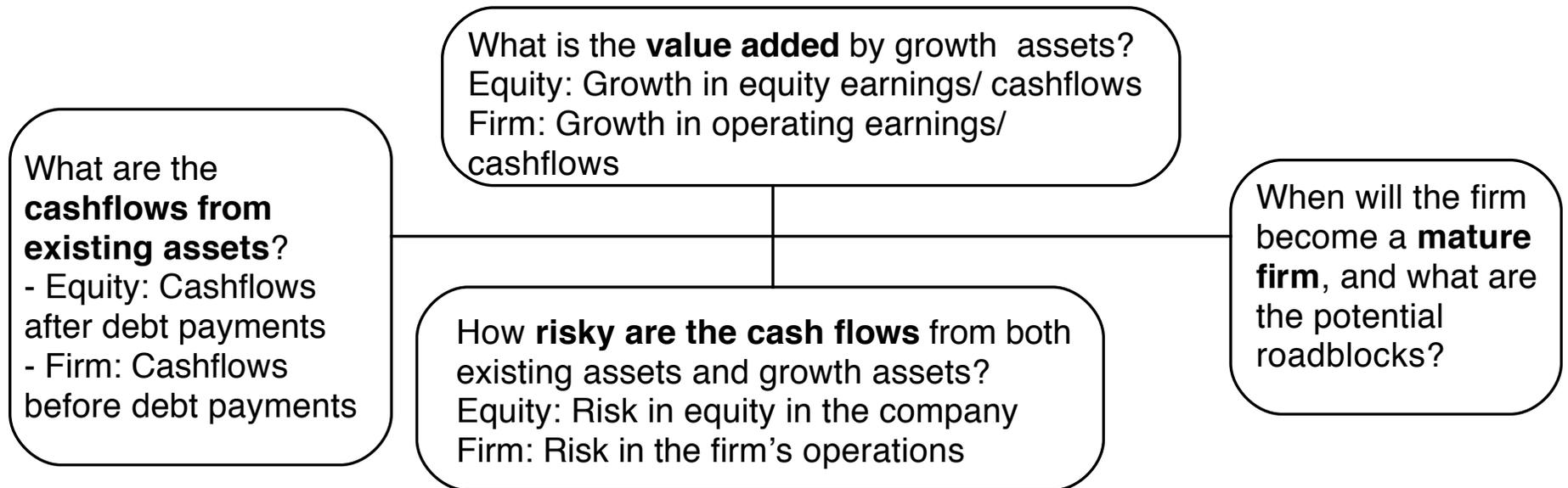
DCF: UNRAVELING THE MYSTERIES

- The value of a risky asset can be estimated by discounting the expected cash flows on the asset over its life at a risk-adjusted discount rate:

$$\text{Value of asset} = \frac{E(CF_1)}{(1+r)} + \frac{E(CF_2)}{(1+r)^2} + \frac{E(CF_3)}{(1+r)^3} \dots + \frac{E(CF_n)}{(1+r)^n}$$

1. *The IT Proposition*: If “it” does not affect the cash flows or alter risk (thus changing discount rates), “it” cannot affect value.
2. *The DUH Proposition*: For an asset to have value, the expected cash flows have to be positive some time over the life of the asset.
3. *The DON'T FREAK OUT Proposition*: Assets that generate cash flows early in their life will be worth more than assets that generate cash flows later; the latter may however have greater growth and higher cash flows to compensate.

THE KEY QUESTIONS IN VALUATION...



DCF AS A TOOL FOR INTRINSIC VALUATION

Value of growth

The future cash flows will reflect expectations of how quickly earnings will grow in the future (as a positive) and how much the company will have to reinvest to generate that growth (as a negative). The net effect will determine the value of growth.

Expected Cash Flow in year $t = E(CF) = \text{Expected Earnings in year } t - \text{Reinvestment needed for growth}$

Cash flows from existing assets

The base earnings will reflect the earnings power of the existing assets of the firm, net of taxes and any reinvestment needed to sustain the base earnings.

$$\text{Value of asset} = \frac{E(CF_1)}{(1+r)} + \frac{E(CF_2)}{(1+r)^2} + \frac{E(CF_3)}{(1+r)^3} + \dots + \frac{E(CF_n)}{(1+r)^n}$$

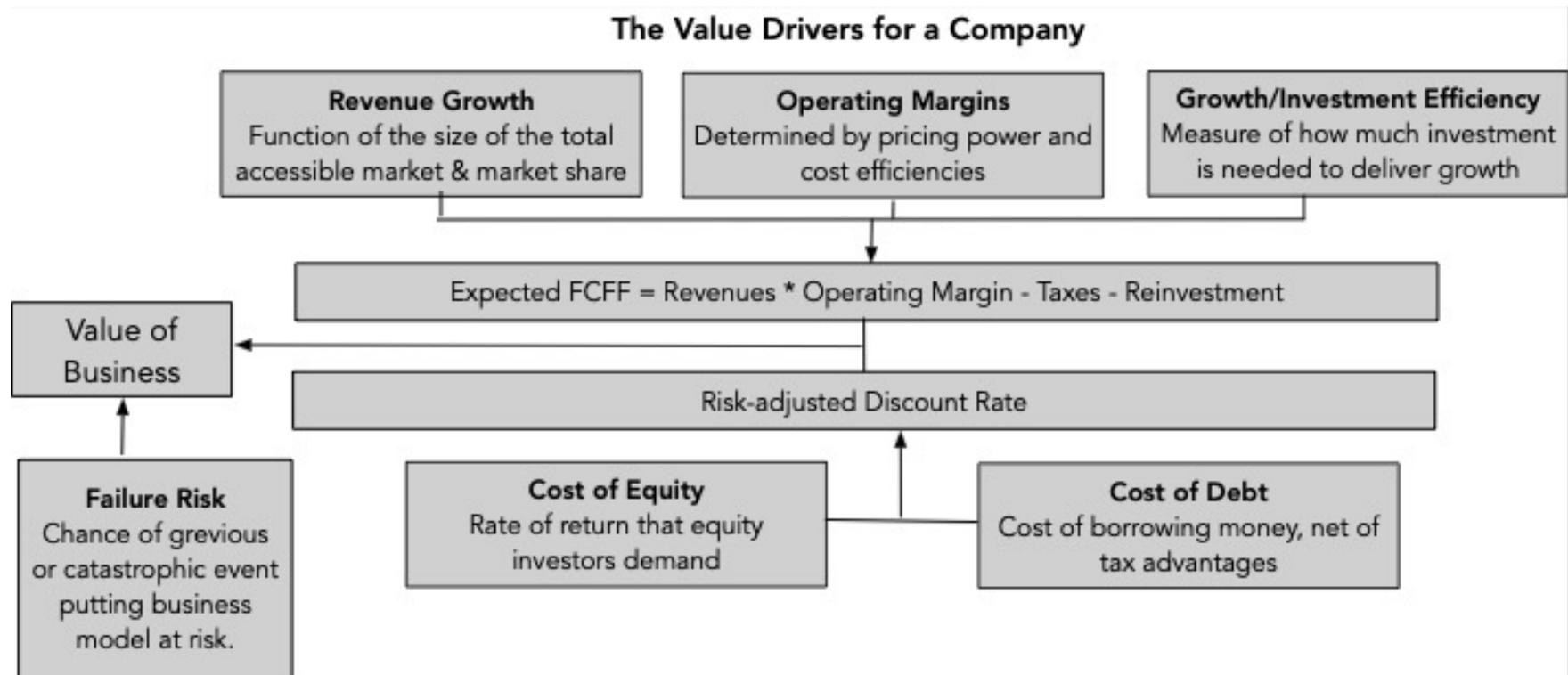
Steady state

The value of growth comes from the capacity to generate excess returns. The length of your growth period comes from the strength & sustainability of your competitive advantages.

Risk in the Cash flows

The risk in the investment is captured in the discount rate as a beta in the cost of equity and the default spread in the cost of debt.

THE BASICS OF VALUE



1. REVENUE GROWTH

Revenue Growth and Magnitude

Market Size and Growth

1. *Current Market size*: The size of the market for the company's products & services, given geography it is targeting and product type.
2. *Expected Growth in Market*: Growth in total market, as technology and market conditions change.

X

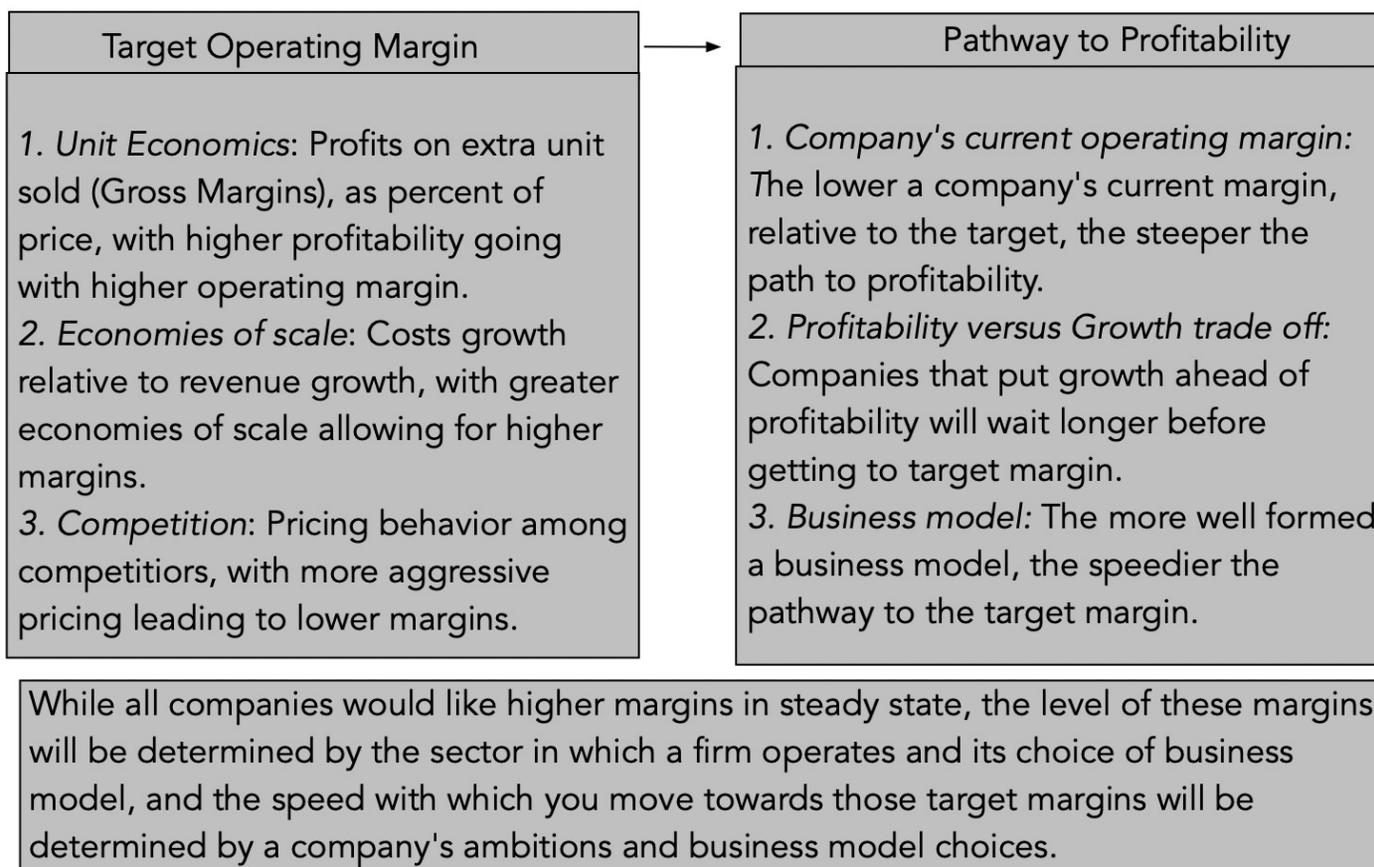
Market Share

1. *Company's current market share*: If company's current market share is low, potential for growth in market share at expense of competition.
2. *Industry economics*: Nature of the business (a few big winners or splintered competition).
3. *Strength of company's competitive advantages*: Stronger and more sustainable competitive advantages should allow for higher market share.

The potential for revenue growth is greater for companies with small revenues (and market share) in a big and growing market, especially if the company has strong competitive advantages in winner-take-all businesses.

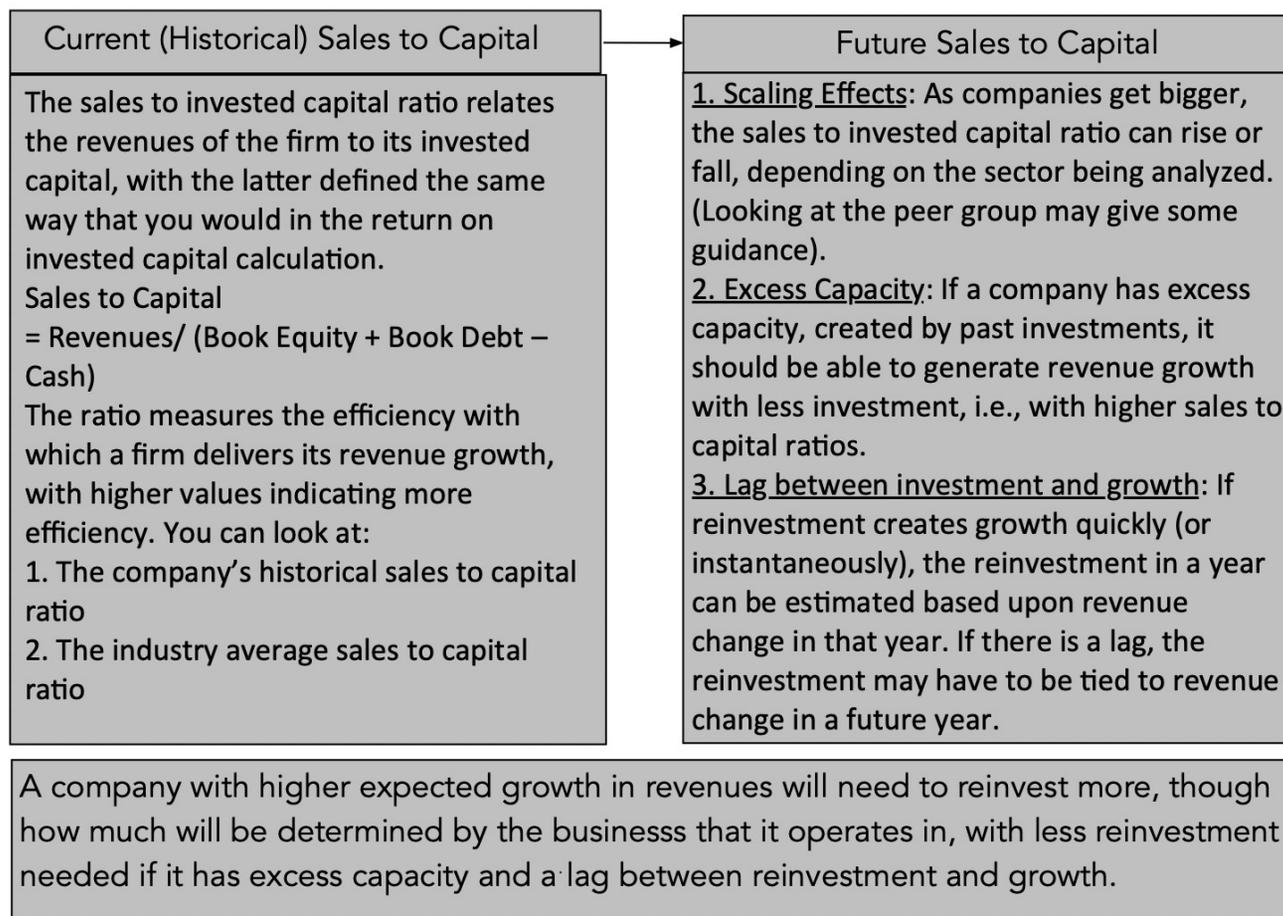
2. TARGET MARGINS (AND PATH THERE)...

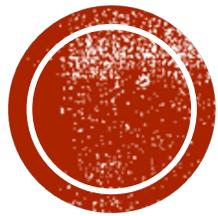
Operating Margin: Target and Pathway



3. SALES TO INVESTED CAPITAL: A PATHWAY TO ESTIMATING REINVESTMENT

Sales to Invested Capital: Reinvestment





LEFT BRAIN OR RIGHT BRAIN?



LEFT BRAIN OR RIGHT BRAIN?

The side of the brain we tend to use more may determine our learning styles, not to mention instructors' teaching methods:

LEFT SIDE



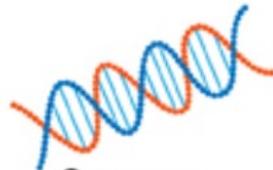
Linear

Processes information by taking pieces, lining them up, and arranging them in a logical order to draw conclusions.



Reality-based

Deals with reality the way it is. When affected by the environment, adjustment can be easily made.



Sequence

Processes information in order. This makes for easy daily planning and accomplishing tasks.

$$f(x) = \frac{x}{3} + 5$$

Symbolic

Processing symbols is no problem such as letters, words, and mathematical notation.

RIGHT SIDE



Holistic

Processes information by starting with the answer. It sees the big picture first, not the details.



Fantasy-oriented

Processes information based on what they think the answer is. Often they find the answer intuitively.



Random

Processes information through random processing. Tasks are done randomly and in parts.



Concrete

Processing requires things to be concrete such as feeling, seeing, or touching the real object.

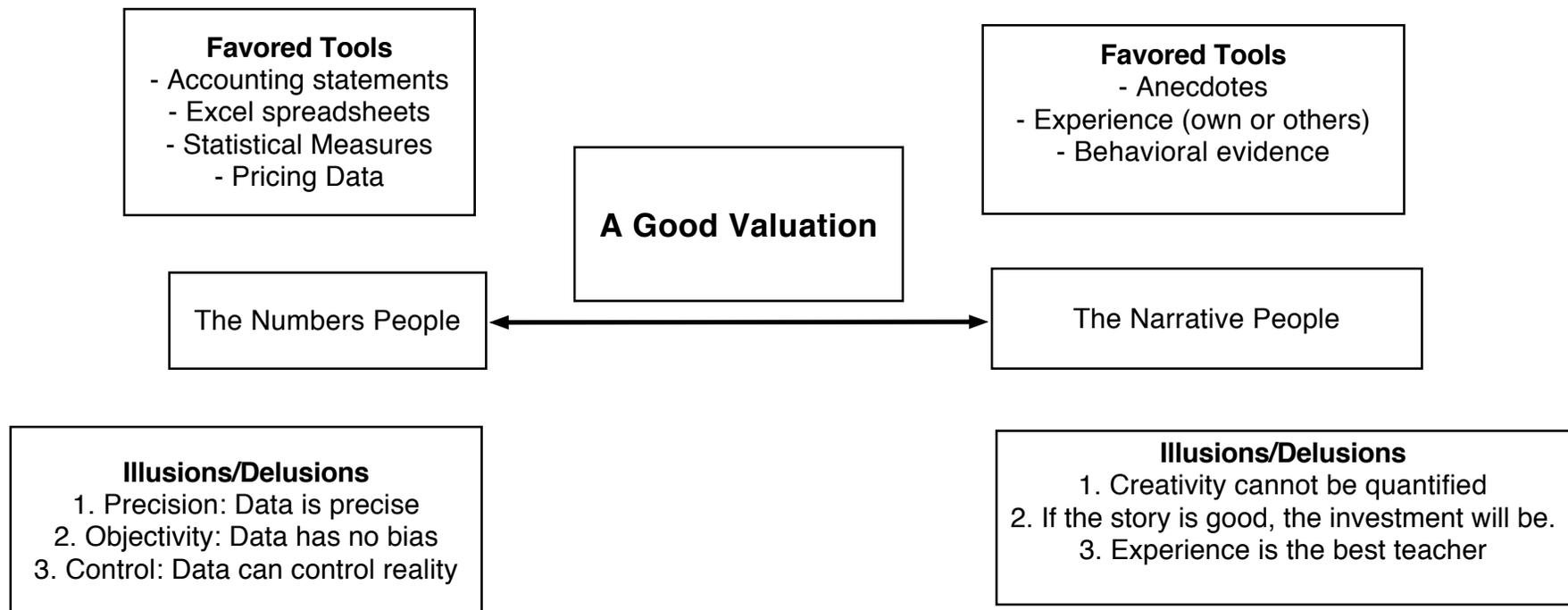
THE DELUSIONS OF THE NUMBER CRUNCHERS

- **The illusion of precision:** If you use numbers, you are being more precise than when you don't, and the more numbers you use, the more precise you become.
- **The illusion of “no bias”:** Numbers don't lie and data does not have an agenda. Thus, analysts who use numbers are more likely to be unbiased.
- **The illusion of control:** If you put a number on something (your cash flows, expected growth rate, risk etc.), you can control it better.

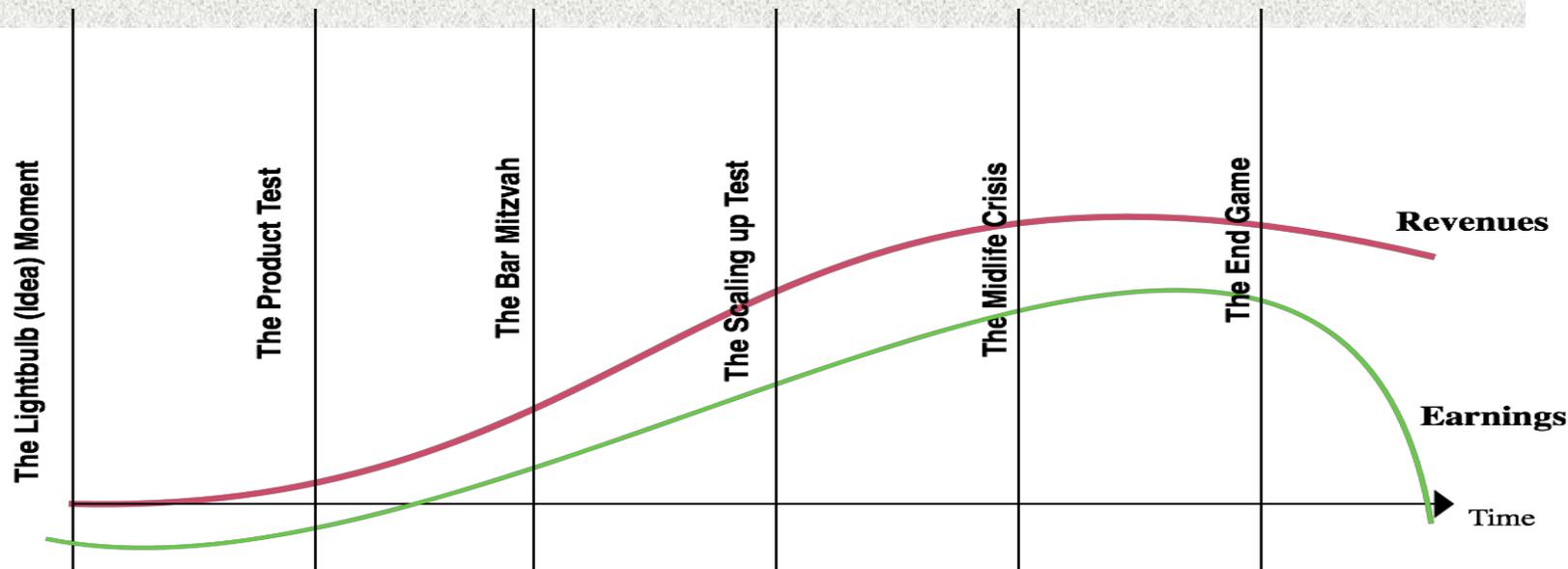
THE DELUSIONS OF THE STORY TELLERS

- **Number crunchers don't dream in technicolour:** Creativity and Numbers are mutually exclusive. If you talk about numbers, you cannot be creative, and if you are being creative, talk about numbers only crimps your creative instincts.
- **Creativity is deserving of reward:** If your story is good, your business will success and your investment will pay off.
- **Experience is the best teacher:** If you have pulled this off before (started and succeeded at running a business), your story is more believable.

VALUATION AS A BRIDGE

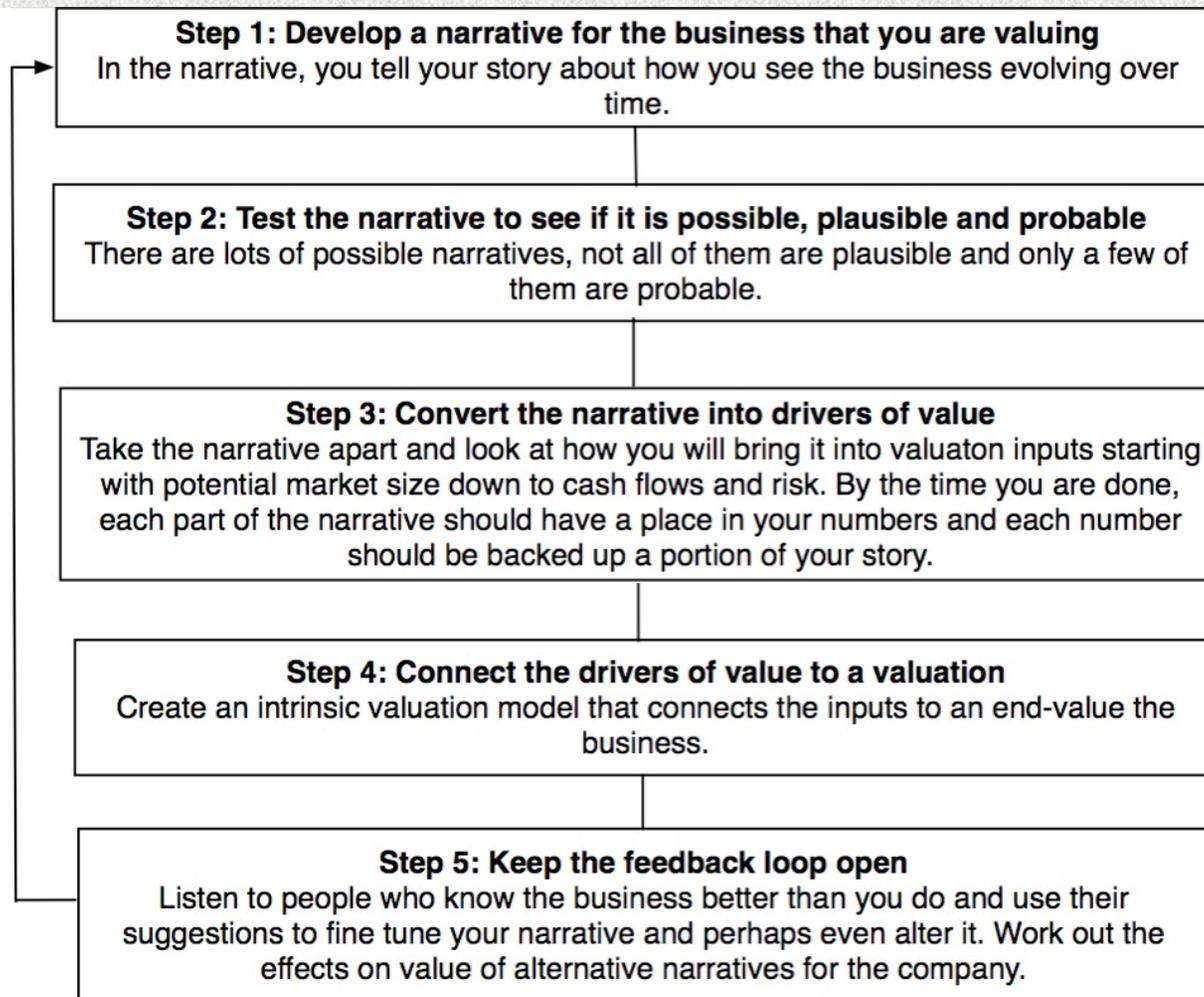


IN VALUE, THE EMPHASIS SHIFTS AS WELL, FROM NARRATIVE TO NUMBERS...



<i>Lifecycle stage</i>	Start-up	Young Growth	High Growth	Mature Growth	Mature Stable	Decline
<i>Narrative versus Numbers</i>	All Narrative	Mostly narrative	Narrative + Numbers	Numbers + Narrative	Mostly Numbers	All Numbers
<i>Narrative Drivers</i>	How big is the narrative?	How plausible is narrative?	How profitable is narrative?	How scalable is narrative?	How sustainable is narrative?	How happy is the ending?
<i>Narrative Differences</i>	Unconstrained & Large differences	Constraints mount as numbers build up Differences across investors narrow, as history deepens				Constrained & Narrow differences

FROM STORIES TO NUMBERS: THE STEPS



STEP 1A: SURVEY THE LANDSCAPE

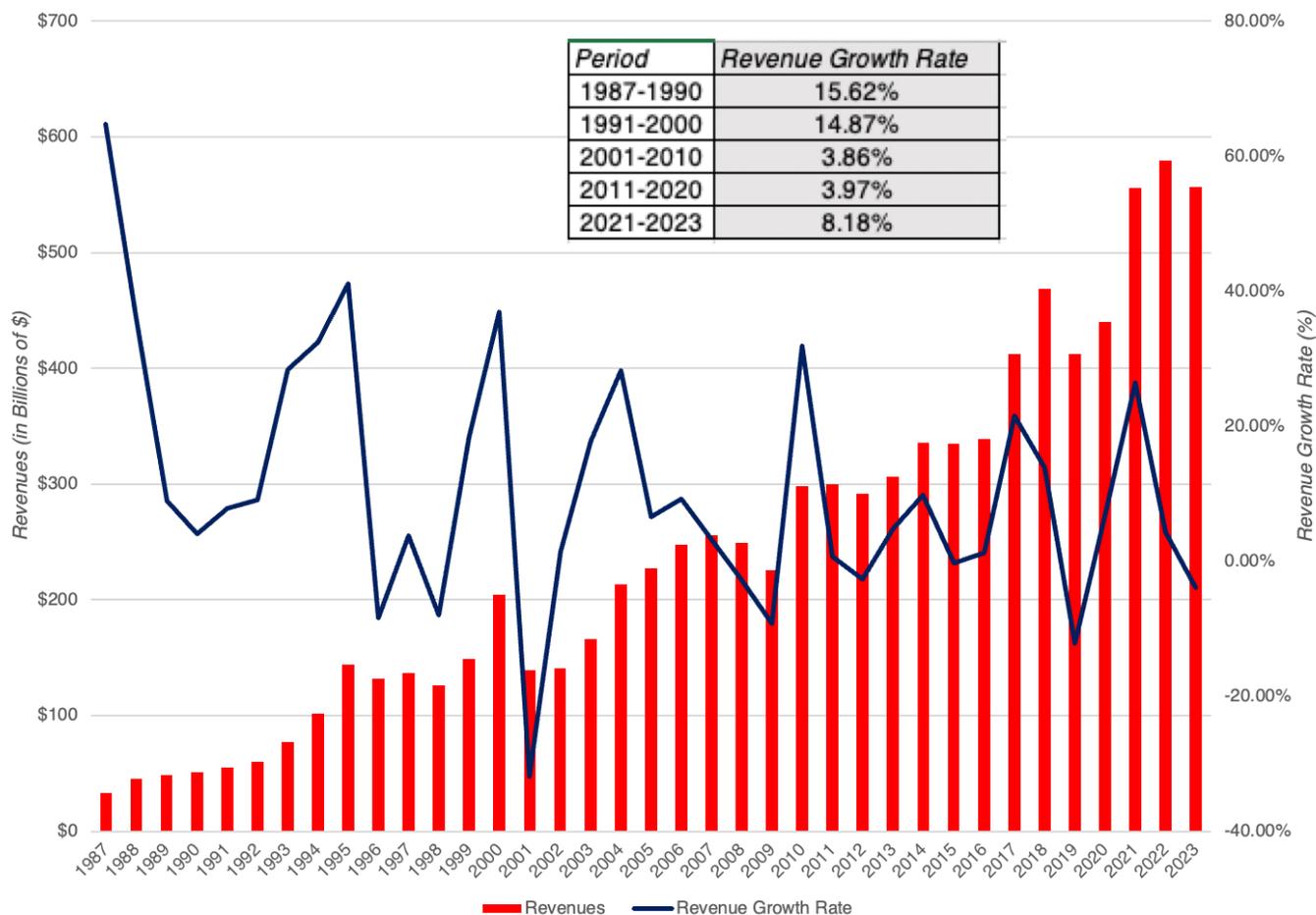
- Every valuation starts with a narrative, a story that you see unfolding for your company in the future.
- In developing this narrative, you will be making assessments of
 - Your company (its products, its management and its history).
 - The market or markets that you see it growing in.
 - The competition it faces and will face.
 - The macro environment in which it operates.

THE LANDSCAPE?

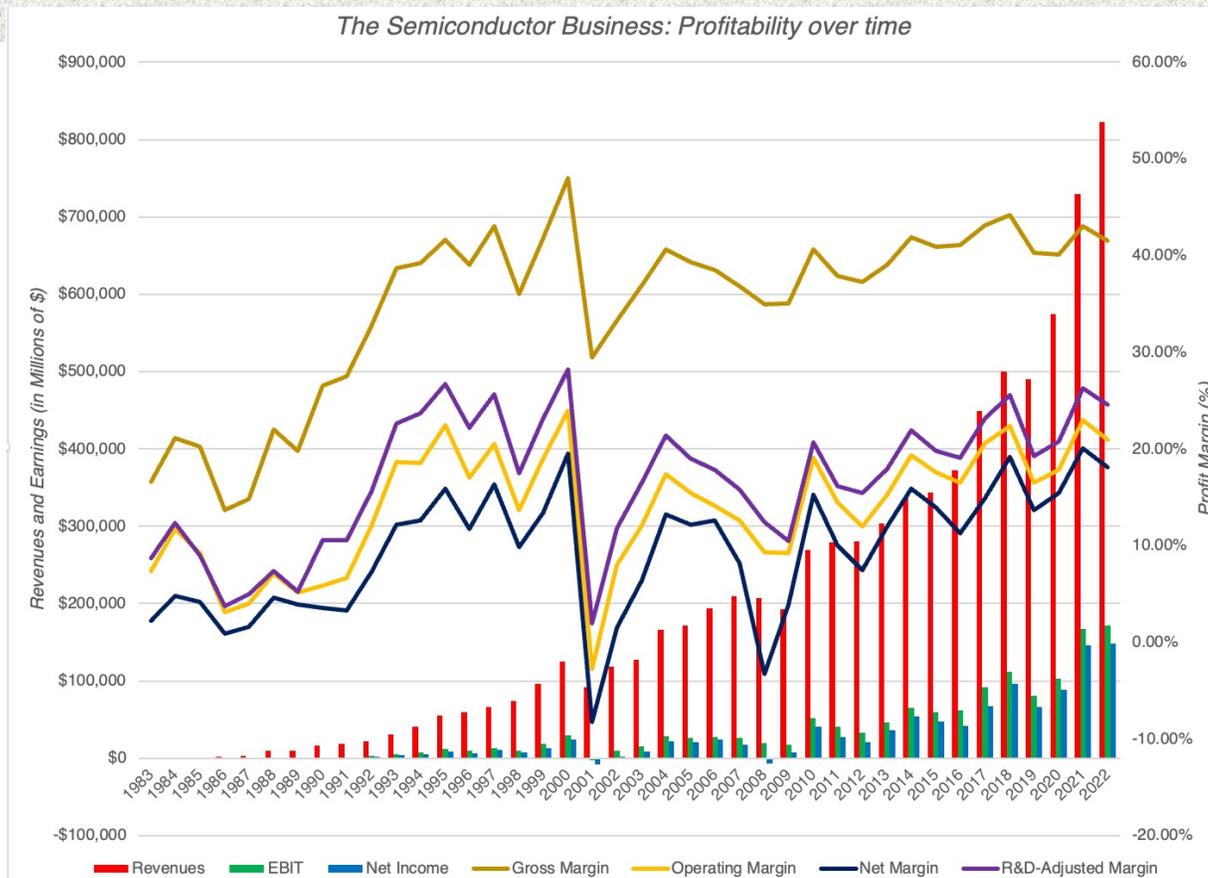
- Total Market: The first step in valuing a business is sizing the market, and while acronyms abound, this requires understanding what products or services you offer, and what business you are in.
- Taking stock: The second step is assessing how this market is growing and how it is structured. In particular,
 - Is it a market that is splintered or prone to consolidation?
 - Who are your competitors in this market?
- Your company's standing: Where does your company stand in this market?
 - If you have historical data, look at growth & profitability trends
 - If not, make an assessment anyway...

THE SEMICONDUCTOR BUSINESS – A GROWTH BUSINESS THAT IS MATURING!

The Semiconductor Business: Revenues and Growth



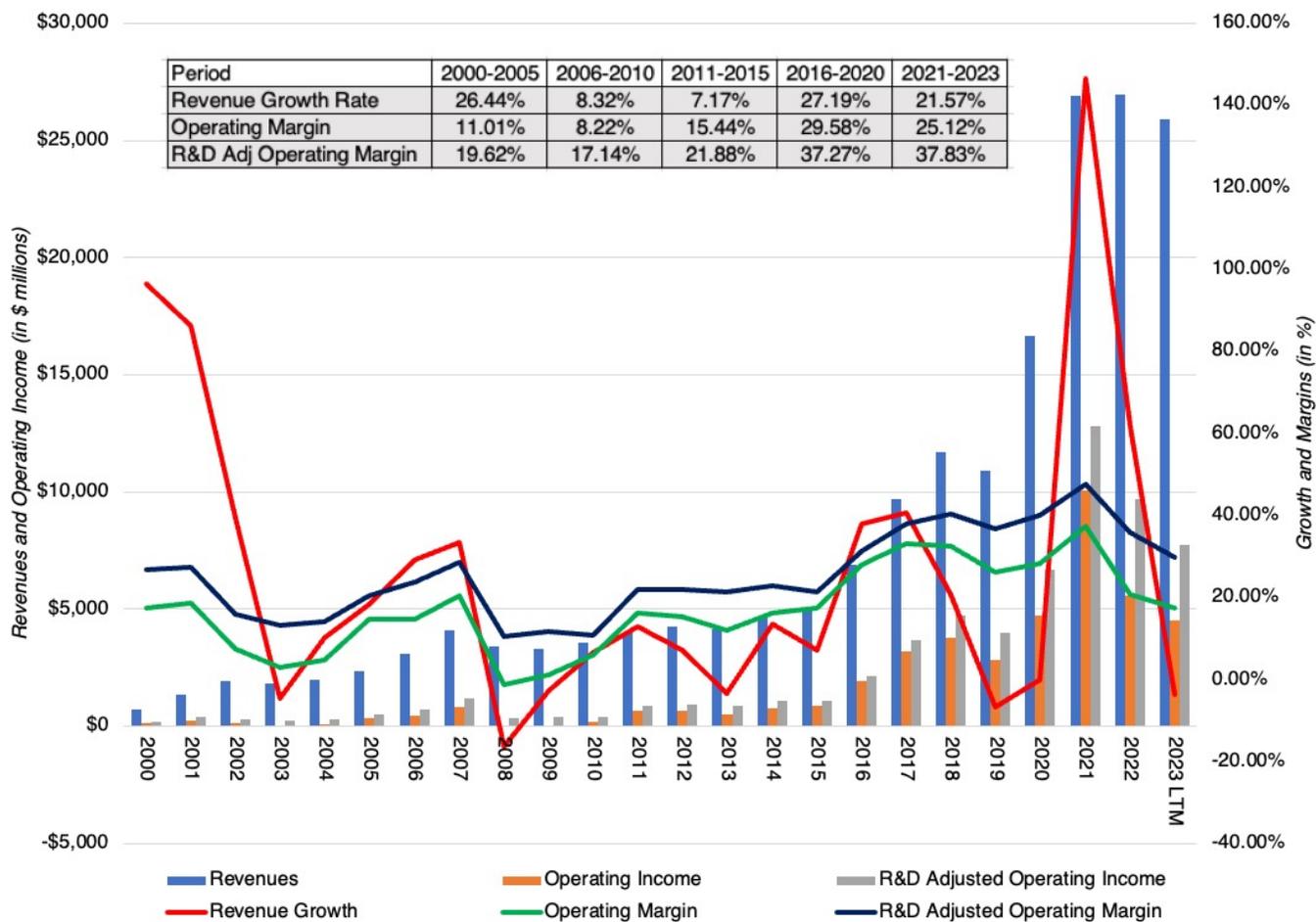
PROFITABLE, WITH CYCLES...



Time Period	1983-1990	1991-2000	2001-2010	2011-2020	2021-2022
Gross Margin	19.36%	38.77%	36.57%	40.58%	42.28%
Operating Margin	6.70%	17.25%	11.45%	17.23%	21.94%
Net Margin	3.23%	12.22%	6.17%	13.38%	19.08%
R&D Adjusted Margin	7.73%	21.60%	14.79%	19.90%	25.46%

NVIDIA - OPPORTUNISTIC GROWTH

NVIDIA: Operating History from 2000 to 2023



AN EARNINGS REPORT IN 2024: AND DATA UPDATES...

Revenue Growth

The good news is that revenues in the second quarter more than doubled (122.4%), relative to revenues in the same quarter in the previous year. The bad news is that growth rate is down from the revenue growth rates in the last three quarters.

Economies of scale (Operating margin)

The operating margin (62.06%) would be the envy of any business, but the increase in margins, reflecting economies of scale, seen in previous quarters has been reversed.

Unit Economics (Gross margin)

The gross margins were sky high (75.15%), in the top decile of all US companies, but here again, that numbers is leveling off, suggesting that while unit economics remain impressive, the improvements have leveled off.

	2023 Q2	2023 Q3	2023 Q4	2024 Q1	2024 Q2
Revenues	\$13,507.00	\$18,120.00	\$22,103.00	\$26,044.00	\$30,040.00
Gross Income	\$9,462.00	\$13,400.00	\$16,791.00	\$20,406.00	\$22,574.00
Operating Income	\$6,800.00	\$10,417.00	\$13,614.00	\$16,909.00	\$18,642.00
Net Income	6,188.0	9,243.0	12,285.0	14,881.0	16,599.0
EPS	\$0.25	\$0.37	\$0.50	\$0.60	\$0.68
	2023 Q2	2023 Q3	2023 Q4	2024 Q1	2024 Q2
Revenue Growth (Yon	101.48%	205.51%	265.28%	262.12%	122.40%
Gross margin	70.05%	73.95%	75.97%	78.35%	75.15%
Operating margin	50.34%	57.49%	61.59%	64.92%	62.06%
Net margin	45.81%	51.01%	55.58%	57.14%	55.26%

Leverage effects (Net margin)

The company has very little debt, not much in terms of non-operating assets (no cross holdings) and a low effective tax rate (about 13%), making its net margin (55.26%) close to its operating margin.

The Bottom Line on Nvidia's second quarter results

Nvidia's second quarter earnings, standing alone, represent an astonishing combination of triple-digit revenue growth and top-tier margins, but when you have primed the market for improvements on those dimensions, disappointment is inevitable. It may not be fair, but Nvidia set a standard for performance in the last three quarters that no company can maintain for very long, and by those standards, Nvidia underperformed. More critically, this is likely to accelerate in future quarters, as scale works against them on revenue growth, TSMC will bargain for more worsening unit economics and competition will pick up (hurting operating margins).

STEP 1B: CREATE A NARRATIVE FOR THE FUTURE

- Every valuation starts with a narrative, a story that you see unfolding for your company in the future.
- In developing this narrative, you will be making assessments of your company (its products, its management), the market or markets that you see it growing in, the competition it faces and will face and the macro environment in which it operates.
 - Rule 1: Keep it simple.
 - Rule 2: Keep it focused.

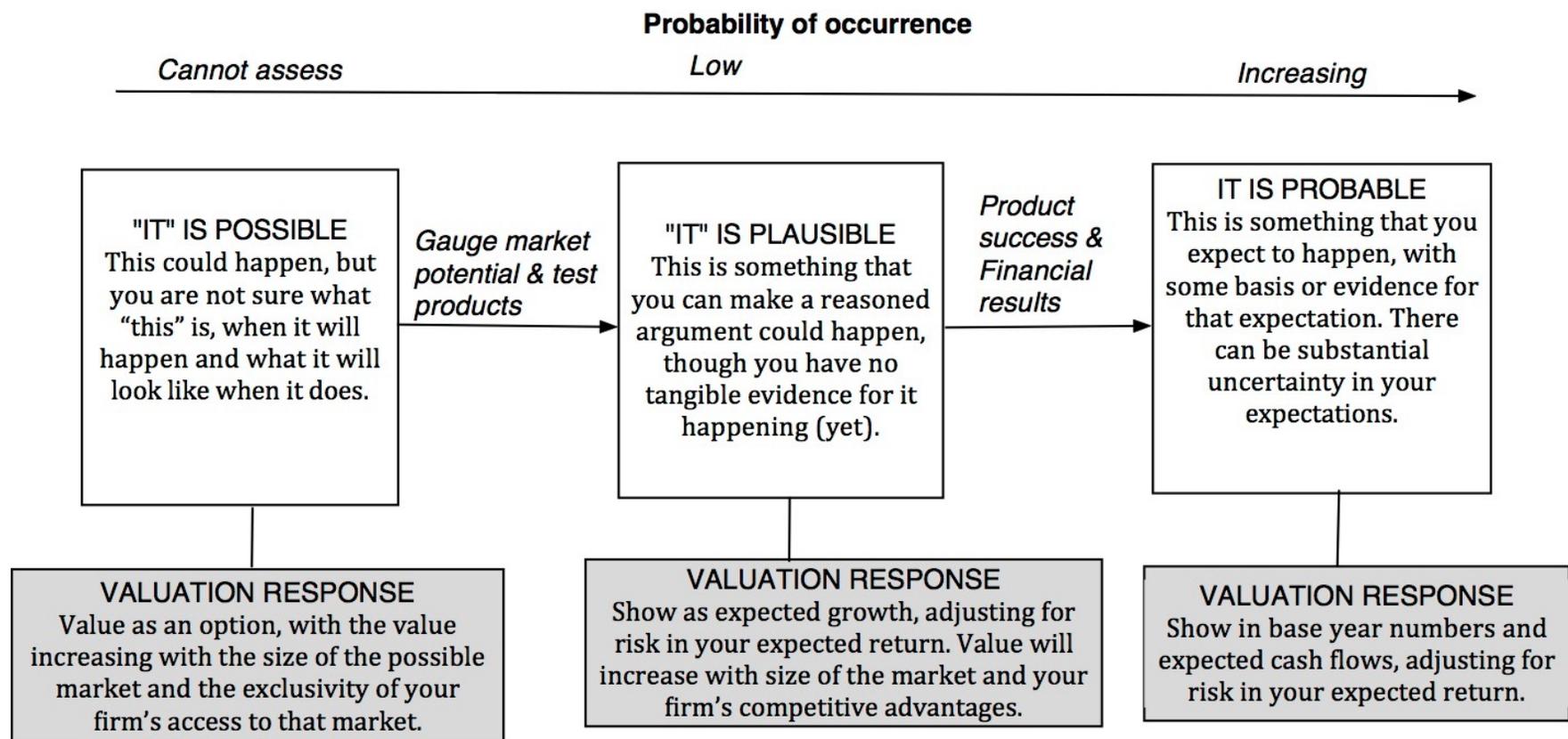
BUSINESS STORY BASICS

- A good business story is **not a list of bullet points**, but a narrative of what you do as a business, the (unmet or under-met) need that you are filling and why you can monetize that need.
- A good business story is **not filled with details and buzzwords** that only business insiders understand, but is understandable to someone who is a novice to this business.
- A good business story **has a hook**, something that makes people not only remember you, but understand your actions as a business.
- A good business story **is bounded** – by the realities of natural and economic laws.

NVIDIA: THE PAYOFF TO OPPORTUNISM

- Powered by its lead in the AI chip business, Nvidia will continue on its path of high growth, but even with dominance, that growth will level off. While Nvidia might find other new markets, none of them are likely to provide the market size to allow for continued growth.
- As a design company, Nvidia will be able to generate supernormal profit margins. However, it will face push back from powerful players on the other side:
 - On the unit economics side, Nvidia will have to share more of its spoils with TSMC, as the two are locked into an embrace that neither can break away from.
 - On the customer side, Nvidia's four biggest customers are giants themselves, and will either look to competition or develop their own chips, putting stress on pricing power.
- On the reinvestment side, Nvidia will continue to reinvest in the next generations of chips, but in a market place where others are throwing large amounts of money at doing the same.

STEP 2: CHECK THE NARRATIVE AGAINST HISTORY, ECONOMIC FIRST PRINCIPLES & COMMON SENSE



THE IMPOSSIBLE, THE IMPLAUSIBLE AND THE IMPROBABLE

The Impossible

Bigger than the economy

Assuming Growth rate for company in perpetuity > Growth rate for economy

Bigger than the total market

Allowing a company's revenues to grow so much that it has more than a 100% market share of whatever business it is in.

Profit margin > 100%

Assuming earnings growth will exceed revenue growth for a long enough period, and pushing margins above 100%

Depreciation without cap ex

Assuming that depreciation will exceed cap ex in perpetuity.

The Implausible

Growth without reinvestment

Assuming growth forever without reinvestment.

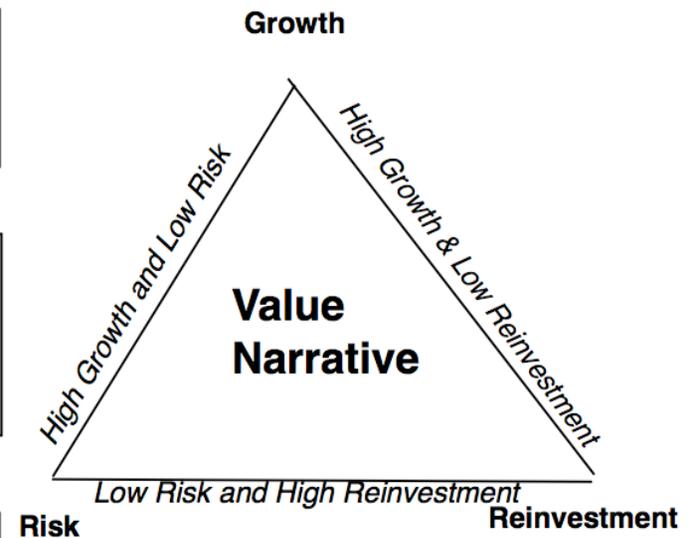
Profits without competition

Assuming that your company will grow and earn higher profits, with no competition.

Returns without risk

Assuming that you can generate high returns in a business with no risk.

The Improbable



NVIDIA: THE 3P TEST

- The AI chip market will grow from \$80 billion in 2024 to \$500 billion in 2034.
 - That would require that the AI product/service market be about \$2.5 to \$3 trillion.
 - And that the infrastructure to build this market will be about 20% of total revenues
- Nvidia will maintain a dominant market share (60%) of this market, down from its current 80%.
 - Competitors will expend significant amounts of money, developing their own chips, but the first mover advantage will keep Nvidia at the top
- Nvidia will remain a money-making machine, but its margins will come under pressure, from both its supplier (TSMC) side and consumers (big tech).

THE RUNAWAY STORY: WHEN YOU WANT A STORY TO BE TRUE...

- With a runaway business story, you usually have three ingredients:
 1. Charismatic, likeable Narrator: The narrator of the business story is someone that you want to see succeed, either because you like the narrator or because he/she will be a good role model.
 2. Telling a story about disrupting a much business, where you dislike the status quo: The status quo in the business that the story is disrupting is dissatisfying (to everyone involved)>
 3. With a societal benefit as bonus: And if the story holds, society and humanity will benefit.
- Since you want this story to work out, you stop asking questions, because the answers may put the story at risk.

The Impossible: The Runaway Story

The Story



+

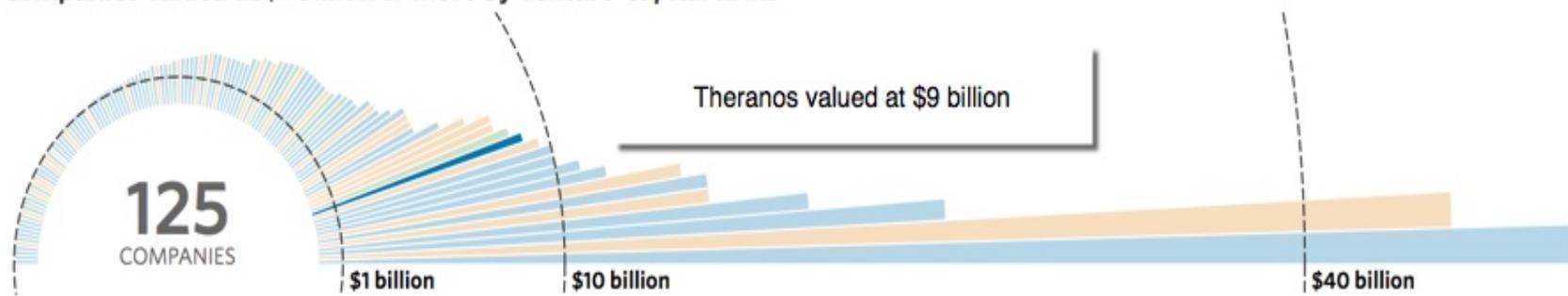
The Checks (?)

Board Member	Designation	Age
Henry Kissinger	Former Secretary of State	92
Bill Perry	Former Secretary of Defense	88
George Schultz	Former Secretary of State	94
Bill Frist	Former Senate Majority Leader	63
Sam Nunn	Former Senator	77
Gary Roughead	Former Navy Admiral	64
James Mattis	Former Marine Corps General	65
Dick Kovocovich	Former CEO of Wells Fargo	72
Riley Bechtel	Former CEO of Bechtel	63
William Foege	Epidemiologist	79
Elizabeth Holmes	Founder & CEO, Theranos	31
Sunny Balwani	President & COO, Theranos	NA

+

Money

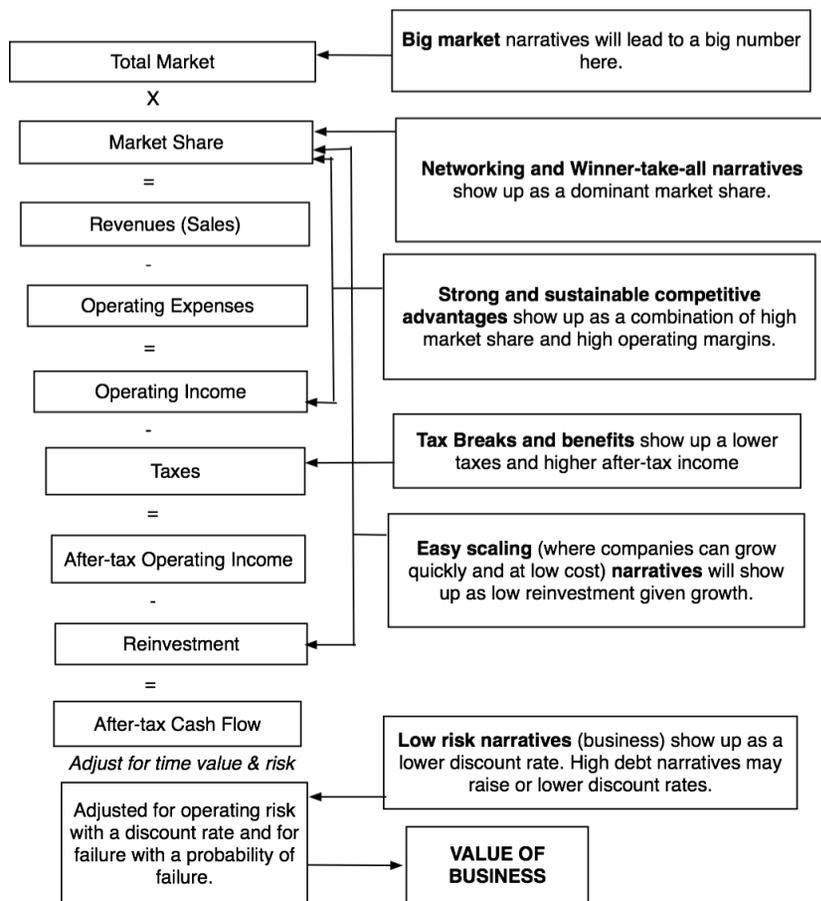
Companies valued at \$1 billion or more by venture-capital firms



Valuations as of October 2015

Select companies from the chart or table for more detail.

STEP 3: CONNECT YOUR STORY TO VALUE DRIVERS



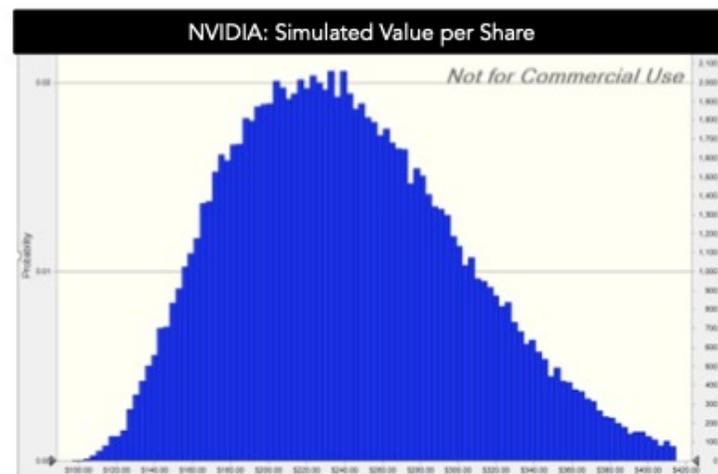
- **The “It” Proposition:** If it does not affect the cash flows or the risk, it cannot affect value.
 - If your storyline has heft, it should show up in one of the key value inputs.
 - If you struggle with finding an input to change, your story is not complete (or may need revisiting).

STEP 5: KEEP THE FEEDBACK LOOP OPEN

- When you tell a story about a company (either explicitly or implicitly), it is natural to feel attached to that story and to defend it against all attacks. Nothing can destroy an investor more than hubris.
- Being open to other views about a company is not easy, but here are some suggestions that may help:
 - Face up to the uncertainty in your own estimates of value.
 - Present the valuation to people who don't think like you do.
 - Create a process where people who disagree with you the most have a say.
 - Provide a structure where the criticisms can be specific and pointed, rather than general.

FACE UP TO UNCERTAINTY...

NVIDIA: VALUE SIMULATION (JUNE 12, 2023)

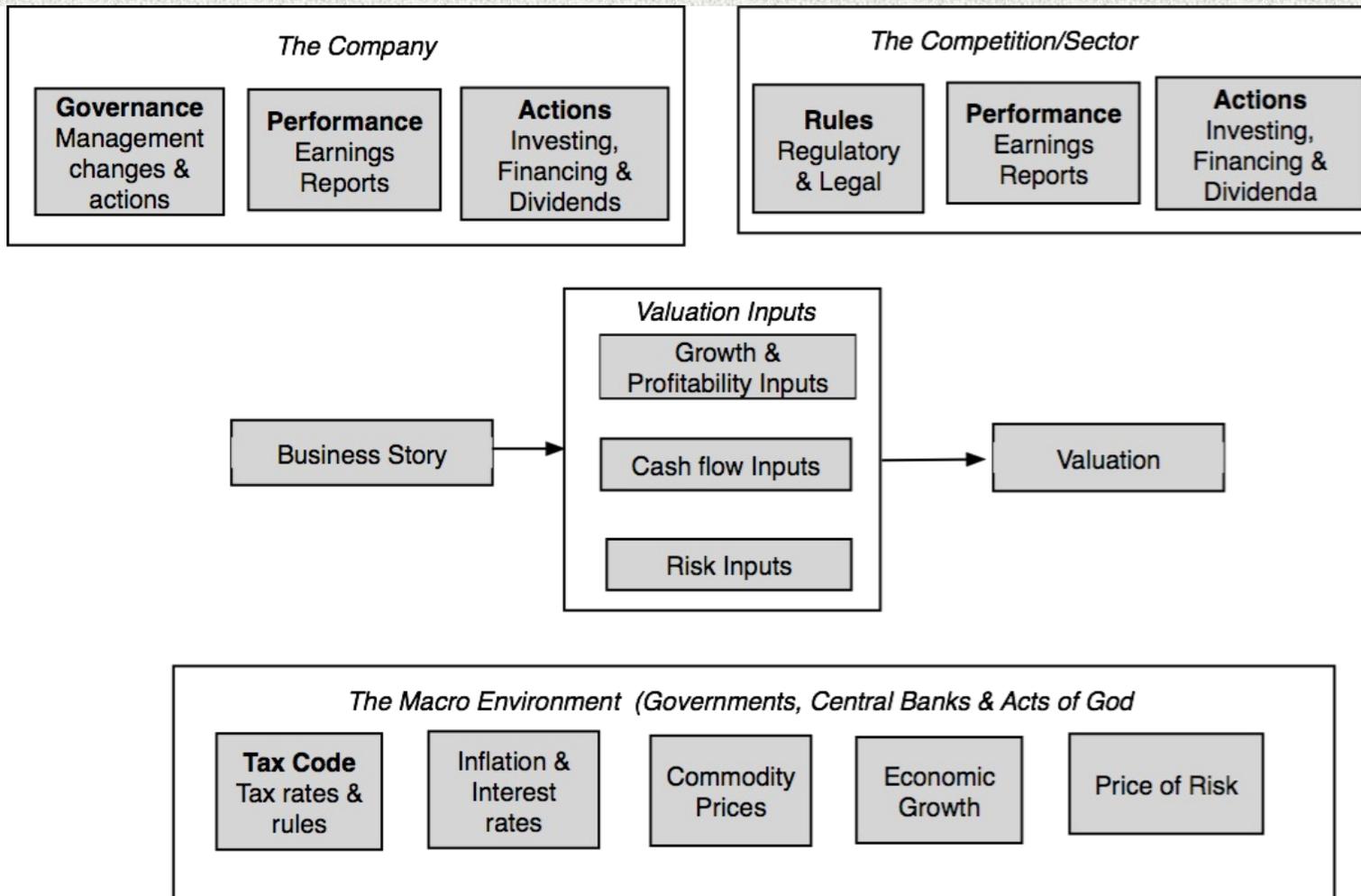


Percentile	Value Per Share
0%	\$96.51
10%	\$166.01
20%	\$186.59
30%	\$203.88
40%	\$220.23
50%	\$236.28
60%	\$252.97
70%	\$271.77
80%	\$294.04
90%	\$326.17
100%	\$555.75

STEP 6: RECOGNIZE THAT NARRATIVES CHANGE

Narrative Break/End	Narrative Shift	Narrative Change (Expansion or Contraction)
<p>Events, external (legal, political or economic) or internal (management, competitive, default), that can cause the narrative to break or end.</p>	<p>Improvement or deterioration in initial business model, changing market size, market share and/or profitability.</p>	<p>Unexpected entry/success in a new market or unexpected exit/failure in an existing market.</p>
<p>Your valuation estimates (cash flows, risk, growth & value) are no longer operative</p>	<p>Your valuation estimates will have to be modified to reflect the new data about the company.</p>	<p>Valuation estimates have to be redone with new overall market potential and characteristics.</p>
<p>Estimate a probability that it will occur & consequences</p>	<p>Monte Carlo simulations or scenario analysis</p>	<p>Real Options</p>

AND WHY THEY DO SO...



THE DEEPSEEK EFFECT ON THE AI STORY

The pre-DeepSeek Story

The AI market will include an array of products and services, that buyers (consumers and businesses) will **pay trillions for**, but to enter this market, you have **hefty entrance requirements** - the willingness to invest tens of billions in computing power and access to troves of data (preferably exclusive).



Story Dynamics Continuum

Story Break

DeepSeek will allow competitors to enter every part of the AI product and service market, with existing computing power and little (or no) access to data. That will make the AI product and service market a free-for-all, in terms of competitor, and commoditized.

Catastrophe

Story Change

DeepSeek will allow competitors to enter the low-power portion of AI product and service market, with existing computing power and little (or no) access to data. That will create a bi-furcated market, with the premium AI products and services still commanding high prices/margins, and commoditized AI products & services, with low prices and profitability.

Reassessment

Story Shift

DeepSeek will not change the fundamentals of the AI market, leaving the high entry cost barriers and an end market that is still huge and profitable. However, its entry will make those investing in AI architecture more cautious about spending money, and about coming up with new AI ideas.

Recalibration

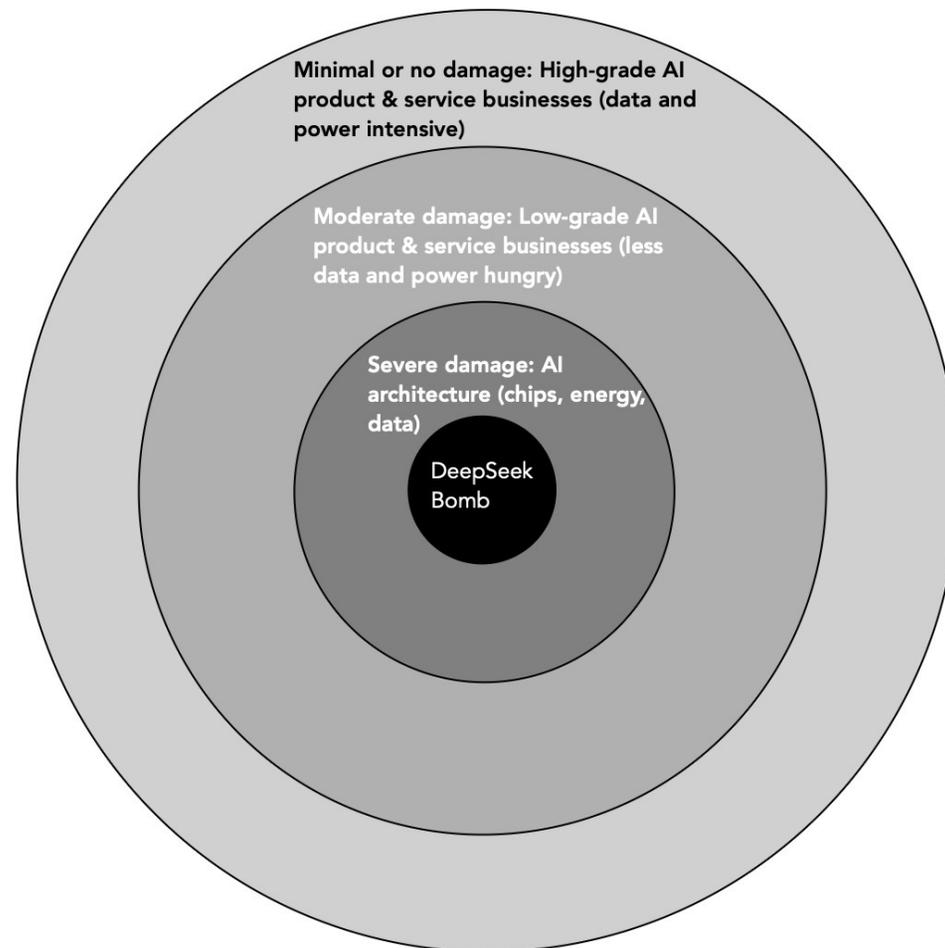
THE VALUE EFFECT AT NVIDIA

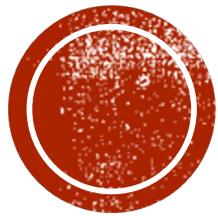
	<i>In September 2024 (pre DeepSeek)</i>	<i>In January 2025 (post DeepSeek)</i>
AI chip market size in 2035	\$500 billion	\$300 billion
Nvidia's market share	60%	60%
Nvidia's operating margin	60%	60%
Nvidia's risk (cost of capital)	10.52% \rightarrow 8.49%	11.79% \rightarrow 8.50% (Higher riskfree rate + higher ERP)

MY POST-DEEPSEEK NVIDIA VALUATION

Nvidia												Jan-25																											
Base Year and Comparison			Growth Story (Revenue)				Profitability Story (Margin)				Growth Efficiency Story			Terminal Value																									
	Company	Industry	The AI business will be big, but the DeepSeek entry has bifurcated it, into commoditized and premium, and Nvidia will continue to maintain its dominance of the latter.				Nvidia will continue to have high margins in its core businesses, and while the AI chip market will be smaller than it was pre-DeepSeek, but some of Nvidia's current competitors may shift to the other AI market.				Sales to capital stays higher than industry average, as company continues to get growth off past R&D, and focuses research on new AI and auto chips.			Growth Rate	4.70%																								
Revenue Growth	128.62%	7.74%												Cost of capital	8.50%																								
Revenue	\$113,269													Return on capital	20.00%																								
Operating Margin	68.06%	21.34%												Reinvestment Rate	23.50%																								
Operating Income	\$77,091																																						
EBIT (1-t)	\$30,025																																						
Value of Rest	\$750,229		1	2	3	4	5	6	7	8	9	10	Terminal year																										
Value of AI	\$983,484		Revenue (Gaming/Other)	\$ 55,279	\$ 63,571	\$ 73,107	\$ 84,073	\$ 96,684	\$ 109,195	\$ 121,075	\$ 131,754	\$ 140,661	\$ 147,272	\$ 154,193																									
Value of Auto	\$134,100		Revenue (AI)	\$ 82,992	\$ 100,928	\$ 117,808	\$ 133,632	\$ 148,400	\$ 156,128	\$ 163,152	\$ 169,472	\$ 175,088	\$ 180,000	\$ 188,460																									
Probability of failure =	0.00%		Revenue (Auto)	\$ 3,036	\$ 5,304	\$ 8,004	\$ 11,136	\$ 14,700	\$ 17,328	\$ 20,172	\$ 23,232	\$ 26,508	\$ 30,000	\$ 31,410																									
Value of operating assets =	\$1,867,813		Revenues (Total)	\$ 141,307	\$ 169,803	\$ 198,919	\$ 228,841	\$ 259,784	\$ 282,651	\$ 304,399	\$ 324,458	\$ 342,257	\$ 357,272	\$ 374,063																									
- Debt	\$10,225		R&D Adj Operating Margin	65.00%	63.00%	62.00%	61.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%																									
- Minority interests	\$0		Operating Income	\$ 91,850	\$ 106,976	\$ 123,330	\$ 139,593	\$ 155,870	\$ 169,590	\$ 182,640	\$ 194,675	\$ 205,354	\$ 214,363	\$ 224,438																									
+ Cash	\$38,487		EBIT (1-t)	\$ 79,450	\$ 92,534	\$ 106,680	\$ 120,748	\$ 134,828	\$ 142,795	\$ 149,582	\$ 154,961	\$ 158,739	\$ 160,772	\$ 168,329																									
+ Non-operating assets	\$2,237		Reinvestment	\$ 11,969	\$ 12,377	\$ 9,147	\$ 8,699	\$ 8,024	\$ 7,119	\$ 6,006	\$ 6,717	\$ 7,032	\$ 7,363	\$ 39,557																									
Value of equity	\$1,898,312		FCFF	\$ 67,481	\$ 80,157	\$ 97,533	\$ 112,049	\$ 126,804	\$ 135,676	\$ 143,576	\$ 148,244	\$ 151,706	\$ 153,409	\$ 128,771																									
- Value of options	\$0												\$ 3,388,719.59																										
Value of equity in common sto	\$1,898,312		Cost of Capital	11.79%	11.79%	11.79%	11.79%	11.79%	11.13%	10.48%	9.82%	9.16%	8.50%																										
Number of shares	24,490.00		Cumulated WACC	0.8945	0.8001	0.7157	0.6402	0.5727	0.5153	0.4664	0.4247	0.3891	0.3586																										
Estimated value /share	\$77.51		Sales to Capital	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50																										
Price per share	\$123.00		ROIC	125.04%	122.55%	121.39%	124.44%	127.52%	125.53%	123.75%	122.13%	118.82%	114.32%	20.00%																									
% Under or Over Valued	58.68%																																						
			Risk Story				Competitive Advantages				AI and Auto Business: Market Size and Market Share																												
			Initial cost of capital computed based upon industry(semiconductors) and Nvidia's low debt mix and geographic exposure. Over time, Nvidia's cost of capital will drift down but will remain higher (third quartile) of all companies in market.				Strong competitive edges allow NVIDIA to earn well above its cost of capital for the next decade and beyond.				<table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">AI</th> <th colspan="2">Auto</th> </tr> <tr> <th>Current</th> <th>In 2034</th> <th>Current</th> <th>In 2034</th> </tr> </thead> <tbody> <tr> <td>Total Market (\$ M)</td> <td>\$80,000</td> <td>\$300,000</td> <td>\$20,000</td> <td>\$200,000</td> </tr> <tr> <td>Market Share</td> <td>80%</td> <td>60%</td> <td>\$0</td> <td>\$0</td> </tr> <tr> <td>NVIDIA revenues</td> <td>\$64,000</td> <td>\$180,000</td> <td>\$1,200</td> <td>\$30,000</td> </tr> </tbody> </table>						AI		Auto		Current	In 2034	Current	In 2034	Total Market (\$ M)	\$80,000	\$300,000	\$20,000	\$200,000	Market Share	80%	60%	\$0	\$0	NVIDIA revenues	\$64,000	\$180,000	\$1,200	\$30,000
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THE DEEPSEEK EFFECT ON AI COMPANIES





THE END

“There is no real ending. It’s just the place where you stop the story.”