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Dear Partner,

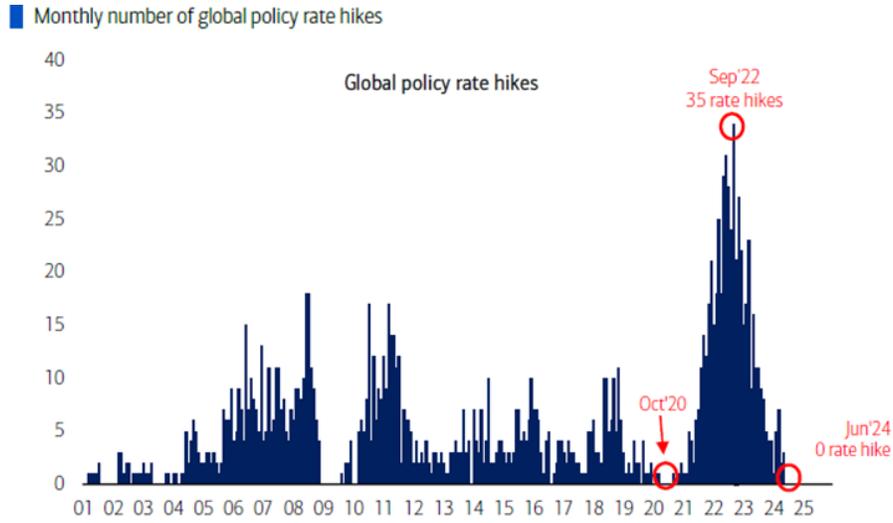
The second quarter of 2025 offered positive performance results to global equities. During the quarter Alkeon Growth Partners, LP returned 25.04% (net of all fees, expenses and incentive allocation) versus a 10.97% return for the MSCI AC World. Since its inception (January 1998), the strategy has annualized at 12.86% (net of all fees, expenses and incentive allocation) per year versus an annualized 5.20% return for the MSCI AC World. This translates into a total cumulative return of 2683.26% for the strategy versus 302.80% for the MSCI AC World.

	Q2 2025	2025	Alkeon Growth Strategy Since Inception (cumulative)	Alkeon Growth Strategy Since Inception (annualized)
<b>Alkeon Growth Partners<sup>1</sup></b>	<b>25.04%</b>	<b>20.19%</b>	<b>2683.26%<sup>2</sup></b>	<b>12.86%<sup>2</sup></b>
MSCI World	10.96%	8.59%	329.90%	5.45%
MSCI AC World	10.97%	9.10%	302.80%	5.20%

*Past performance is no guarantee of future results. Investing in securities involves substantial risks. Please see Important Notes at the end of this letter.*

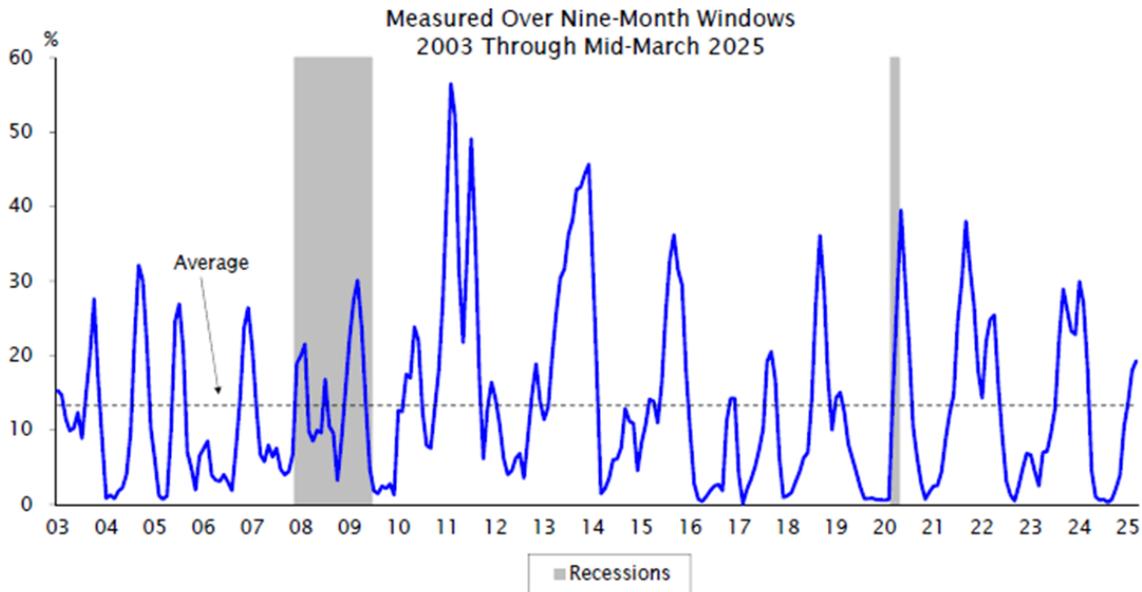
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As we have discussed in prior communications, 2023 marked the end of the most aggressive global tightening cycle in decades, which particularly hurt high growth stocks over this period. This dynamic sharply changed in 2024. Specifically, June 2024 was the first month since October 2020, in which no central bank globally raised rates.



**Exhibit 1.** Monthly Number of Global Policy Rate Hikes, July 2024, source BofA Global Research.

As central banks cut rates in 2024 at the fastest rate since the Covid crisis, earnings dominated other factors affecting stock returns. But now the environment is changing again, and in 2025 macro factors are becoming important in dissecting return attribution.



**Exhibit 2.** Share of Return Dispersion Explained by Macro Surprises, March 2025, source Empirical Research.

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Despite positive returns in the last couple of years, the cumulative correction in high growth stocks over the last four and half years has been severe. Specifically, and according to Empirical Research, the 75 fastest growing US stocks corrected more than 69% vs. the market from their early 2021 peak through their trough in early 2023, erasing all 2019 and 2020 relative gains; in fact, by early 2023 all relative gains since 2017 had been erased! This was remarkable.

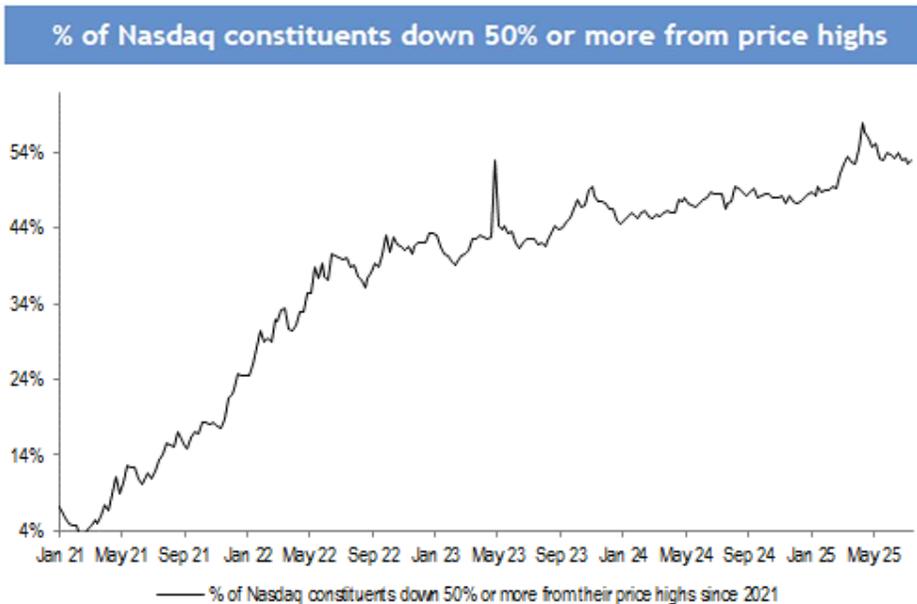
But even with the market's appreciation from 2023 to now, the correction in high growth stocks still stands at more than 39% from the early 2021 highs.



**Exhibit 3.** *The Big Growers Relative Growth of a Dollar (Equally Weighted), July 2025, source Empirical Research.<sup>3</sup>*

This severe correction in high-growth stocks – since their early 2021 peak and in recent months– continues to present potential *significant opportunities to buy high quality, classic growth compounders at attractive relative multiples*, in our view.

Additionally, we currently believe there still exist broad groups in which stocks have not yet recovered, where attractive risk/reward opportunities are persisting. For example, more than half of Nasdaq stocks are still down 50% or more from their 2021 highs.



**Exhibit 4.** *Percentage of Nasdaq Constituents Down More Than 50% Since 2021 Price Highs, July 2025, source JP Morgan.*

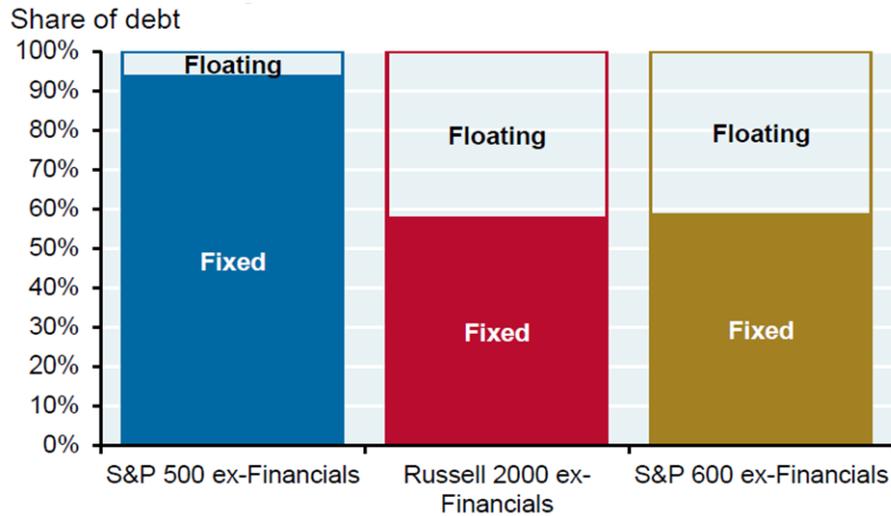
Moreover, many high growth segments of the market have actually continued to de-rate. For example, both Fintech and non-profitable Tech are still currently trading at Price/Sales relative multiples below their historical medians, with non-profitable Tech trading close to all-time lows.



**Exhibit 5.** *Global Fintech & Non-Profitable Tech Price/Sales, July 2025, source JP Morgan.*

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This would change of course if long-term rates were to go down, a key objective of the new administration in the US. Lower rates would also help the relative profitability of small cap stocks, which, excluding financials, have been carrying a larger amount of floating rate debt vs. large cap stocks.



**Exhibit 6. Fixed vs Floating Rate Debt, July 2024, source JP Morgan.**

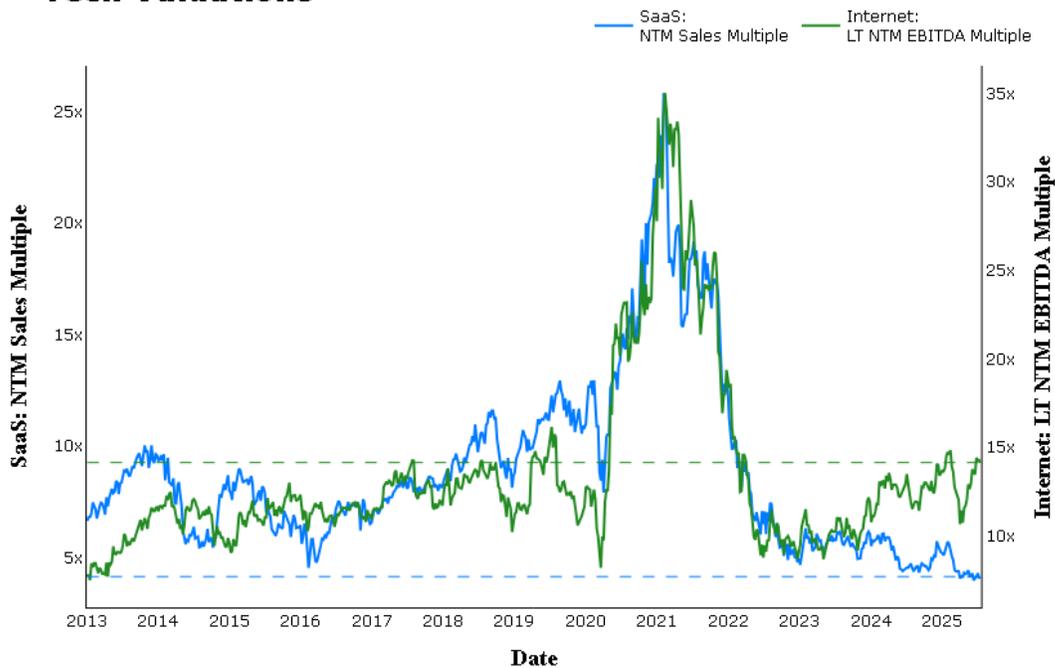
The challenge, however, small caps may face is the tug of war between falling rates and a structurally challenged economy. Historically, small capitalization equities tend to perform better early in the economic cycle (for example coming out of a recession), not late in the cycle. Small caps also tend to include lower quality names, with much lower free cash flow margins, significantly higher debt to cash flow ratios and a much larger percentage of unprofitable companies in aggregate, relative to large caps.

	Operating Margin T12	Net Debt/EBITDA	Earnings Growth Q2	% Constituents Reported a Loss		
				Current	Decade ago	Start of Millenium
Russell 2000	4.1%	4.5	2.9%	42.2%	31%	22%
S&P 500	14.5%	1.5	13.2%	5.0%	4%	6%

**Exhibit 7. Russell 2000 Index vs S&P 500 Index, July 2025, source Alkeon, Bloomberg, and FactSet.**

To offer a last example of how the correction in high growth stocks since 2021 has a long way to change course, both SaaS companies and fast-growth Internet companies are currently trading at multiples significantly below their 2021 peaks.

## Tech Valuations



**Exhibit 8. SaaS and High Growth Internet Valuations, July 2025,**  
source FactSet and Alkeon.<sup>4</sup>

Emphatically, we also believe these opportunities are select. As we will elaborate below, given high market valuations and the widening gap between winners and losers (due in part to the impact of AI), we believe stock picking and the ability to short stocks and use market hedges to mitigate risk have become increasingly important in the current market – which we characterize as unattractive in the aggregate. Such active efforts to short stocks and hedge the portfolio have become imperative, in our view, *given the increased potential for tail risk events and elevated macroeconomic and geopolitical uncertainty.*

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*The Broad Equity Market is Expensive and Unattractive*

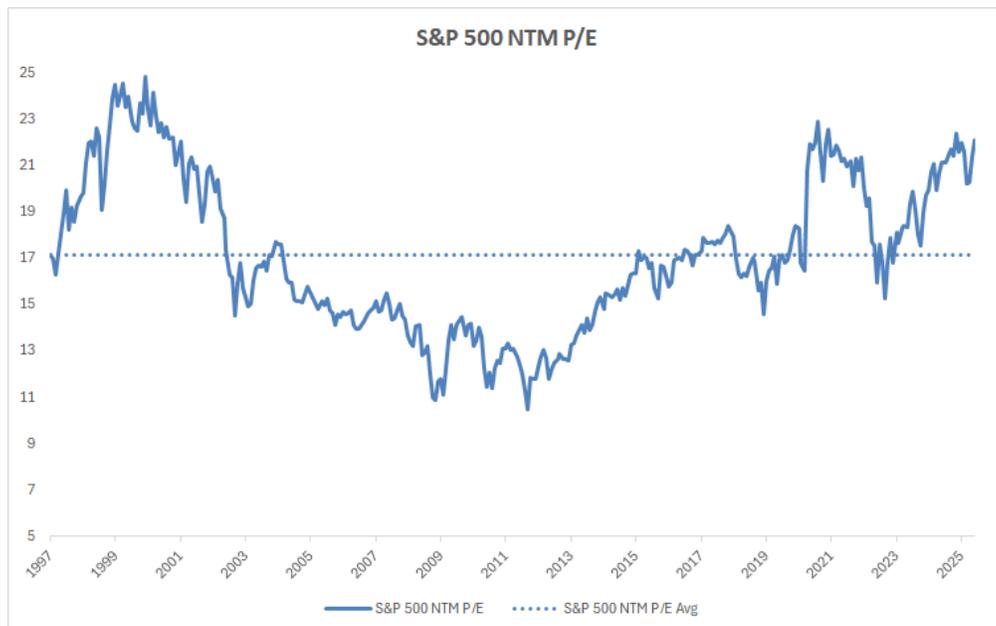
We are concerned about the level of valuations in the equity market, especially in the US. Last year the S&P 500 produced a total return almost three times its underlying earnings growth. On the other hand, 10-Year Treasury yields rose by 70bps in 2024.<sup>5</sup> Such divergence was very alarming.

As rates have stayed flat this year, the US market has remained expensive, with a forward P/E ratio that stands 39% above its historical median.

12m Fwd. P/E across key geographies			
	Current	20Y Median	Current vs Median
Spain	11.5	11.5	0%
Italy	11.7	11.4	3%
China	11.5	11.1	3%
UK	12.5	12.1	3%
Japan	14.8	14.2	5%
Switzerland	17.4	16.1	8%
World ex US	15.1	13.7	10%
France	14.4	13.0	11%
EM	12.9	11.6	11%
Eurozone	14.5	12.8	13%
Germany	15.0	12.4	21%
World	19.8	15.0	32%
US	22.6	16.2	39%

**Exhibit 9.** 12-Month Forward P/E, July 2025, source JP Morgan.

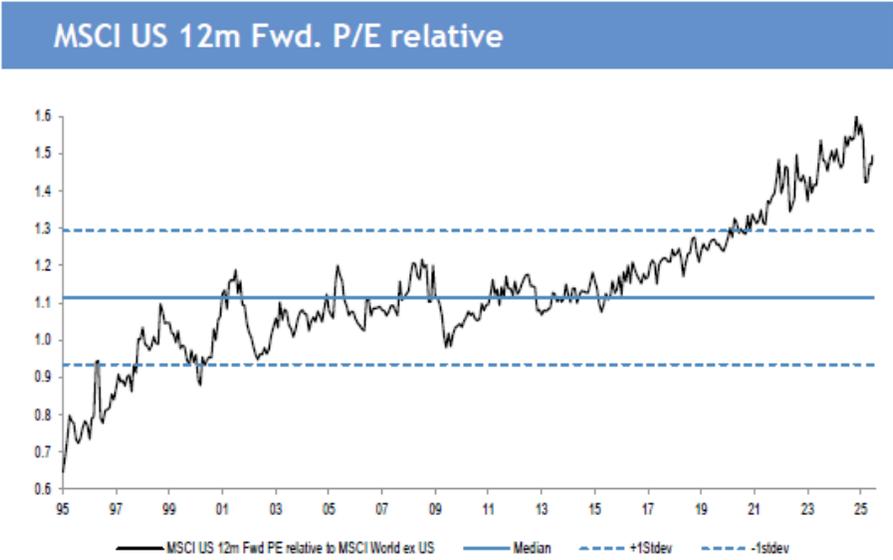
The only times the forward P/E on the S&P 500 was higher in recent decades was in early 2021 (post-Covid rally) and the Internet bubble in the late 90's.



**Exhibit 10.** S&P 500 Index NTM P/E, June 2025, source Morgan Stanley.

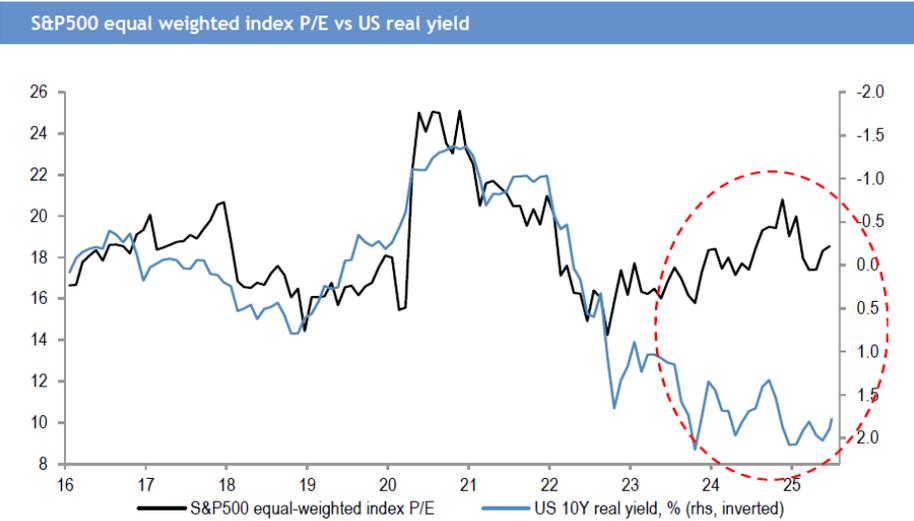
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Not only is the US market unattractive on a standalone, absolute basis, but it also remains expensive against the rest of the world on a relative basis.



**Exhibit 11.** MSCI US 12M Forward P/E Relative to World ex US, July 2025, source JP Morgan.

Moreover, even the S&P 500 equally weighted P/E, which normalizes outliers, and removes concentration, shows the US market remains extended vs. real yields.

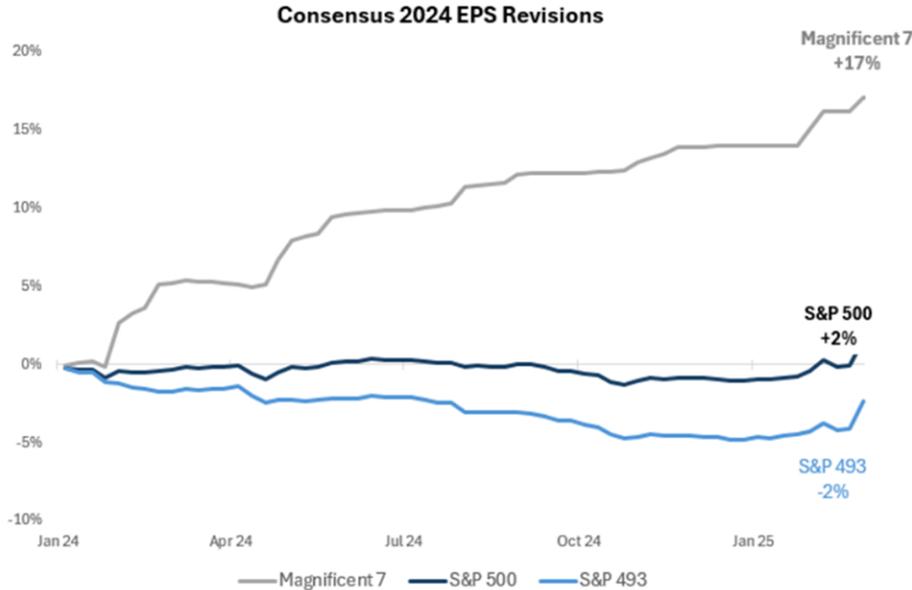


**Exhibit 12.** S&P 500 Equal Weighted Index P/E vs. 10-Year Treasury Yield, July 2025, source JP Morgan.

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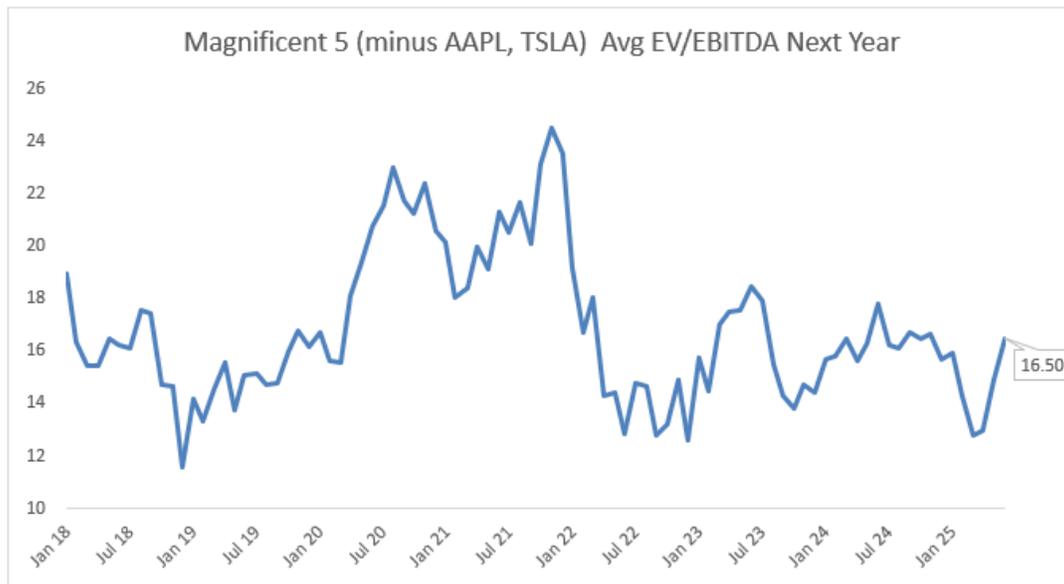
Notably, not only do broad equity market valuations remain very high, but also earnings growth and earnings revisions have been underwhelming.

In fact, earnings revisions for the S&P 500 excluding the “Magnificent Seven”<sup>6</sup> (the “S&P 493”) have been negative.



**Exhibit 13.** Negative Revisions for the S&P 493 and the Aggregate S&P 500 Index vs. the Magnificent Seven, February 2025, source Factset, Alkeon.

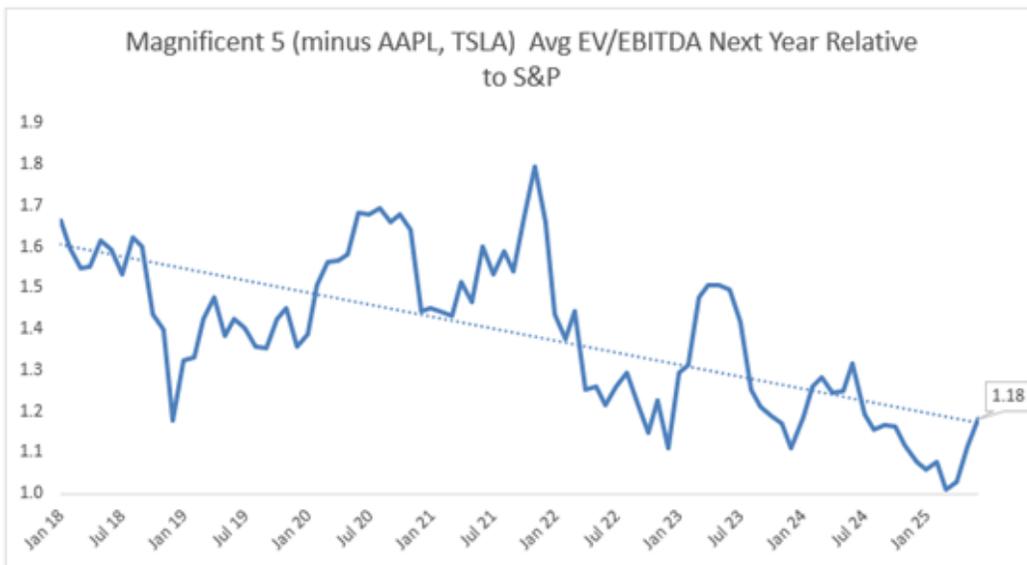
This of course begs the question, are the Magnificent Seven overvalued? While we currently believe broad equity market valuations remain extended, for the five of the seven stocks in the Magnificent Seven which actually grew earnings both in 2023 and 2024, absolute cash flow valuations do remain at one of the lowest levels in recent years.



**Exhibit 14.** Magnificent 5 (ex AAPL, TSLA) Average Forward Year EV/EBITDA, June 2025, source Alkeon and Bloomberg.

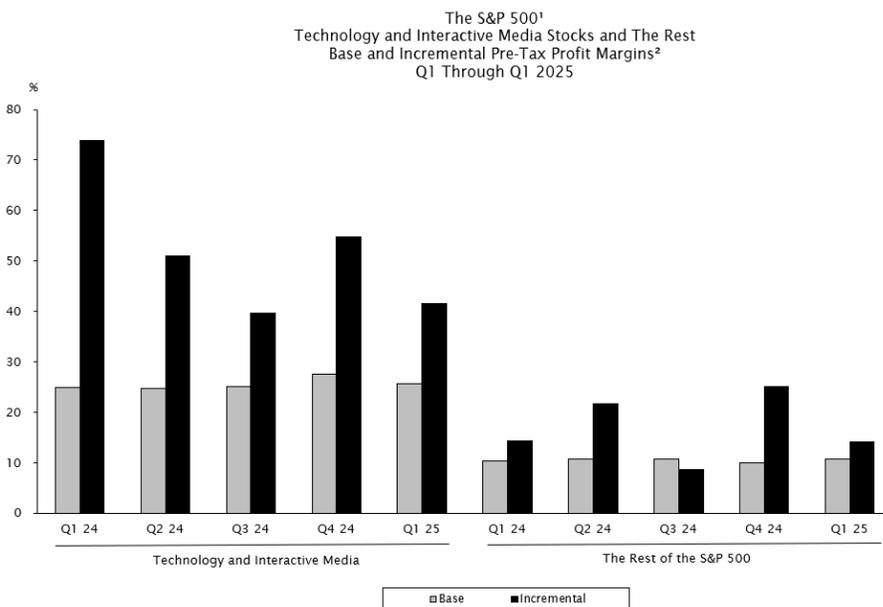
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Impressively, against the S&P 500, relative cash flow valuations for the same group of five stocks have actually sharply come down over the last seven years!



**Exhibit 15.** Magnificent 5 (ex AAPL, TSLA) Average Forward Year EV/EBITDA Relative to S&P 500 Index, June 2025, source Alkeon and Bloomberg.

This is not surprising, given the significant cost-cutting and price optimization initiatives commenced by a number of these and other companies in recent years, some of which had never optimized for margins, e.g., companies like Meta and Spotify, which had never done so since IPO-ing. These recent profit optimization efforts created exceptional operating leverage, with industries such as technology and interactive media remarkably producing incremental strong pre-tax profit margins on new sales that far exceed the rest of the market.

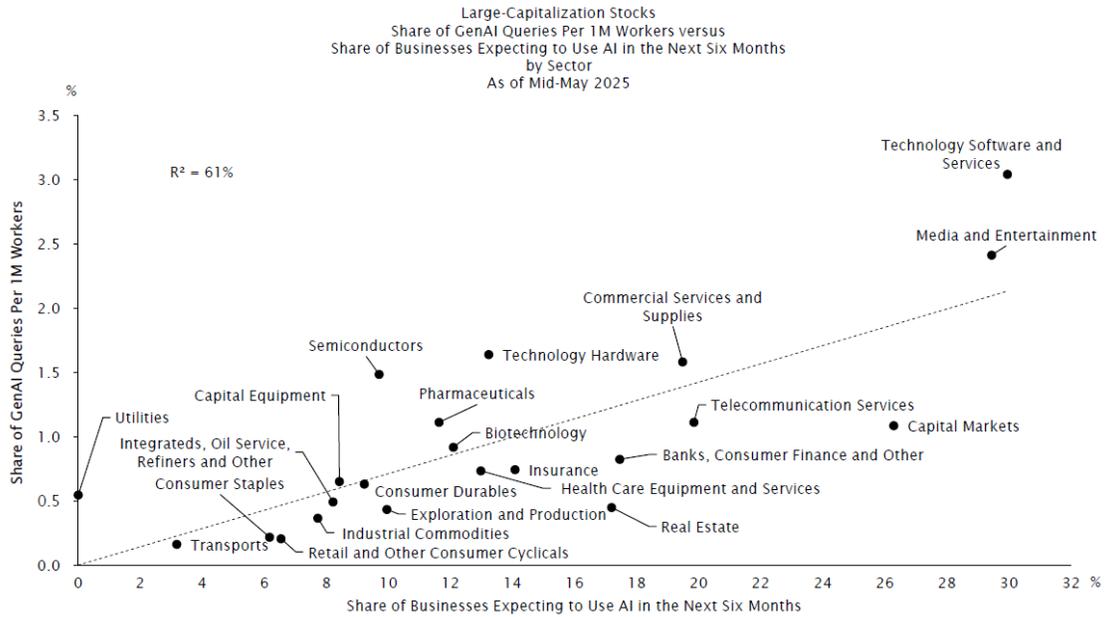


<sup>1</sup>Excludes financials and REITs.  
<sup>2</sup>Incremental margins are those earned on a dollar of new sales.

**Exhibit 16.** Technology and Interactive Media Incremental Pre-Tax Margins, July 2025, source Empirical Research.

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We expect this trend to continue as Technology, Media and Communications are among the biggest adopters of AI, which should lead to increased productivity efficiencies and therefore expanding margins.



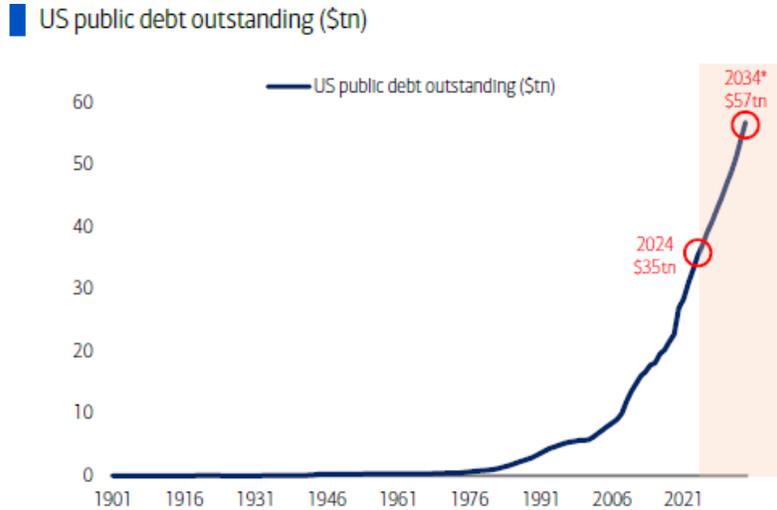
**Exhibit 17.** *Share of GenAI Queries and Businesses Expecting to Use AI by Sector, May 2025, source OpenAI and Empirical Research.*

In summary, we strongly reiterate the need to be highly selective in the current market. In fact, and given the elevated levels of macroeconomic uncertainty, *we do believe it is more imperative than ever before to balance our high conviction long investments in quality secular growth companies with alpha-seeking short investments as well as structured market hedges,* and to also stay globally diversified, as we seek to reduce concentration in any single country, currency or regional economy.

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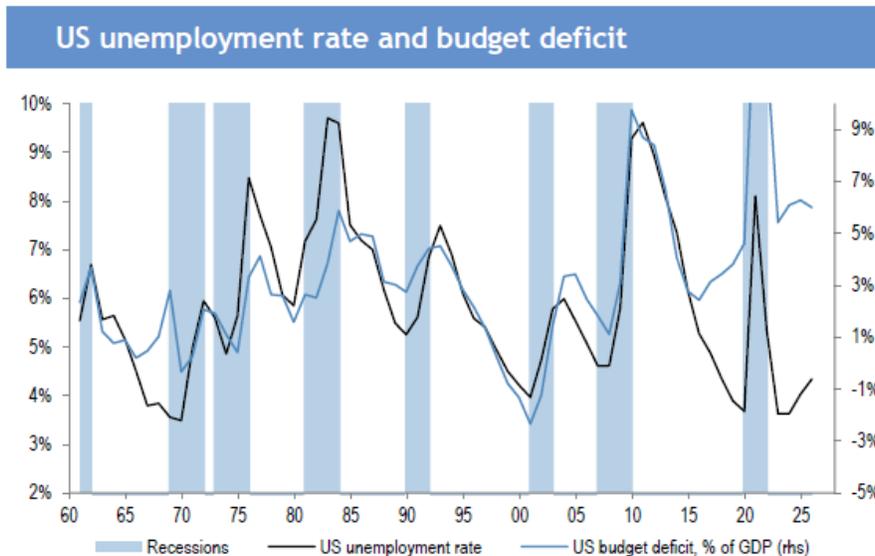
*US Economy is Structurally Challenged*

Structurally the economy in the US remains especially vulnerable, as the three D's, Debt, Demographics and technological Disruption remain in full force and are highly disinflationary. Additionally, and of particular concern, the spike in US government debt over the last two decades has increased bearish risk scenarios for asset prices and systemic instability, such as default, currency debasement and inflation. Against this backdrop, we believe a long/short strategy balanced with hedges that seek to mitigate macroeconomic uncertainty and tail risks can offer a suitable fit to equity investors in the current high-risk environment.



**Exhibit 18.** *US Public Debt Outstanding & CBO projections, November 2024, source BofA Global Research.*

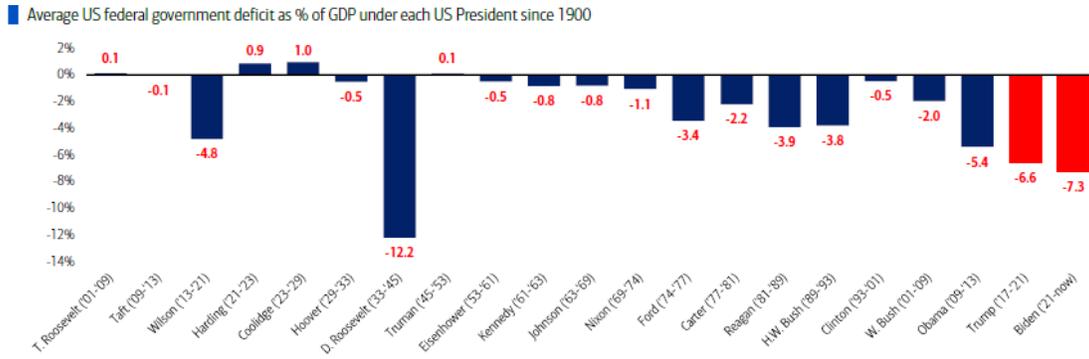
The huge surge in government debt is particularly worrisome, as historically the correlation between US unemployment and the budget deficit has been quite high.



**Exhibit 19.** *US Unemployment Rate and Budget Deficit, July 2025, source JP Morgan.*

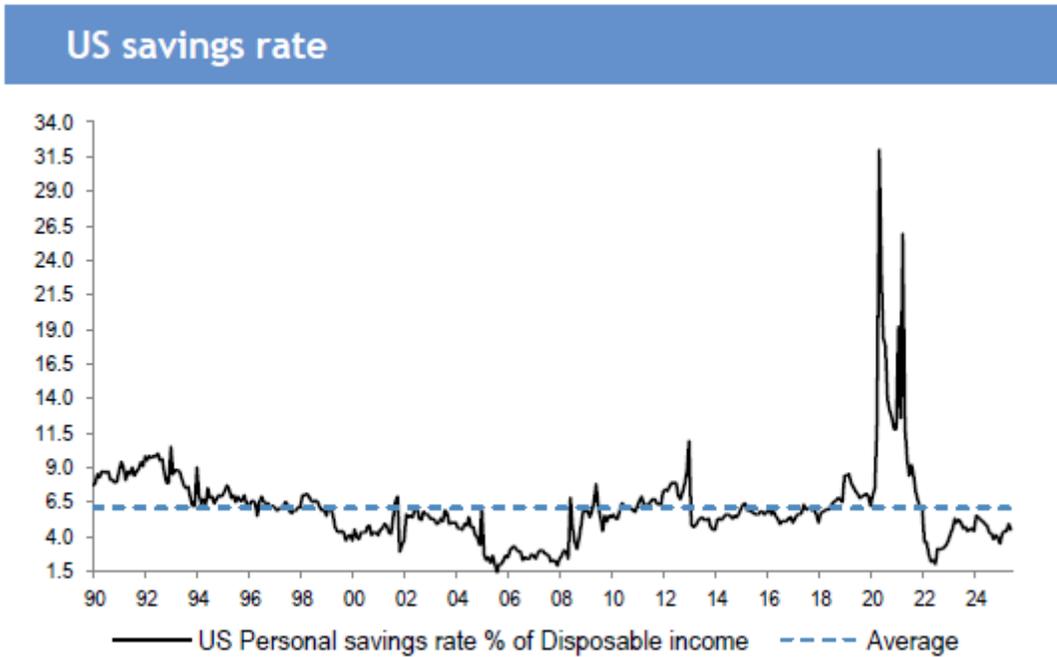
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To make things worse, the US is running the largest deficit since the Second World War.



**Exhibit 20.** Average US Federal Government Deficit as a Percentage of GDP under Each President since 1900, source BofA Global Research.

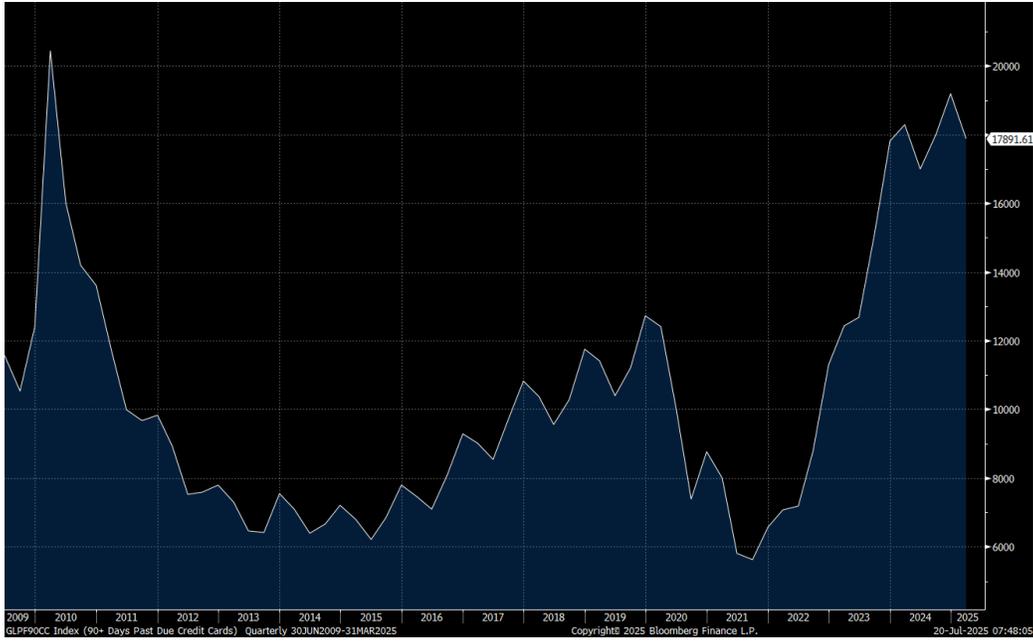
On the consumer side, the recent economic turmoil (since Covid) has made the retirement crisis even worse. Half of private-sector employees do not even have an employer-sponsored retirement plan,<sup>7</sup> and recently the US savings rate collapsed to the lowest level since the Global Financial Crisis.



**Exhibit 21.** US Personal Savings Rate, July 2025, source JP Morgan.

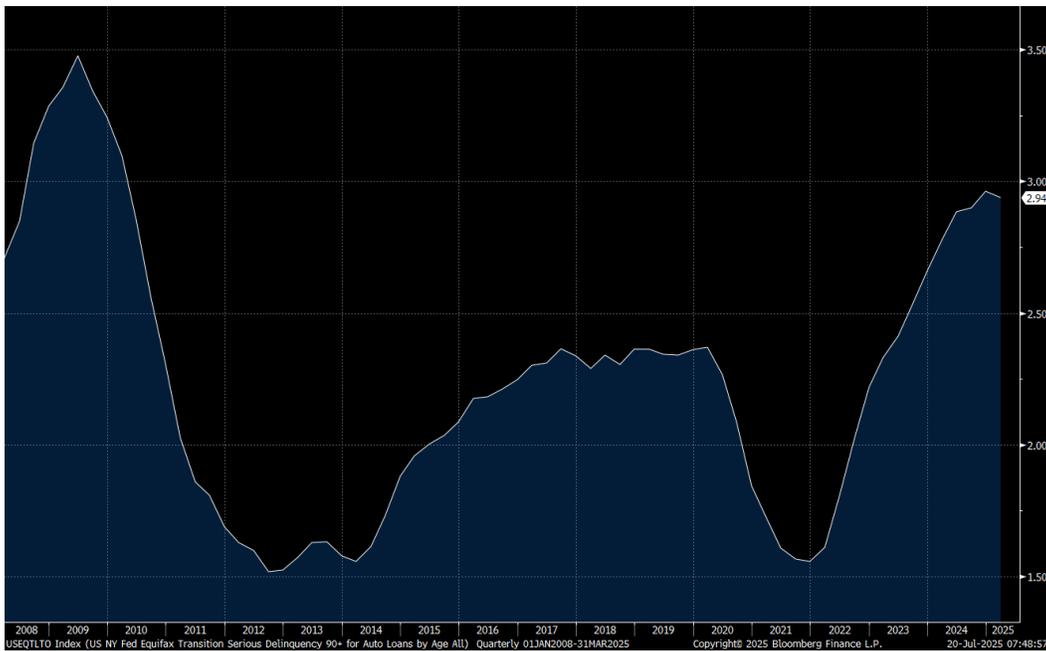
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In fact, the picture for consumers is deteriorating, especially as credit delinquencies are at the highest levels since the global financial crisis.



**Exhibit 22. 90+ Days Past Due Credit Card Level – Highest since the Global Financial Crisis, source Bloomberg.**

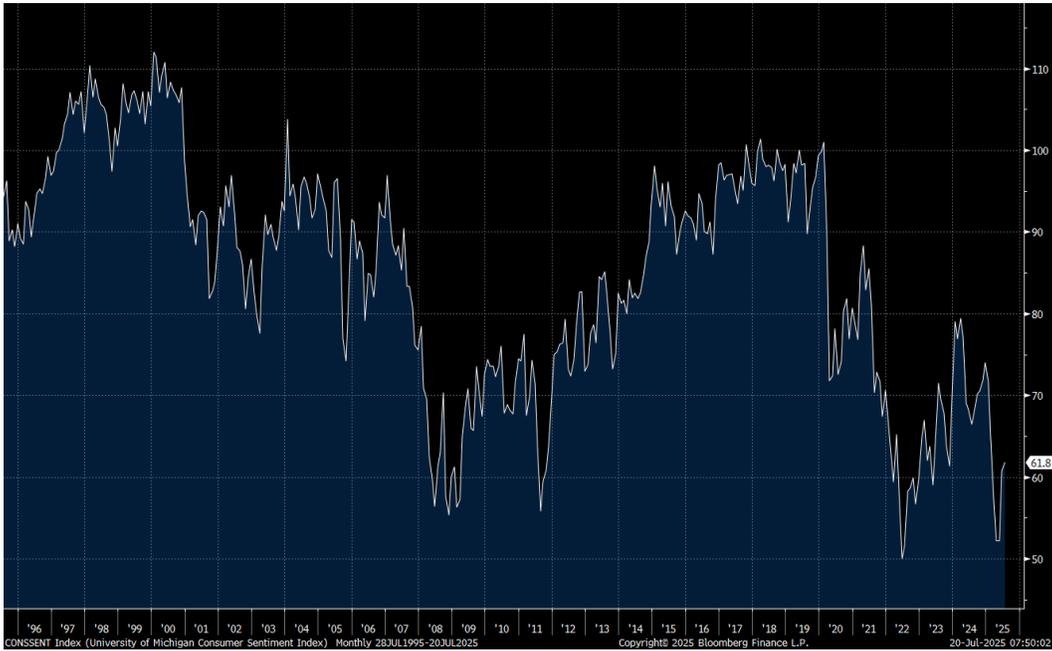
Similarly, auto loan delinquencies also have risen to the highest level since the global financial crisis.



**Exhibit 23. 90+ Days Past Due Auto Loans – Highest since the Global Financial Crisis, source Bloomberg.**

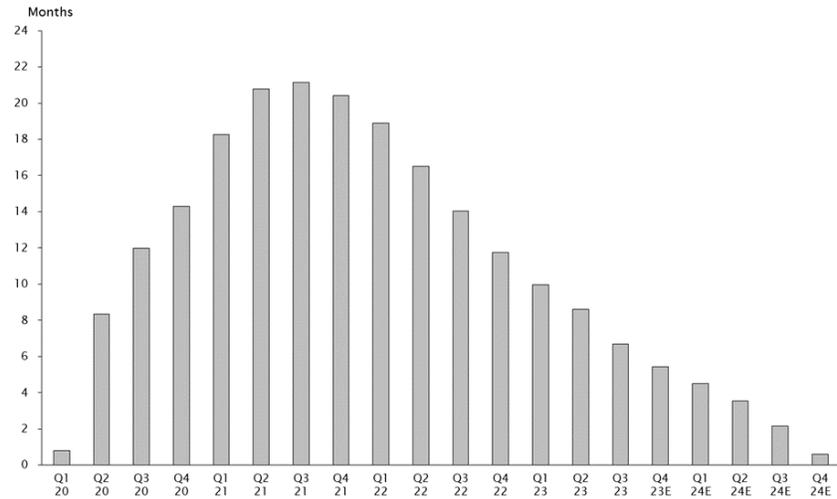
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And consumer confidence has dropped to the lowest level since the pandemic.



**Exhibit 24.** University of Michigan Consumer Sentiment Index, source Bloomberg.

This is unlikely to change in a meaningful manner soon, as excess savings have been depleted and have been trending downward recently.

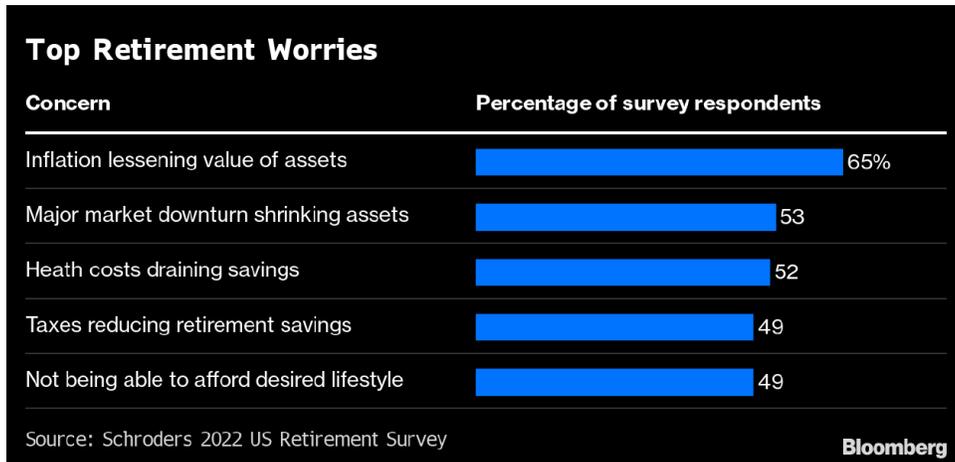


Barbiero, O. and Dhiren Patki, 2023. "Have US Households Depleted All the Excess Savings They Accumulated during the Pandemic?" Federal Reserve Bank of Boston Current Policy Perspectives, de Soyres, F., Moore, D. and Julio Ortiz, 2023. "An Update on Excess Savings in Selected Advanced Economies," FEDS Notes, U.S. Department of Commerce, Empirical Research Partners Analysis and Estimates.

**Exhibit 25.** US Consumers Cumulative "Excess" Savings Measured in Months of Typical Savings, April 2025, source Empirical Research.

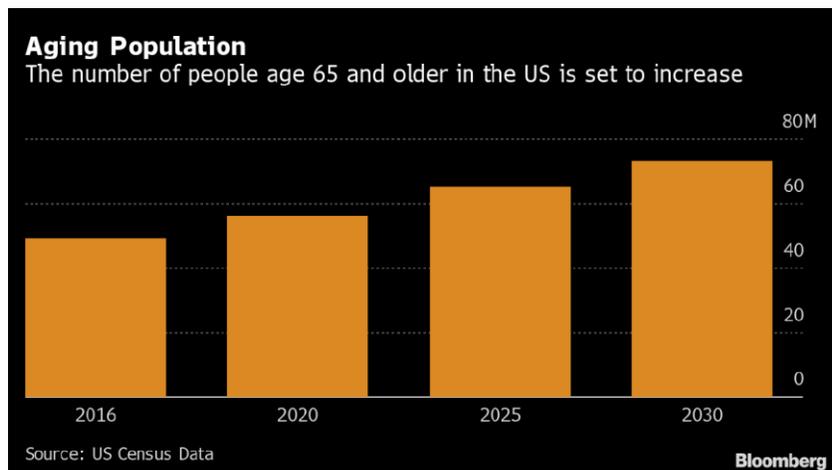
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There is already a multi-trillion-dollar retirement savings shortfall in US households, and it is likely to get worse.



**Exhibit 26.** *Top Retirement Worries, source Bloomberg.*

With respect to Demographics, as baby boomers retire, the number of people aged 65 or above in the US is projected to increase to 21% of the population (73 million), up from 15% in 2016 (49 million). This is both disinflationary and GDP-contracting, as people need to save more and spend less.



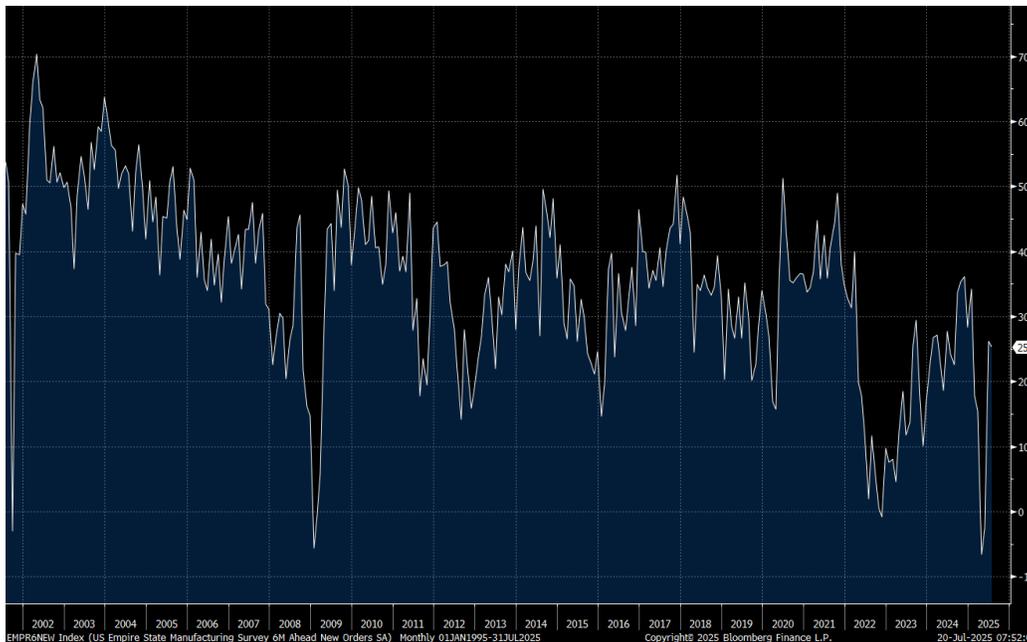
**Exhibit 27.** *Number of People 65 or Older, source Bloomberg.*

Lastly, on the industrial front, manufacturing activity has also weakened.



**Exhibit 28.** ISM Manufacturing, New Orders to Inventories, June 2025, source Bloomberg and Alkeon.

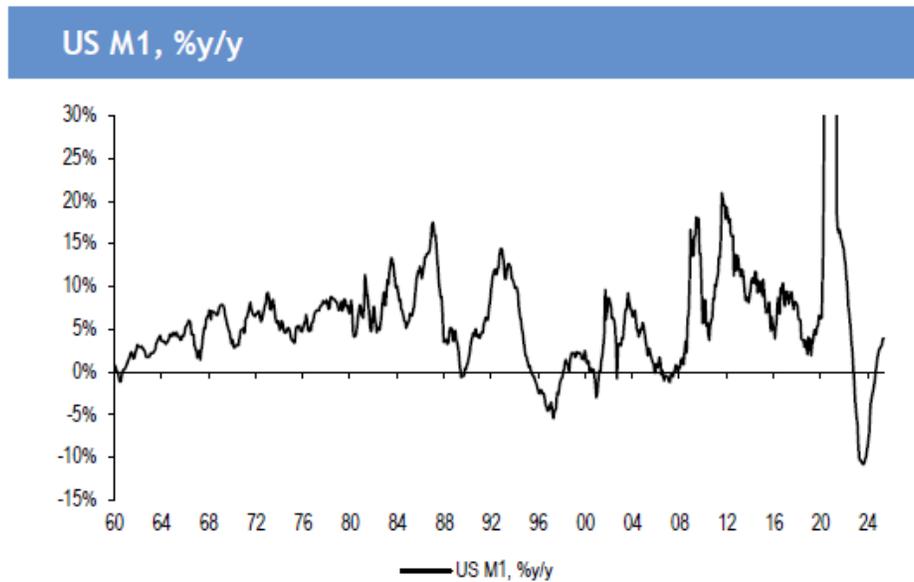
In fact, new orders from the NY Fed Manufacturing survey hit an all-time low.



**Exhibit 29.** US Empire State Manufacturing Survey, source Bloomberg.

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On the other hand, and encouragingly, money supply, a leading indicator of manufacturing PMIs, is bottoming.



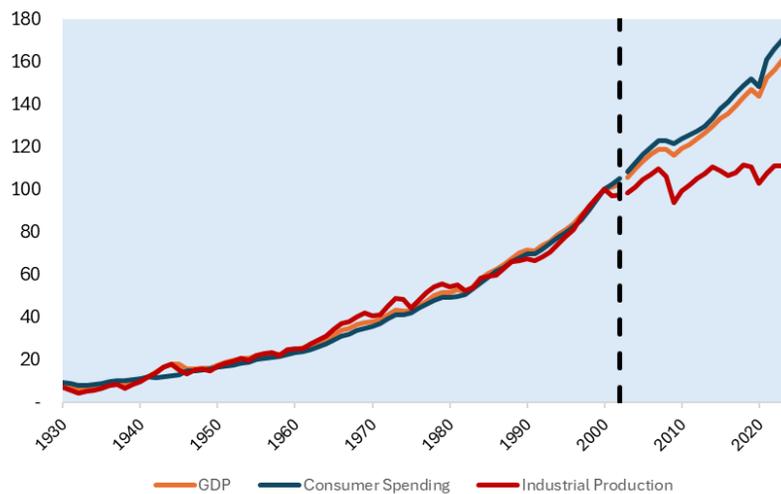
**Exhibit 30.** US M1, % Year over Year, July 2025, source JP Morgan.

### Recent Macroeconomic Uncertainty

One of the main goals of the current administration is to re-industrialize the US economy, as US industrial production has stagnated since non-US superpowers entered the WTO.

### The Silence of the Plants

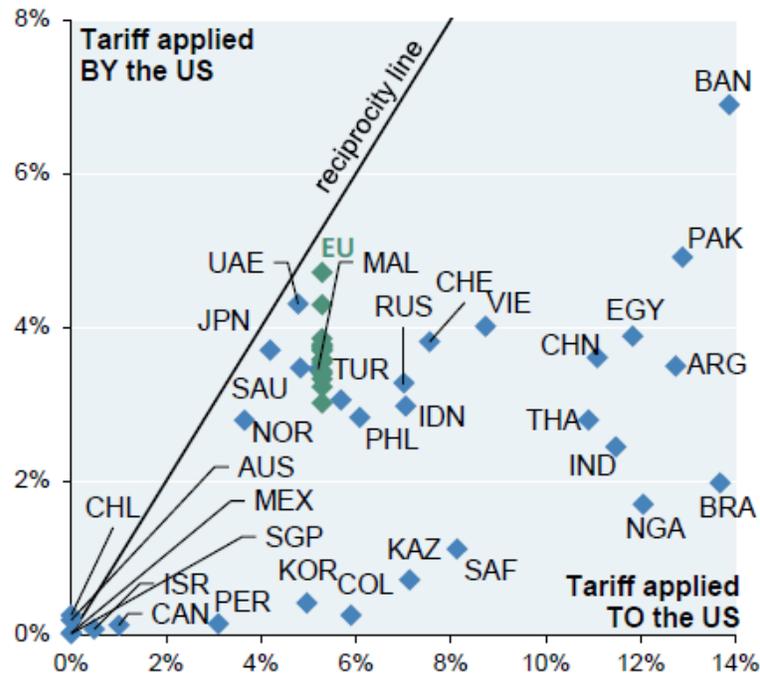
Index (100 = 2000)



**Exhibit 31.** Silence of the Plants, source Alkeon Capital and JP Morgan.

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Along the way, the US allowed almost all other countries to impose higher tariffs than those imposed by the US.



Source: WTO, World Bank, JPMAM. 2015, or most recent available. Tariff is simple average of tariffs on traded goods.

**Exhibit 32. A General Lack of Tariff Reciprocity, source JP Morgan.**

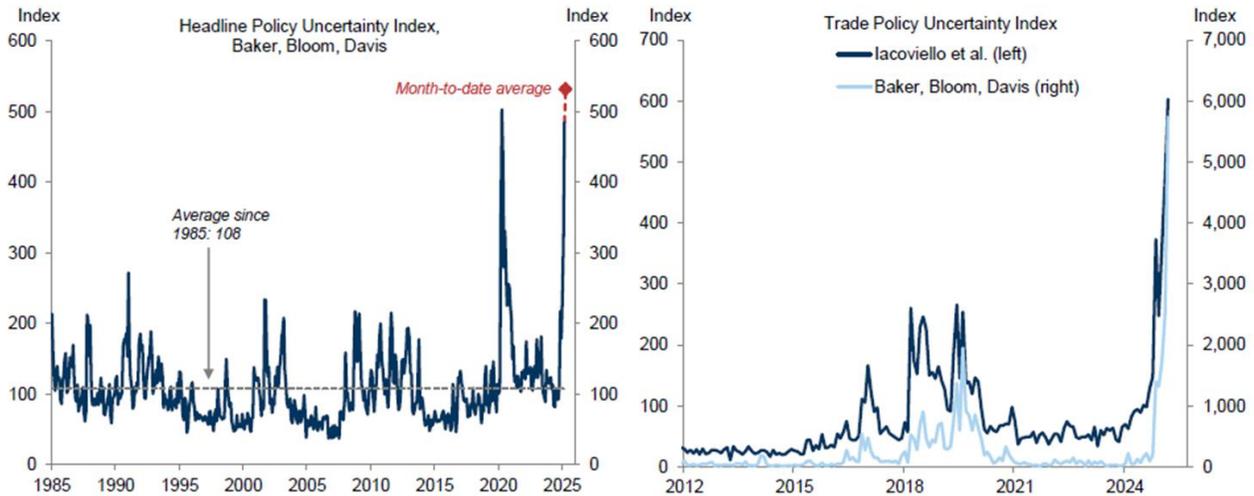
All this prompted the current administration to take unusual action, the magnitude and breadth of which surprised the markets, leading to a significant drop in equities over a two-day window, following the “announcement”.



**Exhibit 33. S&P 500 Drops 10.5% in Two Days Following Tariff Announcement, source Bloomberg.**

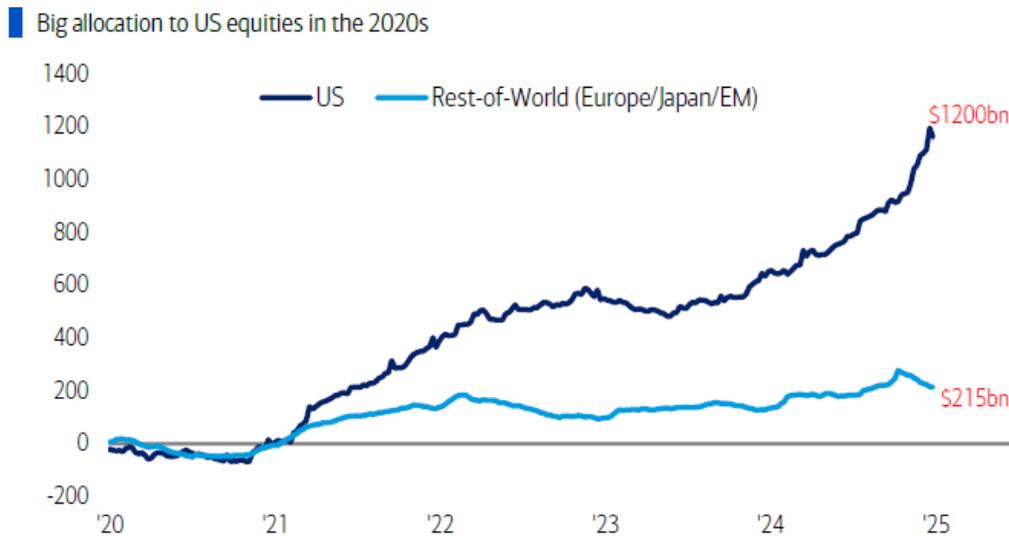
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As a result, both economic and trade policy uncertainty spiked to all-time highs.



**Exhibit 34.** Measures of Overall Economic Policy Uncertainty and Trade Policy Uncertainty, April 2025, source Goldman Sachs.

Broadly speaking, increased uncertainty creates lower levels of activity, which may slow down GDP growth. Given market expectations for inflationary pressures due to tariffs, the risk is the potential for significant economic slowdown and inflation (i.e., stagflation). In such a hypothetical stagflationary environment, real yields, and therefore, the dollar, could come under severe pressure, which could in turn reduce demand for US assets and ultimately undermine the US dollar reserve status.



**Exhibit 35.** Inflows to Equity Funds, US vs. Rest-of-the World, source BofA Global Research.

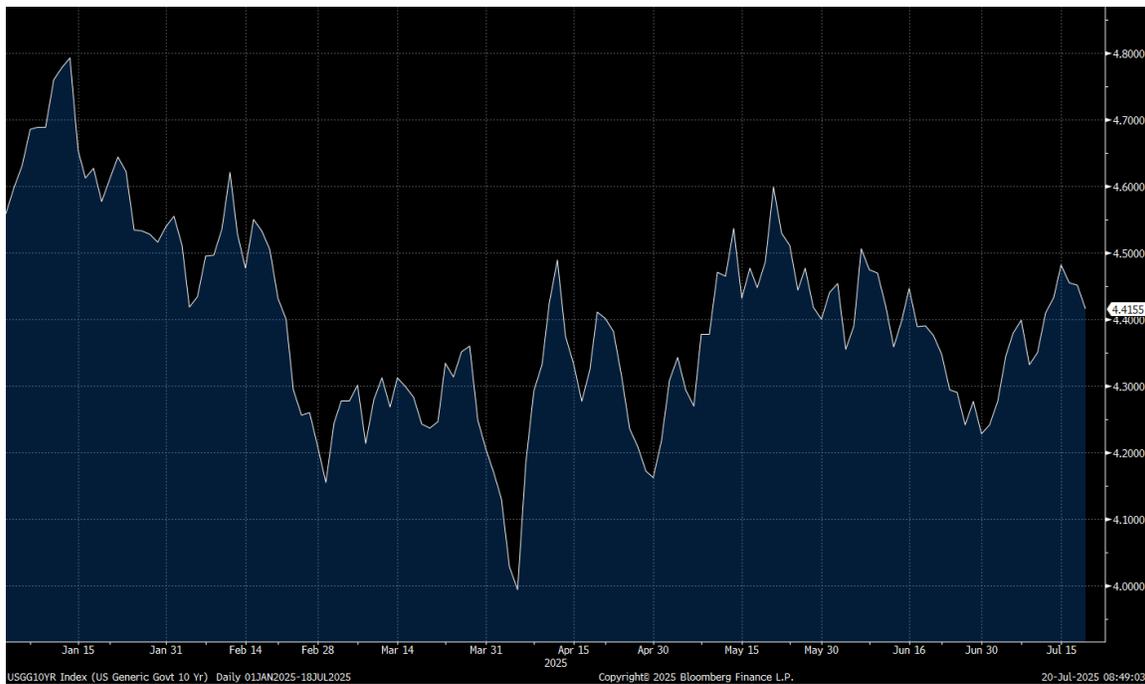
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In fact, it is rare and highly unusual that during a period of equity and credit market stress, both bonds and the dollar would fall sharply (see Exhibits 36 and 37), commonly considered assets of “safety” that typically rise when stress is high.



**Exhibit 36.** Dollar Index Spot, source Bloomberg.

We do not believe the US wants Treasuries to lose their status as a risk-free asset, a key benchmark off which every other financial asset gets priced. This would lead to lower demand for Treasuries and therefore higher yields, which is contrary to one of the main, if not the predominant, goal of the new administration.



**Exhibit 37.** US Treasury Notes/Bonds, source Bloomberg.

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Already, holdings of Treasuries have been falling by nations the administration considers trade or geopolitical adversaries.

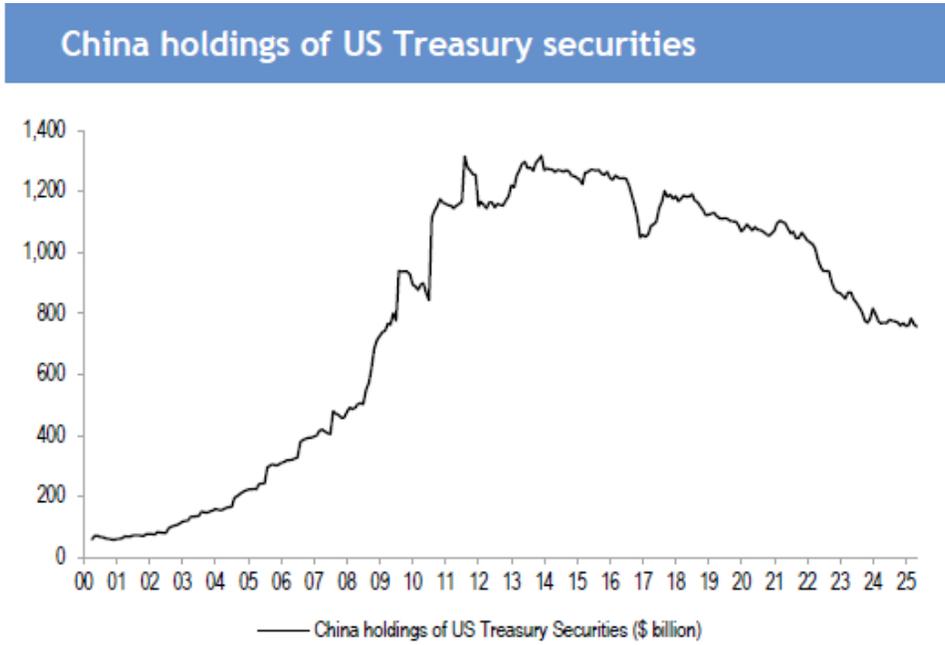


Exhibit 38. China Holdings of US Treasuries, July 2025, source JP Morgan.

The risk of a reduction in US asset allocations is not small, given a picture of “peak exceptionalism” for the US.

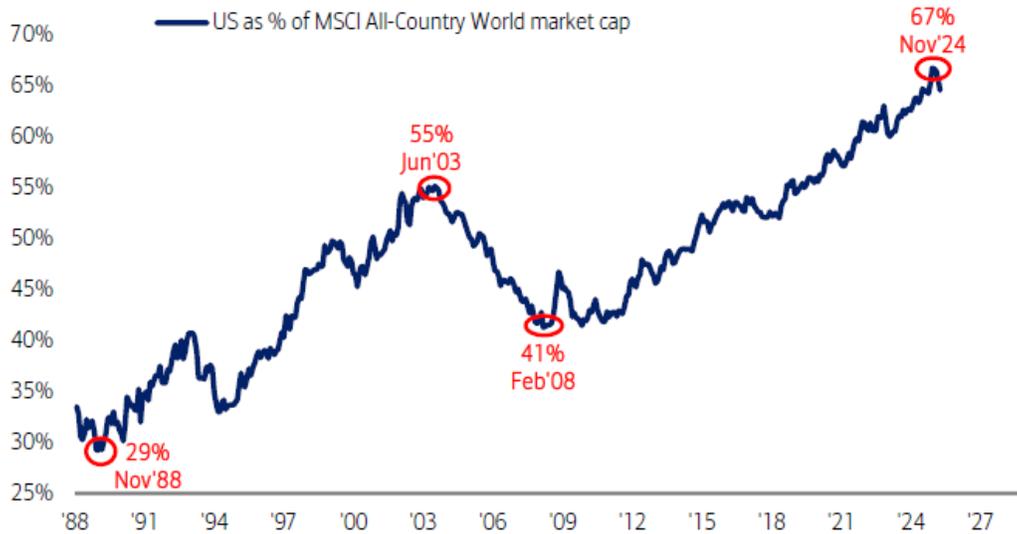


Exhibit 39. US equities as % of MSCI ACWI Index Market Cap, April 2025, source BofA Global Research.

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*Offsets to Macroeconomic Challenges*

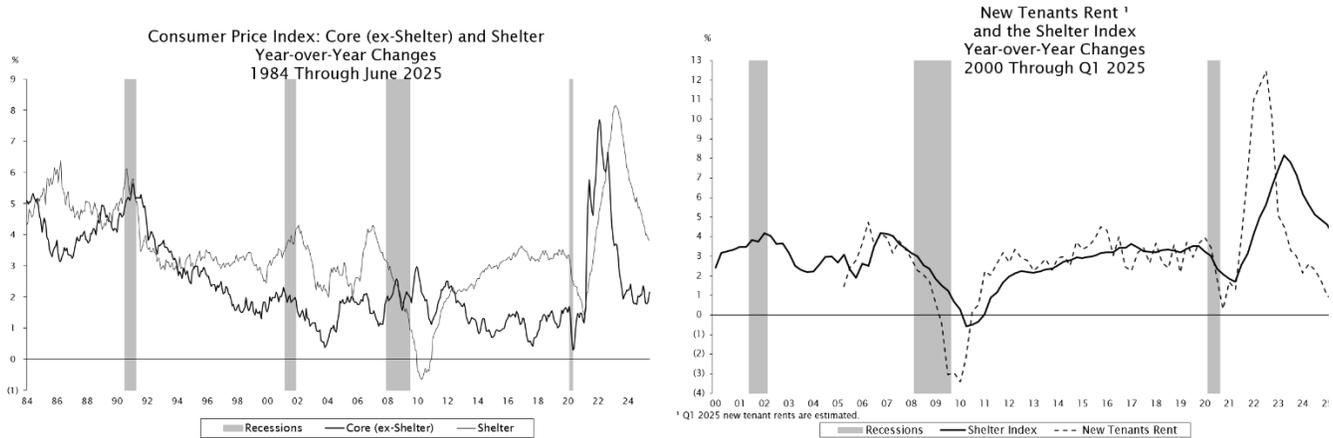
And while the US faces macroeconomic challenges, there are positive offsets worth highlighting.

First, there is optimism that a large number of trade deals – and potentially a war deal could be completed this year. This is reinforced by the reflective forces of trade stress on some foreign nations.



**Exhibit 40.** *Canada Small Business Confidence Index, source BofA Global Research.*

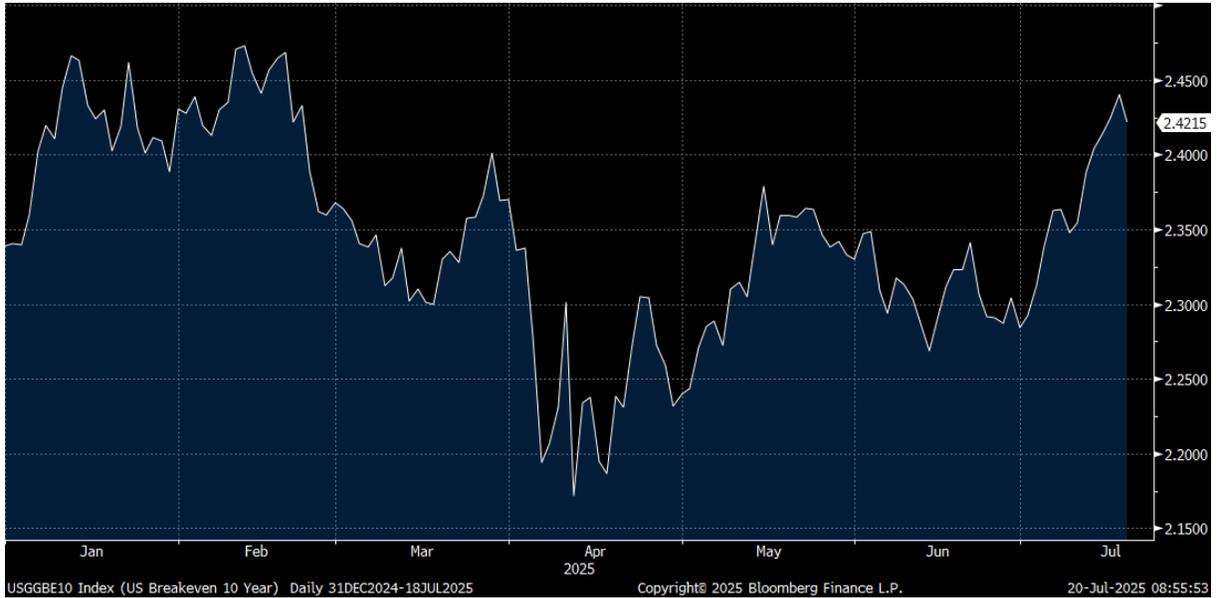
Second, key components of the Consumer Price Index (CPI) are exhibiting disinflationary trends. This may offset some of the potential inflationary pressure due to tariffs. In particular, shelter (i.e., housing cost), which is the largest component of the CPI, is based on surveys and generally lags the real world by nine to twelve months. As one can see below, not only has core inflation (ex-shelter) been coming down sharply, rents in the real world have also been seeing substantial disinflation.



**Exhibit 41.** *Shelter Component of Inflation and New Tenants Rents, source Empirical Research.*

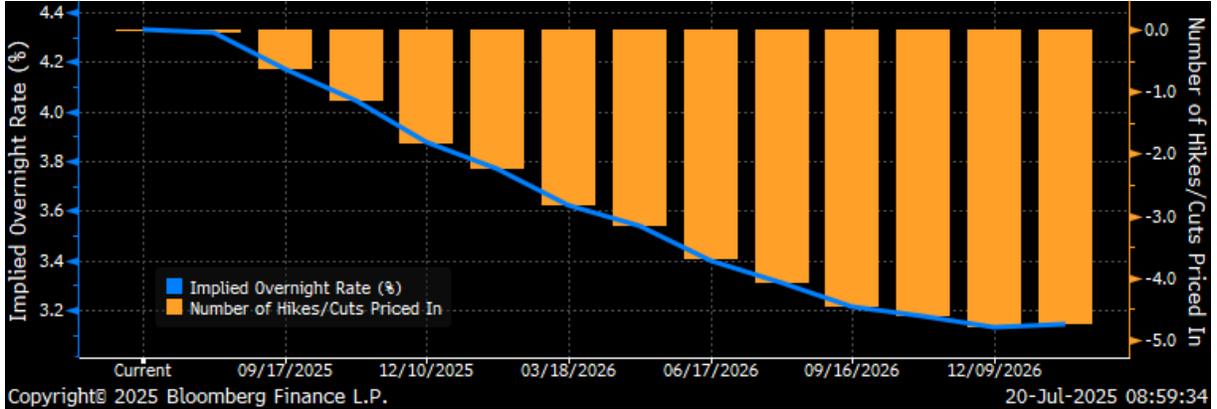
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In fact, the 10-Year breakeven, one of market's most robust estimates of future inflation (embedded in the 10-Year Treasury Inflation Protected Note), fell in 2022, ending at just 2.30%, remained around that low level (relative to nominal yields) throughout 2023 and 2024, and is only slightly higher in 2025.



**Exhibit 42.** YTD 10-Year Treasury Breakeven, source Bloomberg.

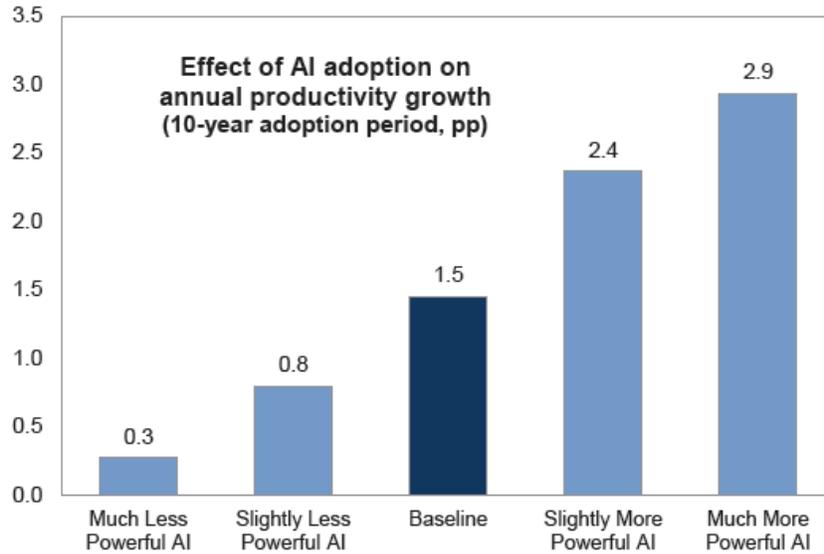
Third, the Fed may act to alleviate any emerging severe pressure on economic activity. Overall, Fed Funds Futures are indicating that we may be entering a yield-peaking phase. This could eventually create a strong environment for growth equities over the coming year, in our opinion.



**Exhibit 43.** Market Expectation of Fed Funds Rate Cycle, July 2025, source Bloomberg.

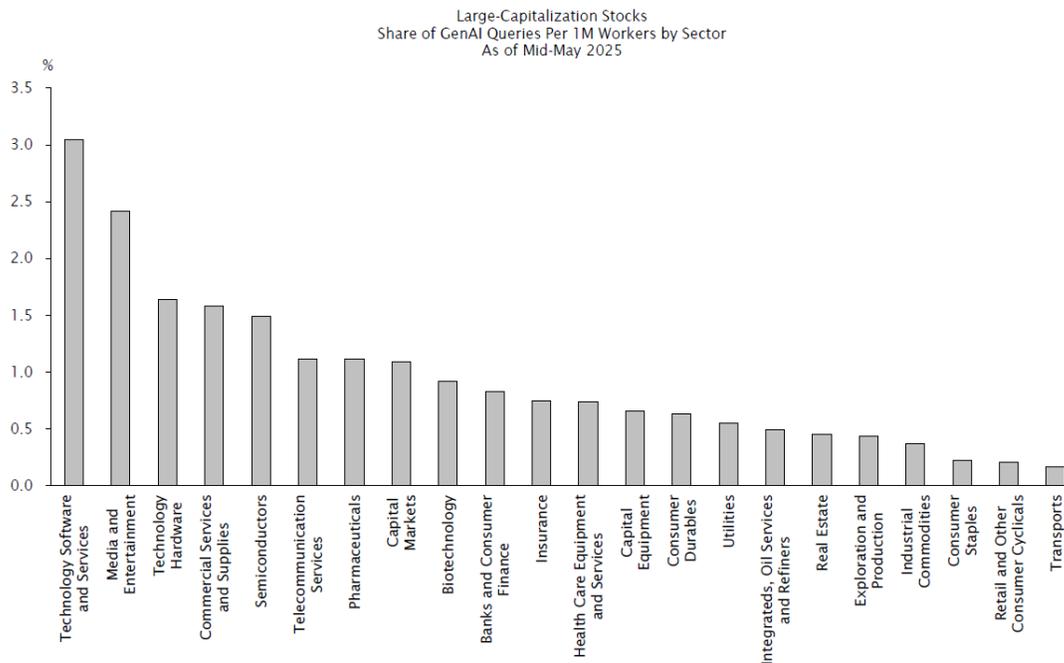
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The fourth positive offset is of course AI, and specifically its effect on productivity. As we will detail later on in this letter, increases in productivity have accounted for the majority of GDP growth in recent decades, and it is estimated that AI is likely to create a productivity boost we have only seen a few times in the past one hundred years, potentially adding a gain of 1.5% in output per year, as a base case.



**Exhibit 44.** *Estimated Effect of AI Adoption on Productivity Growth, June 2023, source Goldman Sachs.*

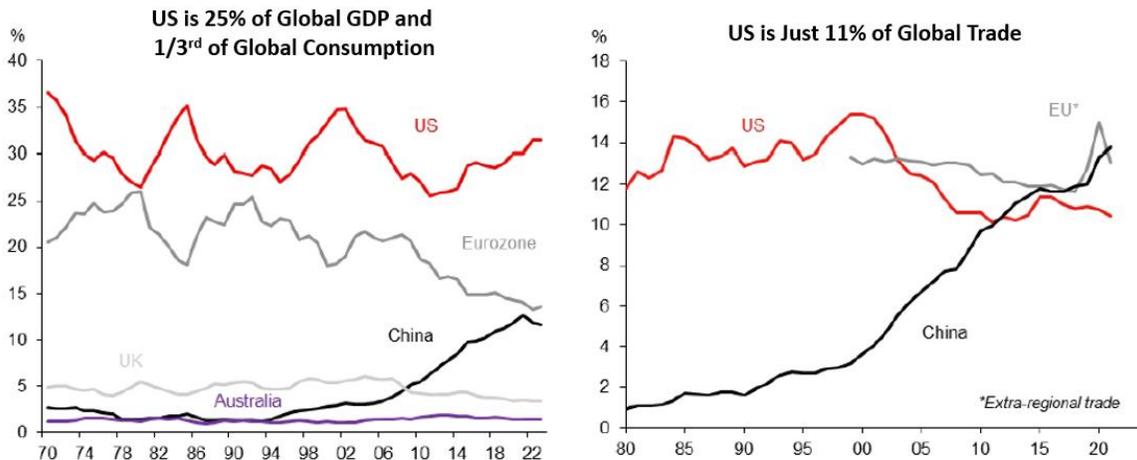
Among the biggest potential winners, are Technology, Media and Communications, which remain among the biggest adopters of AI.



**Exhibit 45.** *Share of GenAI Queries Per 1M Workers by Sector, May 2025, source Empirical Research.*

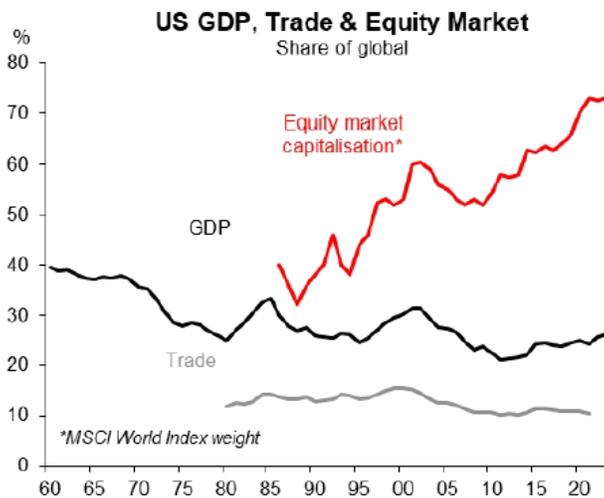
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Which brings us to the fifth positive offset. Despite the macroeconomic uncertainty and tail risks that do remain elevated, there are still opportunities to make money through stock picking, long and short, in our current view. Stepping back for a moment, even though the US is almost one third of global production, it is just 11% of global trade. Globalization and trade activity has simply shifted overseas.



**Exhibit 46.** Household Consumption and Global Goods Trade – Share of Total, July 2025, source Macquarie.

And even though both US GDP and US trade as a percentage of global GDP and global trade, respectively, have dropped in recent years, successful technology companies have driven US market capitalization relative to the global market to record highs. **Technology is stronger than trade.**



**Exhibit 47.** US GDP, Trade and Equity Market– Share of Total, July 2025, source Macquarie.

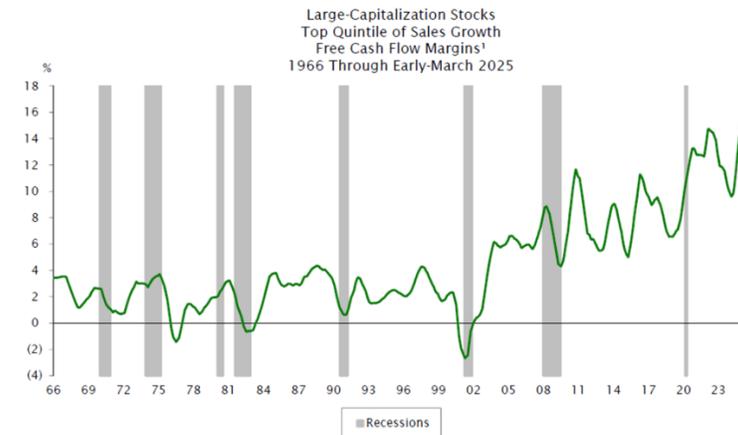
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*Growth Assets and the Economy*

As we believe we continue to face macroeconomic uncertainty, significant tail risks and an expensive equity market, one of the elements of our long book strategy is to seek to overweight investments in companies that have strong product cycles, among other criteria, which allows them to reasonably withstand any prolonged economic weakness.

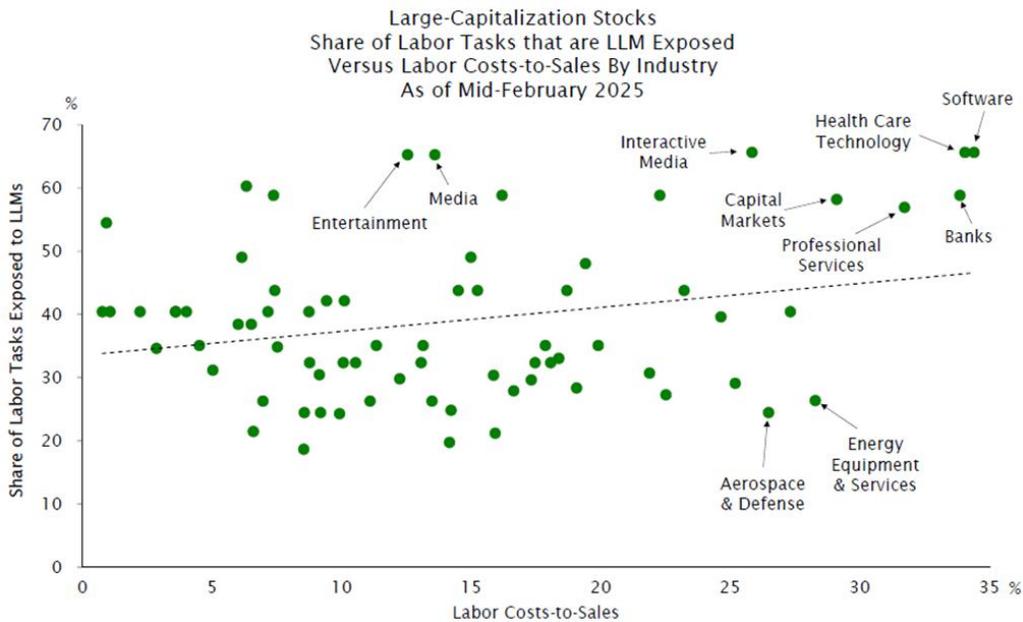
We believe this combination of a broadly unattractive market and select areas of strong secular growth driven by innovation can create a dynamic that elevates the attractiveness and scarcity value of secular growth assets with product cycles that are largely independent of the economic cycle. This is especially true at a time when risks remain elevated, in our view.

In this connection, companies at the top quintile of sales growth also generally exhibit strong free cash flow margins, four times the historical average level, over a period in which growth premiums have remained the same.



**Exhibit 48.** Large Cap Stocks, Top Quintile of Sales Growth Free Cash Flow Margins, source Empirical Research.

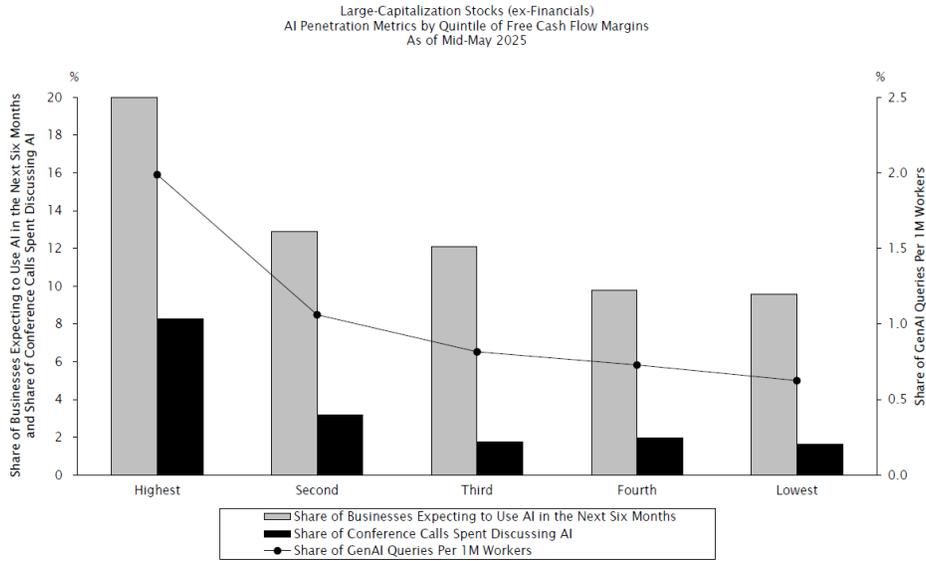
Moreover, many such high margin sectors lend themselves to better AI cost savings, further elevating their superior margin and free cash flow profile.



**Exhibit 49.** Large Cap Stocks, Share of Labor Tasks that are LLM Exposed, source Empirical Research.

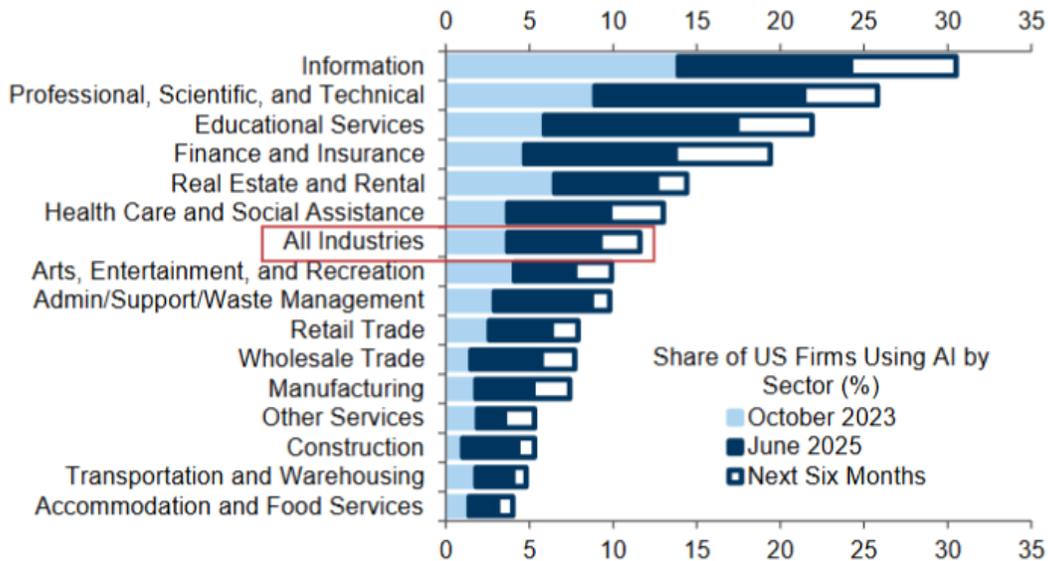
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Indeed, high margin, high IP sectors use AI the most.



**Exhibit 50.** AI Penetration Metrics of Quintile of Free Cash Flow Margins, May, 2025, source Empirical Research.

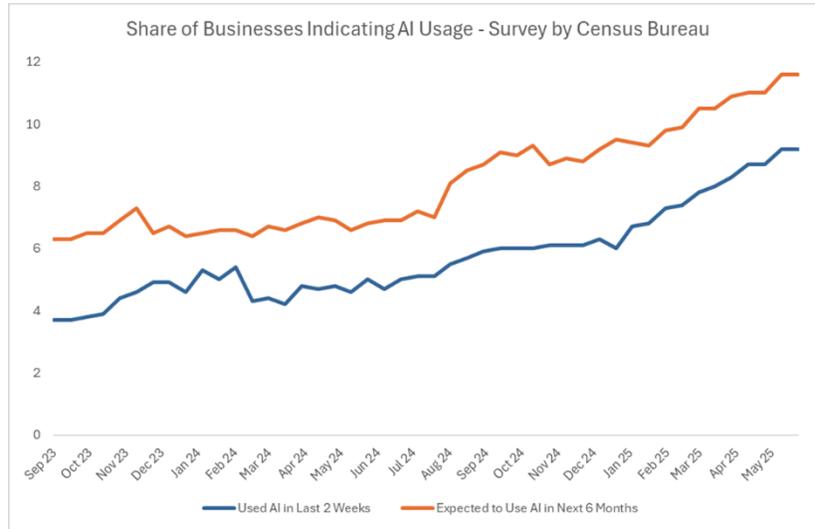
To put it in a different way, and highlight the value of focusing on product cycles instead of the economy, no matter how fast GDP grows, the AI adoption cycle being in its early stage of adoption, provides a long runway of growth, in our opinion.



**Exhibit 51.** AI Adoption by Firms, June 2025, source Goldman Sachs.

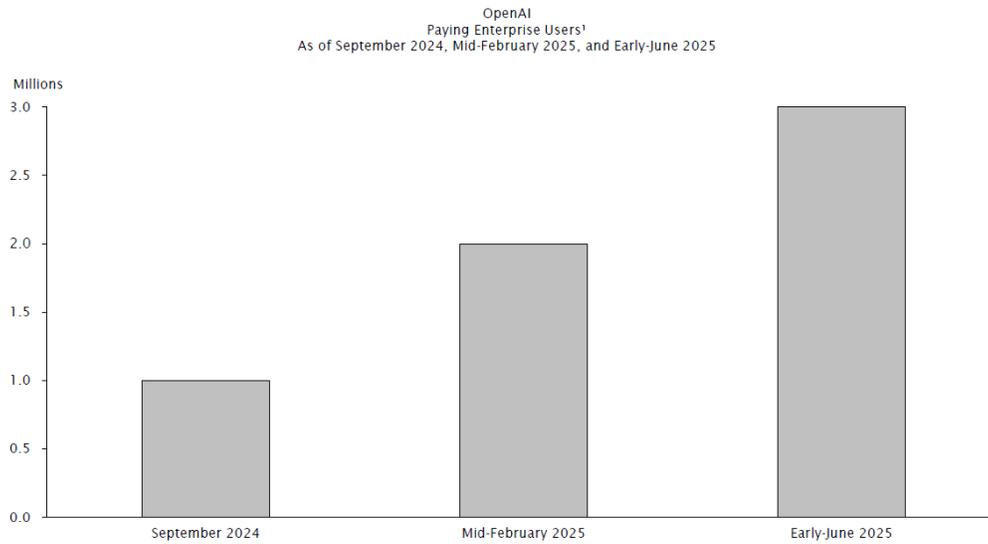
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Data from the Census Bureau confirms this early, but steadily increasing adoption curve.



**Exhibit 52.** Share of Businesses Indicating AI Usage, June 2025, source Census Bureau, Alkeon.

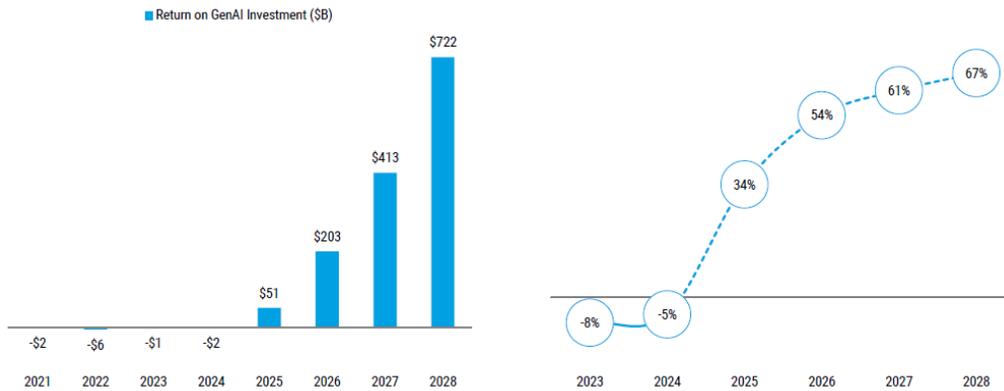
The adoption data is also consistent with the number of paying enterprise users reported by OpenAI and others.



**Exhibit 53.** OpenAI Paying Enterprise Users, June 2025, source OpenAI and Empirical Research.

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In fact, following years of strong infrastructure investment, ROI for generative AI (“GenAI”) is just beginning to inflect positively, projected to reach nearly 70% gross margin in a few years.



**Exhibit 54.** Return on GenAI Investment, source Morgan Stanley.



**Amy Hood,**  
CFO, Microsoft

And I'll go ahead and say, **our margins on the AI side of the business are better** than they were at this point by far than when we went through the same transition in the server to cloud transition.  
*(April 2025)*

As a result, we expect sizable increases in AI spending in years to come.



**Jamie Dimon,**  
CEO, JP Morgan

We spend about \$2 billion on AI. We have something like 600 actual end use cases, some are really important and some are more minor. **That number will probably double next year and maybe triple (and) just keep on growing.** There will be no job, no process, no function—nothing that takes place—that won't be affected by (AI), mostly for the positive. **You know, there will be some job losses...**  
*(June 2025)*



**Michael Dell**

10% productivity improvements pretty easy, 20% reasonably common, sightings of 30% or 40% – these are massive numbers. You have a \$114 trillion dollar global economy in 2025, and services economy is two thirds of that. **If we believe 10-20% productivity improvement is possible, then the investment in AI should be in the order of \$2-4trl, per year. And that is not where we are, it's a lot less than that.**  
*(July 2025)*

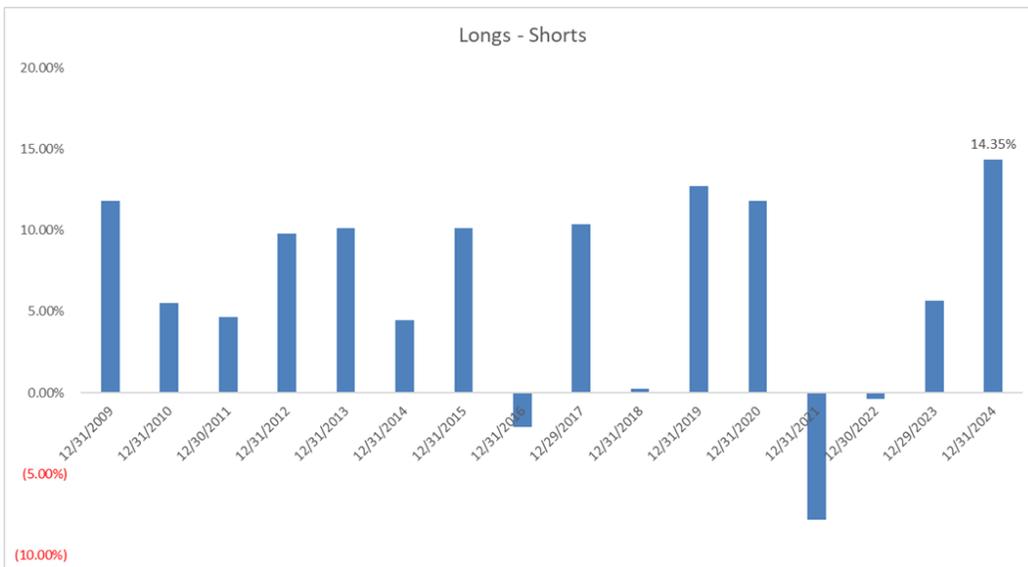


**Larry Ellison**

"I mean I don't know how to describe it. I've never seen anything remotely like this. I mean people are calling up and asking us, please, can you find us more capacity."  
*(Oracle, June 2025)*

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In short, despite being cautious on the market in aggregate, we remain bullish on the potential opportunities for both stock picking and double-alpha generation (on both long and short investments). In fact, one of the largest hedge fund prime brokers recorded a record level of alpha generation among long-short equity managers in 2024.



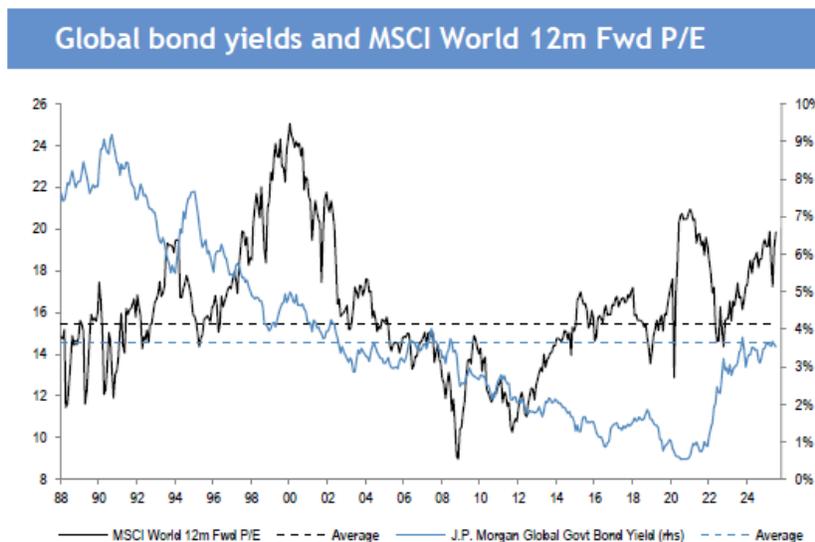
**Exhibit 55. Annual Appreciation of Global Equity Positions, Long versus Short, Across Equity L/S Funds Only, source Morgan Stanley Prime Brokerage.<sup>8</sup>**

In summary, we believe a long/short strategy, balanced with market hedges and alpha-seeking shorts, can offer a suitable fit to equity investors in the current high-risk environment. Our message in the current equity market is simple: **Stay Hedged, Stay Balanced with Shorts, Stay Globally Diversified.**

In the following, Section I of the letter reviews key valuation considerations for looking at the market today. Next, Section II of the letter reviews what we see as fundamental drivers supporting technology stocks. Then Section III of the letter provides our detailed outlook for the secular growth opportunities we see in the technology sector going forward, including recent fascinating developments in Generative AI.

### Broader Valuation Considerations

From a relative asset valuation perspective, we currently believe global equity valuations are elevated relative to bonds, although they appear more reasonable relative to their cost of capital. Specifically, on both a price-to-free-cash-flow basis and a price-to-return-of-capital (dividends plus buybacks) basis (see Exhibits 58 and 60 below, respectively) the market has been trading at reasonable levels, relative to its long-term average.



**Exhibit 56.** MSCI World Index P/E and Global Sovereign Bond Yields, July 2025, source JP Morgan.

Additionally, the gap between dividend yield and bond yield is unattractive across regions globally.

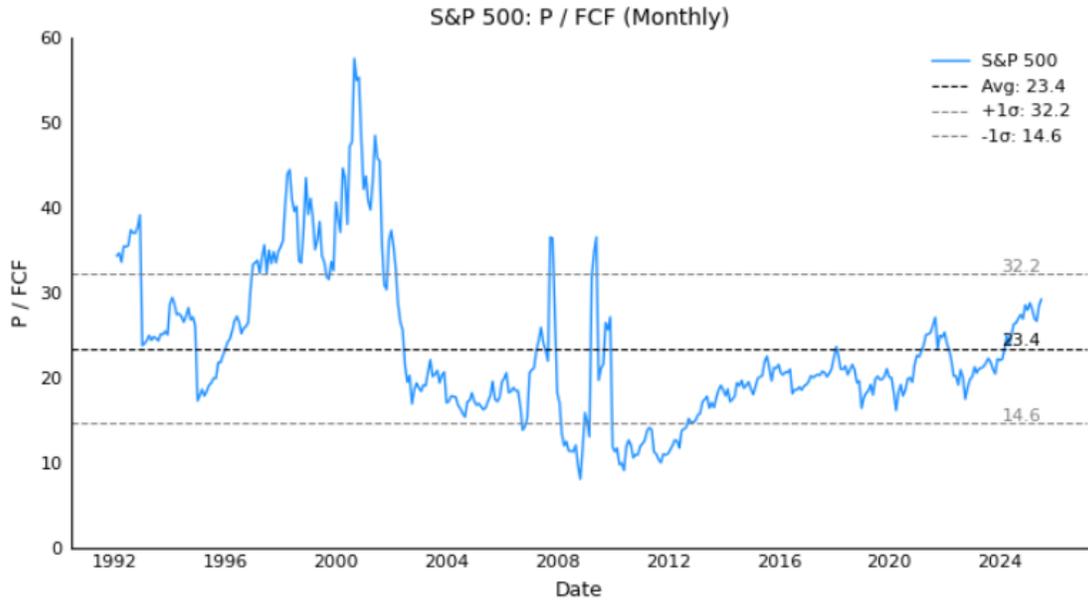
	Dividend yield	10Y Bond yield	Dividend yield minus bond yield	Average since '00	Current vs Average (bp)
US	1.2%	4.3%	-3.0%	-1.5%	-157
Japan	2.3%	1.4%	0.9%	0.9%	-6
Eurozone	3.0%	2.9%	0.1%	0.4%	-30
UK	3.5%	4.5%	-1.0%	0.5%	-152

\*Current as of 1<sup>st</sup> Jul '25

**Exhibit 57.** Average Developed Market Yield Gap, 2024 vs. 2000, July 2025, source JP Morgan.

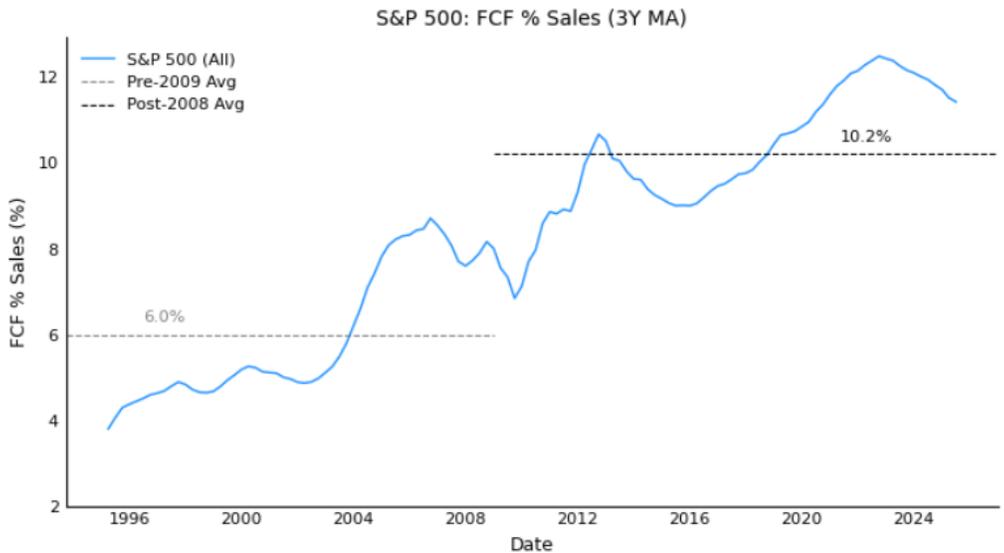
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On the other hand, cash flow generation has been very strong, enabling cash flow valuations to remain reasonable relative to average historical levels.



**Exhibit 58.** S&P 500 Index, Price/Free-Cash-Flow Ratio, June 2025, source Factset, Alkeon.

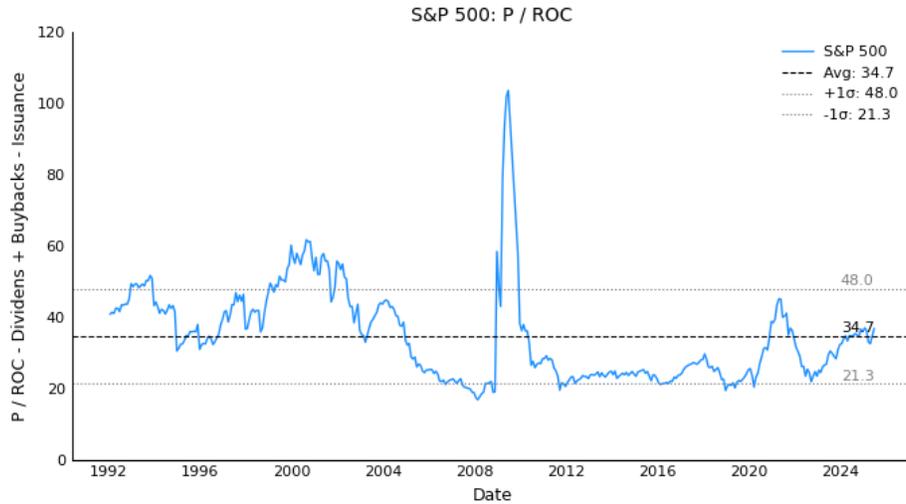
It is not surprising that although absolute P/Es remain elevated, P/FCF levels are more attractive. In particular, it is important to note that US companies have increasingly adopted asset-light models over the past decade. The result has been the almost doubling of free cash flow generation as a percentage of sales to above 10% in recent years.



**Exhibit 59.** S&P 500 Free Cash Flow as a Percentage of Sales, June 2025, source Factset, Alkeon.

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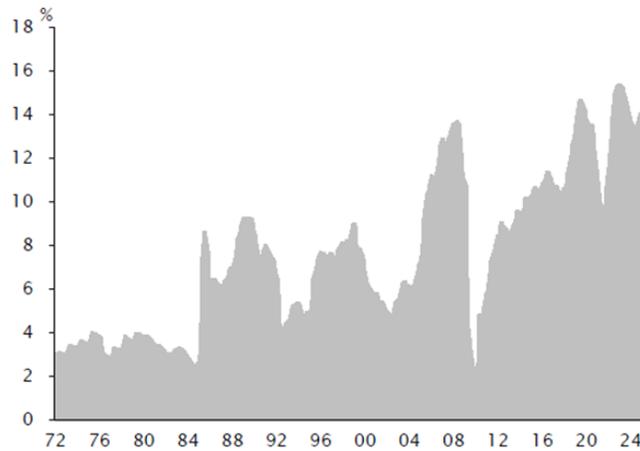
Furthermore, from a price to return on capital (dividends plus buybacks) standpoint, US equities have been trading at reasonable levels relative to the historical average.



**Exhibit 60.** S&P 500 Price to Return of Capital Multiple, June 2025, source Factset, Alkeon.

By the end of last year, the market had generated approximately a 20% ROE<sup>9</sup> and returned approximately three quarters of that to shareholders, negating the argument that value in stocks solely depends on future growth projections.

**Large-Capitalization Stocks  
Return of Capital to Shareholders  
As a Share of the Equity Base<sup>1</sup>  
1972 Through Late-December 2024**



<sup>1</sup>Trailing four-quarter data; measured as aggregates; smoothed on a trailing three-month basis.

**Exhibit 61.** Large Cap Stocks Return of Capital to Shareholders, January 2025, source Empirical.

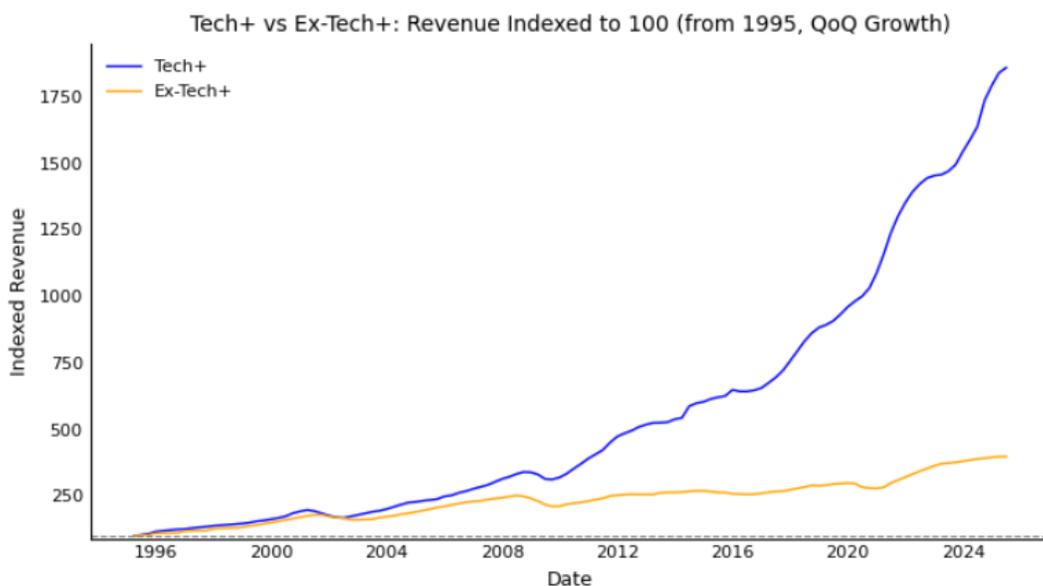
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Against this broad backdrop, we continue to favor high quality growth sectors such as technology and communication services. We believe these sectors are supported by, one, superior fundamentals, e.g., high barriers to entry, stronger balance sheets, and higher returns on invested capital; two, strong secular growth trends; three, a broader scarcity of growth assets; and, four, supporting cash flow valuations relative to the underlying growth rates.

In particular, and as we have stated in previous investor communications, we consider technology to be not only a growth investment but also a defensive one. This is due to its cost-cutting (high ROI) and productivity-enhancing proposition to the end customer, superior balance sheet, strong cash flow conversion, low labor cost to sales, ongoing industry consolidation, and, lastly, strong underlying secular innovation trends.

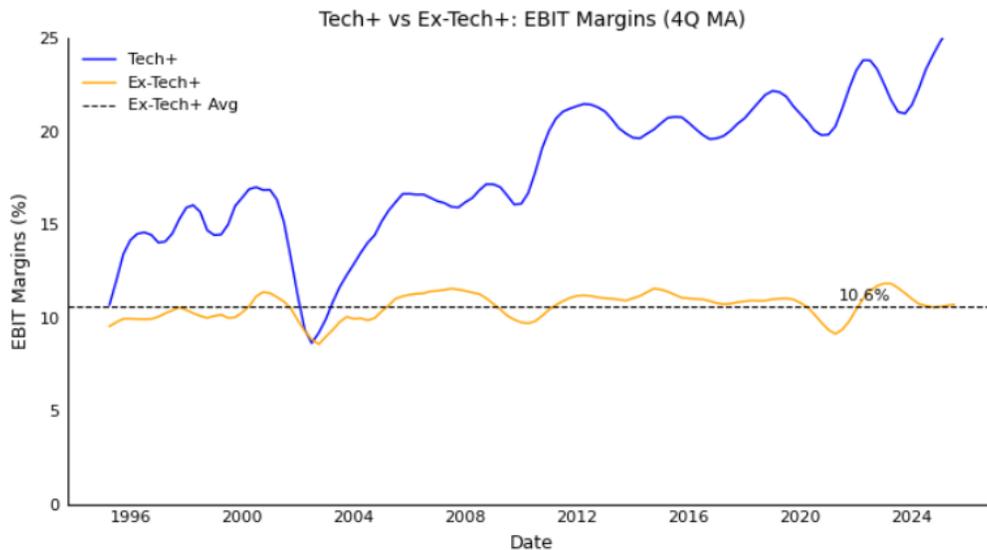
*To this last point, companies that innovate tend to be less correlated to the economic cycle. This is consistent with our own desire to identify secular growth stories with company-specific product cycles that are less dependent on the economic cycle.*

It is noteworthy that revenue growth for technology stocks has substantially exceeded that of the broader market in the last decade. We would also add that, importantly, this was just not the case during the tech bubble, when technology revenues (and earnings) underperformed, lagging price appreciation.



**Exhibit 62.** S&P 500 Index Technology Revenue Growth, June 2025, source Factset, Alkeon.

Lastly, during the last decade margins for technology stocks more than doubled the market level.



**Exhibit 63. S&P 500 Index Technology EBIT Margins Growth, June 2025,**  
source Factset, Alkeon.

In summary, we consider the current investment opportunity set to be attractive for a select number of high-quality growth equities on a relative basis, particularly as the market overall remains extended.

*This is an environment of scarce secular growth opportunities, elevated market valuations, increased geopolitical uncertainty, and technological disruption that increases the gap between the “haves” and the “have-nots”, all of which we believe enhances the spectrum of opportunity for long-short investing currently.*

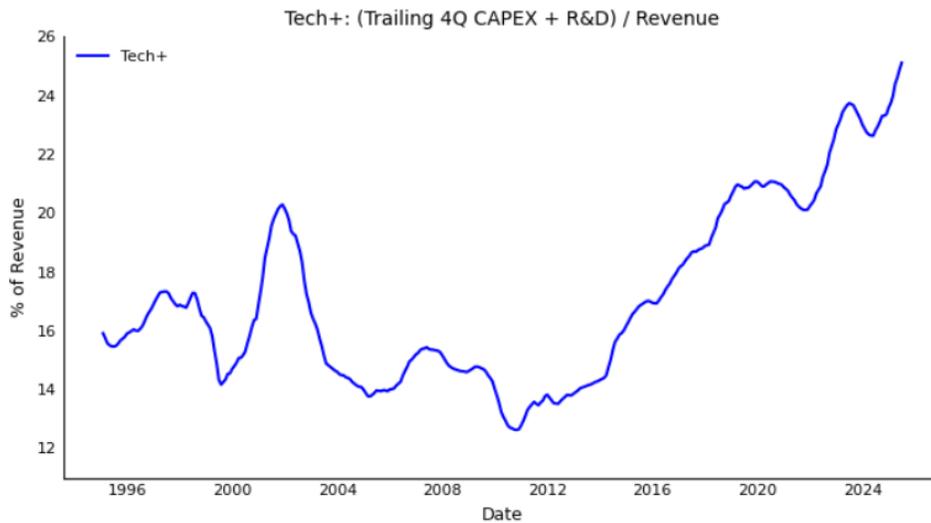
### **Strong Fundamentals for Technology Stocks**

Moving the discussion beyond the attractiveness of relative valuations, and looking at underlying sector fundamentals, we do maintain a constructive view on the technology sector. In particular, we consider technology to be not only a growth investment but also a defensive one due to its cost-cutting (high ROI) and productivity-enhancing proposition to the end customer, superior balance sheet, strong cash flow conversion, low labor cost to sales, ongoing industry consolidation, and the secular benefit from “work-from-everywhere” trends.

In recent communications, we have extensively discussed the driving elements behind the sector’s continued and persistent relative outperformance. In particular, when carefully dissecting underlying fundamental drivers of technology stocks, it is clear that chief among the reasons technology stocks have consistently grown earnings above market rates, and are well-positioned to continue to do so in the future, is their persistently high level of business reinvestment, measured as a percentage of sales. This high level of reinvestment has allowed technology companies to maintain a powerful combination of high barriers to entry and high margins.

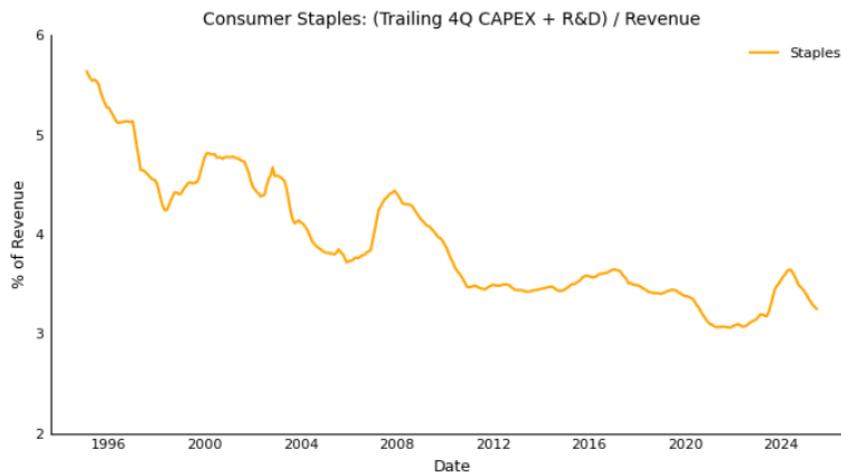
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This business model of high ROIC and high rate of reinvestment is an archetype of the high-quality growth companies we seek to identify, analyze and invest in. We note that the level of business reinvestment by technology stocks has re-accelerated in recent years, approaching an all-time high level of nearly 25% recently.



**Exhibit 64.** Technology Capex plus R&D as a Percentage of Sales (Trailing 4Q Basis), June 2025, source Factset, Alkeon.

In contrast, the amount of business reinvestment for consumer staples, for example, has been disappointing and generally declining for over two decades, which has potentially grave implications for future earnings growth.



**Exhibit 65.** Consumer Staples Capex plus R&D as a Percentage of Sales (Trailing 4Q Basis), June 2025, source Factset, Alkeon.

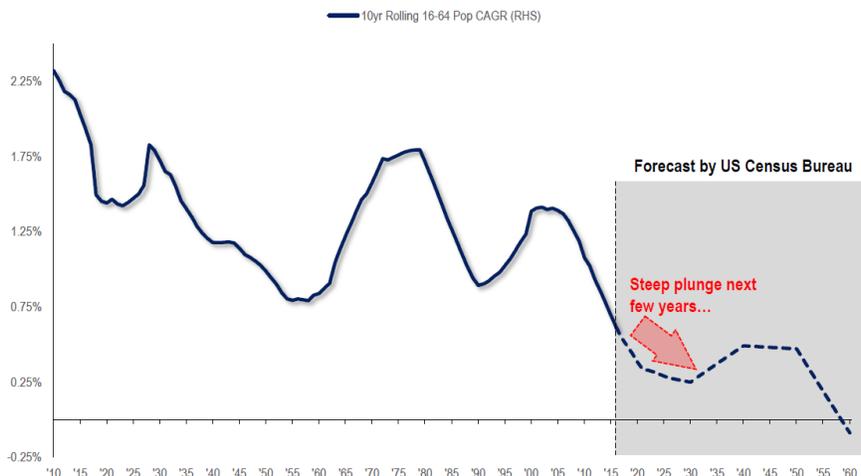
Not only does this high level of business reinvestment lead to an attractively high ROIC profile for technology companies, it also provides fundamental investors with an additional benefit, namely an opportunity to research and evaluate newly emerging business units that are parts of these larger enterprises at an early stage.

These promising, but early-stage growth business units often have the potential to contribute meaningfully to company revenues and earnings in future years, while they may remain a drag to profitability (and thus consensus expectations) in the near term. This gap between near-term earnings expectations and longer-term earnings realizations can provide a study framework to deeply analyze and invest in growth businesses early on, as they embark on a path of earnings acceleration, but before consensus expectations catch up to the real growth trajectory.

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Furthermore, and looking at the correlation to the economic cycle, one of the main reasons why technology investments have been attractive and generally resilient in most market environments is the presence of strong underlying secular growth-driving product cycles, which are company-specific, are fueled by innovation and, as such, have historically been largely decoupled from the economic cycle.

Secularly, the technology sector also stands likely to benefit for years to come from increased spending due to an emerging long-term labor shortage in the US over the next fifteen to twenty years. Specifically, the growth rate of the US population working pool (ages 16-64) is set for a steep decline within the next few years, and expected to turn negative by late 2060, something our country has never seen before.<sup>10</sup>



**Exhibit 66.** 10-Year Rolling Change of US Worker Population Pool, source Fundstrat.

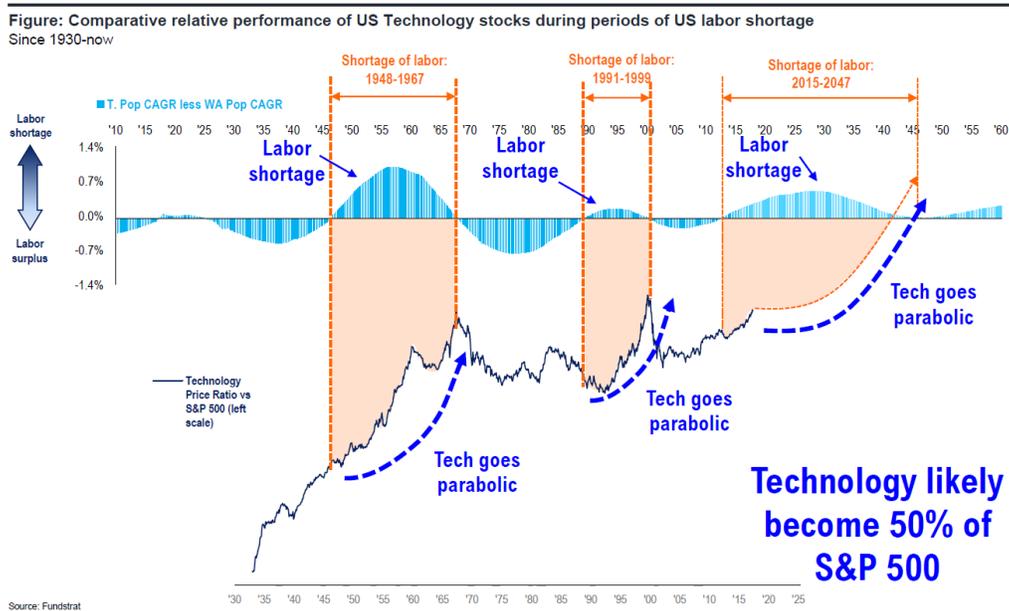
In past labor shortages, technology spending has spiked.<sup>11</sup> Remarkably, this incredibly strong demographic tailwind is independent of and incremental to the upcoming wave of technological innovation, which is in itself transformative and represents a sea-change event. The result is a potentially powerful dual engine of secular growth for technology stocks that can lift consensus expectations meaningfully on a secular basis over a multi-year period.



**Exhibit 67.** Technology Spending as a Percentage of GDP, source Fundstrat.

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Historically, the outperformance of technology stocks against the S&P 500 during periods of labor shortage has indeed been dramatic and, according to Fundstrat, has the potential to lift the technology sector to a 50% weight in the S&P 500 during this upcoming long-term labor shortage cycle over the next two decades.



**Exhibit 68.** *Technology Price Ratio vs. S&P 500 Index and US Labor Shortage/Surplus, source Fundstrat.*

As we will elaborate in the next section, the long-term secular growth outlook for the sector is actually improving, in our view. This, we believe, creates an attractive risk/reward opportunity ahead of a potential large-scale, broadly impactful wave of technological innovation, similar to the internet wave of the 1990s. But, unlike the innovation cycle in the late 90's, technology stocks now are highly profitable and among the most attractive in the S&P 500.

*In summary, even though the underlying superior revenue and earnings growth for technology companies relative to other sectors has been well documented, it is in fact the current, forward-looking risk/reward opportunity –ahead of the most disruptive and transformative cycle of AI innovation– that is perhaps the most underappreciated aspect of investing in technology.* This is especially true considering how early we are in the AI innovation cycle, in our view. This is something we will fundamentally examine and explain in detail in Section III of this letter.

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**Secular Outlook for Technology**

*“There have been four major historical eras defined by the way we work. The Hunter-Gatherer Age lasted **several million years**. And then the Agricultural Age lasted **several thousand years**. The Industrial Age lasted **a couple of centuries**. And now the Information Age has lasted just **a few decades**. And now today, **we’re on the cusp of our next great era as a species.**” Maurice Conti, Director of Applied Research & Innovation, Autodesk*



**Elon Musk**

“The rate of improvement of AI is **faster than any technology I’ve ever seen, by far.**”  
(All-In Summit, September 2024)

“As a computer scientist, I’ve never seen anything as exciting as all of [this] AI progress”  
(All-In Summit, September 2024)



**Sergey Brin**

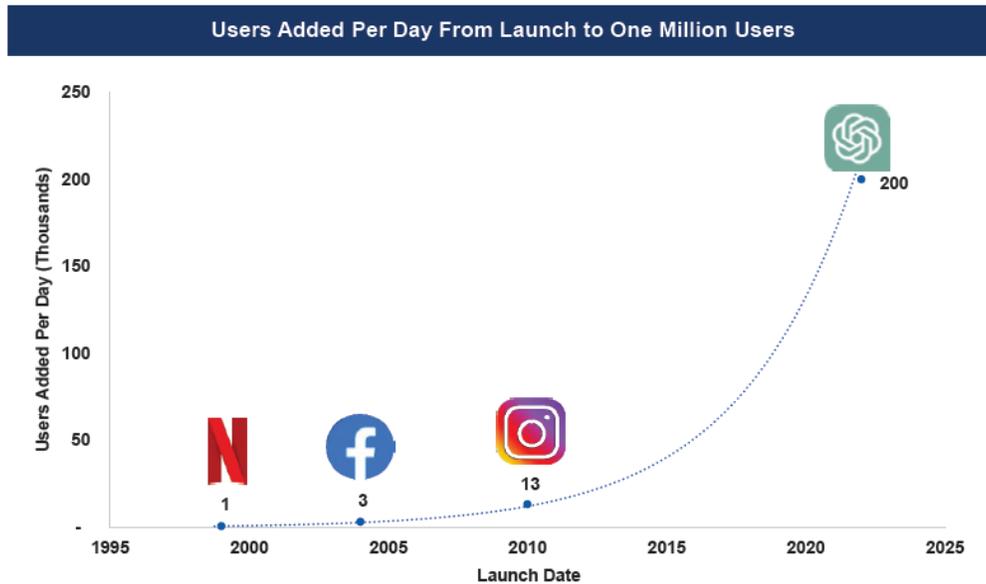
**"Inference demand is about to go up by a billion times.** That's the part that most people haven't completely internalized. This is the Industrial Revolution.“  
(October 2024)



**Jensen Huang**

In recent years, we have extensively detailed our outlook on AI, and more recently modern (Generative) AI and, lastly at the end of 2024, the pre-AGI phase of AI, with (“Artificial General Intelligence”) generalized reasoning capabilities, advanced multimodality and test-time training. We expect this cycle to continue to be wide in scope, transformative and highly disruptive.

As the digital foundation of the global economy expanded rapidly, it began to enable disruption in a matter of months. Businesses were able to reach millions of users in the shortest time ever.



**Exhibit 69.** Users Added per Day from Launch to One Million Users, source Morgan Stanley.

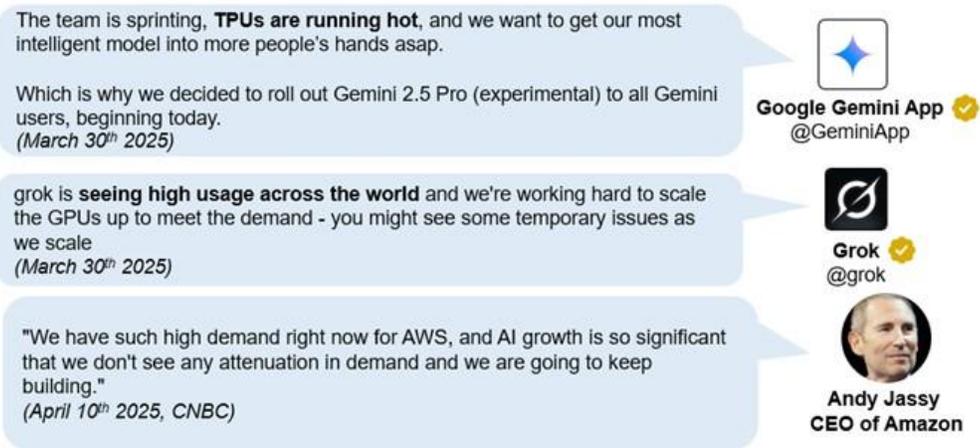
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Remarkably, this dynamic is now accelerating with OpenAI recently reporting adding 1 million users in just one hour!

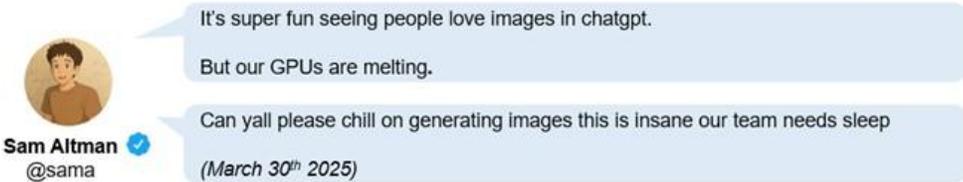


Sam Altman (@sama) announced that the ChatGPT launch 26 months ago was one of the craziest viral moments he'd ever seen, and that they added one million users in five days. He also stated that they added one million users in the last hour as of April 1st, 2025.

And user activity continues to remain hot across platforms.



This section contains three tweets. The first is from Google Gemini App (@GeminiApp) dated March 30th, 2025, stating that the team is sprinting, TPUs are running hot, and they want to get their most intelligent model into more people's hands asap. The second is from Grok (@grok) dated March 30th, 2025, stating that Grok is seeing high usage across the world and they're working hard to scale the GPUs up to meet the demand. The third is from Andy Jassy, CEO of Amazon, dated April 10th, 2025, on CNBC, stating that they have such high demand right now for AWS, and AI growth is so significant that they don't see any attenuation in demand and they are going to keep building.



Sam Altman (@sama) tweeted that it's super fun seeing people love images in ChatGPT, but their GPUs are melting. He also mentioned that they need to chill on generating images because it's insane and their team needs sleep, as of March 30th, 2025.

Popular memes recreated in the style of Studio Ghibli using GPT 4o Image generator



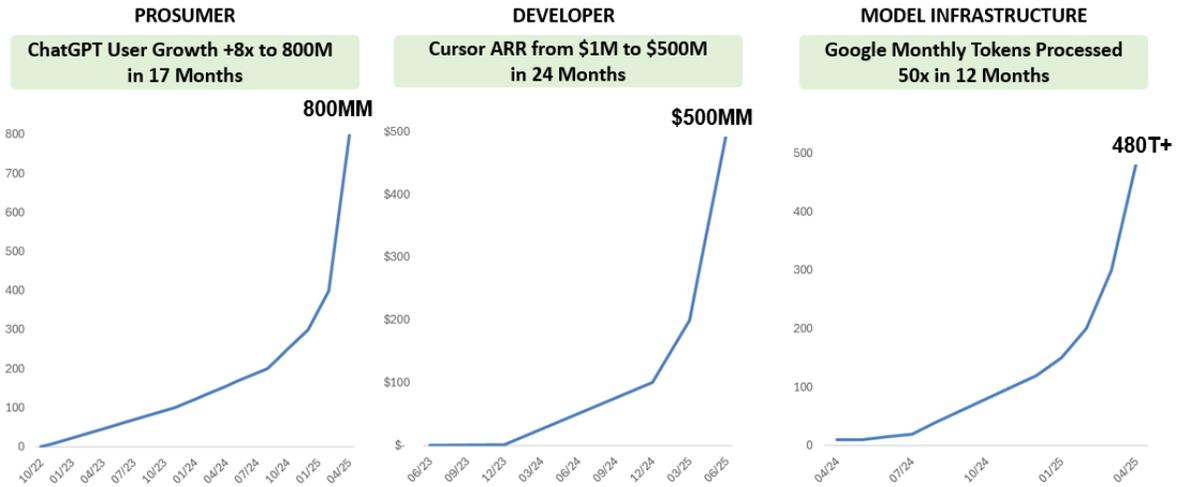
Exhibit 70. User Activity Remains Hot Across Platforms, source Google, Grok, Sam Altman, X.

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Looking at the progress AI has made this year, AI user, revenue and token growth has exceeded even our own above-consensus internal projections for 2025. The growth has been incredible, and has surprised even company insiders.

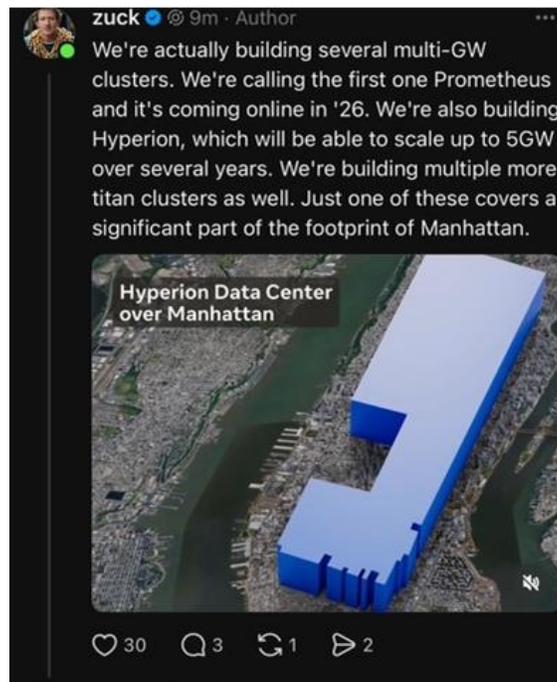


This time last year, we were processing 9.7 trillion tokens a month across our products and APIs. Now, we're processing over 480 trillion – that's 50 times more.  
(May 20<sup>th</sup>, 2025)



**Exhibit 71.** AI User, ARR & Token Growth, source OpenAI, Cursor and Google.

As a result, companies are dramatically accelerating their plans for data center build-outs. For example, in July 2025 META announced they are building multiple gigawatt clusters, including 1GW Prometheus scheduled to come online in 2026, and Hyperion which will be built in phases and scale up to 5GW.



**Exhibit 72.** Mark Zuckerberg on Hyperion Data Center, source X.

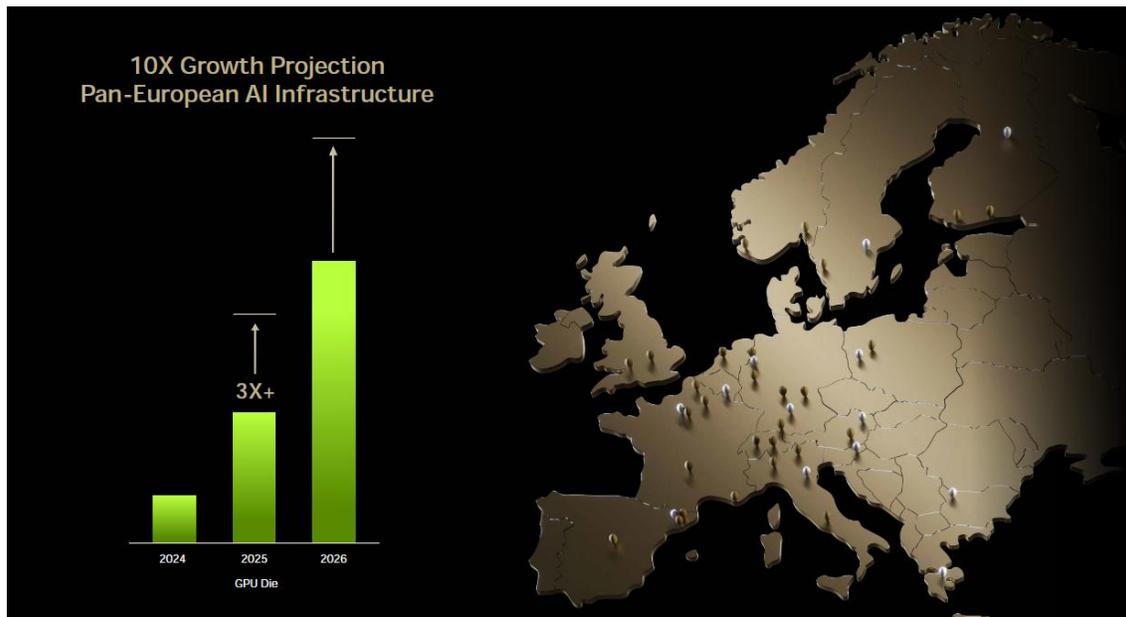
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In fact, in 2025 AI growth has accelerated everywhere, across Consumer AI, Enterprise AI and Cloud AI, topped by a major inflection point in Sovereign AI growth.

Global Acceleration in Sovereign Announcements		
<b>UAE</b>	G42 + OpenAI Stargate (Abu Dhabi)	<b>5 GW capacity</b> ; 10 mi <sup>2</sup> site; 1 GW live; multi-phase rollout
<b>Saudi Arabia</b>	HUMAIN (PIF-backed)	<b>\$7B build plan</b> , 6.6 GW by 2034, 18K Blackwell chips in Phase 1
	AWS + HUMAIN AI Zone	<b>\$5B investment</b> , SageMaker & Q stack + 100K citizens upskilled
<b>France</b>	Mistral + NVIDIA Sovereign Cloud	<b>18K Blackwell GPUs</b> ; part of French sovereign LLM stack
<b>Germany</b>	Deutsche Telekom + NVIDIA	<b>10K Blackwell GPUs now</b> , scaling toward 100K "AI factory"
<b>Europe</b>	GTC Paris AI Gigafactories	<b>3,000+ exaflops</b> , 200+ new data centers, 5+ GPU megafactories
<b>Singapore</b>	Temasek joins Microsoft AI infra fund	<b>\$30-100B fund</b> , global deployment via MGX-led initiative
<b>Malaysia</b>	DNex + Google Sovereign Cloud	<b>\$2B investment</b> , chip design hub + data residency
	YTL Green Data Center + NVIDIA	<b>\$4.3B AI campus</b> , 500 MW solar, 1.4 EF compute power

**Exhibit 73. Sovereign Announcements on AI, source ChatGPT.**

Europe alone is projected to grow its AI infrastructure 10x by 2028.



**Exhibit 74. 10x Growth Projection of Pan-European AI Infrastructure, source Nvidia.**

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Stepping back for a moment, to contemplate how quickly all this developed, the origins of this new amazing technological revolution can be traced just a few years back. In our quarterly communications, we first extensively discussed the AI revolution in 2017, the year in which Alphabet introduced their Transformer architecture, which was then split into BERT (short for Bidirectional Encoder Representations from Transformers, a machine-learning framework for natural language processing) and a series of GPT models.

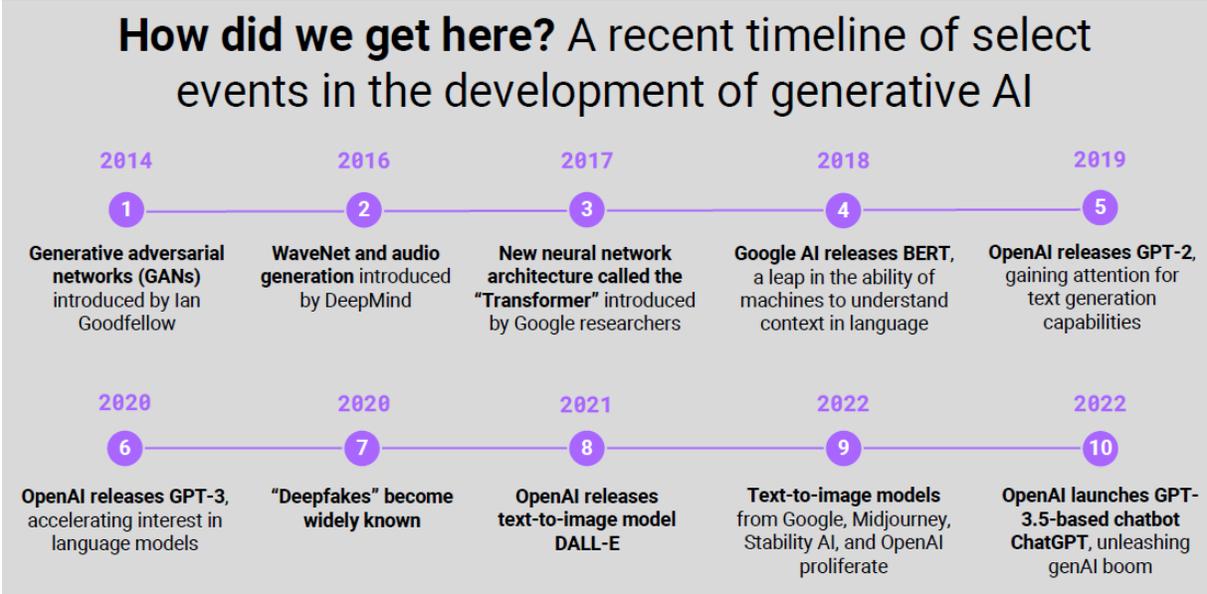


Exhibit 75. The History of Generative AI, source CB Insights.

The following year, 2018, marked the first year in which the amount of data generated by machines surpassed the amount of data generated by humans (see Exhibit 113). This data explosion then began to feed new large and complex AI models, which in turn needed an advanced and powerful new compute platform for model training.

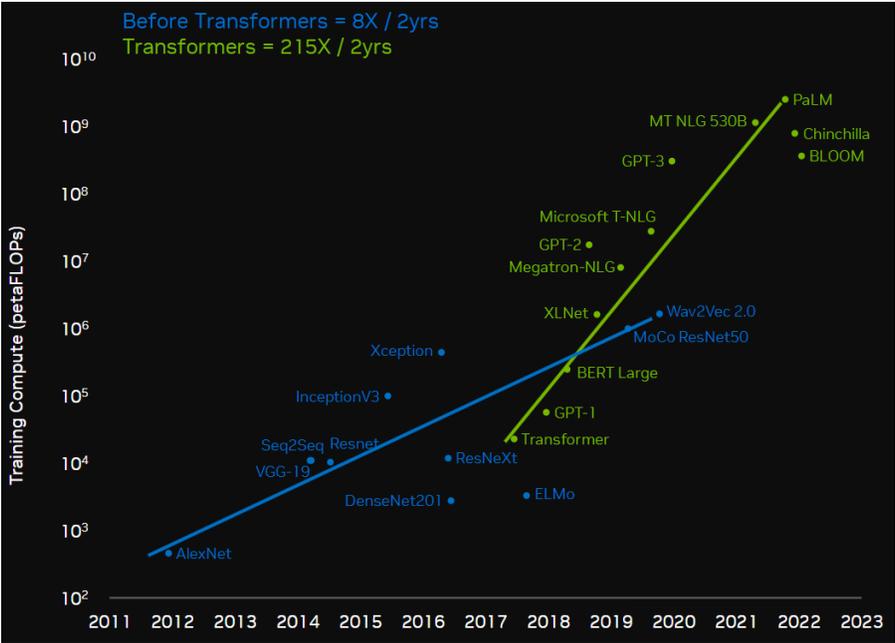
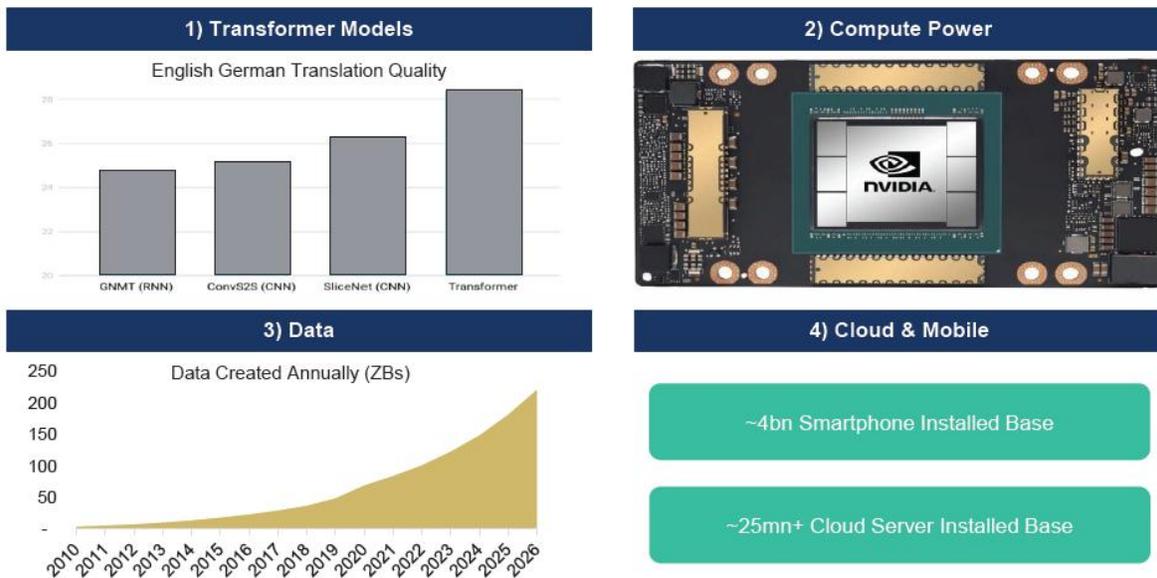


Exhibit 76. GPU Computing Powers AI Advances, source Nvidia.

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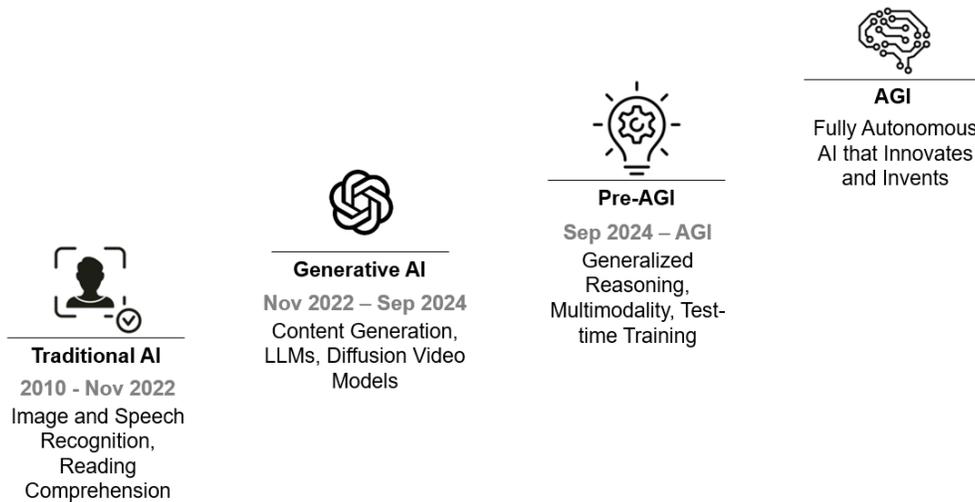
The creation of a powerful compute platform that was able to accommodate and handle AI models with tremendous complexity occurred between 2020 and 2022, ultimately leading to the tipping point for modern, generative AI at the very end of 2022 (AI going mainstream with the launch of ChatGPT).

It was precisely this marriage of powerful transformer models and advanced compute hardware platforms that led to generative AI breakthroughs in recent years, bringing modern AI to the mainstream.



**Exhibit 77.** Four Key Factors That Led to The Current “AI Breakthroughs”, source Morgan Stanley.

And recently, we took a further huge leap forward, with the introduction (at the end of 2024) of AI models with advanced reasoning capabilities. This marks the start of the pre-AGI phase, in our view.



**Exhibit 78.** Four States of AI, source Alkeon.

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These pre-AGI phase models leverage training compute to self-reflect, consider different reasoning paths, look ahead or back-track and THINK for a long time before answering complex questions.

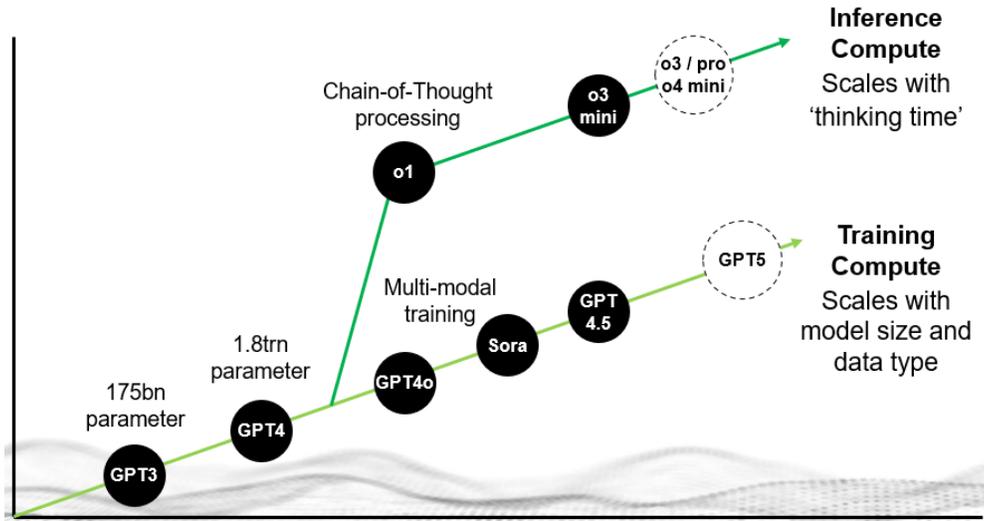


Exhibit 79. AI Scaling Evolution – Pre-Training and Inference, source Alkeon.

These brand new, generalized reasoning models, alongside the emergence of multimodal, synthetic and enterprise data, are likely to power a new cycle of growth in the next few years, in our view.

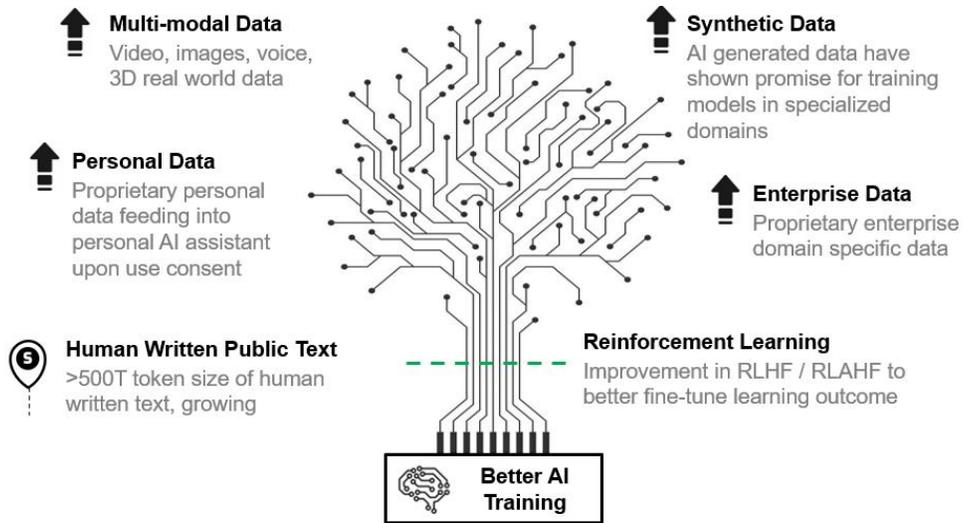


Exhibit 80. AI Scaling Evolution – Data, source Alkeon.

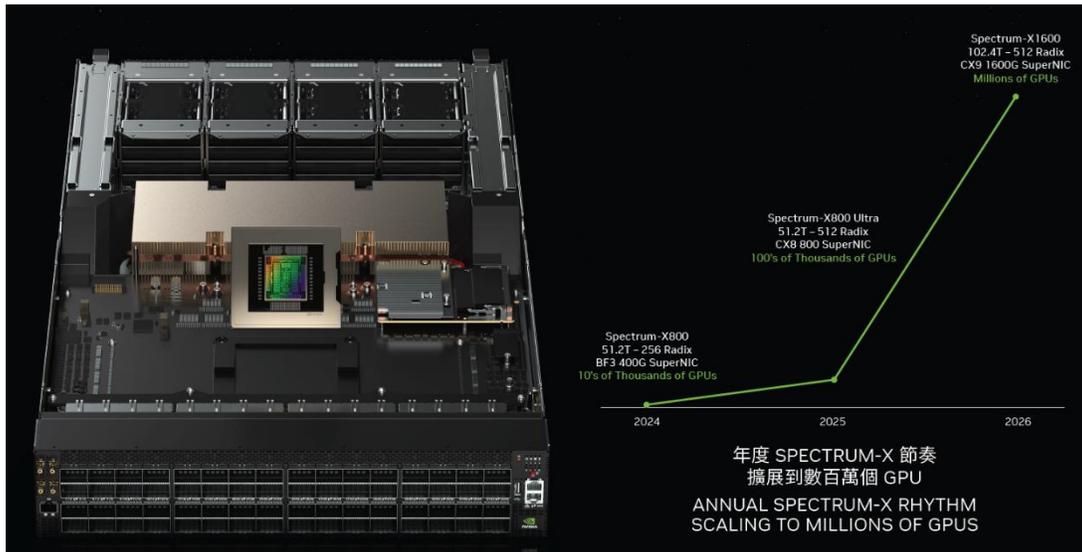
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As we will discuss later, recent advanced reasoning models require a tremendous amount of compute power, particularly as scaling now occurs on two dimensions, both training and inference. Newly introduced AI chips such as Blackwell chips accelerate compute power exponentially.



**Exhibit 81.** 1000x AI Compute in 8 Years, August 2024, source Nvidia.

This elevated compute capacity is needed to accommodate advanced AI models, i.e., generalized reasoning models, which will require hundreds of thousands and eventually millions of GPUs for training and inference.

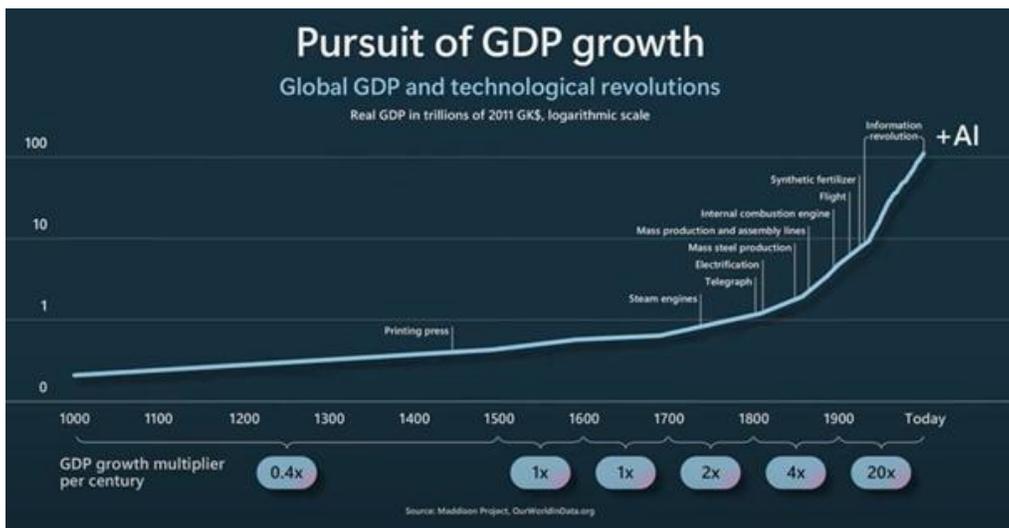


**Exhibit 82.** Scaling to Millions of GPUs, June 2024, source Nvidia.

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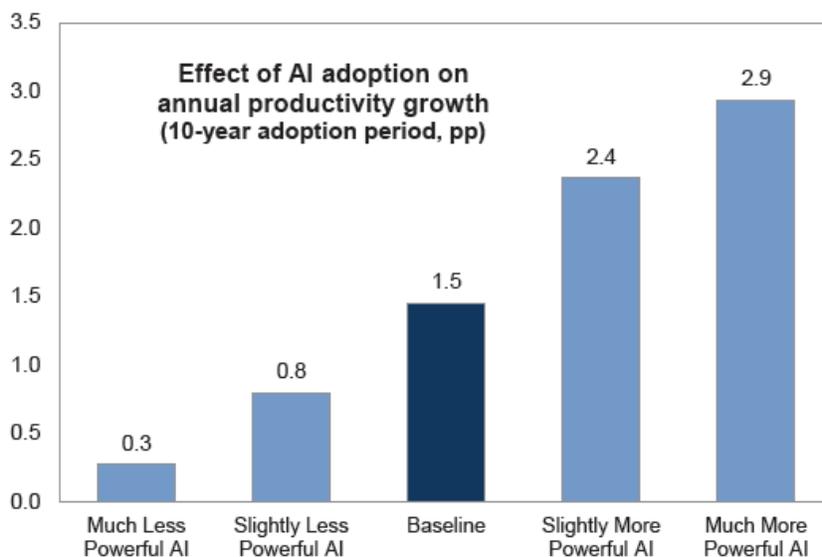
Given these most recent advances in both model complexity and compute power, which we witnessed at the very end of 2024 and in 2025, we believe it is fair to say that the modern AI revolution is just beginning, and it will transform the world.

Importantly, we also believe this tectonic wave of technological innovation is likely to fuel GDP growth, as innovation and growth go hand in hand, and, like previous cycles of innovation, AI is likely to ultimately create more jobs than it destroys.



**Exhibit 83.** Global GDP and Technological Revolutions, source Microsoft.

This is partly because, one, the effect of AI on annual productivity growth can be very significant. AI is likely to create a productivity boost we have only seen a few times in the past one hundred years, potentially adding a gain of 1.5% in output per year, as a base case scenario.

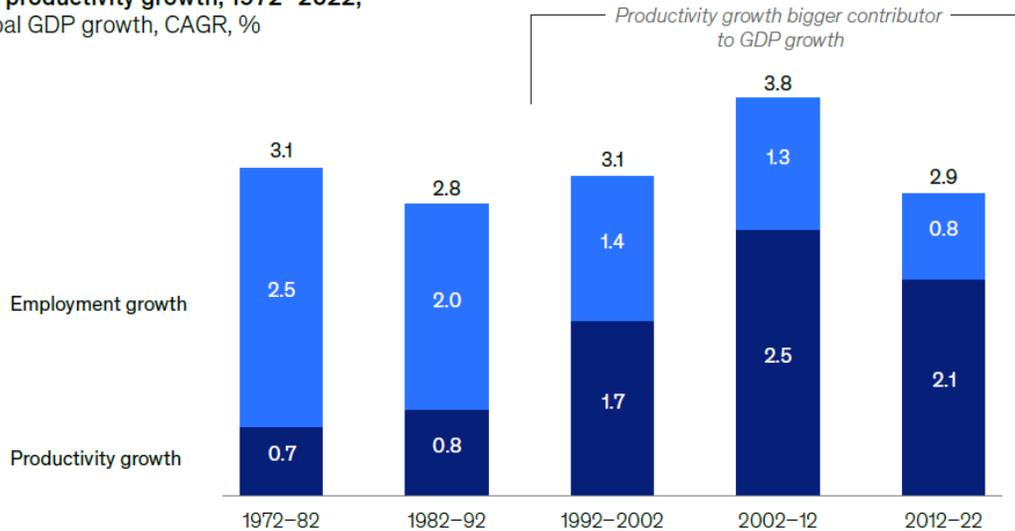


**Exhibit 84.** Estimated Effect of AI Adoption on Productivity Growth, June 2023, source Goldman Sachs.

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And two, which is important to highlight here, productivity growth has been the main engine of GDP growth over the past thirty years, with the link between the two being very strong historically.

**Real GDP growth contribution of employment and productivity growth, 1972–2022, global GDP growth, CAGR, %**

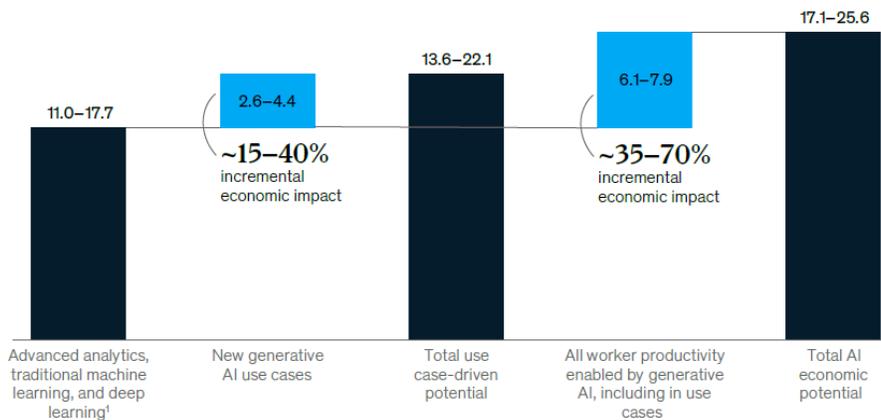


**Exhibit 85. Real GDP Growth Contribution of Employment, source McKinsey.**

Like previous major innovation cycles, there will be a transitory phase of job evolution. In particular, generative AI is expected to disrupt the labor markets in a significant manner. McKinsey & Company has estimated that 60-70% of all workloads can be impacted or eventually be automated by AI. Looking at hundreds of occupations and detailed work activities, McKinsey estimated that a total economic benefit of \$17.1 to \$25.6 trillion annually, across all industries, with the incremental Generative AI impact in the \$6.1-\$7.9 trillion range.

**Generative AI could create additional value potential above what could be unlocked by other AI and analytics.**

**AI's potential impact on the global economy, \$ trillion**

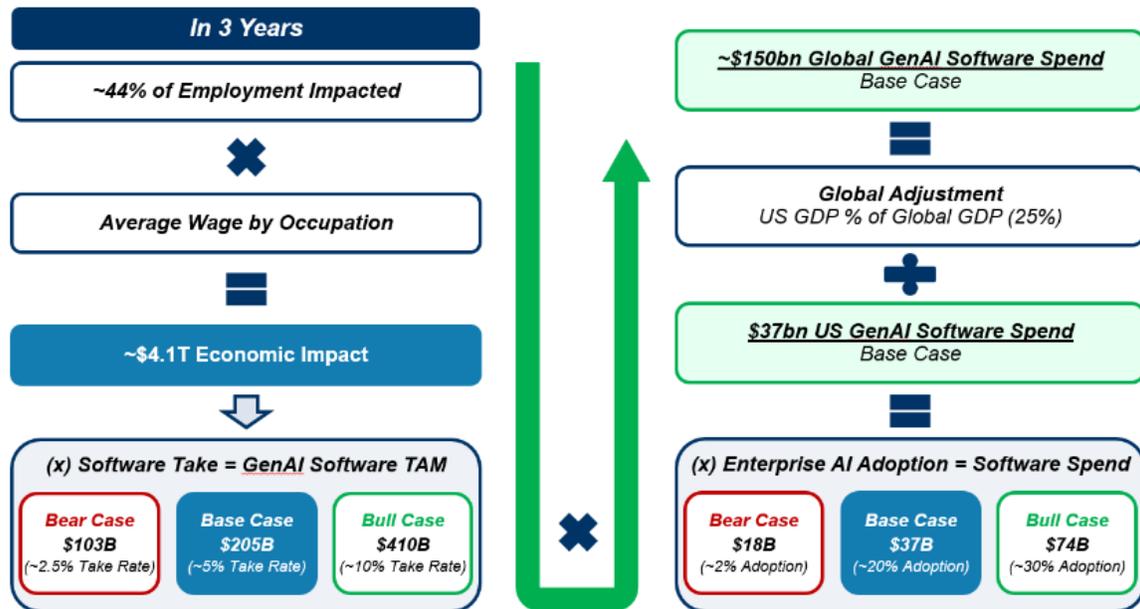


<sup>1</sup>Updated use case estimates from "Notes from the AI frontier: Applications and value of deep learning," McKinsey Global Institute, April 17, 2018.

**Exhibit 86. AI's Potential Impact on the Global Economy, \$ Trillion, source McKinsey.**

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There are more conservative estimates, but of the same incredible magnitude. For example, Morgan Stanley estimates that Generative AI can impact approximately 25% of labor today and 44% in three years, affecting \$2.1 trillion of labor costs associated with these jobs today and \$4.1 trillion in three years, just in the US.<sup>12</sup> Globally, the incremental software opportunity alone is estimated to reach \$150 billion in three years.



**Exhibit 87.** Global Generative AI Software Impact, January 2024, source Morgan Stanley.

Fundamentally, the reason behind such large-scale positive economic impact is simple, AI provides instant and large productivity gains.<sup>13</sup>



Michael Dell

“There aren't many gifts of 20% and 30% productivity that I can think of, certainly in my working lifetime, and as a result, this is a conversation in every boardroom.”  
(Goldman Sachs Communacopia + Technology Conference, September 2024)



databricks

“In just a year, Heathrow sped up forecast insights from two weeks to four hours while decreasing the margin of error from 30% to 10%, allowing the airport to become more efficient and accelerate productivity.”  
(Company Press Release, September 2024)

“Especially as the models get smarter, we’ve heard examples of senior lawyers at law firms who said, ‘I just had o1 (OpenAI’s reasoning model) write a legal brief for me. **That would have taken a \$1,000 an hour associate six hours. And it did it in five minutes.**’ “  
(December 2024)



Kevin Weil,  
CPO at OpenAI

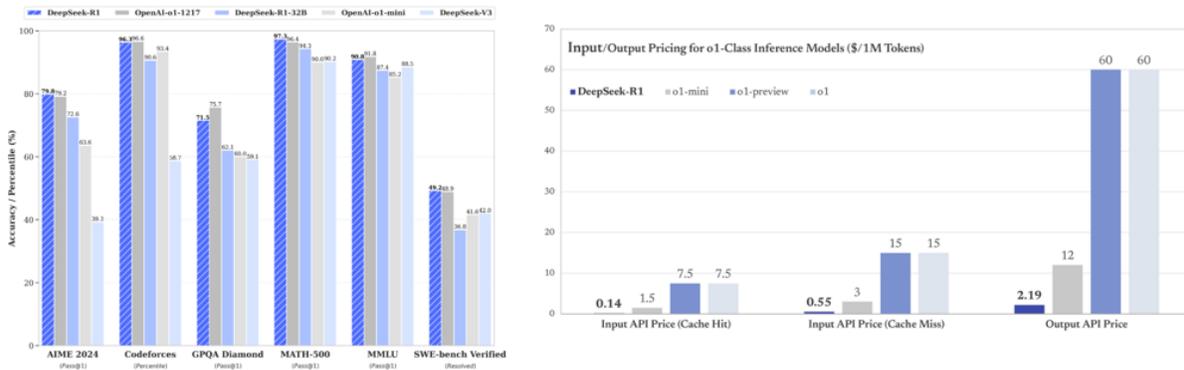
**Recent Developments and 2025 Expectations**

Recent activity has remained frantic with new model releases accelerating. A large wave of new AI models were released just in the first quarter of 2025, across the globe.

	<b>OpenAI</b> o3-mini and o3 o3-pro o4-mini GPT-4.5 GPT-4o image generator Deep Research Operator	<b>Google</b> Gemini 2.0 Pro Gemini 2.5 Pro Gemini 2.5 Flash Gemini Robotics Gemma 3.0 Veo 3.0	<b>Anthropic</b> <b>Claude</b> 3.7 Sonnet 4.0 Opus 4.0 Sonnet	<b>META</b> <b>llama</b> 4 Maverick 4 Scout	<b>xAI</b> Grok 3 Grok 4	<b>MSFT</b> Phi 4 mini Phi 4 multimodal		
	<b>Deepseek</b> R1 R1-0528 V3-0324	<b>Alibaba Qwen</b> 2.5 Max 2.5 Omni and VL QwQ 32B 3.0 model family	<b>Bytance</b> <b>Doubao</b> 1.5 Pro 1.6 Seedance 1.0 Pro	<b>MiniMax</b> 01 Speech-02	<b>Baidu</b> <b>Ernie</b> 4.5 X1 4.5 Turbo X1 Turbo	<b>Tencent</b> <b>Hunyuan</b> T1 Voice 3D-2.5	<b>Manus AI</b> General purpose AI agent	<b>Kimi</b> K1.5 <b>InternLM</b> 3
	<b>Cohere</b> Command A	<b>Mistral</b> Small 3 Medium 3 Magistral Small Magistral Medium	<b>AI21</b> Jamba 1.6	<b>LG AI</b> EXAONE Deep				

**Exhibit 88.** A Large Wave of Major New AI Models were Released in 2025 1H, source Alkeon.

Models became more powerful and more efficient, starting with Deepseek’s R1 released earlier this year. R1 deployed a series of innovative techniques to drastically lower inference cost.



**Exhibit 89.** Performance on Par with OpenAI-o1/ Input/Output Pricing for o1-Class Inference Models, February 2025, source DeepSeek.

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And we currently expect further exciting releases by R1 in 2025.

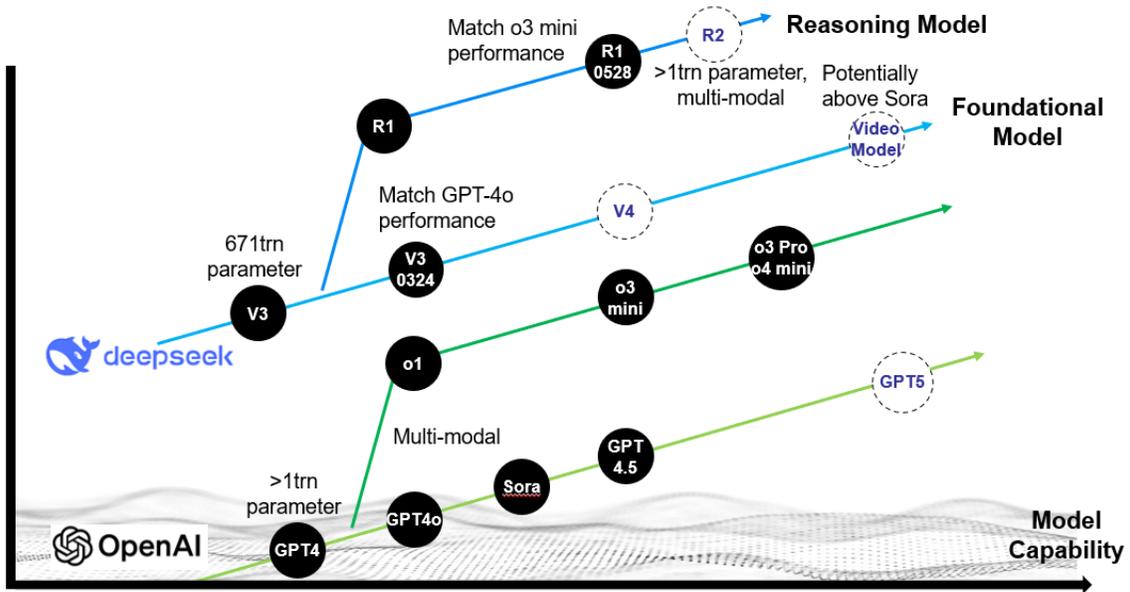


Exhibit 90. China LLM Development, source Alkeon.

Following R1's success, and more recently, Llama 4 took another step forward in AI efficiency, using a similar Mixture of Experts (MoE) architecture, i.e., relying on multiple specialized submodels to handle different parts of input data, as a foundation.

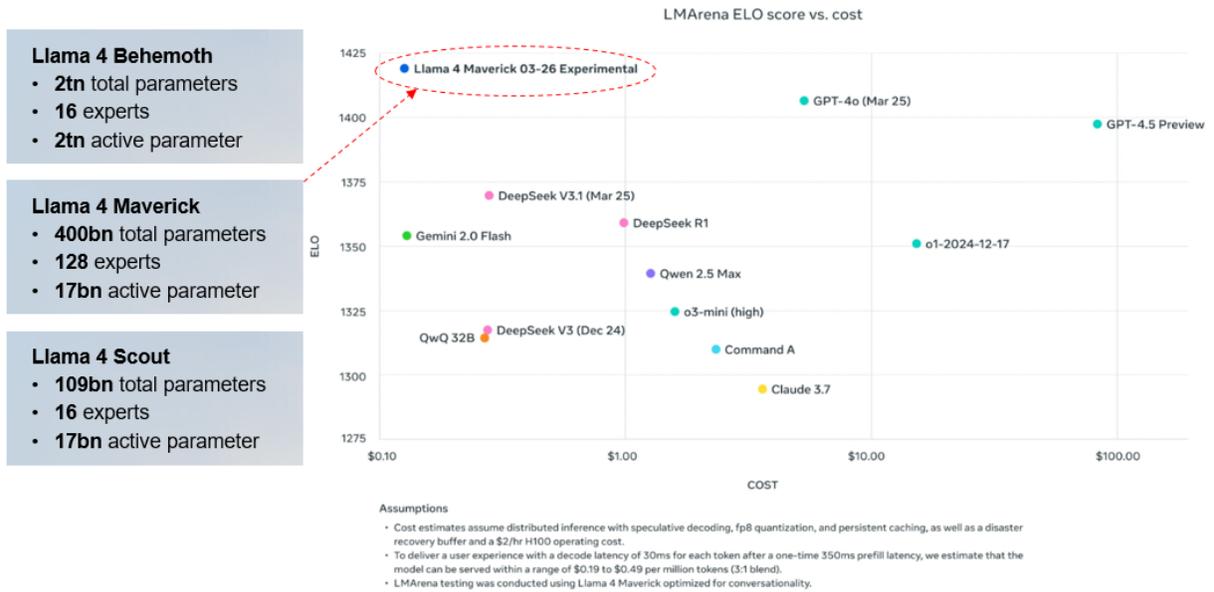


Exhibit 91. Llama 4 Benchmark, April 2025, source Meta.

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Gemini 2.5 Pro topped several reasoning benchmarks, even without test-time techniques!

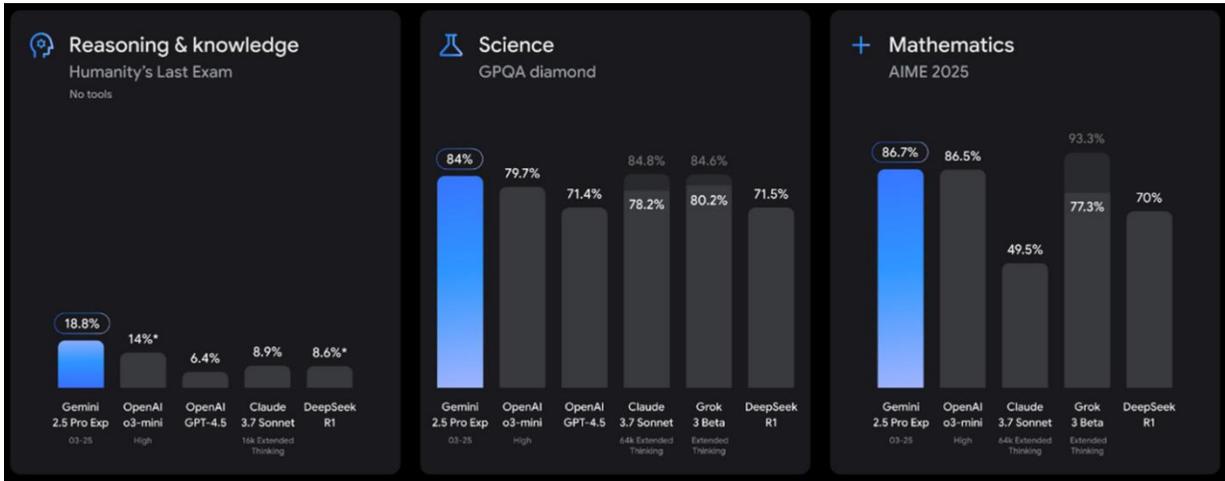


Exhibit 92. Gemini 2.5 Pro Benchmark, March 2025, source Google.

And Grok4 is now bringing post-graduate level expertise in academic disciplines, scoring 100% in the 2025 American Invitational Math Exam (AIME).

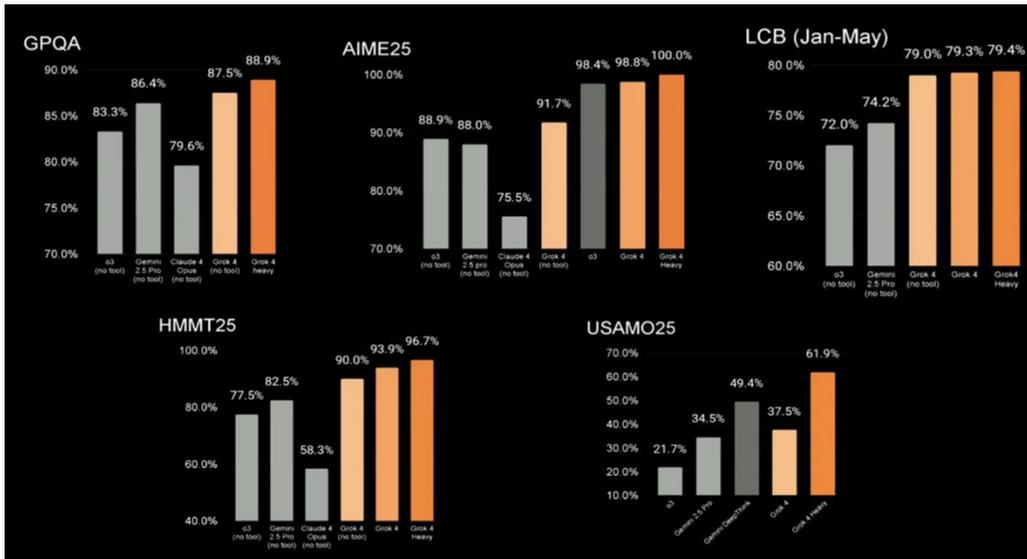
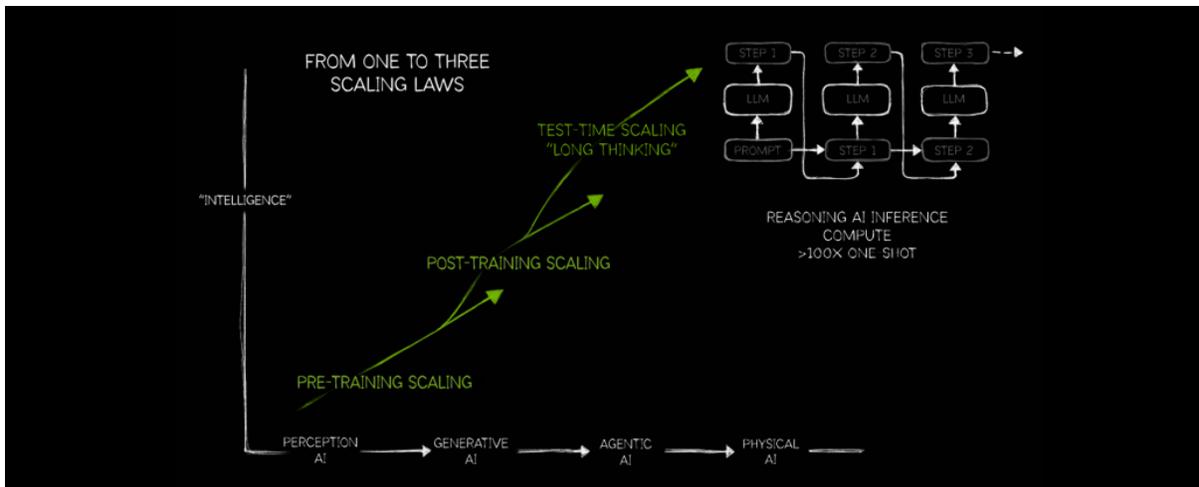


Exhibit 93. Grok 4, July 2025, source xAI.

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Moreover, as we look forward, we expect to see even more advanced reasoning models emerge, bringing us closer and closer to AGI and beyond to the era of superhuman models.

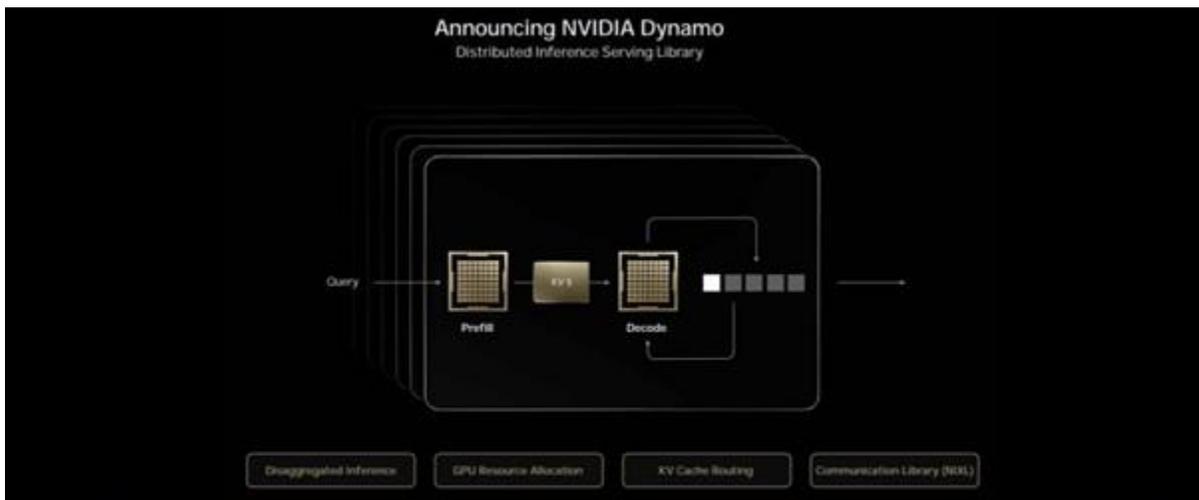


Jensen Huang

“There are three fundamental questions in AI. How do you solve the data problem? How do you train without humans in the loop? And how do you scale - how do you find an algorithm where the more resources you provide, the smarter AI becomes? This is where almost the entire world got it wrong. The scaling law of AI is more resilient -and in fact, hyper-accelerated.” (GTC, March 2025)

**Exhibit 94.** Test-time Scaling Continues to Advance Scaling Laws, March 2025, source Nvidia.

In this connection, new software accelerators allow AI factories to further and further scale AI inference and reasoning.



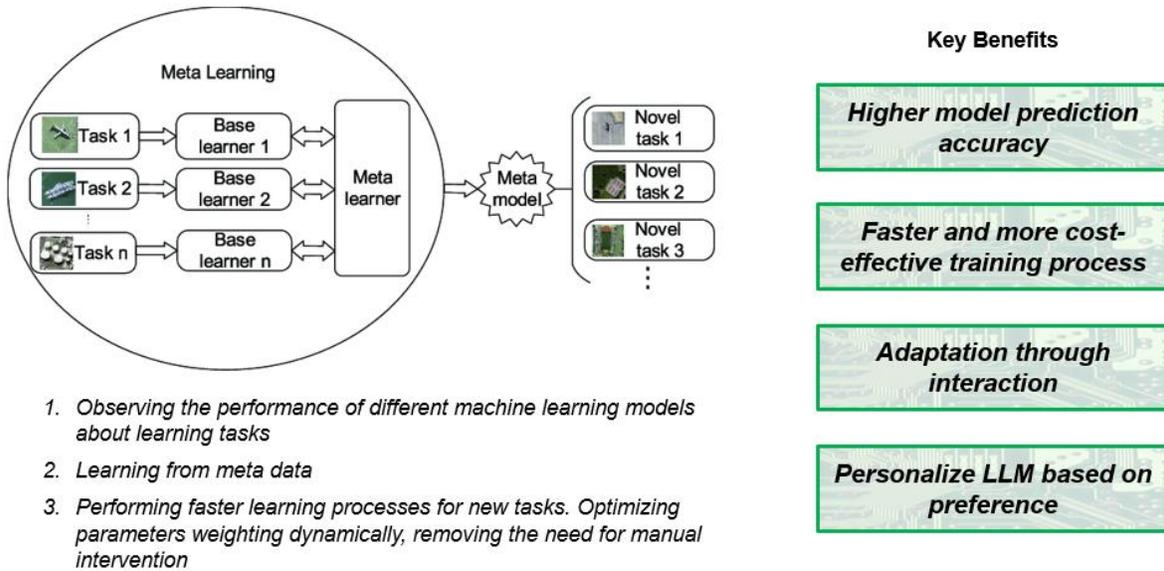
Jensen Huang

“We call it NVIDIA Dynamo. It’s the operating system of an AI factory. It manages parallelism, batching, memory, context - everything needed to orchestrate massive models across thousands of GPUs. Just like VMware was for enterprise IT, Dynamo is for AI agents.” (GTC, March 2025)

**Exhibit 95.** Announcing Nvidia Dynamo, March 2025, source Nvidia.

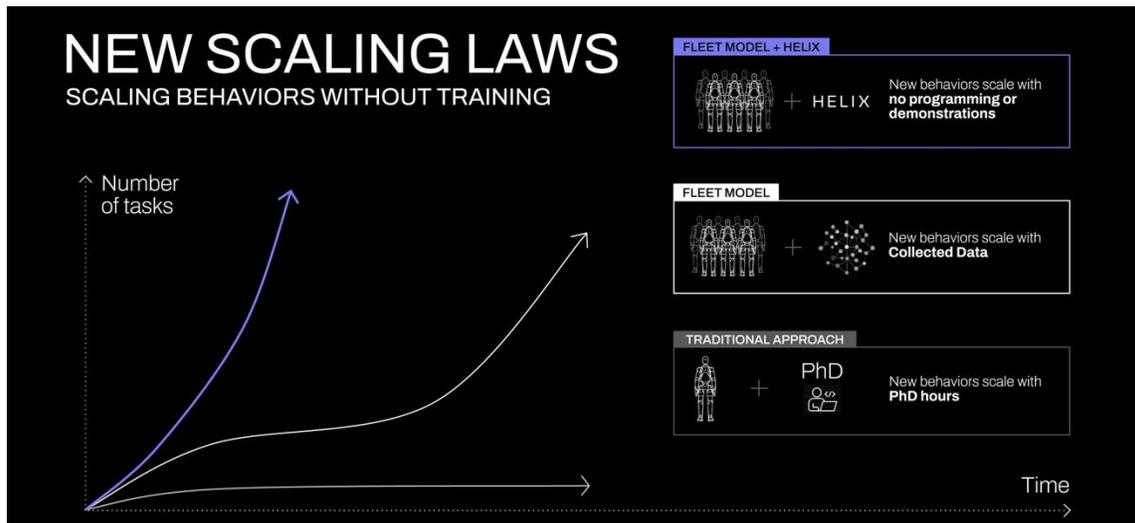
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Enter the era of Meta Learning that enables AI to “learn how to learn”, paving the way towards AGI.



**Exhibit 96.** Illustration of the Meta-Learning Framework, April 2025, source ResearchGate and Alkeon.

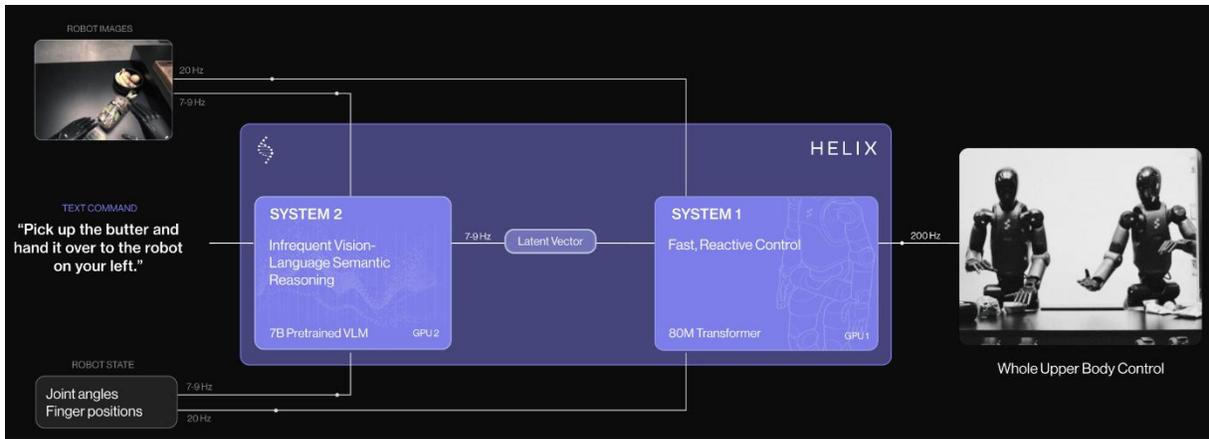
We also witnessed recently an amazing breakthrough, a ChatGPT moment in humanoid robots, with Figure’s Helix exhibiting strong object generalization, the ability to pick up thousands of new objects Helix had never encountered before in training. In conventional heuristic manipulation, skills grow with PhDs who manually script them. In conventional robot imitation learning, skills scale with data collected. With Helix, new skills can be specified on the fly with language.



**Exhibit 97.** Scaling curves for different approaches to acquiring new robot skills, February 2025, source Helix.

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This creates a new scaling law, scaling behavior without training. Helix combines “fast thinking” with “slow thinking” to achieve strong object generalization and high-rate dexterous control at the same time.



**Exhibit 98.** Helix: A "System 1, System 2" VLA for Whole Upper Body Control. February 2025, source Helix.

In another breakthrough in robotic learning, Tesla’s Optimus is now learning directly from human operation videos and can handle household and industrial tasks based on natural language instructions.



**Exhibit 99.** Optimus handles household and industrial tasks based on natural language instructions, source Macquarie, Tesla, May 2025.

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In summary, models are becoming incredibly efficient, driving further demand and leading to Jevon's paradox (the phenomenon where increased efficiency results in increased usage) striking again as we get closer to AGI.



Sam Altman

"look forward to bringing you all AGI and beyond."  
(On X, January 27<sup>th</sup>, 2025)



Satya Nadella

"Jevons paradox strikes again! As AI gets more efficient and accessible, we will see its use skyrocket, turning it into a commodity we just can't get enough of."  
(On X, January 2025)

These new models are bringing a PhD level assistant next to us, at minimum cost.

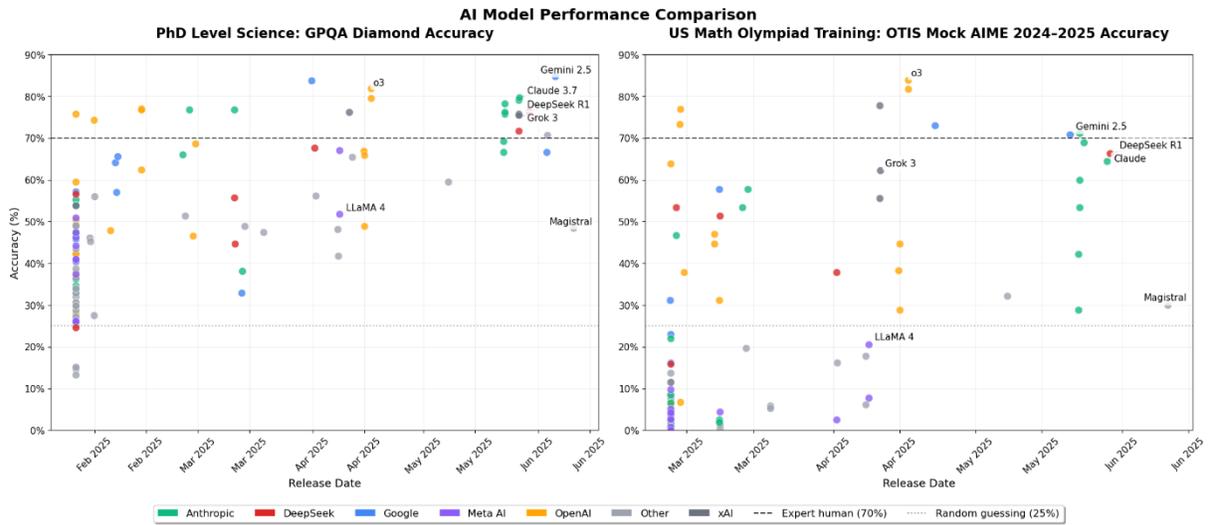


Exhibit 100. Model Evaluation, June 2025, source Epoch AI, Alkeon.

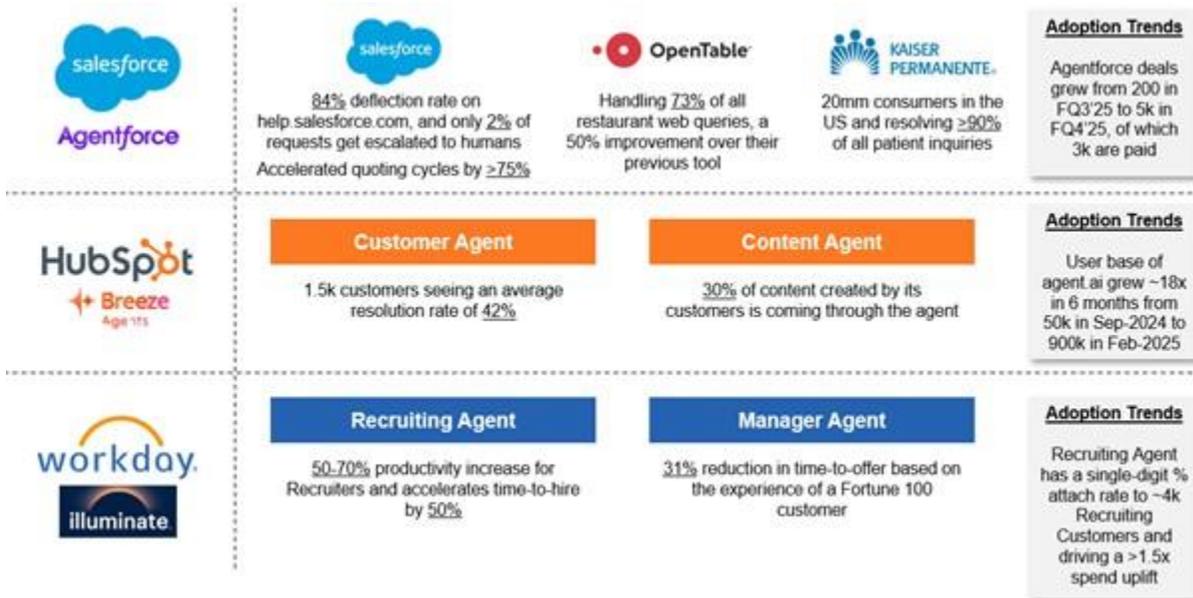
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Lastly, we finally begin to see the emergence of powerful AI agents that leverage advanced “agentic language models” to process complex instructions, develop plans, and execute complex tasks across business domains.



**Exhibit 101.** AI Agents: Third Wave of AI Evolution, September 2024, source Alkeon, Salesforce.

These agents are driving strong productivity and ROI.<sup>14</sup>



**Exhibit 102.** Productivity Gains and ROI, April 2025, source Alkeon.

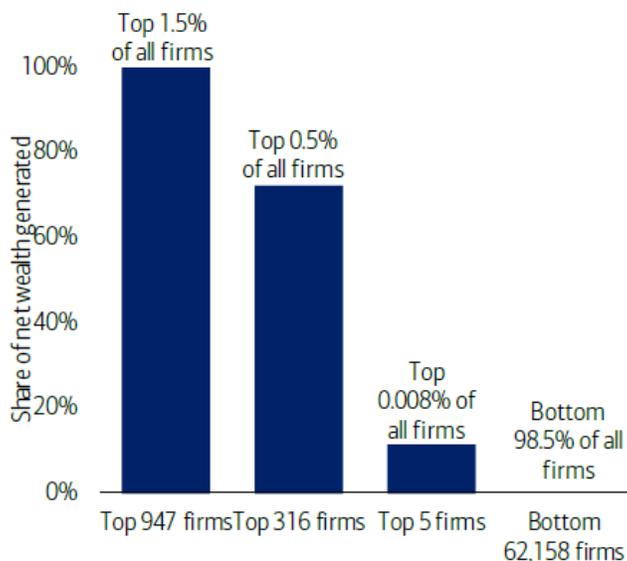
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We currently expect the agentic AI market to scale to hundreds of billions of dollars in the next five years, creating a strong tailwind to business productivity.

Global Knowledge Worker Base (1.065bn)							
Global knowledge worker base	Sales 137MM	Marketing 39MM	Support 66MM	Finance 142MM	HR 70MM	IT 113MM	Operations 105MM
✖ Assumed global median salary	\$26k	\$29k	\$18k	\$30k	\$26k	\$34k	\$26k
Implied global salaries / wages	\$3.6trn	\$1.2trn	\$1.2trn	\$4.2trn	\$1.9trn	\$3.9trn	\$2.7trn
Annual wages of 7 detailed occupation (\$18.6 trillion)							
✖ Avg. % of workflows captured by AI Agent	10%	10%	20%	10%	10%	30%	10%
Productivity uplift	\$0.36trn	\$0.12trn	\$0.24trn	\$0.42trn	\$0.19trn	\$1.17trn	\$0.27trn
Approximate productivity uplift (\$2.77 trillion)							
✖	Assumed software vendor value capture (10%, or customer ROI of 10x)						
	Implied global agentic AI spending by 2030 (\$277bn)						

**Exhibit 103.** *Agentic AI Market Size, July 2025, source BofA Research and Alkeon.*

Overall, this incredible cycle of AI disruption and associated value creation carries another important implication. There is going to be a small number of companies that generate the majority of added wealth. For example, according to BofA Global Research, between 1990 and mid-2020, the global market generated approximately \$56 trillion of wealth. Yet only 1.5% of companies accounted for all of this wealth creation, with an acceleration of this concentrated wealth creation in recent years, in our view.



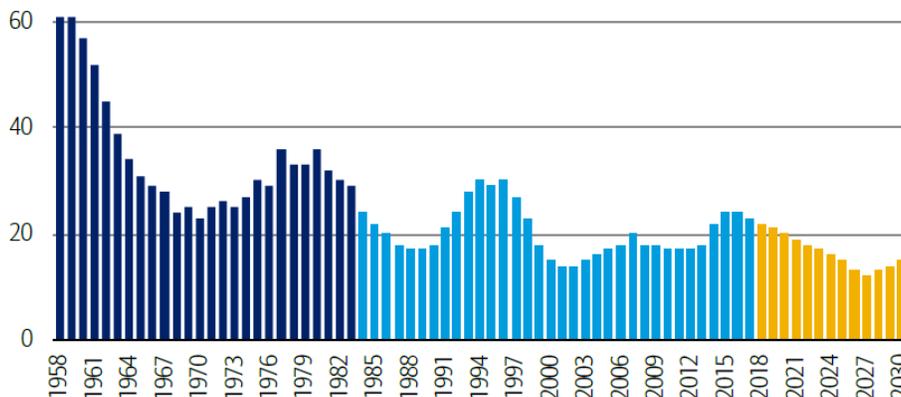
**Exhibit 104.** *Share of Net Wealth Generated by Global Stocks, 1990 to mid-2020, source BofA Global Research.*

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In this connection, BofA Global Research has predicted that 50% of S&P 500 companies could be replaced in ten years. Specifically, the average tenure of an S&P 500 company has been forecast to contract from its high of nearly sixty-one years in 1958, thirty years in the 1980s, and twenty-four years in 1976, to approximately twelve years by 2027.

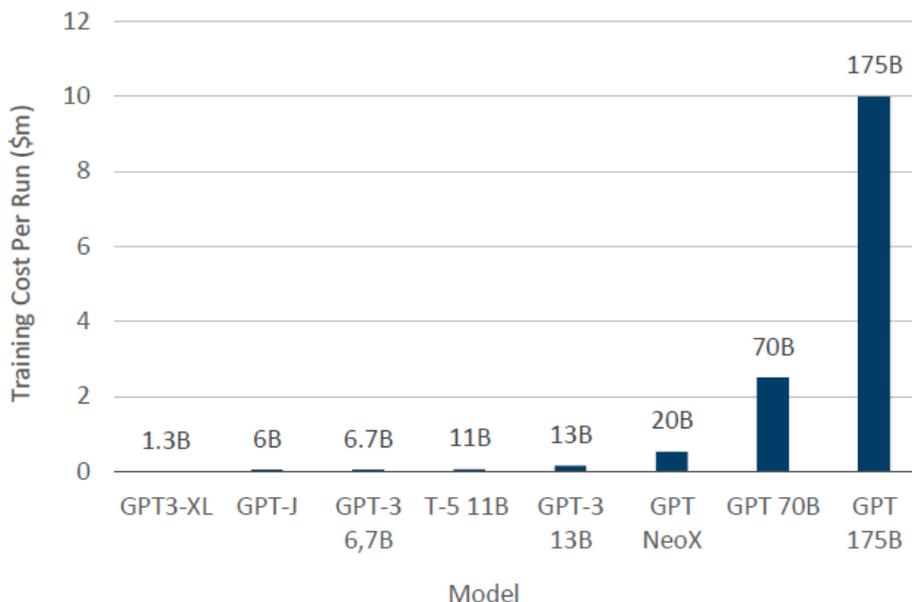
*This supports our view of a highly favorable environment for stock picking, reinforcing the need for investors to remain exceedingly selective.*

Average company lifespan on S&P 500 Index (year, rolling 7 year average)



**Exhibit 105.** Average Lifespan of S&P 500 Index Companies on the Decline, September 2021, source BofA Global Research.

There is a fundamental reason behind this disruption, namely, the costs of innovating are high. AI is expensive, and has become increasingly so, as the cost of AI training soared as models scaled up. For example, a model the size of GPT3 can cost more than \$10 million for a single training run. And trillion parameter models like GPT4 can have training costs upwards of \$50 million for a single training run.

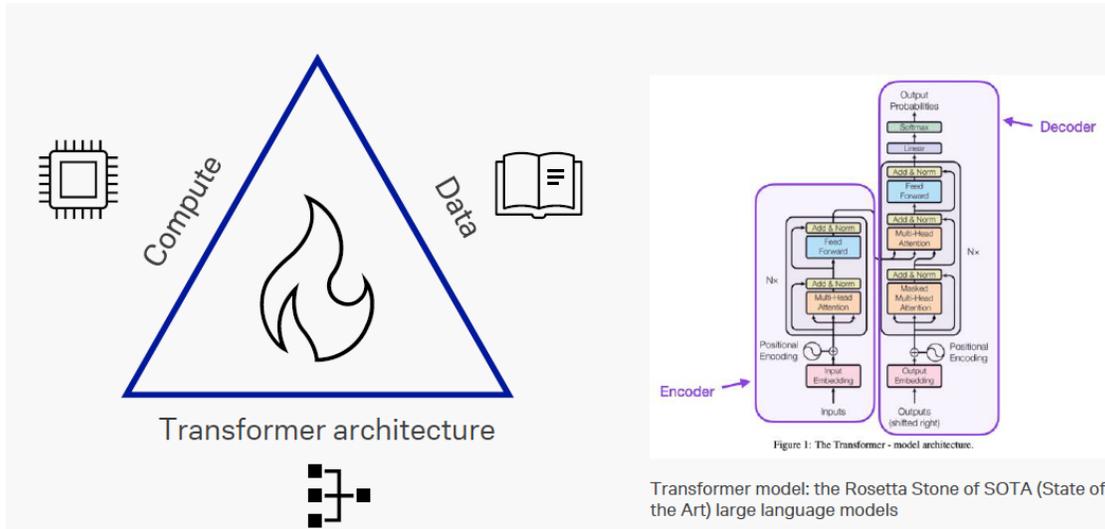


**Exhibit 106.** The Cost of AI Training is Soaring as Models Scale Up (Single-Run Costs), source Nvidia.

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Consequently, we believe this pattern of disruption and concentration in wealth creation is likely to continue in the next decade, widening the gap between the “haves” and the “have nots”, and potentially creating an attractive backdrop for long-short equity investing.

Fundamentally, we currently believe we are at the very beginning of a secular growth path that favors a number of high-quality secular compounders with strong competitive positions. **It is important to stress that the AI revolution is at its very early stages, as only in late 2022 did AI go mainstream with the introduction of ChatGPT.**



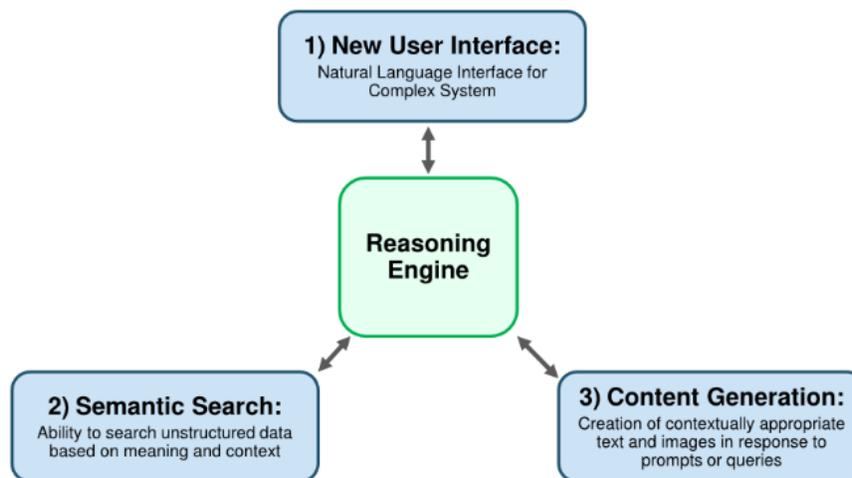
**Exhibit 107.** *The Tipping Point for Generative AI: Massive Computing Power, Data and the Invention of the Transformer Model, source Deutsche Bank.*

Modern AI, which –to the mainstream– is only two and a half years old, represents a huge leap, a step-function improvement over traditional AI models in its ability to handle unstructured data and create new content.

For the first time, the addition of a reasoning engine at the core of the algorithm allows AI to be empathetic and imaginative, creative, generative, and inventive, as it approaches human-mind complexity and deep-path relational reasoning.

**Generative AI Adds a Reasoning Engine to Software Tool Kit**

**By Representing the Relationships Between Words and Images in Numbers, Generative AI Enables Three Core Functions within Enterprise Software**



**Exhibit 108.** *Generative AI Relational Reasoning Capabilities, source Morgan Stanley.*

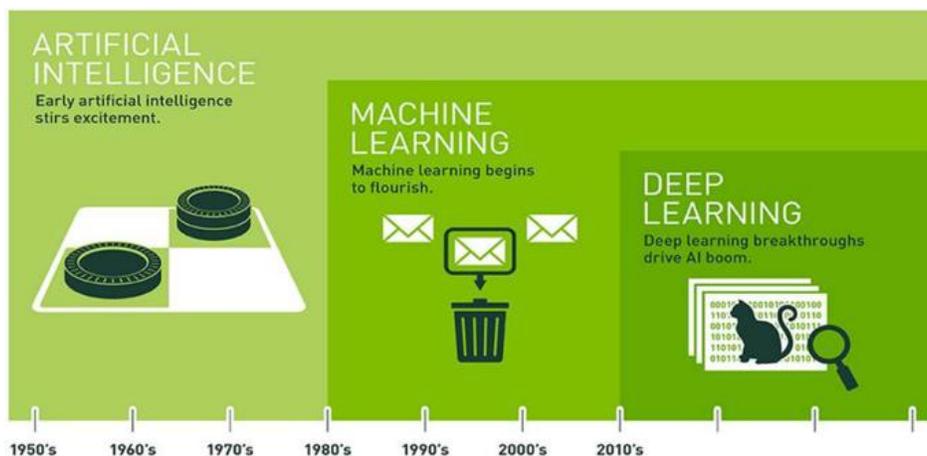
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This new data paradigm is expected to significantly increase the amount of compute power needed to drive these very large datasets and complex Generative, and now Generalized Reasoning, AI models, with now trillions of parameters, over the next several years.

### Early Stages of the AI Revolution and the Future of AI

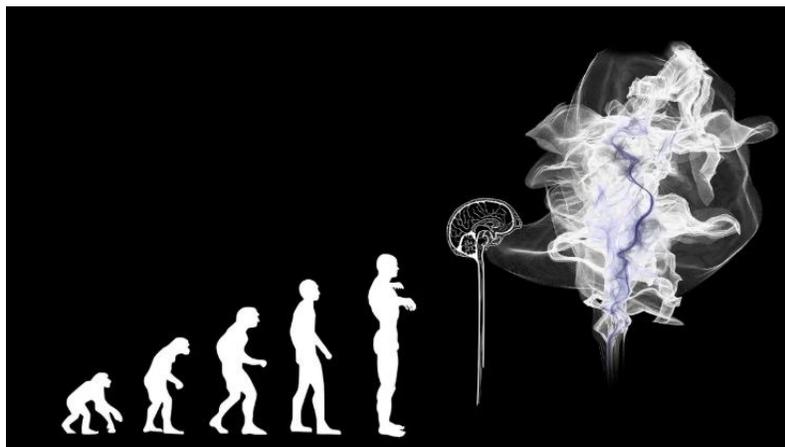
In summary, we believe we remain relatively early in AI's adoption across the broader economy, but we are accelerating rapidly. Looking at the four main drivers of AI growth, we now expect larger enterprises to move from proof-of-concept and experimentation phases to production in 2025, adding to three other market segments with significant 2025 tailwinds, namely the consumer, hyperscalers and sovereign segments. The last of which is also expected to accelerate sizably in coming years.

As we detail below, the AI revolution has been decades in the making. But, until most recently, the compute power needed to handle AI models with tremendous complexity was simply not there.



**Exhibit 109.** *The Era of Deep Learning, source Nvidia and JP Morgan.*

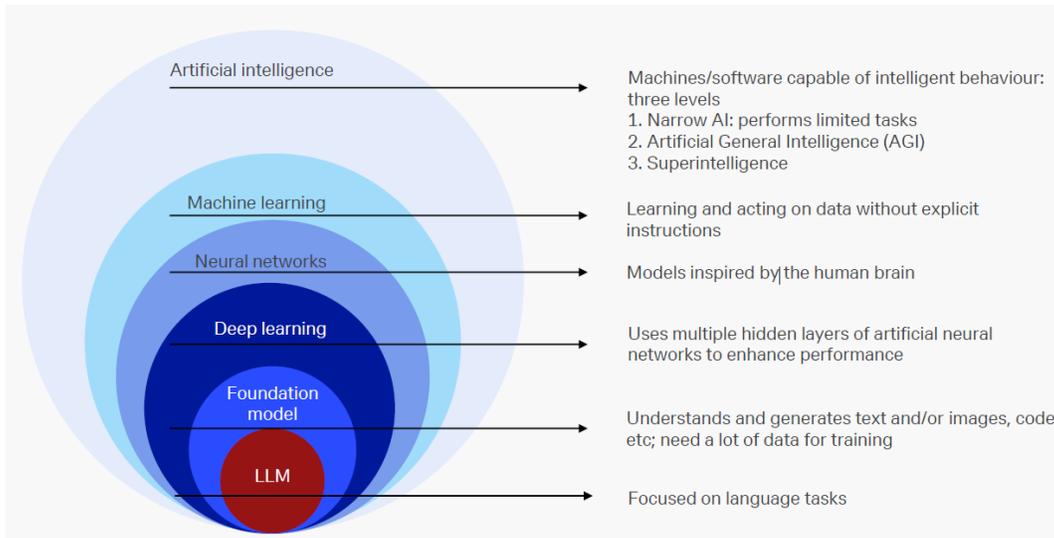
It was only recently in 2020 that AutoML Zero, developed by scientists at Alphabet, elevated the idea of automatic machine learning algorithms that are machine-created and can automatically improve themselves through Darwinian style evolution. This approach elevated machine learning innovation to a different level by un-constraining the hand-designed machine learning algorithm building and discovery process that can bias searches in favor of human-designed algorithms that are inherently limiting in the number of options they consider – as “you cannot search for what you cannot discover”.



**Exhibit 110.** *AutoML-Zero: Evolving Machine Learning Algorithms from Scratch, source Bigthink.*

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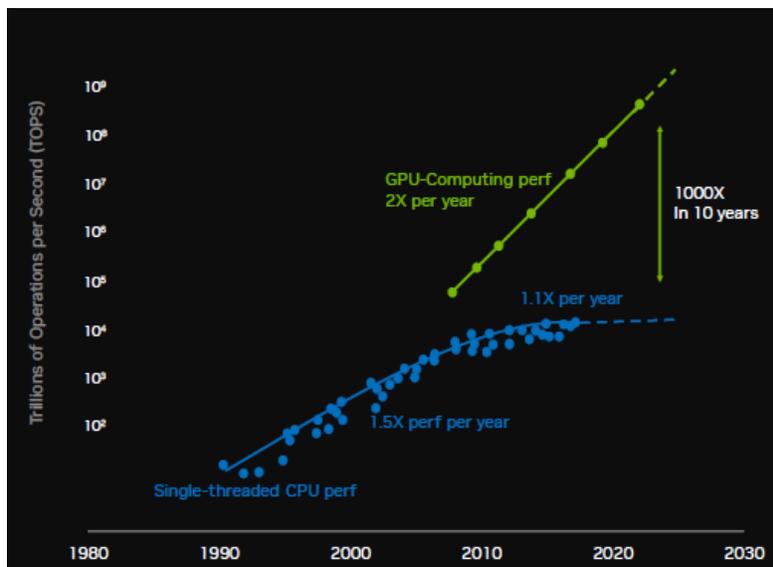
Such models, trained on vast amounts of data, necessitated the creation of powerful compute platforms between 2020 and 2022 that could attack AI problems of tremendous complexity. This ultimately led to the tipping point for generative AI at the very end of 2022, when large language models became capable of understanding and generating human-like text. These models were, for the first time, creative and empathetic, imaginative and generative.



**Exhibit 111.** *What is a Large Language Model and Where Does it Fit into AI?, source Deutsche Bank.*

Advancing and bringing AI to the mainstream at the end of 2022 was a hugely important milestone, as only in the last few years have advances in computing power (a more than 30,000-fold increase in seven years) enabled this new era of AI training. It took one GPU to train AlexNet (the convolutional neural network architecture designed by Alex Krizhevsky) a decade ago, while GPT-3 required 10,000 GPUs for training, all linked together.<sup>15</sup> Current models are trained on hundreds of thousands of GPUs, and we believe that we are moving to clusters of millions of GPUs in coming years.

Incredibly, and as we were marking an inflection point of change in 2023-2024, advancing algorithmically closer to cognitive AI, the hardware which is needed to optimally process huge quantities of data and train these advanced AI models, also advanced exponentially, reaching new milestones at the same time. Enter the era of Accelerated Computing, advanced computing in the post-Moore’s Law era, which can handle problems with tremendous complexity for the first time.

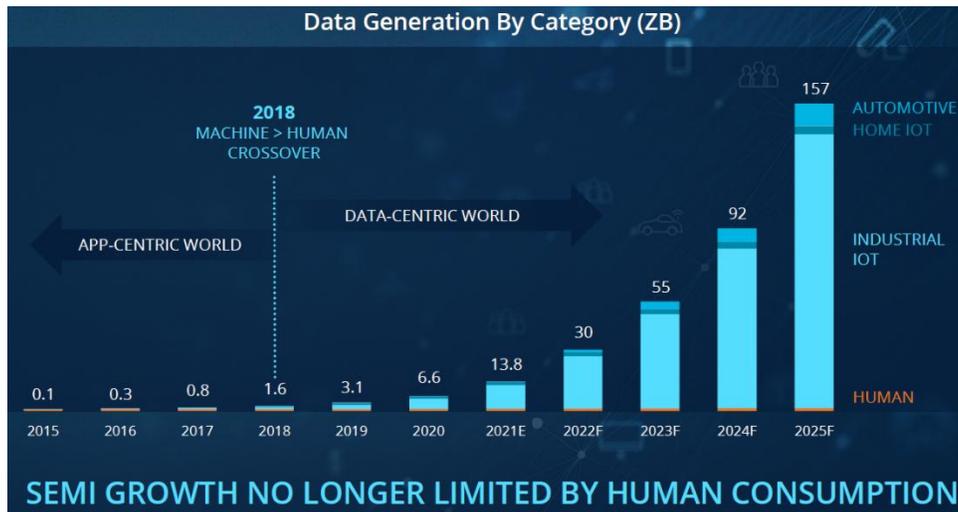


**Exhibit 112.** *Dramatic Acceleration in Inference Performance, source Nvidia.*

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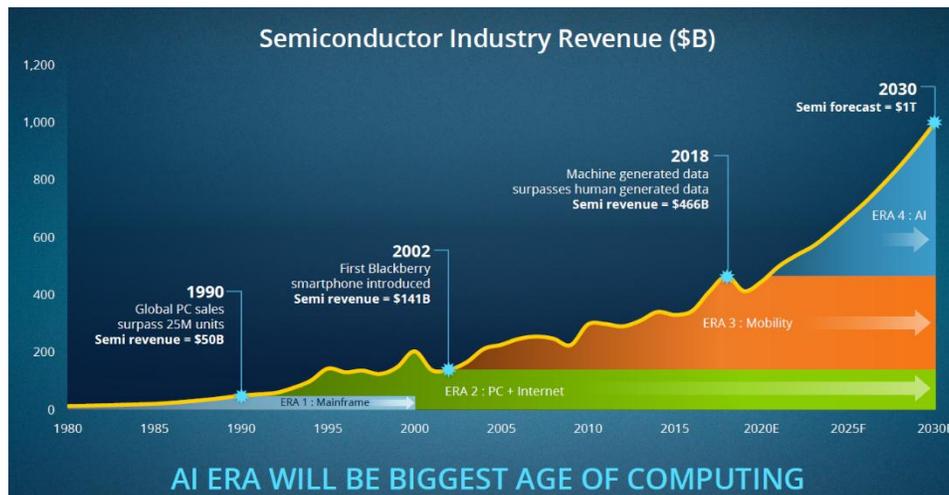
To enable AI models with billions and recently trillions of parameters, AI chips are becoming larger and larger, with designers now embedding significant amounts of fast memory on the chip to handle the demands of AI training algorithms that require a huge amount of communication and a modest amount of relatively easy compute.

Such important hardware advances are coming at the right time, as only a few years ago the amount of data generated by machines surpassed the amount of data generated by humans, and that gap is now widening exponentially.



**Exhibit 113.** Data Generation by Category (in Zettabytes), source Applied Materials.

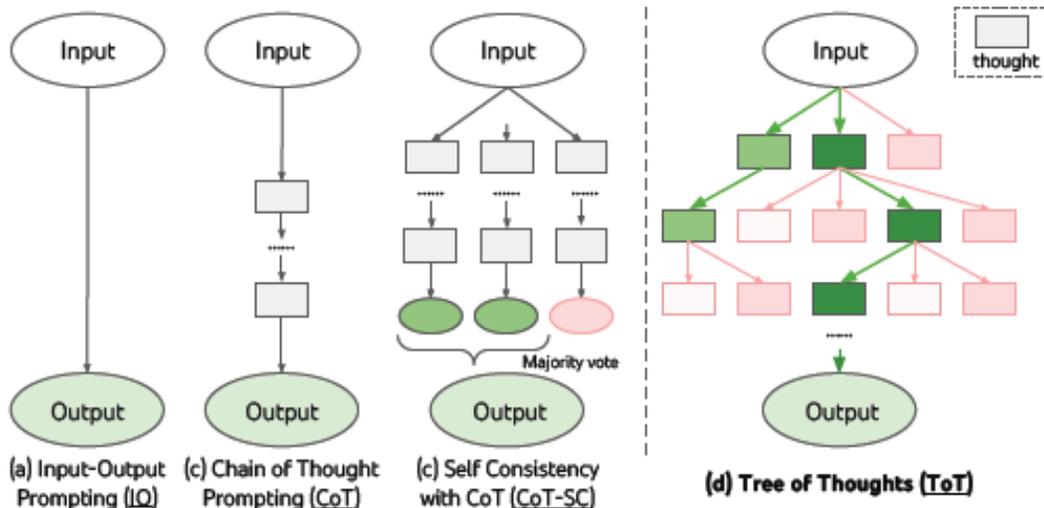
Having now built an advanced computational foundation, the new modern AI era is expected to be the biggest and most transformational era of computing. This carries positive secular growth implications for both software and hardware.



**Exhibit 114.** Semiconductor Industry Revenue, Billions, source Applied Materials.

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Early in 2024, we wrote and talked about the recent emergence of advanced AI models that bring us closer to generalized reasoning. These models can advance on several layers of analysis and reasoning (“deep-path reasoning”), solving complex problems (such as advanced geometry problems) that even powerful LLMs were unable to solve. An example was DeepMind’s “Tree of Thoughts” that can evaluate different reasoning paths, and can look ahead or back-track as needed before making optimal choices.



**Exhibit 115.** Approaches to Problem Solving with LLMs – Each Rectangle Box Represents a Thought, source Google DeepMind and Princeton University.

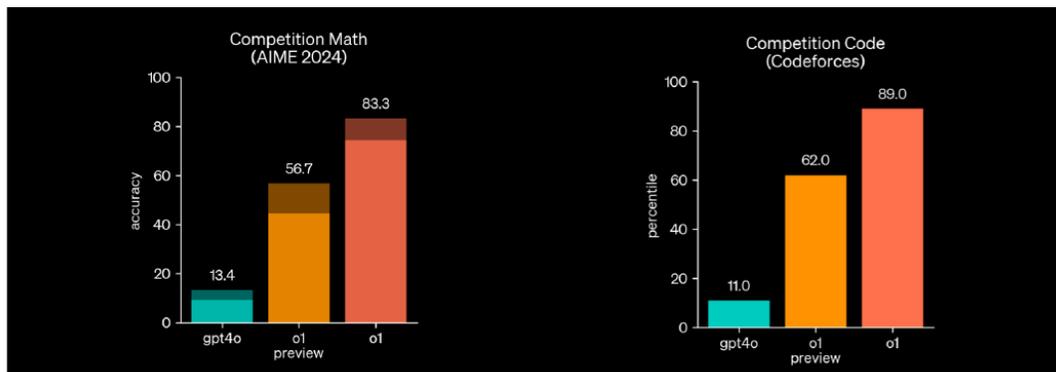
Then, in a seminal moment that marks the start of the pre-AGI era, OpenAI, in September 2024, released a powerful new model, named o1, a model that thinks and self-reflects before responding.

Like a human, the longer o1 thinks the better it does on complex reasoning tasks, such as math and code generation.

**Hunter Lightman** @hunterlightman

For a lot of the time that I have been here we have been trying to make the model better at solving math problems as an example. And we put a lot of work into this, and we've come with different methods.. One thing I kept, every time I would read one of these outputs from the model I would be so frustrated that the model would never seem to question it was wrong or it making mistakes, or things like that. (September 2024)

But one of these early o1 models we actually started talking to it and sort of asked these questions, and it was scoring higher on these math tests we were giving it, we could look at how it was reasoning, and you could see it started to question itself, and had interesting reflections, and that was the moment for me. (September 2024)



**Exhibit 116.** o1 Competition Math and Code Scores, September 2024, source OpenAI.<sup>16</sup>

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o1 also opened up a new dimension of scaling, scaling inference in addition to training.



**Michael Dell**

o1 is trained to “think” before responding. The longer it thinks, the better it does on reasoning tasks. It opens up a new dimension for scaling. We are no longer bottlenecked by pre-training. We can now scale inference compute too. *(September 2024)*

We haven't even talked about inference, and inference will be 90% of the AI workload by the end of the decade. *(September 2024)*



**Noam Brown**  
@polynomial

**Exhibit 117.** Pre-Training, Post-Training and Inference Proportions, September 2024, source OpenAI.<sup>17</sup>

For the first time we saw the model think, self-reflect and improve itself, and we actually watched its chain of thoughts (see Appendix, Exhibits 150-151 at the end of this letter).<sup>18</sup>



**Noam Brown**  
@polynomial

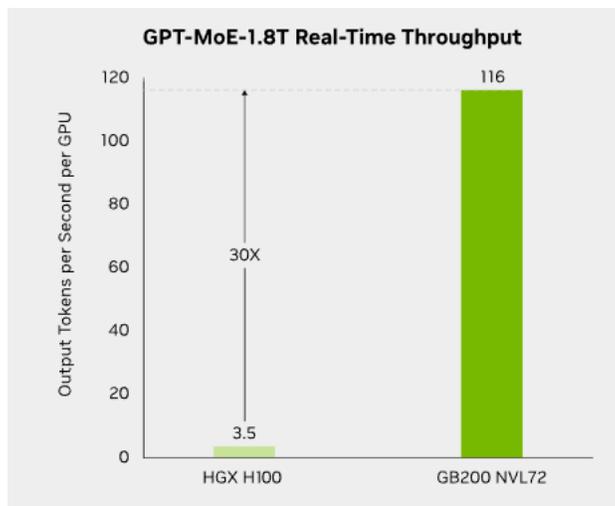
@OpenAI's o1 thinks for seconds, but we plan for future versions to think for hours, days, even weeks. Inference costs will be higher, but what cost? Would you pay for a new cancer drug? For breakthrough batteries? For a proof of the Riemannhypothesis? *(September 2024)*

@Scaling inference time compute can compete with scaling-time compute! *(September 2024)*



**Will Depue**  
@willdepue

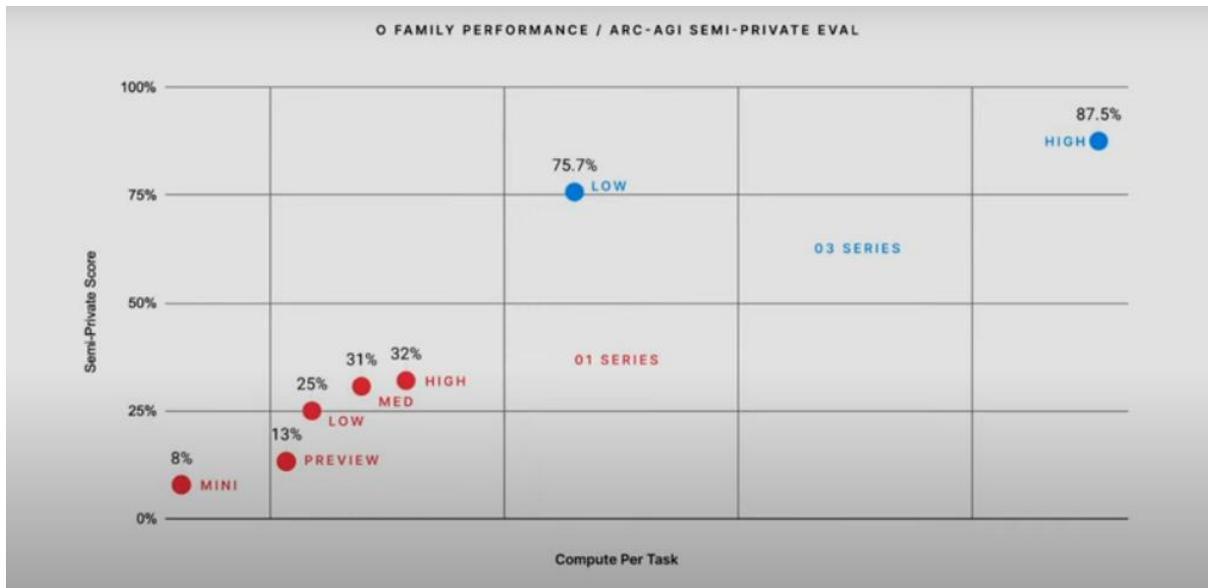
As scaling dramatically occurs during inference, the amount of compute power needed to analyze complex problems for hours can be astronomical. As such, recent advances in inference performance become crucial to the success of models with generalized reasoning capabilities.



**Exhibit 118.** 30x Improvement in Inference Performance, source Nvidia.

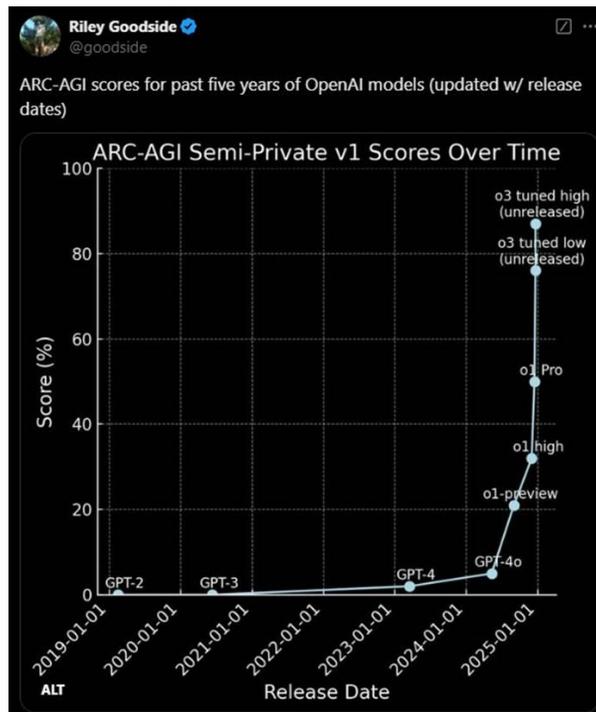
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Incredibly, three months after the introduction of o1, in December 2024, OpenAI introduced a new, even more advanced model, namely o3, that brought generalized reasoning capabilities to a human PhD level.



**Exhibit 119.** Getting Closer to AGI – o3 Achieves New Record 87.5% Accuracy on ARC AGI Benchmark Eval, Exceeding Human Intelligence at 85% Level, source OpenAI.

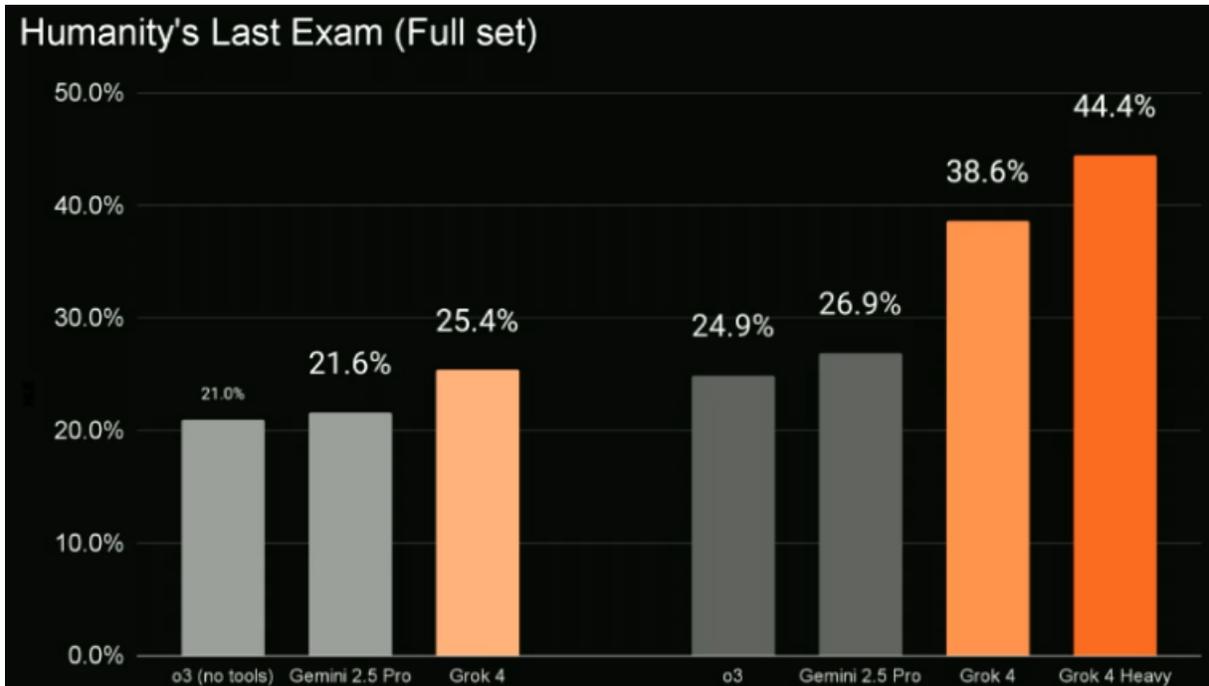
o3 surpassed the human score on ARC AGI benchmark evaluation, officially marking the start of the pre-AGI era. If prior years brought exponential improvement in AI scoring, o3 extended a vertical path in AGI scoring.



**Exhibit 120.** Vertical Improvement in AGI Scoring – ARC-AGI Scores for Past Five Years of OpenAI Models, source Morgan Stanley, X.

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And in 2025, Grok4 advanced GenAI models even further, bringing post-graduate level expertise in academic disciplines, scoring 100% in the American Invitational Math Exam (AIME), and 44.4% on “Humanity’s Last Exam”, a challenging 2,500-quesiton AI benchmarking test created by the Center for AI Safety, much higher than prior models.

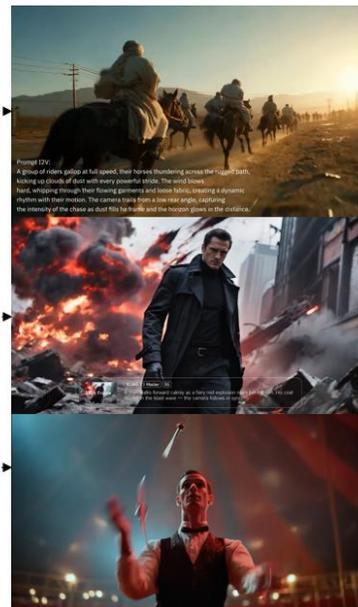


**Exhibit 121.** *Humanity’s Last Exam (HLE) Benchmark Test, source xAI.*

As AI progress is now taking place at unimaginable speed, 2025 also marked a year of significant new advances in multimodality (i.e., AI models that can understand, transform and generate all data forms, including, text, image and video) and AI-powered humanoid robots. In particular, video generation technology so far this year saw accelerated development, fueled by a wave of new models emerging across the globe.

Artificial Analysis Video Arena Leaderboard

Text to Video		Image to Video		# Appearances	Released
Creator	Model	Arena ELO	95% CI		
1	ByteDance Seed	Seedance 1.0	1,292 -7/+8	18,597	Jun 2025
2	Google	Veo 3 Preview (No Audio)	1,244 -7/+7	18,822	May 2025
3	Google	Veo 2	1,133 -7/+6	19,488	Dec 2024
4	Kuaishou	Kling 2.0	1,116 -6/+6	18,853	Apr 2025
5	OpenAI	Sora	1,046 -6/+5	24,645	Dec 2024
6	Kuaishou	Kling 1.5 (Pro)	1,044 -5/+5	24,122	Sept 2024
7	MiniMax	T2V-01	1,040 -4/+4	38,739	Sept 2024
8	Pika Art	Pika 2.0	1,034 -6/+5	24,444	Dec 2024
9	Alibaba	Wan 2.1 14B	1,028 -6/+6	19,379	Feb 2025
10	Kuaishou	Kling 1.6 (Pro)	1,026 -6/+6	19,305	Dec 2024
11	Kuaishou	Kling 1.6 (Standard)	1,025 -6/+6	21,797	Dec 2024
12	MiniMax	T2V-01 Director	1,020 -6/+6	19,897	Jan 2025
13	Tencent	Hunyuan Video (Open Source)	1,005 -6/+6	21,421	Dec 2024



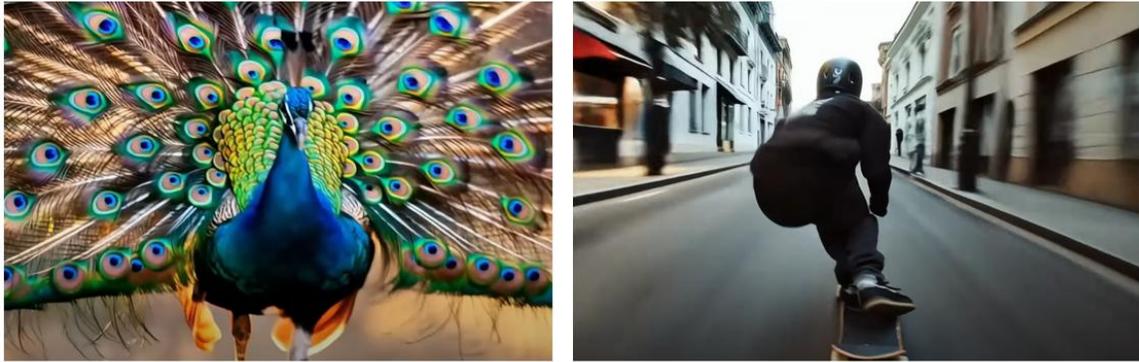
**Exhibit 122.** *Artificial Analysis Video Arena Leaderboard, July 2025, source artificialanalysis.ai.*

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Video models, like Kling AI 2.0, are now democratizing content creation, redefining how studios may operate in the future.

### Kling AI 2.0

[https://www.youtube.com/watch?v=1BJASjim3-4&list=PL6EjM\\_XhcxWI290wu142g-NjT5x4ZEFKF&index=2](https://www.youtube.com/watch?v=1BJASjim3-4&list=PL6EjM_XhcxWI290wu142g-NjT5x4ZEFKF&index=2)



**Exhibit 123.** *Kling AI 2.0, June 2025, source YouTube.*

And Google's Deepmind Veo 3, introduced in June 2025, is producing incredible videos with realistic motion and high quality.

### Veo3

<https://www.youtube.com/watch?v=RpZmXjcGyDU>

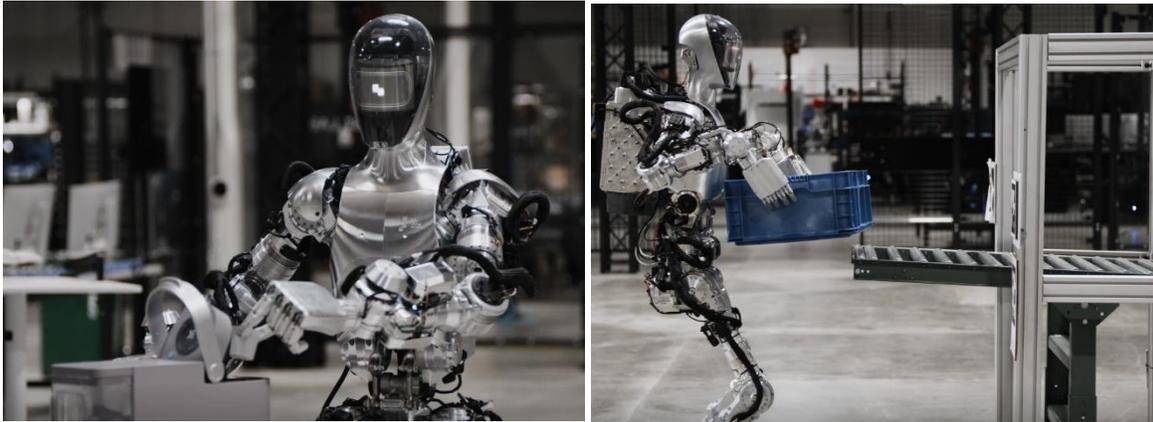


**Exhibit 124.** *Veo 3, June 2025, source YouTube.*

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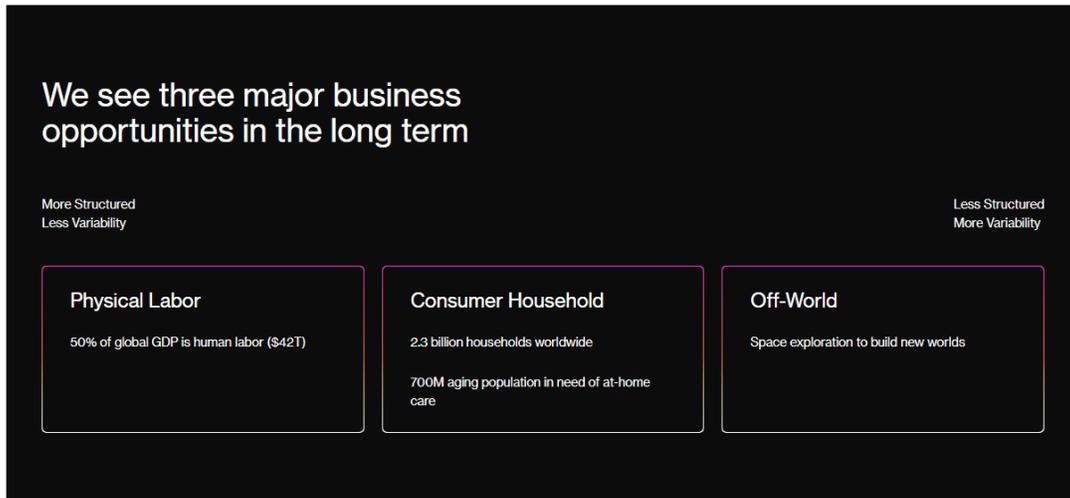
These powerful video and multimodal models add another dimension to the generalized reasoning capabilities and special understanding needed to bring us closer to AGI.

And these new models are now powering humanoid robots, too, such as the newly launched Figure robots.



**Exhibit 125.** *Humanoid Robots, source Figure.*

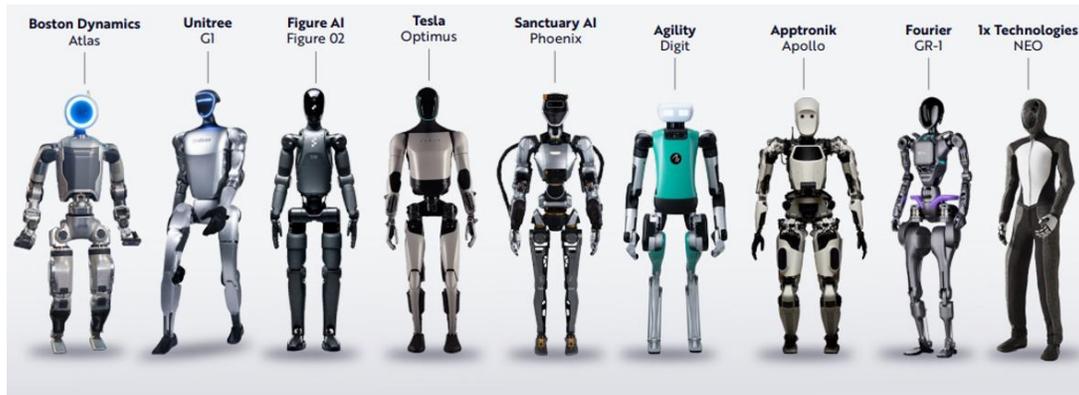
The founder of humanoid robotics firm Figure has famously said, “Every human will own a robot in the future, similar to owning a car/phone today”, which is a belief that other visionaries such as Elon Musk have shared.<sup>19</sup> In this connection, Figure believes that there will be significant labor shortages in certain occupations, with almost 10 million unsafe or undesirable jobs in the US alone, and that “humanoids will revolutionize a variety of industries, from corporate labor roles (3+ billion humans), to assisting individuals in the home (2+ billion), to caring for the elderly (~1 billion), and to building new worlds on other planets”.<sup>20</sup>



**Exhibit 126.** *AI & Robotics Possibility, source Figure.*

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Traditionally, robotics and AI were different fields. But now, with the advent of multimodality for training robots, much more efficiently and faster than the past, the two fields are converging, giving rise to a number of startups that are producing next generation humanoid robots, that can observe, emulate and learn quickly.



**Brett Adcock**  
@Adcock\_brett

Important update: Figure is launching robots into the home  
Our AI, Helix, is advancing faster than any of us anticipated, accelerating our timeline into the home  
Therefore, we've moved-up our home timeline by 2 years; starting Alpha testing this year  
(Founder of Figure Robot, Feb 28<sup>th</sup> 2025, )

**Exhibit 127.** *Humanoid Robots Lineup, source LifeArchitect.ai.*

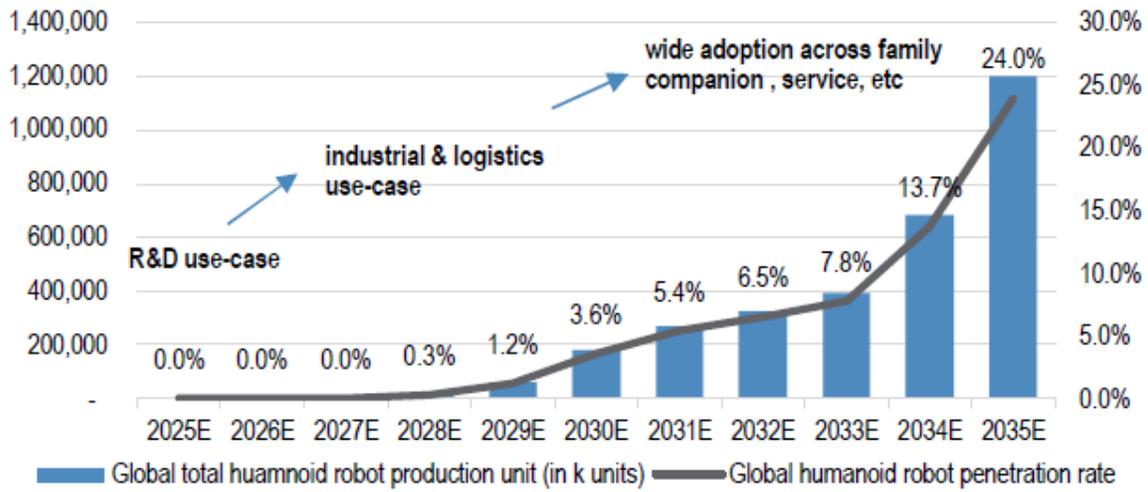
A humanoid is a robot that resembles a human in bodily shape. This is a powerful idea, as the world is already setup for humans to operate in, providing a brownfield environment for humanoids, and expanding the Total Addressable Market (TAM) from manufacturing and warehousing to home assisting, caring for the elderly, education, entertainment and corporate labor.

Type	Industrial robot			Service robot	Humanoid robot
	Traditional industrial robot	Collaborative robot (Cobot)			
Definition	Industrial robots are heavy-duty machines designed to automate the manufacturing process	Cobots are intended for direct human-robot interaction within a shared space, or where humans and robots are in close proximity		Service robots are robots in personal use or professional use that performs useful tasks for humans or equipment.	Humanoid robots are robots designed to resemble humans in appearance and behaviour
Capability	<ul style="list-style-type: none"> <li>- Material handling</li> <li>- Assembly</li> <li>- Welding</li> <li>- Painting &amp; Coating</li> <li>- Quality inspection</li> <li>- Picking, sorting and packing</li> </ul>	<ul style="list-style-type: none"> <li>- Assembly (part selection, dispensing of adhesive, fastening of screws, etc.)</li> <li>- Machine tending</li> <li>- Material handling</li> <li>- Quality inspection</li> <li>- Welding</li> </ul>		Service robots include <b>consumer service robots</b> (domestic cleaning robots, automated wheelchairs, and social interaction robots), and <b>professional service robots</b> (cleaning robots for public places, delivery robots, fire-fighting robots, rehabilitation robots and surgery robots in hospitals, as well as autonomous mobile robots (AMR))	<ul style="list-style-type: none"> <li>- Moving / walking</li> <li>- Interact with humans</li> </ul>
Features	<ul style="list-style-type: none"> <li>- Do work in place of human beings;</li> <li>- Can handle heavier and larger materials than cobots;</li> <li>- Moves at a faster speed than cobots;</li> <li>- Engineers need to re-write codes for any changes;</li> <li>- Often needs safety cages to keep humans out of the workspace</li> </ul>	<ul style="list-style-type: none"> <li>- Do work alongside human beings;</li> <li>- More easily programmable than industrial robots;</li> <li>- Not designed for heavy manufacturing;</li> <li>- Usually cheaper than industrial robots</li> </ul>			<ul style="list-style-type: none"> <li>- Could perform complex actions that require human-like dexterity, such as picking up objects, walking and climbing stairs;</li> <li>- Able to behave like humans and interact with humans</li> </ul>
User case	<ul style="list-style-type: none"> <li>- Manufacturing factory</li> <li>- Warehouse</li> </ul>	<ul style="list-style-type: none"> <li>- Manufacturing factory</li> <li>- Agriculture</li> <li>- Medical</li> <li>- Pharma</li> </ul>		<ul style="list-style-type: none"> <li>- Transportation &amp; logistics</li> <li>- Hospitality</li> <li>- Medical robotics</li> <li>- Professional cleaning</li> <li>- Agriculture</li> </ul>	<ul style="list-style-type: none"> <li>- Manufacturing factory</li> <li>- Warehouse</li> <li>- Entertainment</li> <li>- Education</li> <li>- Home assistance</li> <li>- Elderly care</li> </ul>
Example					

**Exhibit 128.** *Types of Robots – Humanoid Robots Are a New Addition to the Robot Industry, July 2024, source Deutsche Bank.*

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Overall, Humanoid Robots represent a huge potential market opportunity, at very early stages of growth.



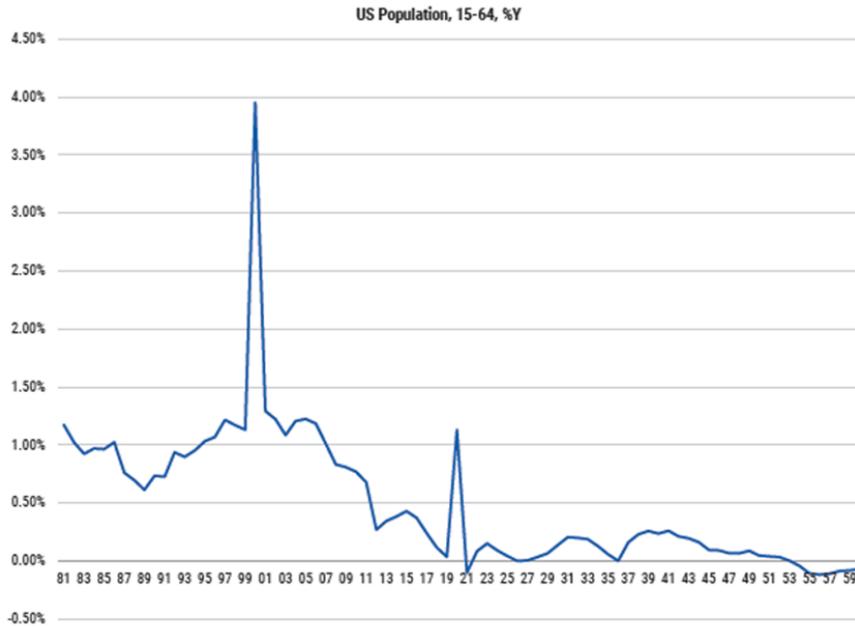
**Exhibit 129.** Global Humanoid Robot Adoption Rate Expectations, February 2025, source JP Morgan.

Some new advanced features include upside-down walking, adaptive rollover, climbing over obstacles and jumping.



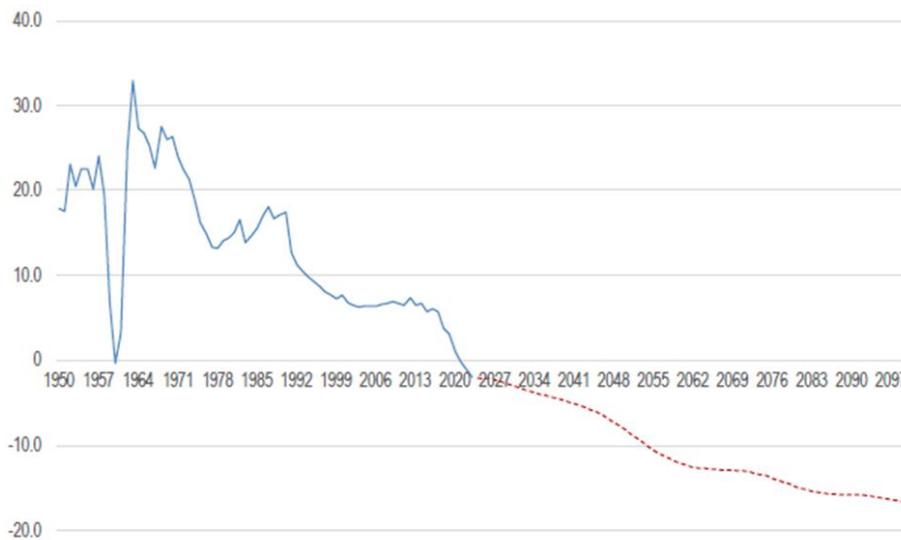
**Exhibit 130.** Incredible Stability and Flexibility, <https://www.youtube.com/watch?v=lvFqJmSL5h0>, source Unitree.

Fueling this growth path is simply bad demographics, globally. As demographics represent a big headwind to labor force both in the US and overseas, Humanoid Robots can absolutely become a needed solution to a major challenge.



**Exhibit 131.** *US Population Growth – Growth is Expected to Slow Further, June 2024, source Morgan Stanley.*

And China, in particular, is facing an even more dramatic demographic challenge.



**Exhibit 132.** *China's Natural Rate of Change, February 2025, source JP Morgan.*

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Unsurprisingly, China leads the world in Humanoid patents.

**Patents Mentioning "Humanoid" By Office (Past 5 Years)**

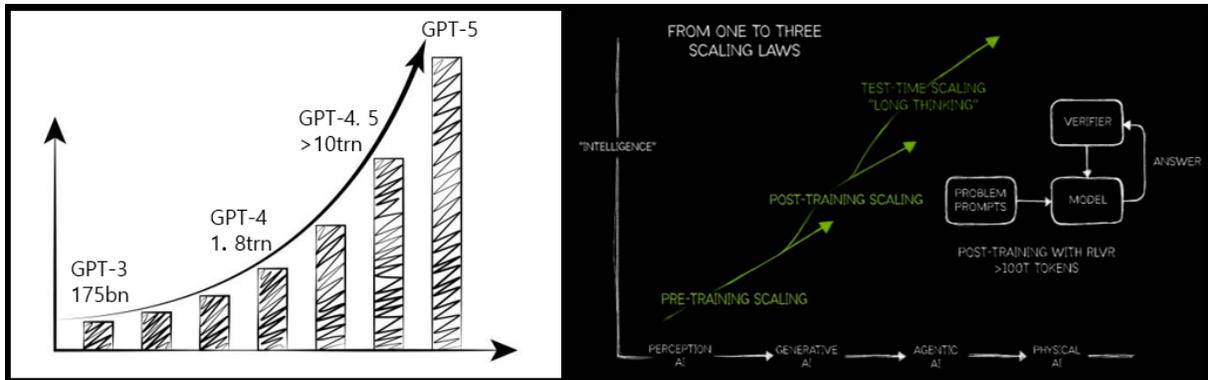
Rank	Patent Office	# Count
1	China	5,724
2	United States	1,455
3	Japan	1,094
4	World Intellectual Property Organization (WIPO)	1,056
5	South Korea	325
6	European Patent Office (EPO)	225
7	Taiwan	191
8	Germany	70
9	Canada	24
10	Brazil	24
11	Poland	23
12	Australia	22
13	Turkey	15
14	France	15
15	Great Britain	14
16	Italy	14
17	Eurasian Patent Organisation (EAPO)	9
18	Spain	8
19	Sweden	7
20	Romania	6

Note: Exhibit limited to top 20.

**Exhibit 133.** *Global Humanoid Patent Applications, March 2025, source Morgan Stanley.*

Overall, we remain excited about the future of AI. Compute is becoming one of the most precious commodities in the world, as AI mega factories emerge, scaling foundational models to tens of trillions of parameters, and scaling post-training to hundreds of trillions of tokens with combined SFT (supervised fine-tuning) and RVVF (reinforcement learning with verifiable rewards), leading to super-intelligent long-thinking models.

Arguably, the only thing we are missing is Multimodal Understanding and Reasoning (i.e., the ability of systems to understand and reason about information presented across multiple modalities), having already conquered everything else, image and speech recognition, language and reading comprehension, math and sciences. AGI may already be closer than we know!



**Exhibit 134.** *GPT Parameter Size Estimate, March 2025, source Alkeon, OpenAI. From One to Three Scaling Laws, March 2025, source NVIDIA.*

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*A Step Back: A Historical Review*

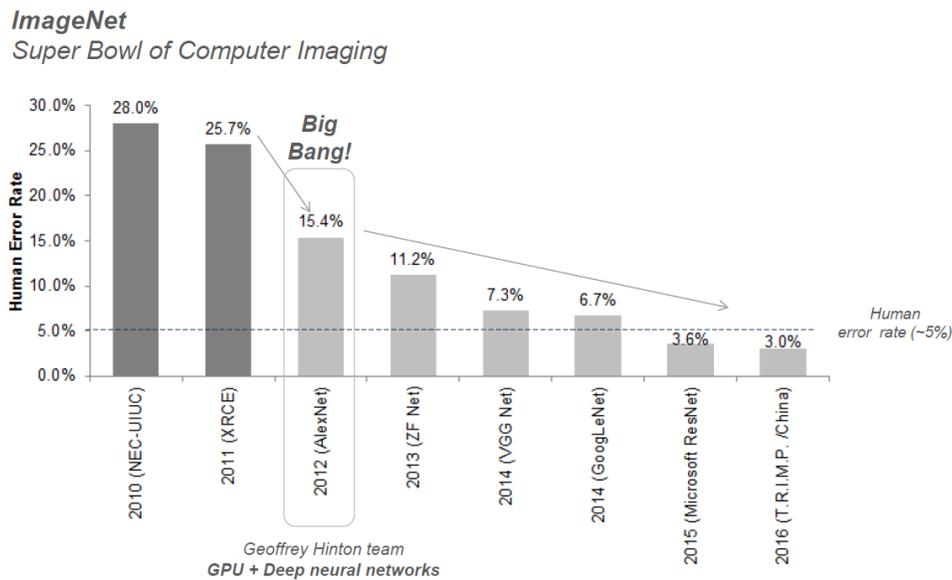
As one contemplates how early we are in this wave of technological innovation, it is instructive to step back and detail the incredible progress that has been made in AI over the last few years and explain why 2022 represented a major inflection point in AI advancement, marking the very beginning of our journey to conquer AGI, and why the Generalized Reasoning models introduced in 2024 marked the start of the pre-AGI era.

To begin, only in recent years have machines begun to recognize images, speech and words better than people. This is despite the fact that the general theory behind parallel processing and computation, which is the foundation of machine learning, had been fully developed and taught in graduate schools for decades. What had been the hurdle for AI until recently, was the inability to cost-effectively deploy the incredible amounts of processing power necessary to solve complex problems with billions of parameters using relatively simple algorithms. Indeed, it took decades to reach this recent inflection point of change.

Looking at the history of commercial AI, it is important to note that it was only in 2007 when Nvidia first introduced its famous CUDA platform that included both the software and the GPU and only in the 2010s that AI researchers started to use GPUs for machine learning.

Then in a historic moment, in 2012, Alex Krizhevsky from the University of Toronto won the annual ImageNet computer image recognition competition (the Super Bowl of computer imaging) using GPUs for machine learning, beating the foremost computer vision experts by a wide margin, and since that moment, the use of GPUs for AI training and highly parallel workloads in high performance surged, as scaling of CPU computing reached its limits.

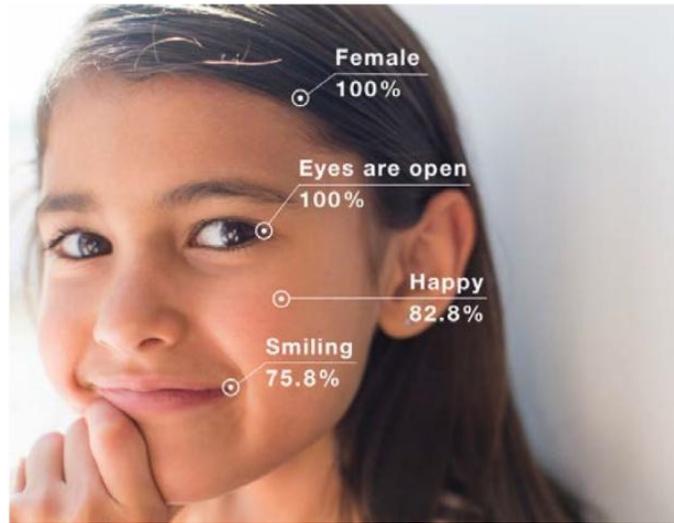
A few years later, another major milestone was reached. Using GPUs, both Alphabet and Microsoft beat the best human score in the ImageNet challenge. Officially now, computers can recognize images better than people can. This is a technological revolution, decades in the making, which, in our view, is now enabling an accelerated pace of growth and adoption of AI at a time when major milestones in image recognition, natural character recognition, natural language processing and speech recognition are regularly being reached.



**Exhibit 135. ImageNet Competition, source KeyBanc.**

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For an AI system, being able to recognize images at a low error rate was a major step towards machine cognition and ultimately relational reasoning. Technology disruptors were quick to embrace the revolution and provide the tools to enable others to do the same. For example, Amazon quickly introduced its AI image recognition tool, Amazon Rekognition, which could detect objects, scenes and faces in images. Using Rekognition, one could locate faces within images and analyze face attributes, such as whether or not the face is smiling, or the eyes are open.



**Exhibit 136.** *Example of Facial Recognition, Facial Analysis, source Amazon.*

As AI models then began to better understand visual information, computers could consequently rely heavily on machine vision to process critical information. For humans, 80% of all information we receive is derived by vision, far outweighing all other senses.<sup>21</sup> Early on, about ten years ago, computers began to read images better than we could.

Simply stated, computer vision is a major enabler of machine cognition and a fundamental component of AI sensing, giving machines the power to extract and intelligently process unstructured data to drive advanced decision-making. The potential commercial implications of this power are dramatic, impacting everything from how we drive to how we shop at the grocery store.



Source: Nvidia.

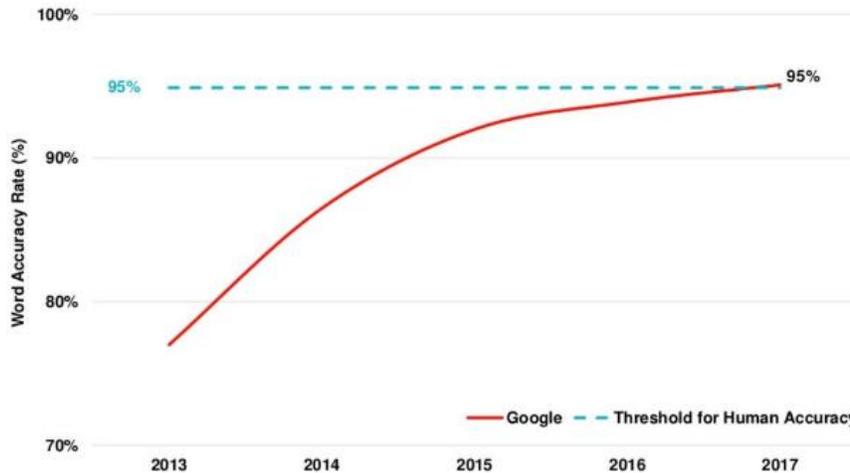


Source: Simbe Robotics.

**Exhibit 137.** *Object Identification & Classification and Retail Shelf Auditing, source Nvidia, Simbe Robotics and JP Morgan.*

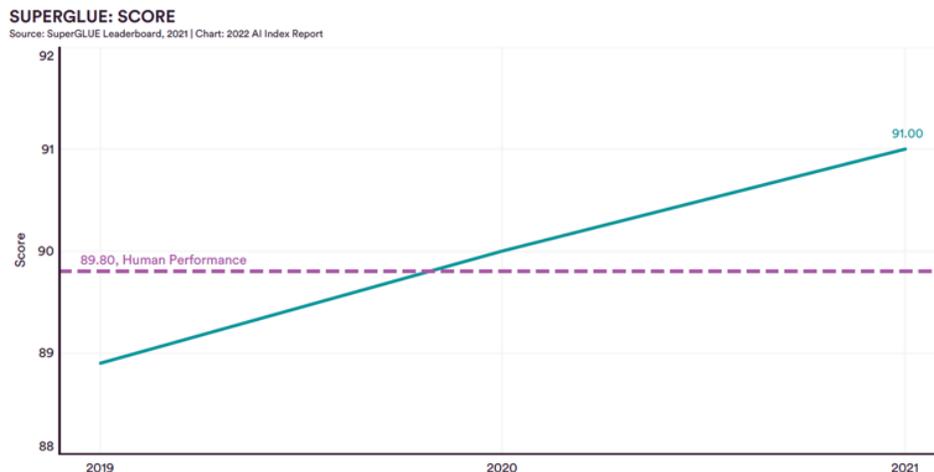
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Having surpassed human levels of performance for visual recognition in 2015, AI reached another major milestone two years later, surpassing humans for speech recognition in 2017.



**Exhibit 138.** Google Speech Recognition Word Accuracy, source AI Index Report.

Reading comprehension superiority was the latest breakthrough in 2020, with Microsoft’s transformer-based deBERTa beating humans on benchmark SuperGLUE, a set of difficult language understanding tasks.



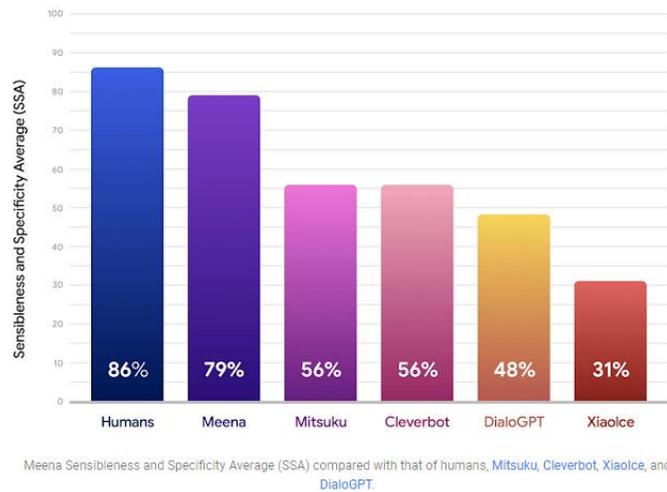
**Exhibit 139.** SuperGLUE Score, source AI Index Report.

SuperGLUE gave a single-number metric that tracked progress on linguistic tasks, including yes/no questions, identification of causality in an event, and commonsense reading comprehension. In late 2020, deBERTa scored 89.9, surpassing the human benchmark of 89.8. deBERTa was integrated in Microsoft products including Bing, Office, Dynamics, and Azure Cognitive services. AI surpassing human performance in reading comprehension was another major and very important milestone towards artificial general intelligence (AGI), the ability of AI to match human understanding and performance of intellectual tasks.

Having solved important image, speech recognition and reading comprehension problems, AI researchers then intensely focused on Natural Language Processing (NLP), a mega problem where the correlation between the size of the model and the sophistication of the algorithm had remained quite high.

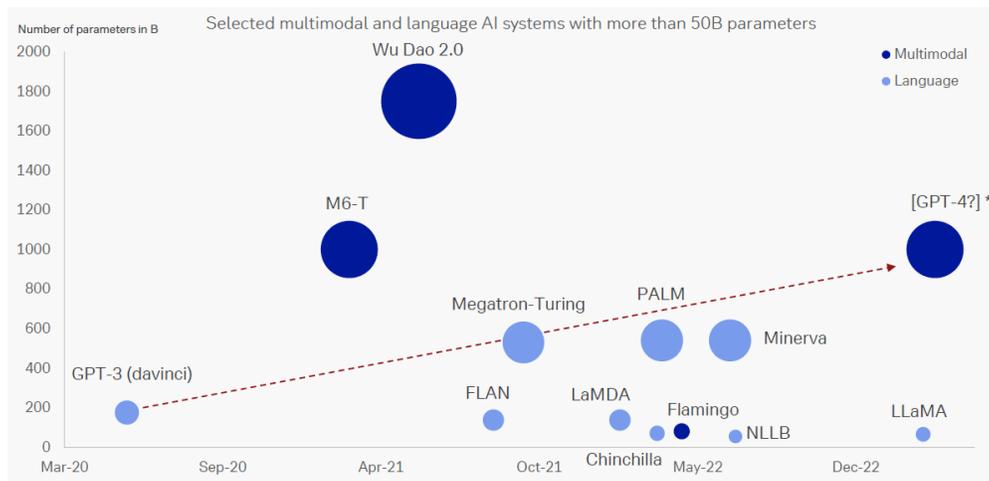
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For the first time around 2019-2020, we saw the emergence of models with billions of parameters. For example, in 2020 Alphabet introduced Meena, an end-to-end neural conversational model that learned to respond sensibly to questions. The Meena model was another example of the complexity of next generation models we discussed above, embedding 2.6 billion parameters and trained on 341 GB of text, filtered from public domain social media conversations. Alphabet claimed a sensibleness score for Meena that was not only above all other advanced agents (chatbots) but also in close reach to human performance.



**Exhibit 140.** Meena Sensibleness and Specificity Average (SSA) vs. Humans and Other Agents, source Alphabet.

These days a large language model can easily be over 1 trillion parameters. The growth in model complexity has been exponential.



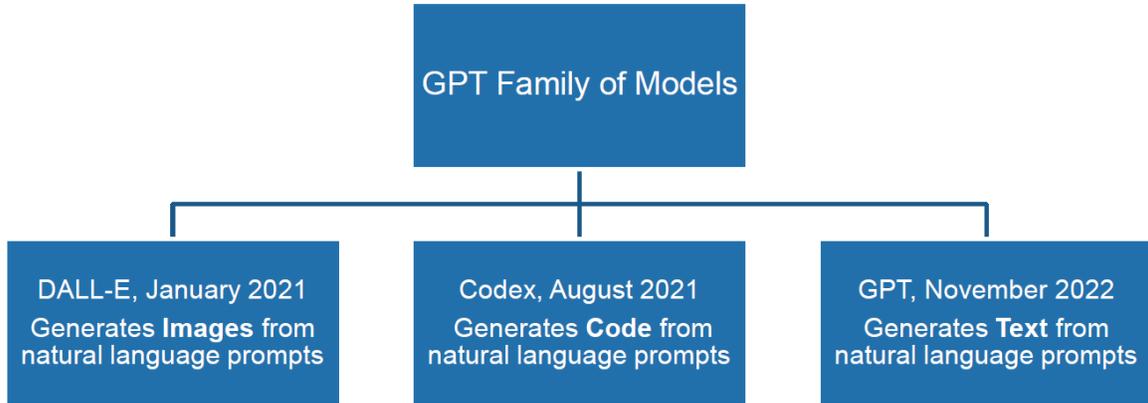
**Exhibit 141.** The Number of Parameters in LLMs Has Surged, Surpassing 1 Trillion, source Deutsche Bank.

One of the key moments that led to the current AI breakthrough was the 2021 introduction of OpenAI’s Generative Pre-Trained Transformer (“GPT-3”), one of the largest language models ever trained at 175 billion parameters. GPT-3 received much attention in 2021, and set the stage for the late 2022 inflection point of bringing AI to the mainstream. There was great hype around GPT-3 from the very beginning. As Jen-Hsun Huang described at GTC 2021 – and we communicated in our 2021 letters:

*OpenAI’s GPT-3 is 175 billion parameters. That is 3,000 larger in just three years. The applications for GPT-3 are really incredible. Generate document summaries, email phase completion, GPT-3 can even generate Java script and HTML from plain English. Essentially telling AI to write code based on what you wanted to do.*<sup>22</sup>

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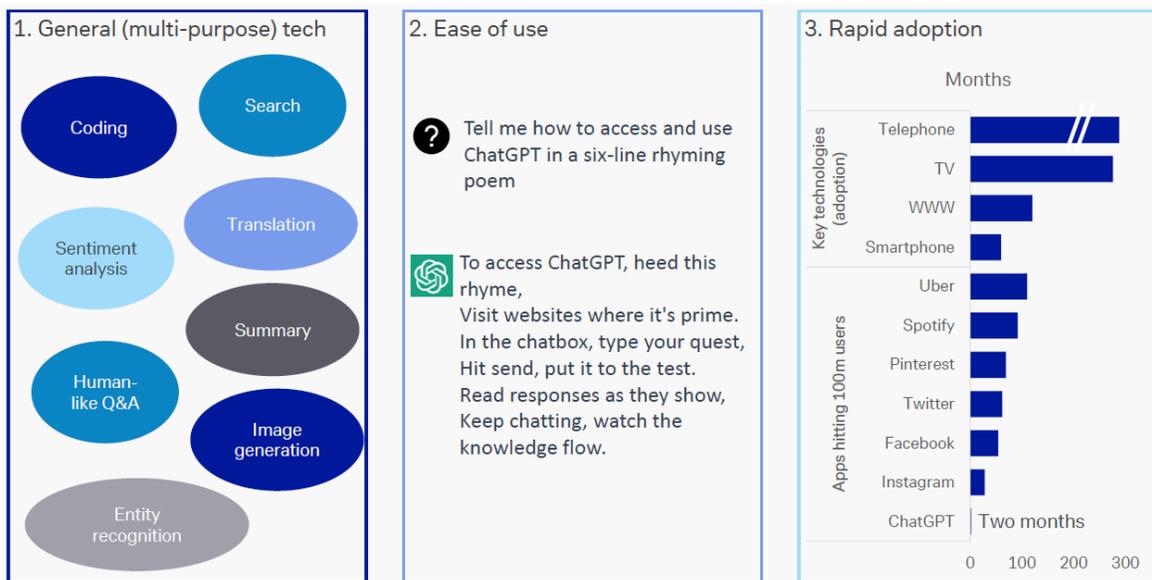
GPT-3 gave rise to an important breakthrough in AI, namely generative AI, which builds models that allow computers to create new content.



**Exhibit 142.** *OpenAI’s Contribution in Focus, source Microsoft.*

ChatGPT, released at the end of November 2022, quickly became one of the most viral technologies of the year. ChatGPT was created by OpenAI as a conversational AI or chatbot. It is a generative AI based on the large language model (LLM) called GPT-3.5, a fine-tuned, more intuitive version of GPT-3 refined through reinforcement learning from human feedback (RLHF). As noted above, GPT-3 was one of the largest language models ever trained at 175 billion parameters. ChatGPT is a smaller, more condensed version of GPT-3.5 and included an additional layer of safety guardrails for users. It was trained on large amounts of data, 300 billion words or 570GB from the internet through 2021, including Wikipedia, social media and news articles.

The game changer for ChatGPT was its free-to-use, open-source model, with a user-friendly UI, reminiscent of iMessage or WhatsApp. This makes it well suited for mass distribution and has enabled the widespread adoption and creative explosion on ChatGPT to date. In fact, ChatGPT reached its first one million users in five days. It took three months for Instagram and three and a half years for Netflix to reach the same milestone. Users could write questions or prompts, and ChatGPT responded in an intelligent, uncannily human-like manner, on any topic that the user wanted, even writing poems, essays, songs, code, and witty jokes. This instantly became a mass market, general purpose, sophisticated chatbot that could write like a human.



**Exhibit 143.** *What Is Special About Generative AI?, source Deutsche Bank.*

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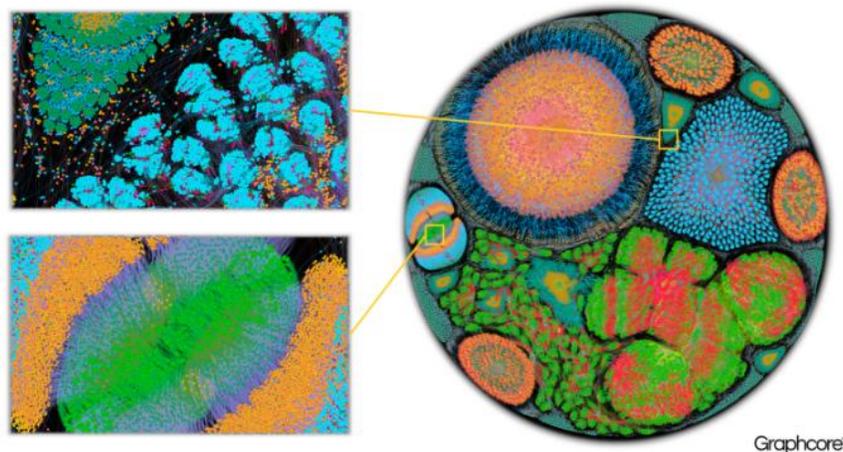
To highlight the dramatic advances of the last four years, in another breakthrough moment, around 2021 researchers at Alphabet developed the world's first trillion parameter model, T5-XXL, a language model with 1.6 trillion parameters. Also, on June 1, 2021, China announced Wu Dao 2.0 ("Wu Dao" means enlightenment), a model similar to GPT-3 only 10 times larger: 1.75 trillion parameters! Wu Dao, like Alphabet's early MUM model, used multi-modality, the ability to learn from text, audio, images and video.

Claimed by its own creators to be 10 times more powerful than GPT-3, Wu Dao could not only understand what people said but also created images, sang and painted. Hua Zhibing, Wu Dao's virtual female child, was reportedly showing signs of relational reasoning and emotional interaction, providing hope that "the virtual girl will have a higher EQ and be able to communicate like a human".<sup>23</sup> Although much of this has yet to be proven, these early models that used multimodality showed a path towards conquering human cognition.



**Exhibit 144.** *Human Mind, source Getty.*

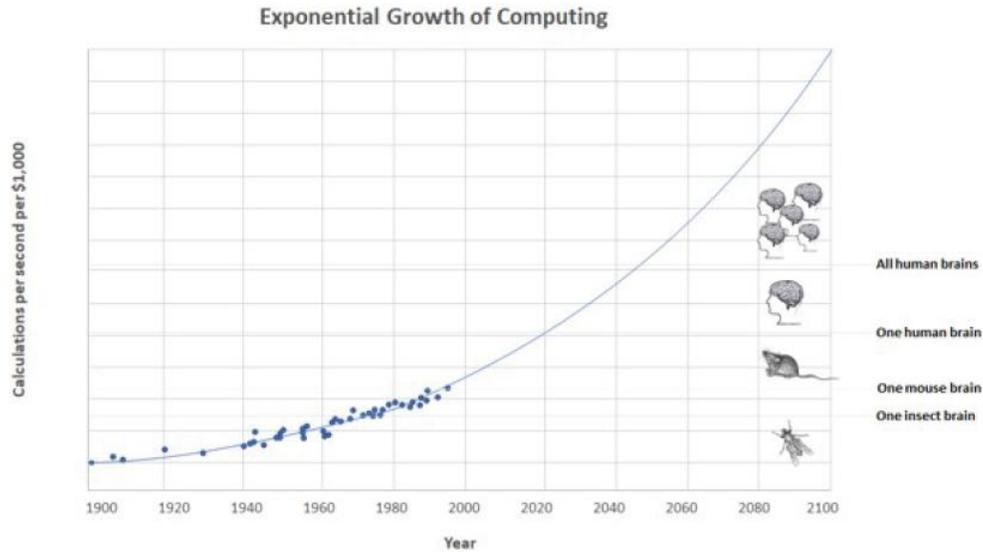
To visualize the incredible potential of next generation AI applications, it is instructive to look at the computational graph of a machine learning system – this is a representation of the model the system builds. Back in 2017, AI startup Graphcore had published an amazing set of images of the computational graphs mapped to its machine learning system, which strikingly looked much like a brain scan.<sup>24</sup>



**Exhibit 145.** *Example of a Machine Learning Model Used in Data Analysis, source Graphcore.*

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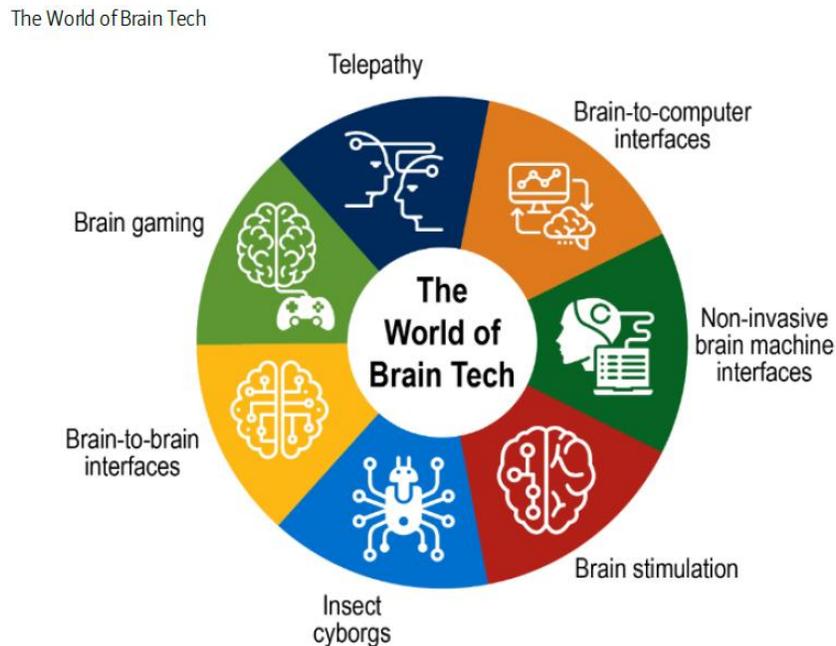
These breakthrough developments in image and speech recognition, conversational AI and now Generalized Reasoning, are now about to fundamentally change our relationship with machines and computers forever, as computers begin to fully learn and utilize our language and fully understand what we see and hear.



**Exhibit 146.** *Computing Power Roadmap, source Ray Kurzweil and Morgan Stanley.*

“As that happens the human-computer interface [will] no longer exist. We will become the interface. We will talk to computers and they will talk back. We [will] see information directly in our eyes. The new form factor is VR/AR.”<sup>25</sup>

As AI slowly becomes more intelligent than the human mind, advances in brain technologies could make the communication between machines and humans seamless. Ultimately, the distinction between the physical mind and the digital mind may not even exist.

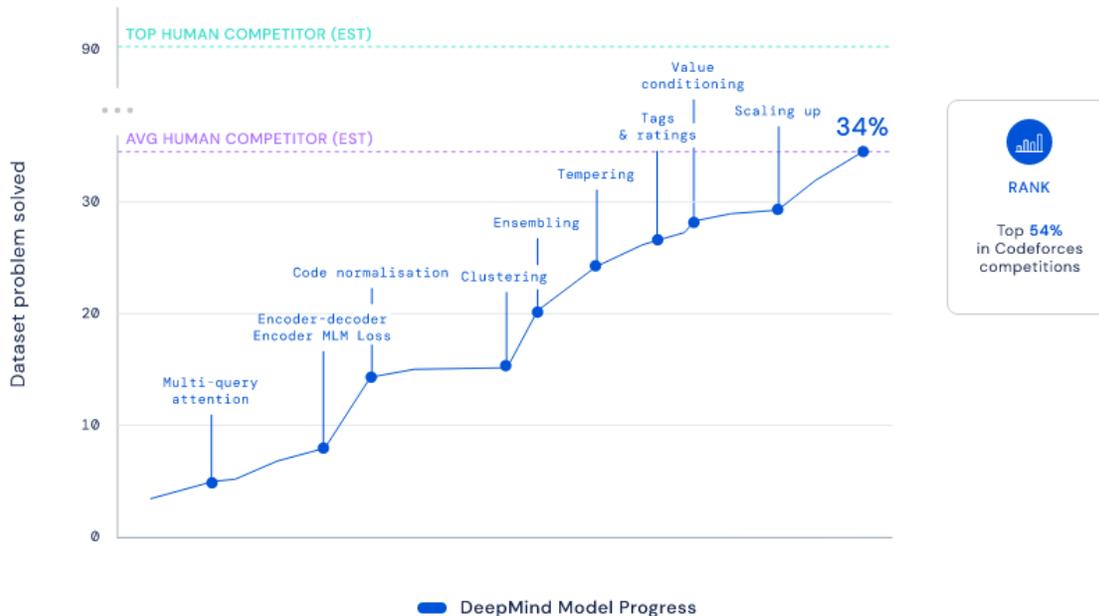


**Exhibit 147.** *Advances in Brain Technology, source BofA Global Research.*

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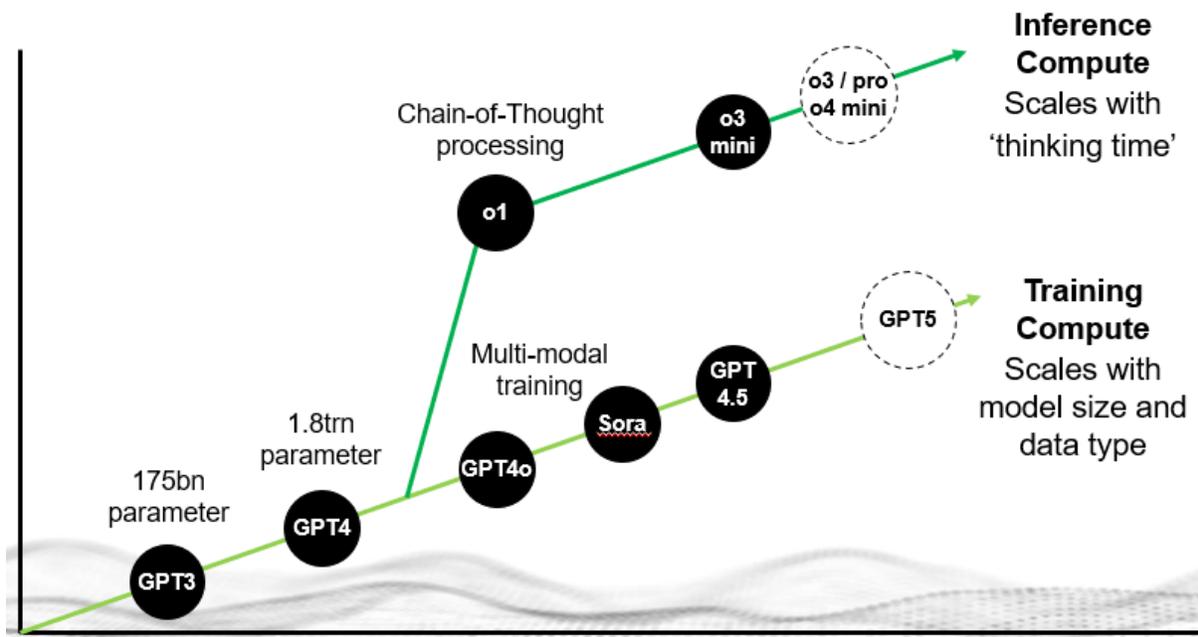
2022 also marked an era in which writing code becomes automated, moving rapidly to the stage where AI will write the majority of computer code. Essentially, you tell AI what to do, and it will write the code.

In 2022, for the first time AI surpassed the average programmer (top 54<sup>th</sup> percentile) in competitive coding. AlphaCode wrote competitive computer programs, generating code using a transformer model, similar to language translation tasks.



**Exhibit 148.** DeepMind Model Progress, source Google.

If 2022 was a pivotal year in which AI went mainstream, (the end of) 2024 became the time we marked the start of Generalized Reasoning, Inference-time Compute and Next-gen Multimodality.



**Exhibit 149.** AI Scaling Evolution – Pre-Training and Inference, source Alkeon.

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In summary, and in our view, AI will be the greatest technological innovation of our time, fundamentally redefining and extending the boundaries of human intelligence, analysis, planning, creativity and invention. For businesses, this means radically changing how the world's largest industries operate.

*"AI is quite possibly the most important – and best – thing our civilization has ever created, certainly on par with electricity and microchips, and probably beyond those." Marc Andreessen, General Partner of Andreessen Horowitz*

#### **IV. Conclusion**

In summary, even as the market remain expensive and vulnerable, we currently view a strong environment for fundamental stock picking for long-term investors, one that is equally attractive for both long and short investments.

We emphasize the need to be selective –more so now than ever before in recent years–, particularly given the elevated tail risks and macroeconomic and global geopolitical uncertainty we currently see. These risks are higher than ever before, in our view, negatively affecting the attractiveness of passive broad market investments.

As a result, we believe it is more imperative than ever to *balance our high conviction long investments* in quality secular growth companies with alpha-seeking short investments as well as structured use of market hedges, and also to stay globally diversified and seek to reduce concentration in any single country, currency or regional economy.

Sincerely,

Alkeon Capital Management Investment Team

<sup>1</sup> Alkeon Growth Partners, LP (AGP) is one of the original feeder funds into Alkeon Growth Master Fund, Ltd. You may be invested in a different feeder fund that also feeds into that master fund. As described in more detail in the Important Notes, your particular investment's performance may differ to some extent from the performance shown above. Performance data presented above is on a fund level and reflects AGP performance, net of actual fees and expenses. AGP commenced operations in January 2003, and investors in AGP are generally subject to a 20% incentive allocation and management fees ranging from 1.25% to 2% depending on the series of interests they hold in AGP. Certain AGP investors (such as Alkeon affiliates) have been or are entitled to management fee and/or performance allocation waivers and have at times constituted, and may constitute in the future, a significant portion of AGP's assets. Therefore, AGP's fund-level returns generally are higher than the performance shown herein for the Alkeon Growth Strategy ("AGS"), whose investors have not received such waivers. In addition, the historical fund-level performance for AGP incorporates various fee classes, some of which are subject to lower fees than the highest fee classes currently offered. Therefore, investors in AGP likely would have experienced lower returns than those shown herein if they were subject to the current highest fee classes during all time periods.

<sup>2</sup> Performance data is from another investment vehicle which is managed substantially pari-passu to AGP and follows substantially the same investment strategy (the "Alkeon Growth Strategy" or "AGS") as AGP and other Alkeon-managed vehicles using the Alkeon Growth Strategy. The other investment vehicle's performance represents the longest track record available for the Alkeon Growth Strategy with an inception date of January 5, 1998 (MSCI data is as of January 1, 1998) and reflects the deduction of the vehicle's actual fees and expenses during the period shown, including the deduction of a 20% incentive fee and a 1% management fee charged to investors prior to March 1, 2004, a 1.5% management fee charged to new investors beginning March 1, 2004 and a 1.75% management fee charged to all investors beginning July 1, 2011. The performance shown above for AGS would have been lower had AGS been subject to the highest management fee share class available to AGP investors. Takis Sparaggis, Alkeon's Chief Investment Officer and the primary portfolio manager of the other investment vehicle, was employed by CIBC Oppenheimer Corp. from January 1998 through June 1999, and by CIBC World Markets Corp. from June 1999 through December 2001, and was the portfolio manager of the other investment vehicle at all times during that period. Effective January 1, 2002, Mr. Sparaggis formed Alkeon, which has continued managing the other investment vehicle's portfolio since that time. While AGP is managed substantially pari-passu using the Alkeon Growth Strategy, performance may vary between AGP, the other investment vehicle and other Alkeon-managed funds using the Alkeon Growth Strategy. Performance results for AGS reflect the returns of the fund as a whole (rather than the returns of a particular investor), and reflect the fund's advisory fees, incentive fees and expenses and include the reinvestment of dividends and income. **Unless otherwise indicated, index returns are presented on a price return basis only - dividends, reinvestment and income are excluded.** The indices are unmanaged and investors cannot invest directly into them. Composite index results are shown for illustrative purposes and do not represent the performance of a specific investment. Please see Important Notes at the end of this letter, including "Comparisons to Indices". Past performance is no guarantee of future results.

<sup>3</sup> Performance against the market measured by the largest 750 stocks in the U.S. by market capitalization as well as any S&P 500 stocks not already included. "Big Growers" are the top 75 high growth profile stocks as ranked by Empirical Research.

<sup>4</sup> SaaS and High Growth Internet constituents defined by Morgan Stanley and JP Morgan, respectively.

<sup>5</sup> Bloomberg, January 2025.

<sup>6</sup> "Magnificent Seven" stocks include Apple, Amazon, Alphabet, Meta, Microsoft, Nvidia and Tesla.

<sup>7</sup> <https://press.aarp.org/2022-7-13-New-AARP-Research-Nearly-Half-Americans-Do-Not-Have-Access-to-Retirement-Plans-at-Work>

<sup>8</sup> Analysis based on equity long-short assets custodied at Morgan Stanley Prime Brokerage. Comparison of annual appreciation of long holdings minus annual appreciation of short holdings, with long holdings and short holdings being aggregated and tracked respectively.

<sup>9</sup> Empirical Research, January 2025.

<sup>10</sup> Fundstrat, August 2017.

<sup>11</sup> Fundstrat, January 2018.

<sup>12</sup> Morgan Stanley, October 2023.

<sup>13</sup> References to specific companies are for illustrative purposes only. While some of these are Alkeon investments as of the date of this letter, Alkeon investments are subject to change, and their inclusion in the letter was not based on investment performance. An investment in any referenced company is speculative and may lose value, and no assumption should be made that an investment by Alkeon was or will be profitable.

<sup>14</sup> Based on Alkeon analysis and opinion as of the date of this letter. For illustrative purposes only, and references to specific companies do not necessarily represent Alkeon investments. See also Endnote 13.

<sup>15</sup> GTC 2021 Nvidia Keynote.

<sup>16</sup> Hunter Lightman, member of technical staff at OpenAI.

<sup>17</sup> Noam Brown, research scientist at OpenAI.

<sup>18</sup> Will Depue, OpenAI employee.

<sup>19</sup> <https://analyticsindiamag.com/soon-everyone-will-own-a-robot-like-a-car-or-phone-today/> and <https://interestingengineering.com/innovation/robots-musk-in-homes>

<sup>20</sup> <https://www.figure.ai/master-plan#the-present>.

<sup>21</sup> Bernstein, AI Part VII, June 2017.

<sup>22</sup> GTC 2021 Nvidia Keynote.

<sup>23</sup> <http://en.people.cn/n3/2021/0607/c90000-9858374.html>

<sup>24</sup> <https://www.graphcore.ai/posts/what-does-machine-learning-look-like>

<sup>25</sup> Bernstein, April 2017.

# Appendix



User

Let  $n$  be an even positive integer. Let  $p$  be a monic, real polynomial of degree  $2n$ ; that is to say,

$$p(x) = x^{2n} + a_{2n-1}x^{2n-1} + \dots + a_1x + a_0$$

for some real coefficients  $a_0, \dots, a_{2n-1}$ . Suppose that  $p\left(\frac{1}{k}\right) = k^2$  for all integers  $k$  such that  $1 \leq |k| \leq n$ .

Find all other real numbers  $x$  for which  $p\left(\frac{1}{x}\right) = x^2$ .

...(thinking)



OpenAI  
o1-preview

To solve this problem, we need to find all real numbers  $x$  such that

$$p\left(\frac{1}{x}\right) = x^2,$$

where  $p$  is a monic real polynomial of degree  $2n$ , and it is given that

$$p\left(\frac{1}{k}\right) = k^2$$

for all integers  $k$  with  $1 \leq |k| \leq n$ .

**Understanding the Given Information:**

- Given Data Points:** We have  $2n$  data points from  $k = \pm 1, \pm 2, \dots, \pm n$ , which provide the values  $p\left(\frac{1}{k}\right) = k^2$ .
- Polynomial Function:**  $p(x)$  is monic of degree  $2n$ , which means its highest-degree coefficient is 1.

**Defining a New Polynomial:**

Let's define a new function

$$q(x) = p\left(\frac{1}{x}\right) - x^2.$$

Our goal is to find all real solutions to  $q(x) = 0$ .

To solve this problem, we need to find all real numbers  $x$  such that

$$p\left(\frac{1}{x}\right) = x^2,$$

where  $p$  is a monic real polynomial of degree  $2n$ , and it is given that

$$p\left(\frac{1}{k}\right) = k^2$$

for all integers  $k$  with  $1 \leq |k| \leq n$ .

**Understanding the Given Information:**

- Given Data Points:** We have  $2n$  data points from  $k = \pm 1, \pm 2, \dots, \pm n$ , which provide the values  $p\left(\frac{1}{k}\right) = k^2$ .
- Polynomial Function:**  $p(x)$  is monic of degree  $2n$ , which means its highest-degree coefficient is 1.

**Properties of  $q(x)$ :**

- Since  $p$  is a polynomial of degree  $2n$ ,  $p\left(\frac{1}{x}\right)$  can be expressed in powers of  $x$ .
- The function  $q(x)$  has zeros at  $x = \pm 1, \pm 2, \dots, \pm n$  because  $q(k) = p\left(\frac{1}{k}\right) - k^2 = 0$ .

**Constructing  $s(x)$ :**

Consider the polynomial

$$s(x) = x^{2n}q(x) = x^{2n}\left(p\left(\frac{1}{x}\right) - x^2\right).$$

Multiplying through by  $x^{2n}$  eliminates denominators, making  $s(x)$  a polynomial.

**Factoring  $s(x)$ :**

We know that  $s(x)$  has roots at  $x = \pm 1, \pm 2, \dots, \pm n$ . Therefore,  $s(x)$  can be expressed as:

$$s(x) = m(x)h(x),$$

where  $m(x) = \prod_{k=1}^n (x^2 - k^2)$  is a monic polynomial of degree  $2n$  whose roots are  $\pm 1, \pm 2, \dots, \pm n$ , and  $h(x)$  is a quadratic polynomial.

**Determining  $h(x)$ :**

We consider  $h(x)$  to be a quadratic polynomial:

$$h(x) = -x^2 + c,$$

where  $c$  is a constant to be determined.

**Matching Coefficients:**

- The leading term of  $s(x)$  is  $-x^{2n+2}$ .
- The leading term of  $m(x)h(x)$  is  $(x^{2n})(-x^2) = -x^{2n+2}$ , ensuring the degrees match.
- Comparing the constant term of  $s(x)$  using  $x = 0$ :

$$s(0) = p^{(0)}(0) - 0 = 1, \text{ where } p^{(k)}(x) = x^k(2n)!$$

$$p\left(\frac{1}{\left(\frac{0}{n}\right)}\right) = \frac{(-1)^n}{(n!)^2}.$$

- Evaluating  $m(0)$  and  $h(0)$ :
- $m(0) = (-1)^n(n!)^2$ .
- $h(0) = -0 + c = c$ .
- Since  $s(0) = m(0)h(0)$ :

$$1 = (-1)^n(n!)^2c,$$

which gives:

$$c = \frac{1}{(-1)^n(n!)^2} = \frac{(-1)^n}{(n!)^2}.$$

- For  $n$  even (since  $n$  is even),  $(-1)^n = 1$ , so  $c > 0$ .

**Finding Additional Solutions:**

Solving  $h(x) = 0$ :

$$-x^2 + c = 0 \implies x^2 = c \implies x = \pm \frac{1}{n!},$$

since  $c = \frac{1}{(n!)^2}$ .

**Conclusion:**

The additional real numbers  $x$  satisfying  $p\left(\frac{1}{x}\right) = x^2$  are  $x = \pm \frac{1}{n!}$ .

Exhibit 150. Chain of Thought – Math Example, September 2024, source OpenAI.

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User



OpenAI  
o1-preview

Write a bash script that takes a matrix represented as a string with format '[1,2],[3,4],[5,6]' and prints the transpose in the same format.

So the user is requesting a bash script that can take a string representing a matrix, such as '[1,2],[3,4],[5,6]' and output its transpose, in the same format.

Let's first understand the input and output formats.

Input: '[1,2],[3,4],[5,6]'  
which corresponds to the matrix:  
1 2  
3 4  
5 6

So the input is a series of rows, each in brackets separated by commas.  
The transpose of this matrix would be:  
1 3 5  
2 4 6

So the requested output is '[1,3,5],[2,4,6]'

Overall Task:  
Write a bash script that takes one argument (the string representing the matrix) and outputs its transpose in the same format.  
Ok, let's think about how to parse the input string in bash, build the matrix (probably in arrays), transpose it, and then output the resulting transposed matrix in the expected format.

Constraints:  
- Since it's bash, we have to be careful with parsing strings.  
- The script should accept the input string as an argument.



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Approach:  
- Parse the input string to extract the matrix elements.  
- Build the matrix as an array of arrays.  
- Transpose the matrix.  
- Output the transposed matrix in the same format.

Implementation Steps:  
1. Capture input string as argument.  
2. Remove any spaces (if any).  
3. Parse the input string to extract numbers into arrays.  
- Since the input is in the format '[1,2],[3,4],[5,6]', we can:  
- Remove outer brackets if necessary.  
- Split the string by ',' to get each row.  
- For each row, remove '[' and ']', then split by ' ' to get elements.  
4. Build a 2D array in bash (arrays containing arrays).  
- Since bash arrays are one-dimensional, we need to simulate 2D arrays.  
5. Transpose the matrix.  
- For transposing, we'll need to switch rows and columns.  
6. Output the transposed matrix in the required format.  
- Reconstruct the output string in the format '[1,3,5],[2,4,6]'



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Now, start coding step by step.

Under potential issues:

- Bash does not have multi-dimensional arrays natively, so we need to simulate.  
- We need to handle numbers that can be more than one digit.

Let me try coding the bash script step by step...(code)

Exhibit 151. Chain of Thought – Coding Example, September 2024, source OpenAI.

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