



Aswath Damodaran

AI'S WINNERS, LOSERS AND WANNABES: BEYOND BUZZ WORDS!

ChatGPT did this!

AI: Buzz Word, World Changer or Something in the Middle?

- It is undeniable that AI is the buzzword of the moment, showing up in almost every aspect of our lives and in markets.
- Nvidia has become the hottest company to invest in, seeing its market cap surge in the last two years, to hit \$ 2 trillion in January 2024.
- Every company seems to be latching on to the AI revolution, sprinkling into earnings reports and mentioning products that are built around AI.
- A surge of venture capital is invested in AI-related businesses.



Intrinsic Value Lead: The It Proposition!

The essence of intrinsic value

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- In intrinsic valuation, you value an asset based upon its fundamentals (or intrinsic characteristics).
- For cash flow generating assets, the intrinsic value will be a function of the magnitude of the expected cash flows on the asset over its lifetime and the uncertainty about receiving those cash flows.
 - Discounted cash flow (DCF) valuation is a tool for estimating intrinsic value, where the expected value of an asset is written as the present value of the expected cash flows on the asset, with either the cash flows or the discount rate adjusted to reflect the risk.
 - Intrinsic valuation models predate the modern DCF model, since investors through the ages have found ways to weight in expected cash flows into value.

The two faces of discounted cash flow valuation

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- 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:

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

where the asset has an n-year life, $E(CF_t)$ is the expected cash flow in period t and r is a discount rate that reflects the risk of the cash flows.

- Alternatively, we can replace the expected cash flows with the guaranteed cash flows we would have accepted as an alternative (certainty equivalents) and discount these at the riskfree rate:

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

where $CE(CF_t)$ is the certainty equivalent of $E(CF_t)$ and r_f is the riskfree rate.

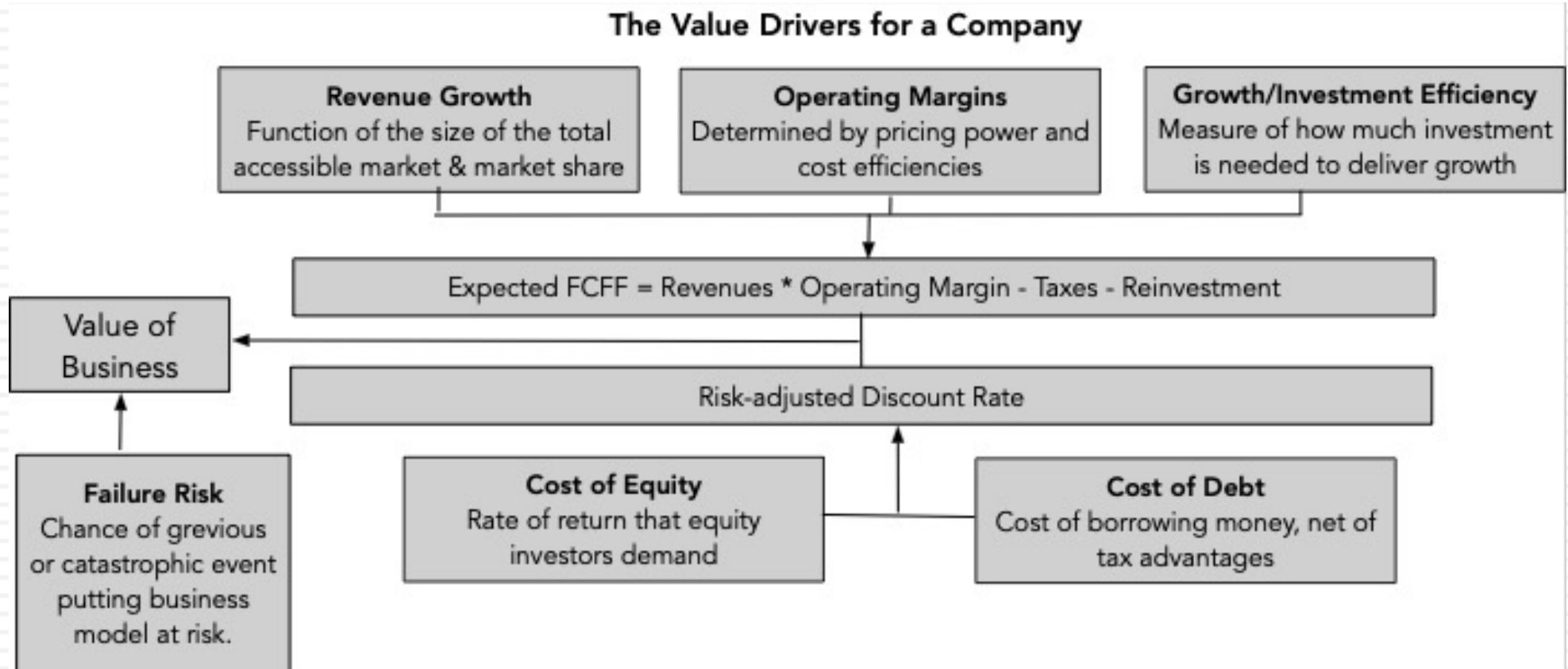
Risk Adjusted Value: Basic Propositions

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1. The “IT” proposition: If IT does not affect the expected cash flows or the riskiness of the cash flows, IT cannot affect value.
2. The “DON’T BE A WUSS” proposition: Valuation requires that you make estimates of expected cash flows in the future, not that you be right about those cashflows. So, uncertainty is not an excuse for not making estimates.
3. 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.
4. 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 drivers of value..

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Revolutionary Change: Promise and Peril!

Aswath Damodaran

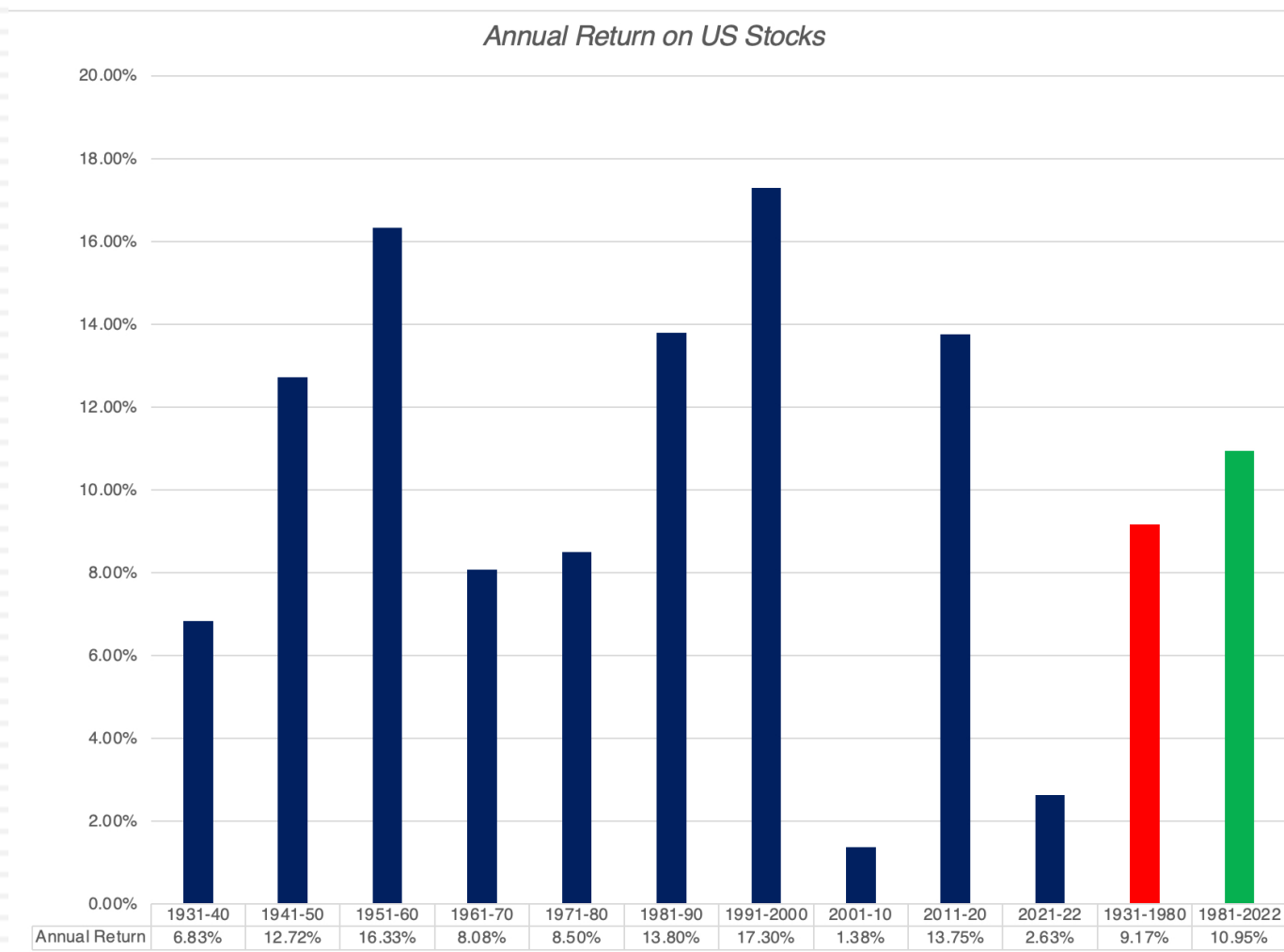
Change coming? Revolutionary or Incremental?

- Revolutionary Changes not only affected wide swathes of businesses, some positively and some adversely, but that they also changed the ways that we live, work and interact.
- In parallel, we have also seen changes that are more incremental, and while significant in their capacity to create new businesses and disruption, don't quite qualify as revolutionary.
- The question of whether a change is revolutionary or incremental depends in large part on:
 - ▣ It's staying power
 - ▣ It's reach across businesses
 - ▣ It's capacity to change how we live and work

Revolutionary Changes (in my lifetime)

Revolutionary Change	Business Effects	Personal Effects
Personal Computers (1980s)	<ul style="list-style-type: none">- New companies built around these new businesses- Disrupt companies in businesses that are displaced by change- Show up as a cost component for companies that buy its products or services	<ul style="list-style-type: none">- New workforce that is skilled in the new businesses- Job losses in businesses that are disrupted by these new businesses- Changes how we live and work
Internet (1990s)		
Smartphones (2000s)		
Social Media (2010s)		

Revolutionary Change: Net Plus or Minus for Markets?



Revolutionary Change: Disruption's Dark Side

- The market is littered with the carcasses of what used to be successful businesses that have been disrupted by technological change.
- Investors in these disrupted companies not only lose money, as they get disrupted, but worse, invest even more in them, drawn by their "cheapness".
 - This happened, just to provide two examples, with investors in the brick-and-mortar retail companies that were devastated by online retail, and with investors in the newspaper/traditional ad companies that were upended by online advertising.
- If AI succeeds in its promise, will there be businesses that are upended and disrupted? Of course, but we are in the hype phase, where much more will be promised than can be delivered, but the biggest targets will come into focus sooner rather than later.



The Big Market Delusion!

Aswath Damodaran

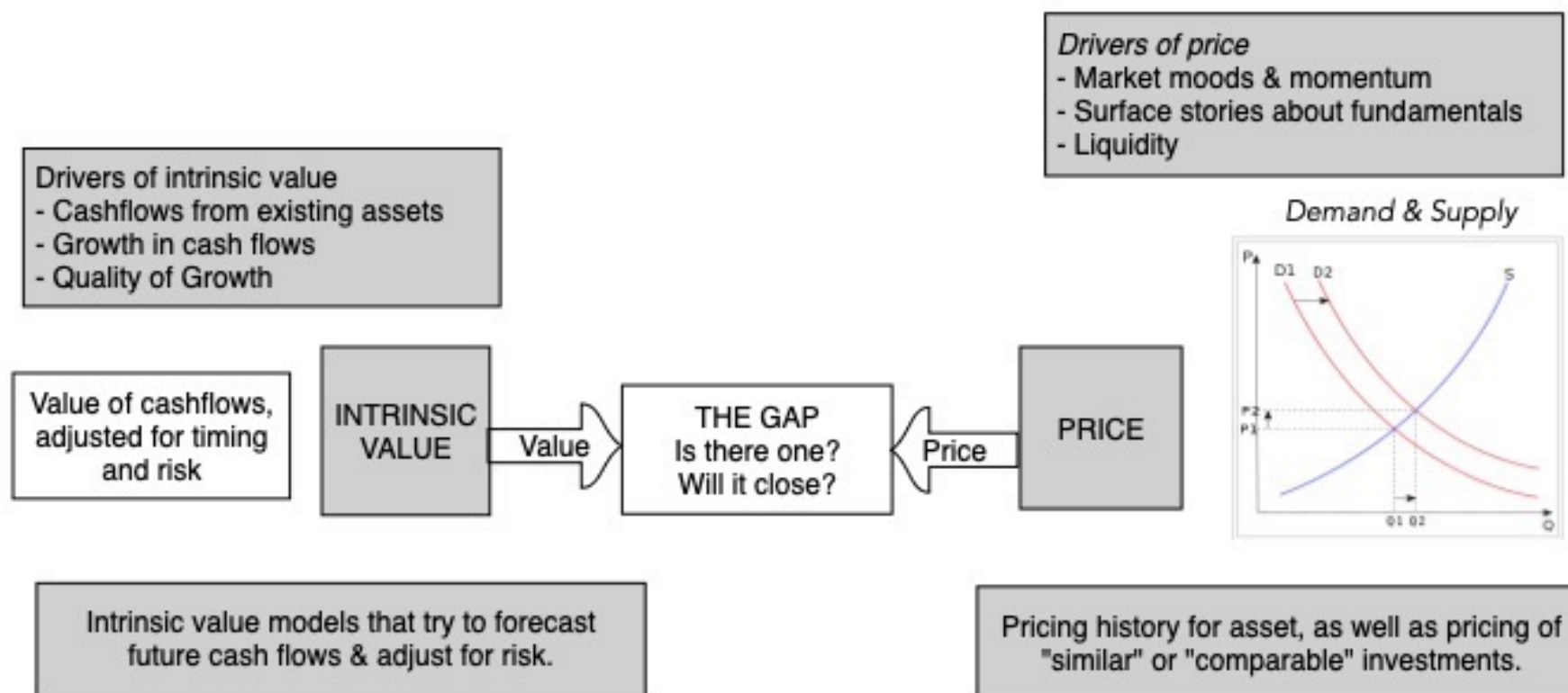
1. Big Markets

- There is nothing more exciting for a nascent business than the perceived presence of a big market for its products and services, and the attraction is easy to understand.
- In the minds of entrepreneurs in these markets, big markets offer the promise of easily scalable revenues, which if coupled with profitability, can translate into large profits and high valuations.
- The logic of impending change is impeccable, but the extrapolation that the change would lead to create huge and profitable markets was made casually.

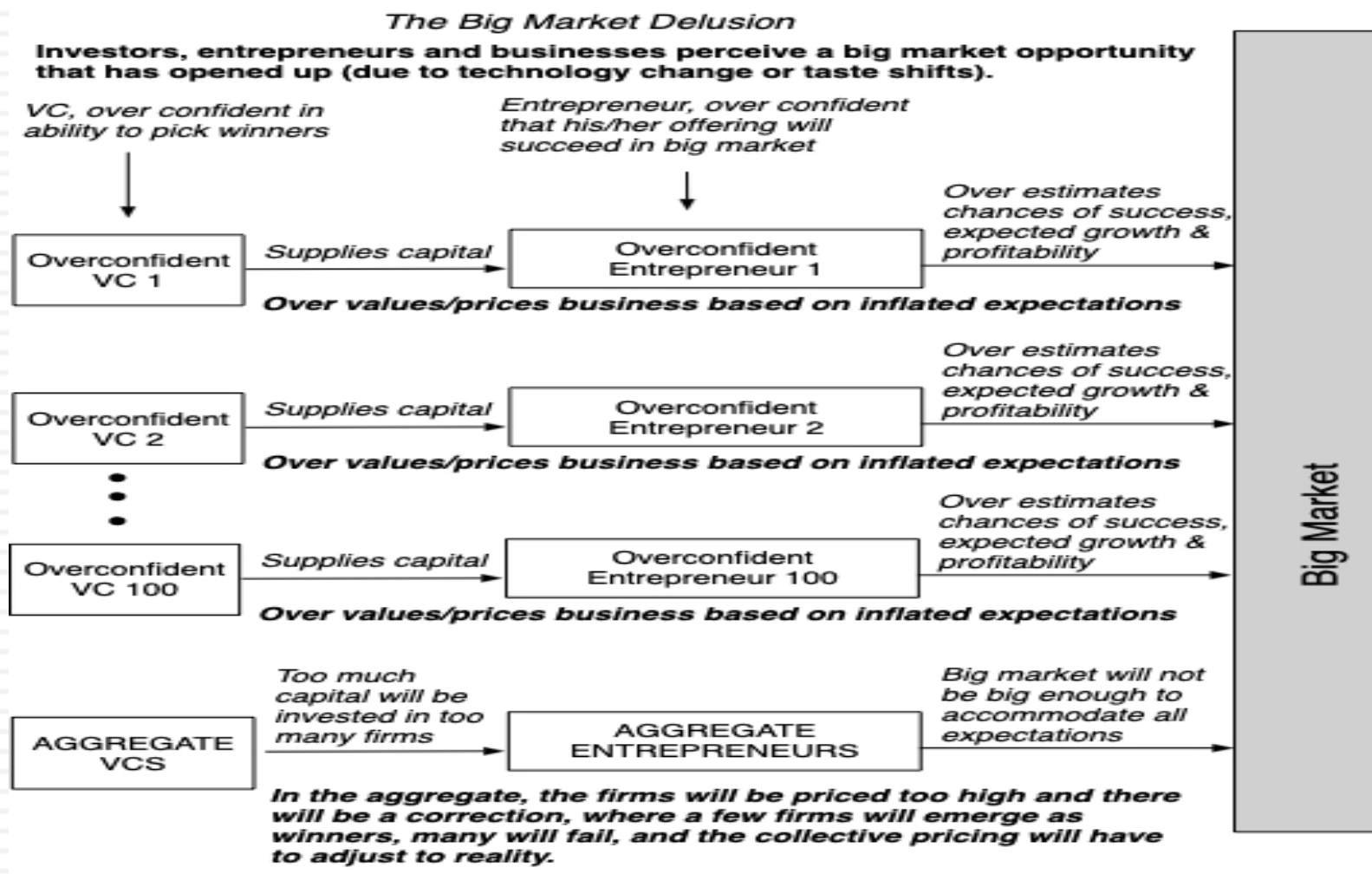
2. Overconfidence

- Daniel Kahneman, whose pioneering work with Amos Tversky, gave rise to behavioral finance as a discipline described overconfidence as the mother of all behavioral biases, for three reasons.
 - First, it is ubiquitous, since it seems to be present in an overwhelming proportion of human beings.
 - Second, overconfidence gives teeth to, and augments, all other biases, such as anchoring and framing.
 - Finally, there is reason to believe that overconfidence is rooted in evolutionary biology and thus cannot be easily countered.
- The problem gets worse with big markets, because of a selection bias, since these markets attract entrepreneurs and venture capitalists, who tend to be among the most overconfident amongst us.

3. The Pricing Game



The Big Market Delusion

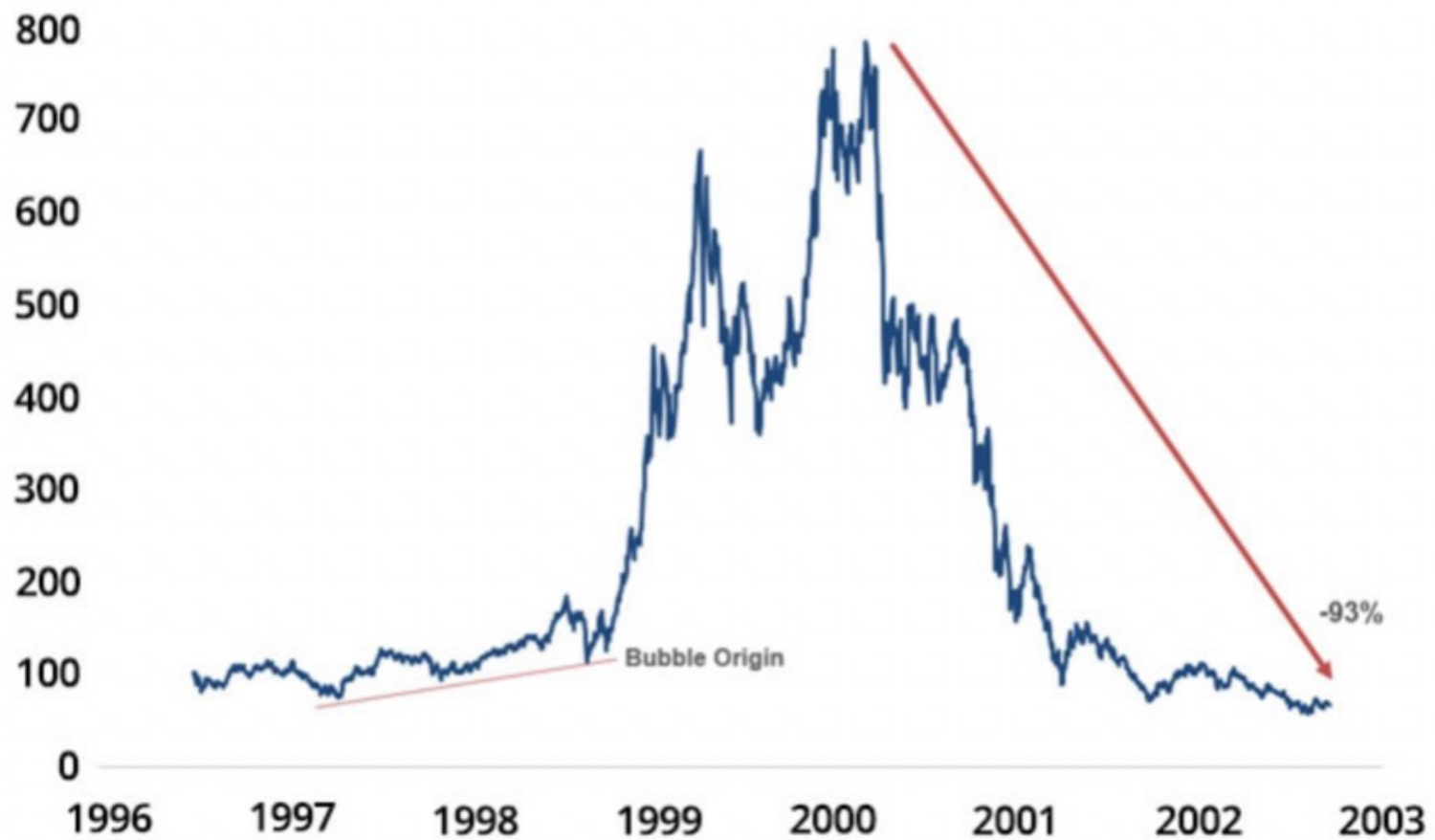


Case Study 1: Internet Retail in 1999

- In 1999, internet retail accounted for 0.5% of all retail sales came from the internet, but internet retail had captured the imagination of investors on the internet.
- In 1999 alone, there were 289 internet IPOs, accounting for 60% of all IPOs, with the average closing up 90% on its offering day.
- In the largest M&A transaction in history (at that point), AOL acquired Time Warner for \$150 billion.

And the correction..

Bloomberg Internet Index



Case Study 2: Advertising in 2015

	<i>Annual CAGR in Total Ad Spending</i>					
<i>Online as % of Total Market</i>		1.00%	2.00%	3.00%	4.00%	5.00%
	30%	\$182.49	\$203.38	\$226.42	\$251.81	\$279.76
	35%	\$212.90	\$237.27	\$264.15	\$293.77	\$326.38
	40%	\$243.32	\$271.17	\$301.89	\$335.74	\$373.01
	45%	\$273.73	\$305.07	\$339.63	\$377.71	\$419.64
	50%	\$304.15	\$338.96	\$377.36	\$419.68	\$466.26

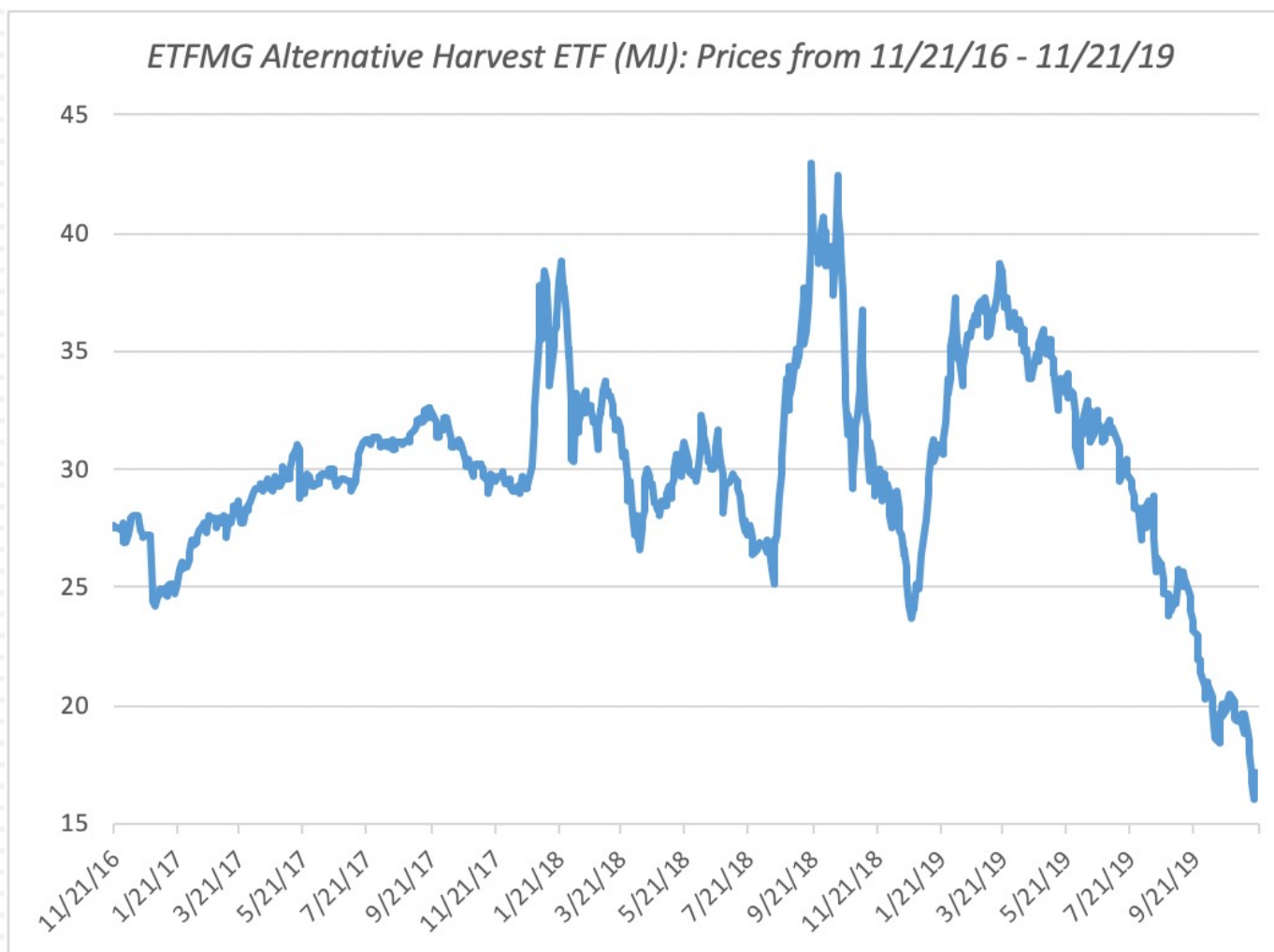
And Online Advertising

<i>Company</i>	<i>Market Cap</i>	<i>Enterprise Value</i>	<i>Current Revenues</i>	<i>Breakeven Revenues (2025)</i>	<i>% from Online Advertising</i>	<i>Imputed Online Ad Revenue (2025)</i>
Google	\$441,572.00	\$386,954.00	\$69,611.00	\$224,923.20	89.50%	\$201,306.26
Facebook	\$245,662.00	\$234,696.00	\$14,640.00	\$129,375.54	92.20%	\$119,284.25
Yahoo!	\$30,614.00	\$23,836.10	\$4,871.00	\$25,413.13	100.00%	\$25,413.13
LinkedIn	\$23,265.00	\$20,904.00	\$2,561.00	\$22,371.44	80.30%	\$17,964.26
Twitter	\$16,927.90	\$14,912.90	\$1,779.00	\$23,128.68	89.50%	\$20,700.17
Pandora	\$3,643.00	\$3,271.00	\$1,024.00	\$2,915.67	79.50%	\$2,317.96
Yelp	\$1,765.00	\$0.00	\$465.00	\$1,144.26	93.60%	\$1,071.02
Zillow	\$4,496.00	\$4,101.00	\$480.00	\$4,156.21	18.00%	\$748.12
Zynga	\$2,241.00	\$1,142.00	\$752.00	\$757.86	22.10%	\$167.49
Total US	\$770,185.90	\$689,817.00	\$96,183.00	\$434,185.98		\$388,972.66
Alibaba	\$184,362.00	\$173,871.00	\$12,598.00	\$111,414.06	60.00%	\$66,848.43
Tencent	\$154,366.00	\$151,554.00	\$13,969.00	\$63,730.36	10.50%	\$6,691.69
Baidu	\$49,991.00	\$44,864.00	\$9,172.00	\$30,999.49	98.90%	\$30,658.50
Sohu.com	\$18,240.00	\$17,411.00	\$1,857.00	\$16,973.01	53.70%	\$9,114.51
Naver	\$13,699.00	\$12,686.00	\$2,755.00	\$12,139.34	76.60%	\$9,298.74
Yandex	\$3,454.00	\$3,449.00	\$972.00	\$2,082.52	98.80%	\$2,057.52
Yahoo! Japan	\$23,188.00	\$18,988.00	\$3,591.00	\$5,707.61	69.40%	\$3,961.08
Sina	\$2,113.00	\$746.00	\$808.00	\$505.09	48.90%	\$246.99
Netease	\$14,566.00	\$11,257.00	\$2,388.00	\$840.00	11.90%	\$3,013.71
Mail.ru	\$3,492.00	\$3,768.00	\$636.00	\$1,676.47	35.00%	\$586.76
Mixi	\$3,095.00	\$2,661.00	\$1,229.00	\$777.02	96.00%	\$745.94
Kakaku	\$3,565.00	\$3,358.00	\$404.00	\$1,650.49	11.60%	\$191.46
Total non-US	\$474,131.00	\$444,613.00	\$50,379.00	\$248,495.46		\$133,415.32
Global Total	\$1,244,316.90	\$1,134,430.00	\$146,562.00	\$682,681.44		\$522,387.98

Case Study 3: Cannabis in 2018

<i>Company</i>	<i>Country</i>	<i>Market Cap</i>	<i>Price/ Book</i>	<i>EV/Sales</i>	<i>EV</i>	<i>Revenues</i>	<i>EBITDA</i>	<i>EBIT</i>	<i>Book Equity</i>
Tilray	Canada	\$13,813	392.08	494.36	\$13,842	\$28	(\$18)	(\$20)	\$35
Canopy Growth	Canada	\$11,516	13.13	170.19	\$11,556	\$68	(\$64)	(\$80)	\$877
Aurora Cannabis	Canada	\$10,161	8.45	239.77	\$10,207	\$43	(\$52)	(\$62)	\$1,202
Aphria	Canada	\$3,677	4.1	127.4	\$3,627	\$28	(\$1)	(\$6)	\$898
Cronos Group	Canada	\$1,754	10.01	236.22	\$1,689	\$7	\$0	(\$1)	\$175
MedMen Enterprises	United States	\$2,520	33.53	87.64	\$2,574	\$29	(\$35)	(\$39)	\$75
The Green Organic	Canada	\$1,445	4.74	NA	\$1,183	\$0	(\$24)	(\$25)	\$305
HEXO Corp	Canada	\$1,351	6	342.9	\$1,159	\$3	(\$5)	(\$5)	\$225
CannTrust Holdings	Canada	\$1,195	8.4	48.64	\$1,126	\$23	\$19	\$18	\$142
Auxly Cannabis	Canada	\$654	2.4	281.46	\$501	\$2	(\$24)	(\$24)	\$273
Aggregate		\$48,086	11.43	204.79	\$47,464	\$232	(\$203)	(\$244)	\$4,208

And the correction...



Common Elements in Big Market Delusions

1. Big Market stories: When asked to justify the pricing of a company in the market, especially young companies with little to show in terms of fundamentals, entrepreneurs, managers and investors almost always point to macro potential, i.e., that the retail or advertising or cannabis markets were huge.
2. Blindness to competition: When the big market delusion is in force, entrepreneurs, managers and investors generally downplay existing competition, thus failing to factor in the reality that growth will have to be shared with both existing and potential new entrants.
3. All about growth: When enthusiasm about growth is at its peak, companies focus on growth, often putting business models to the side or even ignoring them completely.
4. Disconnect from fundamentals: If you combine a focus on growth as the basis for pricing with an absence of concern at these companies about business models, you get pricing that is disconnected from the fundamentals.

The Bottom Line

- In the aftermath of every correction, there are many who look back at the bubble as an example of irrational exuberance. A few have gone further and argued that such episodes are bad for markets, and suggested fixes, some disclosure-related and some putting restrictions on investors and companies.
- Not only are bubbles part and parcel of markets, they are not necessarily a negative. They change the way we live and work. We would choose the chaos of bubbles, and the change that they create, over a world run by actuaries, where we would still be living in caves, weighing the probabilities of whether fire is a good invention or not.
- Our policy advice to politicians, regulators and investors then is to stop trying to make bubbles go away. In our view, requiring more disclosure, regulating trading and legislating moderation are never going to stop human beings from overreaching.



The AI Business Effect

Aswath Damodaran

AI: Revolutionary or Incremental Change

- A year ago, I would have put it in the incremental column, but ChatGPT has changed my perspective. That was not because ChatGPT was at the cutting edge of AI technology, which it is not, but because it made AI relatable to everyone.
- It seems likely (though not guaranteed) that AI has the potential to create major changes in the ways that businesses not only operate, creating new products and services, but the way we live.

AI: Business Potential

Hardware and Infrastructure The AI effect on NVIDIA comes from the increased demand for <u>AI-optimized computer chips</u> , and as that market is expected to grow exponentially, the companies that can grab a large share of this market will benefit.	Data Big data, used more as a buzzword than a business proposition, over the last decade may finally find its place in the value chain, when twinned with AI, but that pathway will not be linear or predictable
Software This software can take multiple forms, from AI platforms, chatbots, deep learning algorithms (including image and voice recognition, as well as natural language processing) and machine learning.	AI Products/Services AI may allow companies to target customers better (increasing revenues) or reduce costs (replacing manual labor with AI-driven applications) and make them more efficient, and by extension, more profitable.

AI: Social Effects

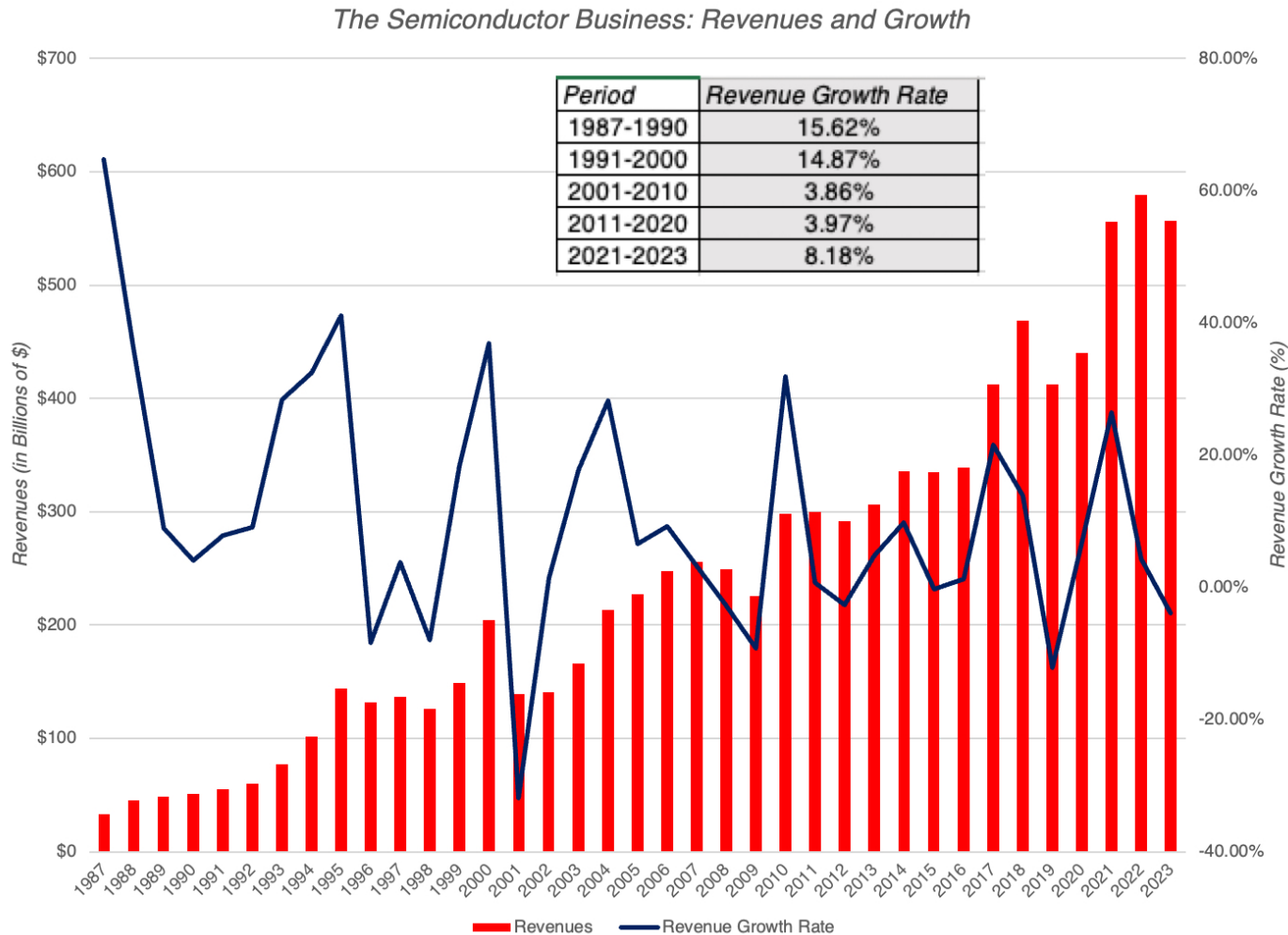
- I know that there are some advocates of AI who paint a picture of goodness, where AI takes over the menial tasks that presumably cause us boredom and brings an unbiased eye to data analysis that lead to better decisions. I know that there are others who see AI as an instrument that big companies will use to control minds and acquire power. With the experience of the big changes that have engulfed us in the last few decades still fresh, I would argue that they are both right.
- There are some who believe that AI can be held in check and made to serve its more noble impulses, by restricting or regulating its development, but I am not as optimistic for many reasons.
 - I believe that both regulators and legislators are woefully incapable of understanding the mechanics of AI, let alone pass sensible restrictions on its usage.
 - Second, any regulation or law that is aimed at preventing AI's excesses will almost certainly set in motion unintended consequences, that at least in some cases will be worse than the problems that the regulation/law was supposed to hold in check.



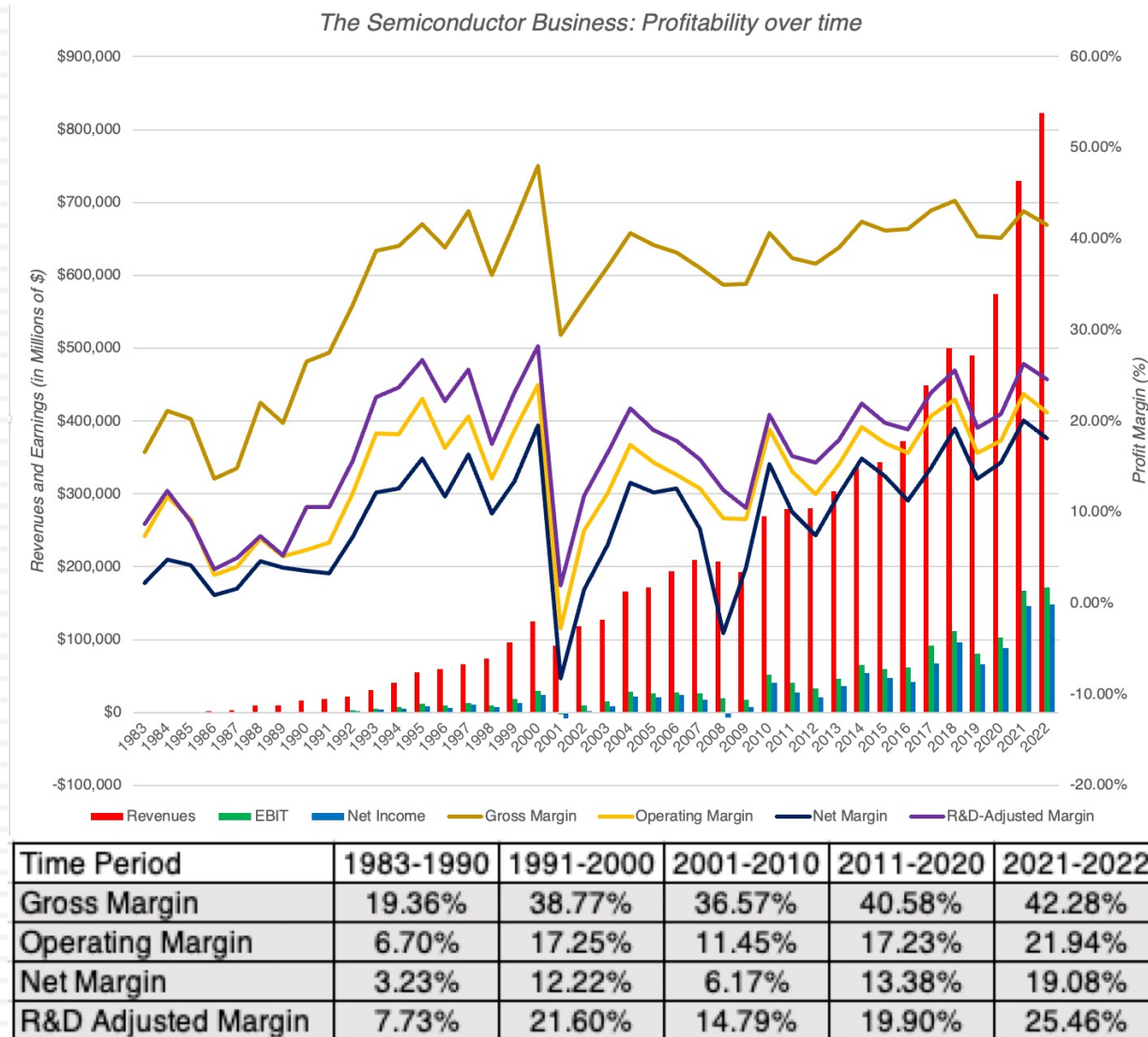
Nvidia: Setting the Stage

Aswath Damodaran

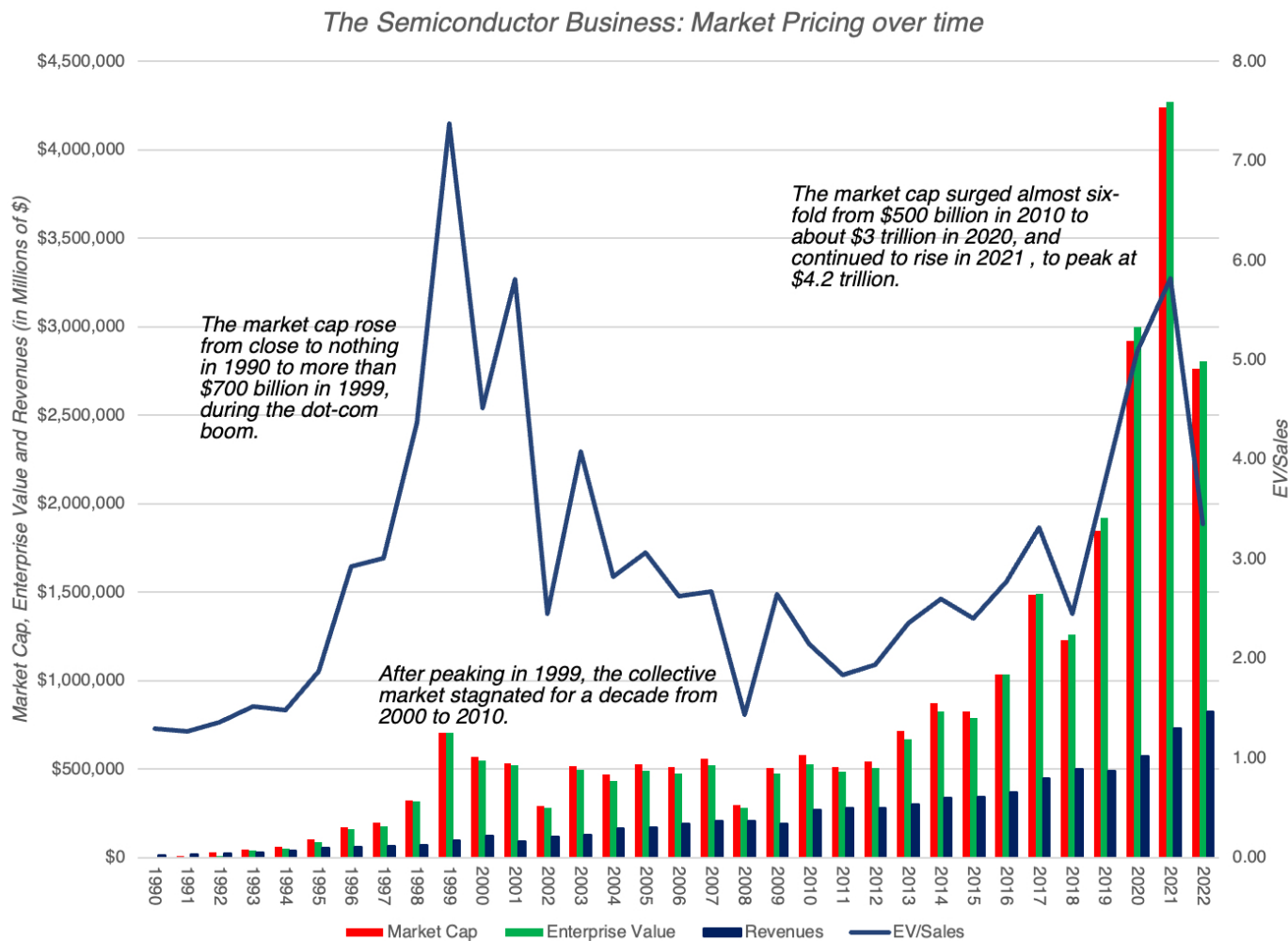
1. The Semiconductor Business – A Growth Business that is maturing!



2. Profitable, with Cycles....



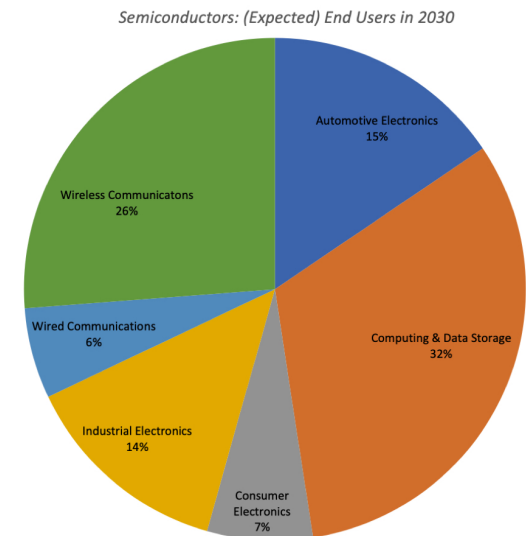
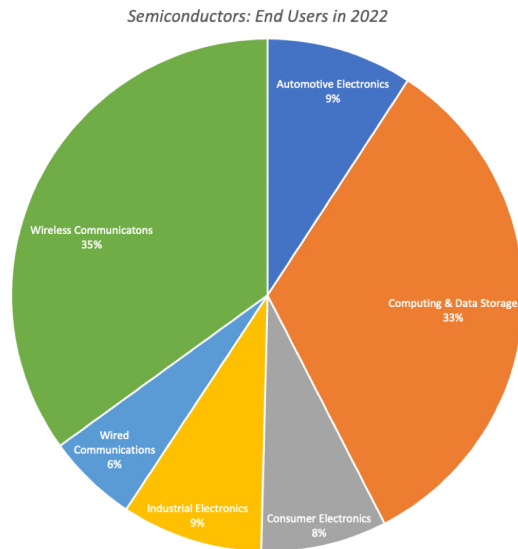
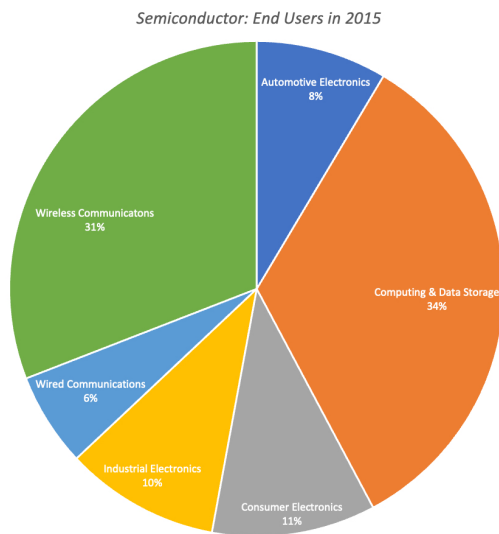
3. A Love-Hate Relationship with Markets



4a. With a Shifting Cast of Winners

1990	2000	2010	2020	2022
1. NEC	1. Intel	1. Intel	1. Intel	1. TSMC
2. Toshiba	2. Toshiba	2. Samsung	2. Samsung	2. Samsung
3. Hitachi	3. NEC	3. TSMC	3. TSMC	3. Intel
4. Intel	4. Samsung	4. Texas Instruments	4. SK Hynix	4. Qualcomm
5. Motorola	5. Texas Instruments	5. Toshiba	5. Micron	5. SK Hynix
6. Fujitsu	6. Motorola	6. Renesas	6. Qualcomm	6. Broadcom
7. Mitsubishi	7. STMicro	7. Qualcomm	7. Broadcom	7. Micron
8. Texas Instruments	8. Hitachi	8. STMicro	8. NVIDIA	8. NVIDIA
9. Philips	9. Infineon	9. Hynix	9. Texas Instruments	9. Applied Materials
10. Panasonic	10. Philips	10. Micron	10. Infineon	10. Texas Instruments

4b. And End Users

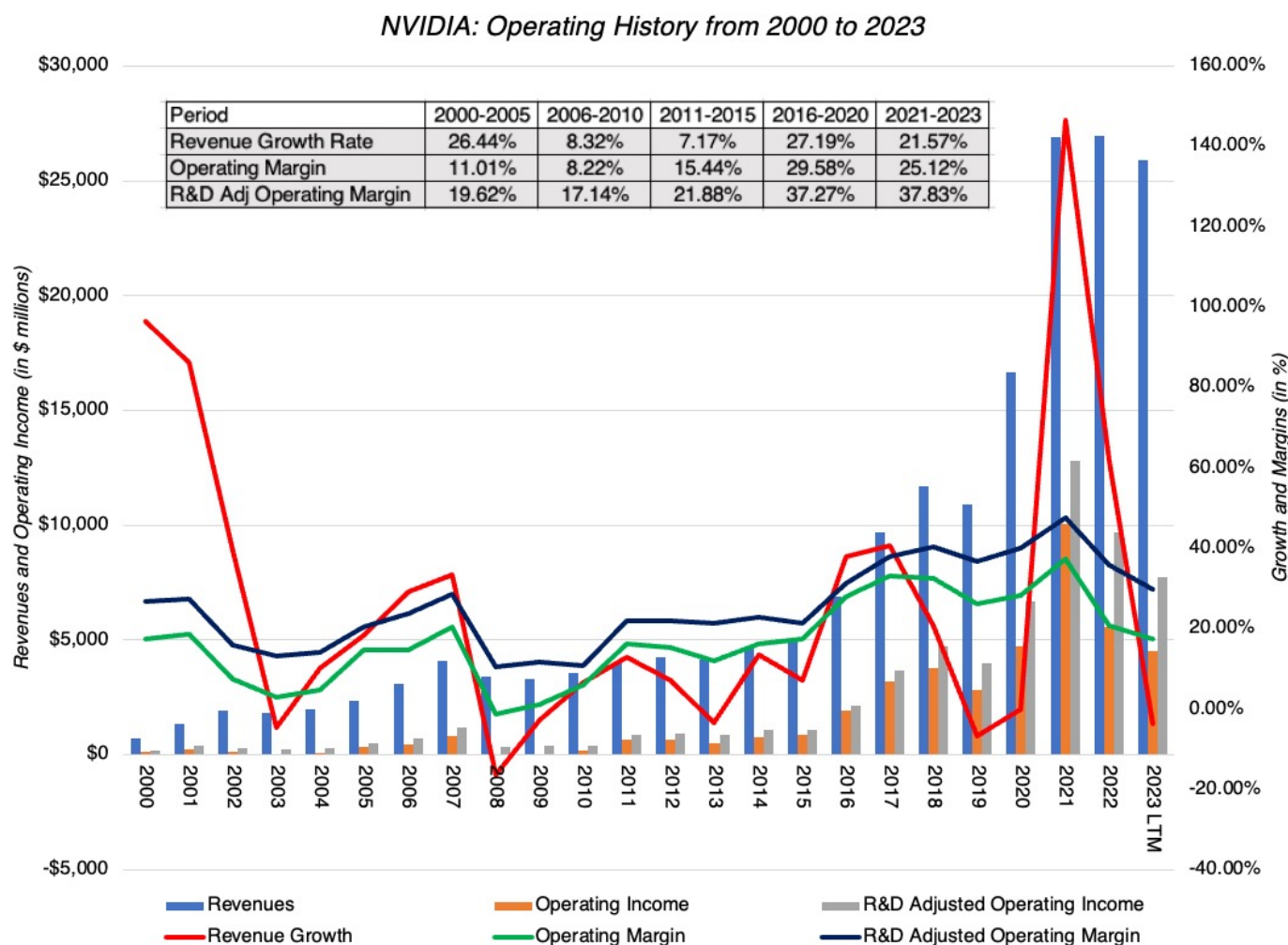




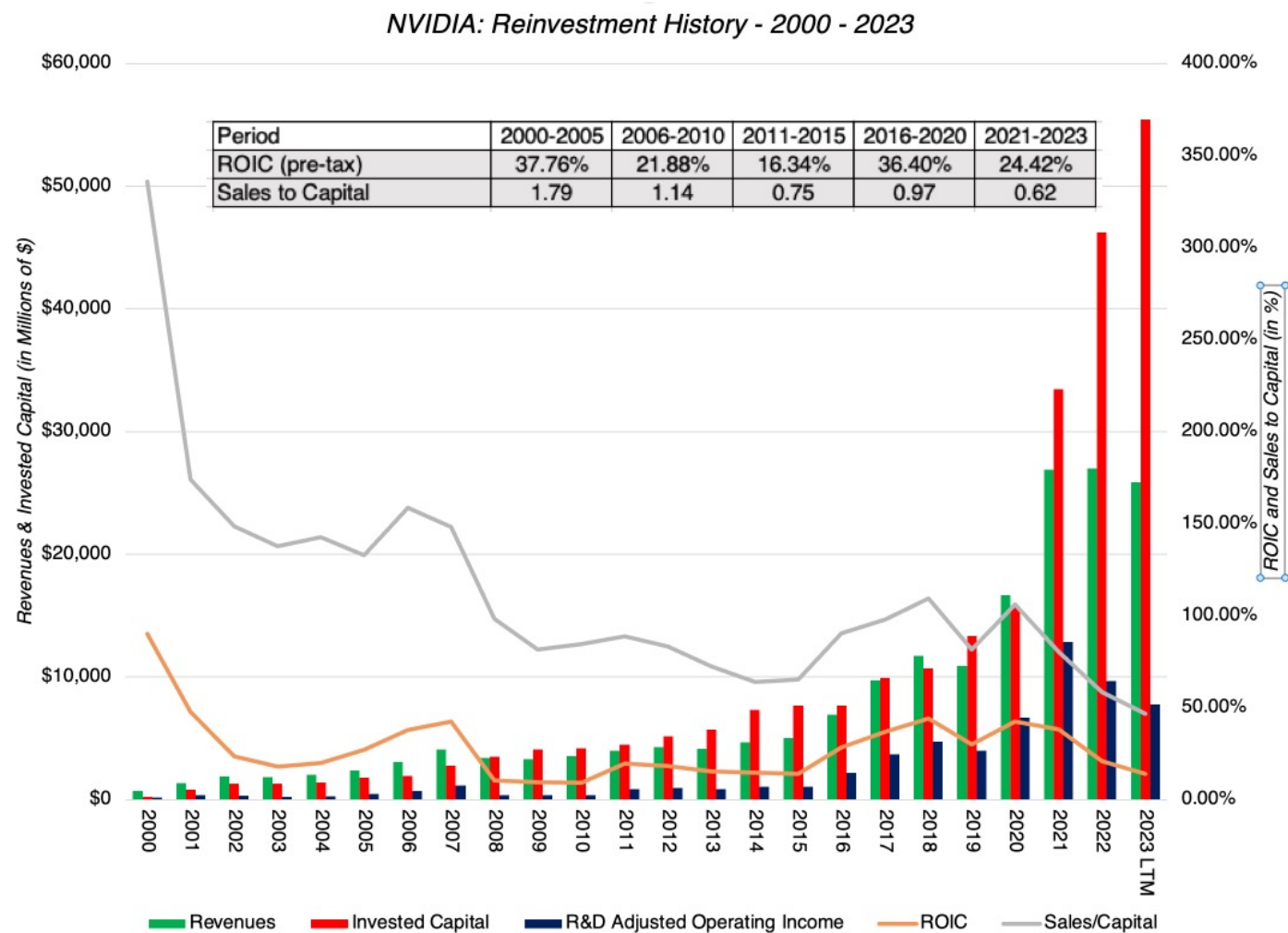
Nvidia: Building the Back story

Aswath Damodaran

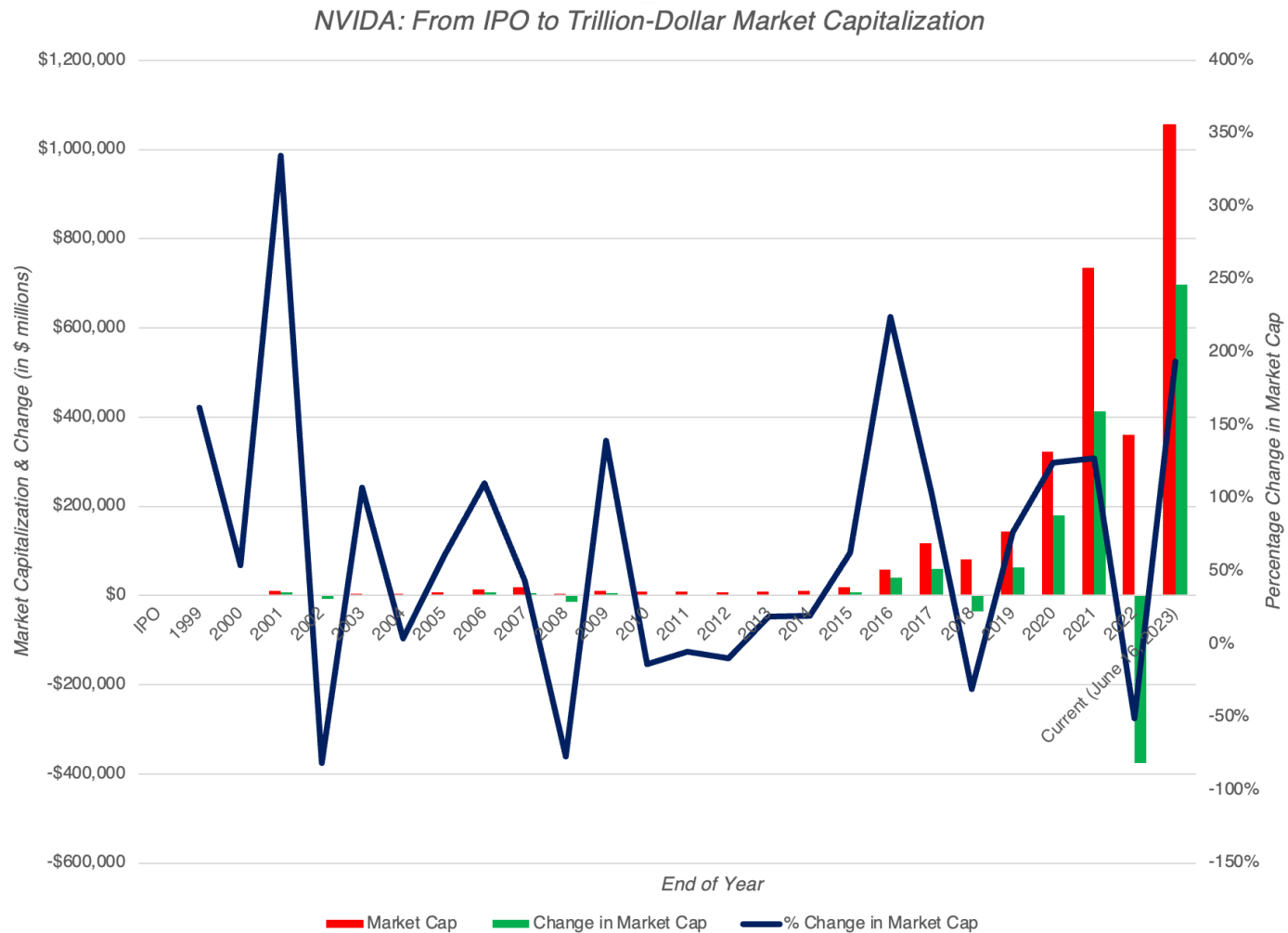
1. Opportunistic Growth



2. With Large (but Productive) Reinvestment!



3. And a Mega Market Payoff





Nvidia: The AI Story

Aswath Damodaran

The AI Chip Story

- The AI story has particular resonance with NVIDIA because unlike most other companies, where it is mostly hand-waving about potential, it has substance in place already and a market that is its target. In particular, NVIDIA has spent much of the last few years investing and developing products for a nascent AI market. This lead time has given NVIDIA not just market leadership, but revenues and profits already. Much of the excited reaction to NVIDIA's most recent earnings report came from the company reporting a surge in its data center revenues, with much of the increase coming from AI chips.
- While the company does not explicitly break out how much of the data center revenues are from AI chips, it is estimated that the total market for those chips in 2022 was about \$15 billion, with NVIDIA holding a dominant market share of about 80%. If those estimates are right, the bulk of the data center revenues for NVIDIA in 2022, which amounted to \$15 billion in all, comes from AI-optimized chips.
- The ChatGPT jolt to market expectations has played out in increases in expected growth of the AI chip market over the next decade, with estimates for the overall AI chip market in 2030 ranging from \$200 billion at the low end to close to \$300 billion at the high end.

NVIDIA: Drivers of Success

- The driver of NVIDIA's success has been its high-performance GPU cards, but it is very likely that the businesses that bought these cards and drove NVIDIA's success in the last decade will be different from the businesses that will make it successful in the next one.
- For much of the last decade, it was gaming and crypto users that allowed the company to set itself apart from the competition, but the bad news is that both of these markets are maturing, with lower expected growth in the future.
- The good news, for NVIDIA, is that it has two other businesses that are ready to step in and contribute to growth.
 - The first is AI, where NVIDIA commands a hefty market share of what is now a relatively small market, but one that is almost certain to grow ten-fold or greater over the decade.
 - The other is in the automobiles business, where more powerful computing is seen as the ingredient needed to open up automated driving and other enhancements. NVIDIA is only a small player in this space, and while it does not enjoy the dominance that it does in AI, a growing market will allow NVIDIA to acquire a significant market share.

Nvidia: Behind the AI Success

- First mover: Nvidia was the first large semiconductor company to see the potential for AI to be a large market, and channel its energies to designing chips for that market.
- Software bundling: Nvidia has software that it bundles with its chips, making them more efficient in delivering results (with less energy being consumed).
- Design, not manufacturing: Nvidia does not make its own chips. It designs the chips for TSMC to manufacture. That does expose them to outsourcing risk, but it does allow them to move faster.

The NVIDIA Growth Story

- Revenue Growth: NVIDIA will remain a high growth company for two reasons.
 - The first is that in spite of its scaling up due to growth over the last decade, at least in terms of revenues, it has a modest market share of the overall semiconductor market, with revenues that are less than half of the revenues posted by Intel or TSMC.
 - The second, and more important reason, is that while its gaming revenue growth is starting to flag, it is well-positioned in AI and Auto, two markets poised for rapid growth. In my story, I will assume that these markets will deliver on their growth promise and that NVIDIA will maintain a dominant, albeit lower, market share of the AI chip business, while gaining a significant share (15%) of the Auto chip business

	AI		Auto		Gaming & Other		NVIDIA	
	Current	In 2033	Current	In 2033	Current	In 2033	Current	In 2033
Total Market (\$ Mil)	\$15,000	\$325,000	\$20,000	\$200,000	Revenue growth: 15% for years 1-5, declining thereafter.		Revenues increase 10-fold over next decade	
Market Share	75%	60%	3.00%	15%				
NVIDIA revenues (\$ Mil)	\$11,250	\$195,000	\$600	\$30,000	\$14,028	\$41,672	\$25,878	\$266,672

As of 2023

NVIDIA: The Rest of the Story

- Profitability: The semiconductor business has a cost structure that has relatively little flex to it, but I will assume in my NVIDIA story that the right margin to focus on is the R&D adjusted version, and that NVIDIA will bounce back quickly from its 2022 margin setback to deliver higher margins than its peer group. While my target R&D adjusted margin of 40% may look high, it is worth remembering that the company delivered 42.5% as margin in 2020 and 38.4% as margin in 2021.
- Investment Efficiency: NVIDIA has invested heavily in the last decade, generating only 65 cents in revenues for every dollar of capital invested (including the investment in R&D), in 2022. I believe that given the company's larger scale, with the payoff from past investments augmenting revenues, the company's sales to invested capital will approach the global industry median, which is \$1.15 in revenues for every dollar of capital invested.
- Risk: I estimated NVIDIA's cost of capital based upon its geographic exposure and very low debt ratio to be 13.13%, but chose to use the industry average for US semiconductor companies, which was 12.21%, as the cost of capital in the initial growth period. Over time, I will assume that this cost of capital will drift down towards the overall market average cost of capital of 8.85%.

Nvidia													Jun-23	
Base Year and Comparison			Growth Story (Revenue)			Profitability Story (Margin)			Growth Efficiency Story			Terminal Value		
	Company	Industry	Even as gaming and other chip businesses mature, NVIDIA's investments in the AI and Auto chip businesses will deliver healthy growth over the next decade.			Margins improve, first as NVIDIA rebounds from a down-year and then long term, because of competitive advantages, especially in their growth businesses and economies of scale.			Sales to capital moves to industry median, as company is able to slow its investment pace, and see payoffs from past investments in AI & Auto.			Growth Rate	3.60%	
Revenue Growth	-15.29%	8.81%										Cost of capital	8.85%	
Revenue	\$14,028											Return on capital	20.00%	
Operating Margin	25.64%	22.96%										Reinvestment Rate	18.00%	
Operating Income	\$3,597													
EBIT (1-t)	\$3,238													
Value of Rest	\$106,978		1	2	3	4	5	6	7	8	9	10	Terminal year	
Value of AI	\$417,459	Revenue (Gaming/Other)	\$ 16,132	\$ 18,552	\$ 21,335	\$ 24,535	\$ 28,215	\$ 31,804	\$ 35,125	\$ 37,991	\$ 40,225	\$ 41,673	\$ 43,173	
Value of Auto	\$58,568	Revenue (AI)	\$ 29,253	\$ 46,512	\$ 63,027	\$ 78,798	\$ 93,825	\$ 116,292	\$ 137,643	\$ 157,878	\$ 176,997	\$ 195,000	\$ 202,020	
Probability of failure =	0.00%	Revenue (Auto)	\$ 1,848	\$ 3,672	\$ 6,072	\$ 9,048	\$ 12,600	\$ 15,504	\$ 18,696	\$ 22,176	\$ 25,944	\$ 30,000	\$ 31,080	
Value of operating assets =	\$583,005	Revenues (Total)	\$ 47,233	\$ 68,736	\$ 90,434	\$ 112,381	\$ 134,640	\$ 163,600	\$ 191,464	\$ 218,045	\$ 243,166	\$ 266,673	\$ 276,273	
- Debt	\$12,080	R&D Adj Operating Margin	35.00%	37.00%	38.00%	39.00%	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%	
- Minority interests	\$0	Operating Income	\$ 16,532	\$ 25,432	\$ 34,365	\$ 43,829	\$ 53,856	\$ 65,440	\$ 76,585	\$ 87,218	\$ 97,266	\$ 106,669	\$ 17,269	
+ Cash	\$15,320	EBIT (1-t)	\$ 14,878	\$ 22,889	\$ 30,928	\$ 39,446	\$ 48,471	\$ 56,933	\$ 64,332	\$ 70,647	\$ 75,868	\$ 80,002	\$ 12,952	
+ Non-operating assets	\$505	Reinvestment	\$ 18,698	\$ 18,868	\$ 19,085	\$ 19,356	\$ 25,183	\$ 24,229	\$ 23,114	\$ 21,844	\$ 20,441	\$ 8,348	\$ 2,331	
Value of equity	\$586,750	FCFF	\$ (3,820)	\$ 4,021	\$ 11,844	\$ 20,090	\$ 23,288	\$ 32,704	\$ 41,218	\$ 48,802	\$ 55,427	\$ 71,654	\$ 10,621	
- Value of options	\$0											\$ 58,568.24		
Value of equity in common stock	\$586,750													
Number of shares	2,470.00	Cost of Capital	12.21%	12.21%	12.21%	12.21%	12.21%	11.54%	10.86%	10.19%	9.52%	8.85%		
Estimated value /share	\$237.55	Cumulated WACC	0.8912	0.7942	0.7078	0.6308	0.5622	0.5040	0.4546	0.4126	0.3767	0.3461		
Price per share	\$409.00	Sales to Capital	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15		
% Under or Over Valued	72.17%	ROIC	37.16%	38.97%	39.85%	40.79%	41.77%	40.31%	38.88%	37.46%	36.06%	34.65%	20.00%	
Risk Story			Competitive Advantages			AI and Auto Business: Market Size and Market Share								
Initial cost of capital set equal to semiconductor industry average, for first 5 years, moving towards average for entire market over time.			Strong competitive edges allow NVIDIA to earn well above its cost of capital for the next decade and beyond.											
						AI				Auto				
						Current	In 2033	Current	In 2033					
						Total Market (\$ M)	\$15,000	\$325,000	\$20,000	\$200,000				
						Market Share	75%	60%	3.00%	15%				
						NVIDIA revenues	\$11,250	\$195,000	\$600	\$30,000				

NVIDA: Value Simulation

□ Revenue Growth

- ▣ Base Case: Revenues of \$267 billion in 2033

- ▣ Distribution:

	<i>Base Case</i>	<i>Distribution</i>	<i>Rationale</i>
AI: Total Market	\$325 billion	Uniform: \$225 to \$425 billion	Range of outside estimates
AI: NVIDIA Share	60%	Lognormal: Std Dev = 15%	More errors on upside than down
Auto: Total Market	\$200 billion	Uniform: \$100 - \$300 billion	Range of outside estimates
Auto: NVIDIA Share	15%	Lognormal: Std Dev = 10%	More errors on upside than down
Gaming & Other: CAGR	15%	Triangular: 5% to 25%	Supplemental (to Gaming) business absence or presence

□ Operating Margin

- ▣ Base Case: Pre-tax operating margin of 40% (target)
- ▣ Distribution: Triangular, with 30% (low) and 50% (high)

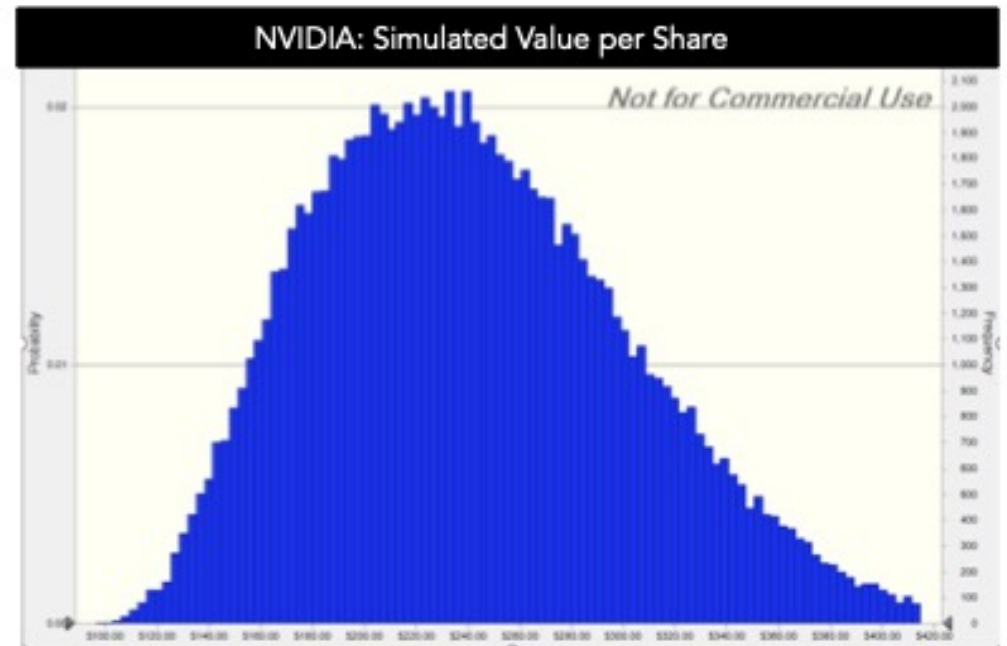
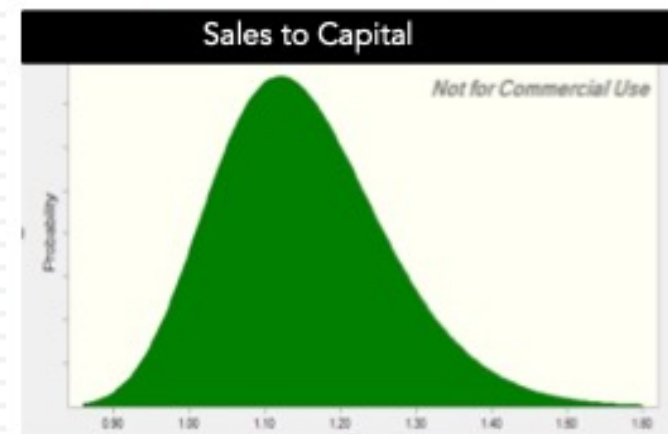
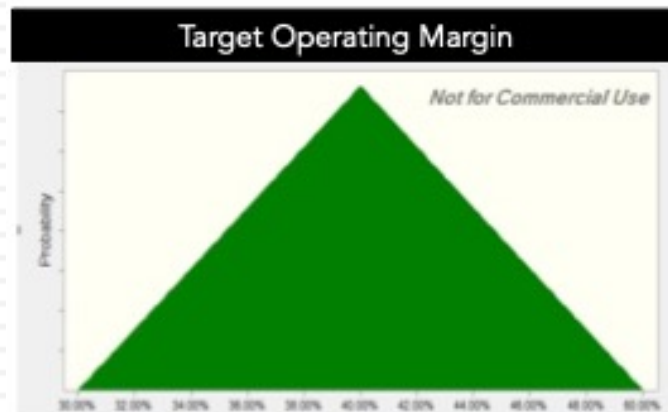
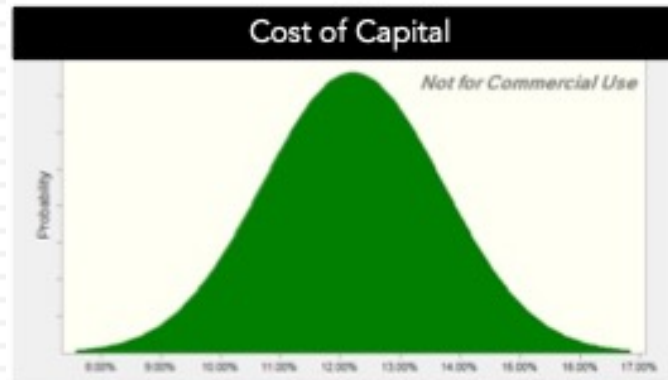
□ Reinvestment

- ▣ Base Case: Sales to Invested Capital of 1.15
- ▣ Distribution: Lognormal, with range from 0.8-1.94

□ Cost of Capital

- ▣ Base Case: Industry average of 12.21%
- ▣ Distribution: Normal Distribution (with standard dev of 1.5%)

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

And a Breakeven Analysis

		<i>Revenues in 2033 (in billions)</i>				
		<i>\$100.00</i>	<i>\$200.00</i>	<i>\$300.00</i>	<i>\$400.00</i>	<i>\$500.00</i>
Operating Margin (%)	30%	\$ 89.09	\$ 137.19	\$ 189.32	\$ 244.03	\$ 296.07
	35%	\$ 104.24	\$ 163.15	\$ 226.88	\$ 293.88	\$ 357.71
	40%	\$ 119.39	\$ 189.61	\$ 264.43	\$ 343.73	\$ 419.35
	45%	\$ 134.54	\$ 216.08	\$ 301.99	\$ 393.58	\$ 480.99
	50%	\$ 149.70	\$ 242.55	\$ 339.54	\$ 443.43	\$ 542.63

The Take-Aways from What ifs?

- The breakeven table reinforces the findings in the simulation, insofar as it shows that there are plausible paths that lead to the current price being a fair value or under value, but these paths require a daunting combination of extraordinary revenue growth and super-normal margins.
- In my view, a target margin of 50% is pushing the limits of possibility, in the semiconductor business, and if NVIDIA finds a way to deliver value that justifies current pricing, it has to be through explosive revenue growth.
- Put simply, you need another market or two, with potential similar to the AI market, where NVIDIA can wield a dominant market share to justify its pricing.

Judgment Day: Investing

- I love NVIDIA as a company and have nothing but praise for Jensen Huang's leadership of the company. My valuation story for NVIDIA reflects all of the positive features in the company will continue into the next decade, but that upbeat narrative still yields a value well below the current price.
- I would be lying if I said that selling one of my biggest winners is easy, especially since there is a plausible pathway, albeit a low-probability one, that the company will be able to deliver solid returns, at current prices.
 - I chose a path that splits the difference, selling half of my holdings and cashing in on my profits, and holding on to the other half, more for the optionality (that the company will find other new markets to enter in the next decade).
 - The value purists can argue, with justification, that I am acting inconsistently, given my value philosophy, but I am pragmatist, not a purist, and this works for me.
- It does open up an interesting question of whether you should continue to hold a stock in your portfolio that you would not buy at today's stock prices, and it is one that I will return to in a future post.

Judgment Day: Trading

	<i>Investing</i>	<i>Trading</i>
Determinants of level	Cash flows, growth and risk	Demand & Supply
Causes for change	Shifts in expected cash flows, growth and risk.	Changes in mood & momentum
Players	Investors , estimating value, and betting on price convergence.	Traders , playing momentum, or shifts in momentum
Key skills	1. Assess risk and value businesses 2. Find pricing catalysts.	1. Gauge market mood/momentum 2. Detect shifts in that mood.
Personal characteristics	(a) Long time horizon, (b) Patience and (c) immunity from peer pressure	(a) Flexible time horizon, (b) Gambling instincts and (c) Crowd Reading
Tools	Intrinsic Valuation (DCF), Forensic Accounting	Peer group pricing, Charts and technical indicators

Trading Follow Through

- If you are a trader, even if you believe that NVIDIA's value is well below its price, you may buy NVIDIA on the expectation that the stock will continue to rise, borne upwards by momentum or incremental information.
 - ▣ Given the strength of momentum as a market-driver, you may very well generate high returns over the next weeks, months or even years, and you should not let "value scolds" get in the way of your enjoyment of your winnings.
 - ▣ My only pushback would be against those who argue that momentum can carry a stock forward forever, since it is the gift that both gives and takes away.
- The strength of momentum in the rise in NVIDIA's stock price will be played out in the the opposite direction, when (not if) momentum shifts, and if you are trading NVIDIA, you should be working on indicators that give you early warning of those shifts, not worrying about value.



AI in the rest of the market

The Rest of the Mag Seven

- While AI is often provided as the collective reason for the rise and resilience of the Mag Seven stocks, other than Nvidia, only Microsoft has made tangible advances on AI.
- Much of Microsoft's success is reflected glory, from its prescient partnership with Open AI and Chat GPT. That said,
 - ▣ There is little that you can point to in Microsoft's bottom line that can be traced to AI.
 - ▣ Open AI, as an entity, is a governance nightmare, a non-profit where the stakeholders very different views of its future.

On the AI hardware front..

- While Nvidia has had the lion's share of the AI chip glory, there are signs that the other chip makers are throwing resources into catching up.
 - To the extent that you believe that one or more of these companies will be the one to take share away from Nvidia in a growing market, you have a winner.
 - Of course, you could always bet on a maker of chips like TSMC as a winner, no matter who dominates the market.
- There is more to AI architecture than AI chips. As the business evolves, you are likely to see the rest of the AI hardware business developing, and winners in that market.
- The question, from a value perspective, is whether the AI business will be commoditized.

On the AI software & data front...

- To the extent that AI is the real payoff from “big data”, and that its requirements in big data are specific, there may be big data providers who have an advantage.
- Among companies that already collect data, the payoff to using AI will be directly proportional to how exclusive their data is, and how well they can use what they learn to modify products and services.

The AI business customers...

- For some companies that are built around providing services that are mechanical (or easily replicated), AI will be an existential threat.
- For most companies, AI will become an expense that they will have to incur, since not spending money on it may put them at a disadvantage, reducing margins and profitability.
- For some companies, the payoff to using AI will come from having exclusive data, that they can turn the AI machine on, and how well they can use what they learn to modify products and services.

AI: Bottom Line

- Even if you buy into the argument that AI will change the ways that we work and play, it does not necessarily follow that investing in AI-related companies will yield returns. You can get the macro story right, but you need to also consider how that story plays out across companies to be able to generate returns.
- Refusing to make estimates or judgments about how AI will affect the fundamentals (cash flows, growth and risk) in a business, just because you face significant uncertainty, will not make that uncertainty go away, and instead will create a vacuum that will be filled by arbitrary AI premiums.
- As a society, it is unclear whether adding AI to the mix will make us better or worse off, since every big technological change seems to bring with it unintended consequences.
- All in all, I am considering asking ChatGPT to write this post for me, using my own language and history, and I am open to the possibility that it could do a better job than I can.