Technology Outlook

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What to do with the Mag-7?

Any good Outlook should start with a look back, and where better than with the Mag-7 (Magnificent Seven[1]). These US tech giants dominated returns in 2023 followed by an exceptional 2024, returning c250% over two years. Since 2020, they have returned an average of 640% compared to c100% for the S&P 500 Index.[i]

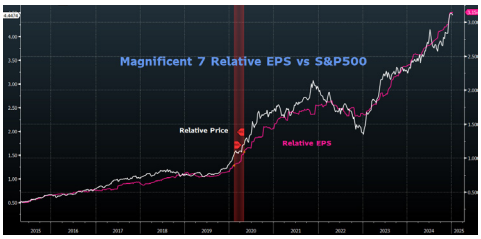
But…how **sustainable is their growth?** Given these gains and further AI investment, we suspect that margin gains will become more difficult to deliver. They will face additional pressure from AWS (Amazon Web Services) reducing the useful life of its servers from six to five years, as it instals newer AI servers. This is a reversal of the trend since 2022, when most cloud and hyperscaler [2] companies lengthened the useful lives of their servers from four to six years (with the exception of Meta and Oracle, that moved from four to five years.[ii]). If other companies follow AWS's lead, it could further pressure Mag-7 margins.

We have long argued that concentration risk alone can be an unhelpful guide to the overall risk of these assets as natural monopolies that dominate their respective markets with user bases in the billions and significant future pricing power potential.

Percentage return

Source: Bloomberg, 3 January 2025.

Magnificent 7 relative EPS vs S&P 500



Source: Bloomberg, 10 January 2025.

Changes to server depreciation policy

Company	Ticker	Nature of the change	Effect
Alphabet Inc.	GOOGL	Change in estimated useful life of servers from 4 to 6 years, and of networking equipment from 5 to 6 years	Decrease in depreciation expense of $3.9 billion or increase in EPS of $0.24 for the year ending December 31, 2023
AMAZON COM INC	AMZN	Change in estimated useful life of of servers from 5 to 6 years, due to "continuous improvements in…hardware, software, and data center designs". Note that for Amazon this is the second change in 3 years - the company changed the depreciable life of servers from 4 to 5 years and of networking equipment from 5 to 6 years effective January 1, 2022	Decrease in depreciation expense of $695 million or increase in EPS of $0.07 for the three months ending on March 31, 2024. The 2022 change in estimate decreased depreciation expenses by $3.6 billion or $0.27 per share for the year ending December 31, 2022.
MICROSOFT CORP	MSFT	Due to increased efficiencies and advances in technology, the estimated useful lives of both server and network equipment increased from 4 to 6 years	An increase in operating income of $3.7 billion and net income of $3.0 billion, or $0.40 per share for the year ending June 30, 2023
INTERNATIONAL BUSINESS MACHINES CORP	IBM	Increased the estimated useful life of servers and networking equipment from 5 to 6 years for new assets and from 3 to 4 years for used assets	Increase in income from continuing operations before icome taxes of $208 million or $0.18 per share for the year ending December 31, 2023
Meta Platforms, Inc.	META	Increase in estimated useful lives of a majority of the servers and network assets from four years to 4.5 years, effective the second quarter of 2022, and further extention of the useful lives to 5 years effective the fourth quarter of 2022	Decrease in depreciation expenses of $860 million or increase in EPS of $0.26 for the year ending on December 31, 2022
ORACLE CORP	ORCL	Increased the estimated useful life of servers from 4 to 5 years	Decreased operating expenses by $434 million for the year ending May 31, 2023

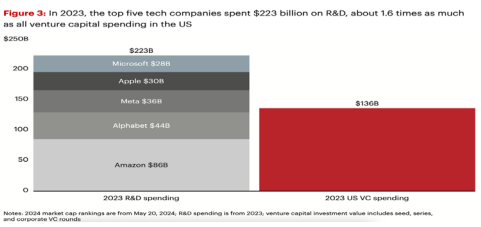
Source: Deep Quarry.

[1]Apple, Microsoft, Alphabet, Amazon, NVIDIA, Meta Platforms and Tesla
[2]The largest cloud service providers (AWS; Microsoft Azure; Google Cloud; Meta Platforms; Apple; TikTok)

Only the paranoid survive

Previous technology cycles have rarely been kind to incumbents, with nearly 50% dropping out of the top ranks every decade.[iii] However, today's market leaders are very aware of the risk of obsolescence, as reflected in their massive R&D (research and development) investments. In 2023 alone, the top five tech companies spent $223bn on R&D, an amount 1.6 times greater than total US venture capital (VC) spending.[iv]

2023 R&D spending vs venture capital spending – US



Source: Bain&Co.

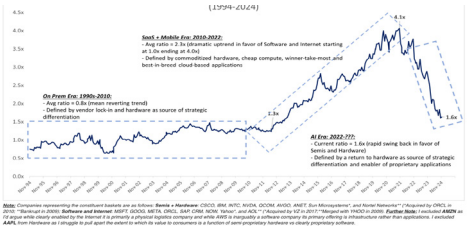
Less good conduits for now

As such we are not concerned about the risk posed to Mag-7 by AI. Instead, we wonder if the negative reception to sharply higher spending from Alphabet, Amazon and Microsoft is signalling the beginning of a new phase, one **where these companies become less effective AI conduits**. While we will continue to evaluate each company on its individual merits, our perspective has shifted. Our 'null hypothesis' has moved from half full to half empty as AI-driven risks to existing profit pools and the diminishing value of incumbency become more apparent.

- ## Software

To our mind, software certainly has been a disappointing conduit for AI, as evidenced by slowing industry growth, widening disparities in company performance and an increasingly uphill AI narrative battle. Software as a Service (SaaS) companies have struggled to monetise AI through premium-priced products – ServiceNow being a rare exception.

Ratio of software and internet equity value to semis and hardware equity value (1994 – 2024)



Source: Morgan Stanley.

The SaaS model itself has also come under early pressure, particularly after Klarna replaced over 1,700 call centre staff with an AI-powered alternative (built on OpenAI) for just $2-3m. Consumption-based alternatives have fared little better and growth has failed to reaccelerate. Weak execution, often symptomatic of a slowing growth environment, has further weighed on infrastructure stocks that were initially seen as better positioned to capture the growth in AI-driven workloads. Additional negative developments include elevated executive turnover, further headcount reductions and limited strategic M&A beyond industrial software.

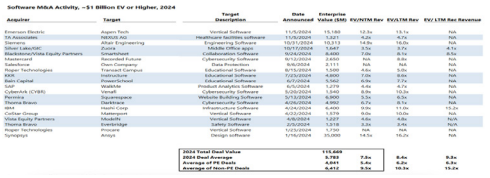
At a high level, we remain uncertain whether software incumbents will be able to sustain long-term monetisation of AI-driven consumption alongside user (seat-based) pricing. Instead, we anticipate companies moving away from traditional seat-based models in favour of ROI (return on investment)-driven selling – never an easy task.

More fundamentally, we believe AI represents a greater existential threat than an opportunity for many incumbent software providers. Looking ahead, AI is likely to automate many tasks currently performed by knowledge workers, reducing reliance on the very software tools designed to support them. The implications of this shift are profound.

That said, there are always reasons to be optimistic. DeepSeek recently acted as a rallying cry for the sector, with significantly lower inference[3] costs making it easier for incumbents to integrate AI without compromising profitability or imposing restrictive usage models. Lower inference costs should also prove beneficial for AI-native startups, allowing them to scale more efficiently. They could also help accelerate enterprise AI adoption, spurring new application development which would be particularly welcome news for software infrastructure providers.

• More M&A activity likely

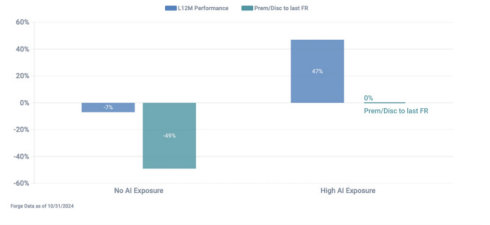
We expect M&A valuations to improve in 2025 as implied 2024 M&A valuation of 7.5x lags current public software valuation at -8.5x NTM rev



Source: Jefferies.

Another potential catalyst for the sector could come from increased M&A (merger and acquisition) activity, building on a strong 2024. Private equity remained highly active, putting companies like Everbridge, Instructure, Smartsheet and Zuora out of their public market misery. There were also several strategic acquisitions, including HP's purchase of Juniper and IBM's acquisition of HashiCorp, alongside a notable wave of consolidation in design and industrial software. Synopsys' $35bn acquisition of Ansys was the largest deal of the year, while Emerson acquired AspenTech for $15bn and Siemens snapped up Altair for $10.3bn.

Median AI vs non-AI performance



Source: Forge, 31 October 2024.

Looking ahead, we expect a further recovery in M&A activity this year and AI could serve as an additional catalyst, with subscale public and private companies likely seeking stronger partners, just as some well-capitalised larger firms look for acquisitions to offset slowing organic growth.

[3]The process of drawing an idea or conclusion from evidence and reasoning

However, current valuations could create headwinds for potential M&A as the average price paid by private equity firms in 2024 remains low. Likewise, strategic deals last year were priced at an average of 15-25% below where growth software is today. Meanwhile, interest in non-AI assets has waned in private markets. According to Forge, they have returned just c1%.[v] over the past 12 months compared to AI-related private companies that have gained 76%..[vi]

- **IPO market set to recover**

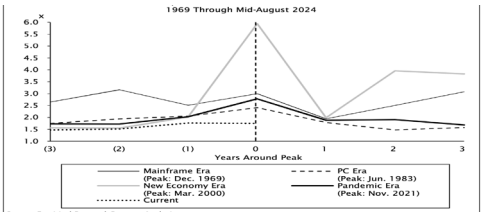
Amount raised via IPOs per year ($ in billions)

Source: Roth Capital. 18 December 2024.

Investment bankers will be hoping that stronger equity markets finally breathe life into the IPO market after a third consecutive lacklustre year, with global proceeds declining **15% in 2024**. However, there were some signs of life in the US where the number of deals rose 38% year-on-year (y/y) with proceeds up 48%..[vii] Notable market entrants included Astera Labs, Reddit, Rubrik and TempusAI. Aftermarket performance was also encouraging, with average gains of c30% for deals >$400m..[viii]

- **It cannot burst if it is not a bubble**

Large-cap technology leaders – relative forward P/E ratios around the peak of past tech booms



Source: Empirical Research Partners.

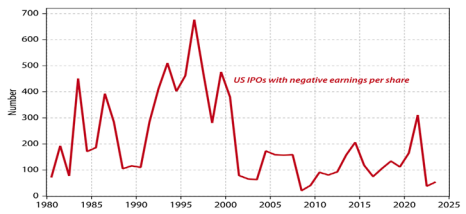
Market action post-DeepSeek, exacerbated by an erratic and tough-to-read US president, has revitalised those who believe we have been in an AI bubble. However, we still believe we remain far from bubble territory.

As the chart opposite demonstrates, large-cap 'technology leaders' traded between 1.5-2x the market multiple, consistent with recent history. This compares favourably with previous technology cycles:

- 1969: Mainframe – c3x
- 1983: PC – c2.5x
- 2000: Dot.com – c6x
- 2021: Pandemic – c2.7x

Then there are the absolute numbers. In 2000, tech made up 32% of market cap but only 12% of its earnings; this compares to 38% of market cap versus 32% of earnings at the end of 2024..[ix]

Loss-making companies making IPOs shot up in the 1990s



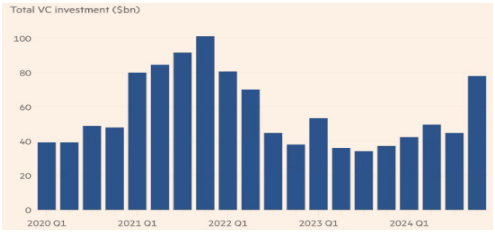
Source: Gavekal Research.

We also find it hard to believe this cycle will end after just a handful of AI-related IPOs; put differently, we believe the IPO market plays a necessary part in fermenting bubble-like conditions by refreshing the listed universe of stocks and allowing investors to 'dream the dream', unencumbered by any previous disappointment. We are, however, conscious that many companies have chosen to stay private for longer with the median age of a company coming public increasing from 6.9 years a decade ago to 10.7 years today.[x] There is little near-term pressure to bring companies public given substantial (and growing) sources of private capital and much greater liquidity options are available for private companies than used to be the case.[xi]

Instead, **we think the current period is more analogous to the mid-1990s** when people were excited about the potential of what Fed Chair Alan Greenspan would go on to call the "new economy" (in late 1997) but had not moved into the self-reflexive euphoria of the full dot.com bubble. The Netscape IPO (March 1995) and Greenspan's "irrational exuberance" speech (December 1996) were early pointers in the bull market.[xii]

Company valuations today are more analogous with those *at least three years ahead of their relative peaks*. Despite AI 'hype', VC investments have only just recovered their 2021 levels on a quarterly basis (c$80bn), and would need to sustain at these levels to even match 2021's $358bn total raise.[xiii]

Total VC investment ($bn)

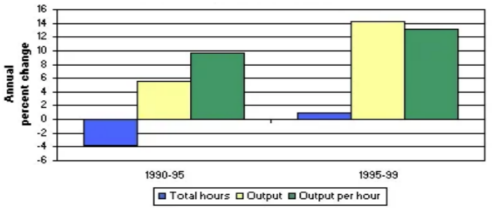


Source: Financial Times.

The dot.com bubble, for all its excesses, coincided with a material jump in labour productivity as the benefits of the 'ICT revolution' began to appear in the second half of the 1990s. Productivity growth has been solid post-Covid but has not yet broken out, and talk of a new AI economy has been sparse outside of tech circles.[xiv]

Likewise, we have yet to see M&A like we did in that earlier period when, for example, the telecom industry used expensive paper to consolidate fibre assets, having barely featured in the mid-1990s.

Labor productivity and related measures for high-tech industries, 1990-95 and 1995-99



Source: Fabricated Knowledge.

• Expect more turbulence

Summary of telecommunications M&A activity, 1993-2000

Year	No. of Mergers	Total Value[1] ($ billions)	Average Value[1] ($ billions)
1993	1	12.6	12.6
1994	0	0	0
1995	2	12.9	6.4
1996	3	56.3	18.8
1997	7	2.2	.5
1998	23	62.9	3.9
1999	30	808.3	26.9
2000	27	507.0	18.8

Source: NBER.

If current conditions more closely resemble the mid-1990s when the internet-era was in its infancy, then we should anticipate greater volatility in the years ahead. It was certainly a feature of the dot.com period, although not all of it endogenous to it. The collapse of LTCM in 1998 (levered 27:1 at peak) caused a systematic selloff following Russia reneging on some of its debt and spurring a currency crisis (Amazon fell by 20% and AOL and Yahoo both declined by 15%).[xv] The Fed cut rates, which, combined with the added impetus of Y2K preparations (which forced $100bn in upgrade spending in total from 1995-2001) drove the final blow-off at the top in 1999-2000.

NASDAQ 100 (1995 – 1998), pre '99 melt up

Source: NASDAQ.

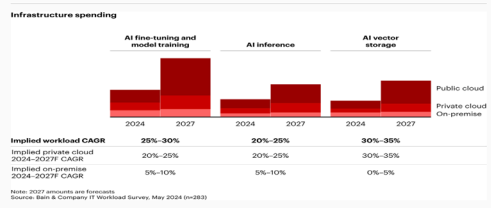
However, before that final 'melt-up', the NASDAQ 100 experienced seven >15% corrections between 1995-98 despite gaining 354% over the period (in dollar terms). Such volatility can be a characteristic of long bull markets and above-average valuations.

However, setting aside current macroeconomic uncertainties, we think volatility is best understood as a persistent feature of new technology cycles, when the innovation curve is at its steepest and both the pace of progress and scale of the opportunity are hard to define. The recent DeepSeek episode underscores this point, proving an important, if unwanted, reminder of this.

Growing AI contribution...

All cloud platforms continue to benefit from AI-related demand. In Q4, Microsoft attributed 13% of Azure's 31% revenue growth to AI,[xvi] up from 6% of 28% Azure growth a year earlier.[xvii] While Amazon does not quantify Amazon Web Services (AWS)'s AI-specific revenue, it called it "a multi-billion-dollar annualised revenue run-rate business". Likewise, Google Cloud Platform reported "very strong" AI demand.

AI workloads could grow 25% to 35% per year through 2027



Source: Bain&Co.

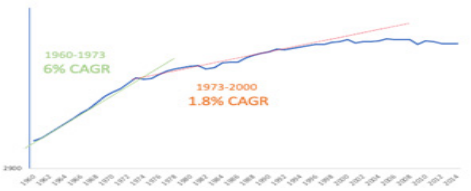
Reacceleration in a cloud market that now exceeds $320bn is going to be tough, though higher cloud penetration rates should equate to lower future growth and greater economic sensitivity. That said, enterprise AI adoption remains nascent. A Goldman Sachs CIO survey suggests it accounts for just 3% of overall workloads today.[xviii]

Bain forecasts AI workload growth of 25-35% per annum between 2024-27 by which time (per Goldman Sachs) it may account for 10% of the total.[xix]

However, these optimistic forecasts likely embed upside from monetisation with software companies such as Salesforce capturing some of AI's productivity gains through higher pricing. **Whether they can do so represents one of the key debates for 2025 and beyond.** History suggests it will not prove as straightforward as incumbents believe as others take the opportunity to challenge in adjacent markets, competing away the upside and potentially more.

It is worth recalling our view that **cloud optimisation** could be permanent rather than a one-off post-pandemic adjustment. We still see parallels to the 1973 oil shock, after which per-capita electricity consumption never returned to its prior trend. One of GenAI's earliest use cases is uncovering inefficiencies, which may reinforce ongoing optimisation. Anyway, we rather like our homemade chart, so we're including it again this year.

US electric power consumption (kWh per capita) 1960 – 2014



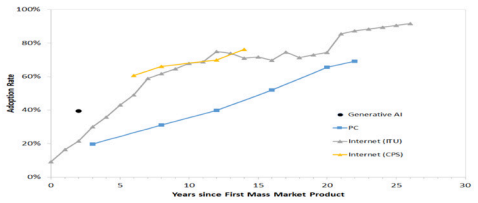
Source: Polar Capital.

AI/new cycle update

1. Rapid adoption

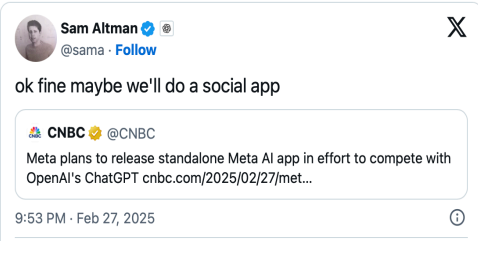
It is clear that **generative AI (GenAI) adoption is significantly outpacing historical trends** seen with both PCs and the internet. By August 2024, c40% of the US population had already used GenAI, compared to c20% who had adopted the internet two years after its commercialisation.[xx]

Adoption rate of generative AI at work and home vs the rate for other technologies



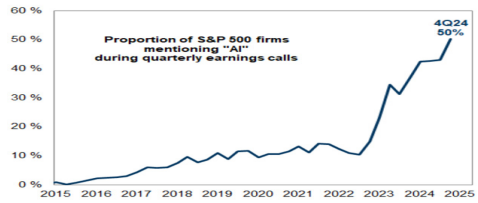
Source: Federal Reserve Bank of St Louis.

AI usage is accelerating even more dramatically than user growth. In January, ChatGPT usage increased by 148% y/y, Perplexity by 279% y/y and Anthropic's Claude by an extraordinary 439% y/y.[xxi] While this traffic growth has yet to visibly impact Google revenues (something we continue to monitor closely), a recent US survey indicated that over 25% of respondents now prefer using AI chatbots instead of traditional search engines.[xxii]



While **enterprise AI adoption** is more moderate, it remains a key strategic priority and corporate AI adoption appears poised to expand substantially. A recent McKinsey survey revealed that 72% of companies now actively use AI, up from c50% observed consistently over the past six years.[xxiii] Echoing this, half the S&P 500 companies referenced AI on their Q4 2024 earnings calls, marking an all-time high.[xxiv]

Proportion of S&P 500 firms mention "AI" during quarterly earnings calls



Source: Goldman Sachs.

2. Model progress

AI models made significant gains during a frenetic 2024. **Frontier models** made continued progress, led by OpenAI's GPT-4o, Google's Gemini 2.0, and Meta's Llama 3. Other so-called GPT-4/Gen2 class models included Anthropic's Claude 3.5 Sonnet, xAI's Grok 2, Mistral and Amazon's Nova as well as Chinese models from Alibaba, DeepSeek and 01.ai.

Many of the gains came from techniques like reinforcement learning, chain-of-thought and retrieval-augmented generation (RAG) helped GPT-4o and Gemini 2.0 easily surpass previous benchmarks set by GPT-4 in code generation and multimodal understanding.[xxv] GPT-4o also introduced a (remarkable) voice mode, enabling real-time, voice-based conversations with the model also able to interpret non-verbal cues.

Notable AI models

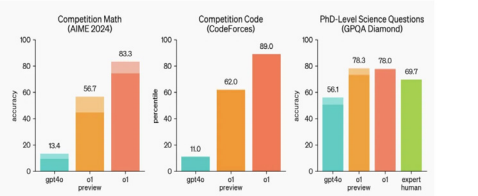
Source: Epoch AI.

Open-source models also continued to make strong progress, particularly in terms of cost efficiency. Llama 3 was reported to have achieved performance comparable to GPT-4 at just 1/50th of the cost, highlighting the increasing competitiveness of open-source AI. Gains were also apparent in **video generation**.

A new scaling vector: test-time compute

The most significant gains during 2024 were generated beyond scaling pretrained models. In September, OpenAI released its *'o1'* models. Unlike most large language models (LLMs), o1 introduced the world to **reasoning models** which due to reinforcement learning are able to generate internal chains of thought (CoT) at run-time which 'think' and 'reason' through complex tasks.

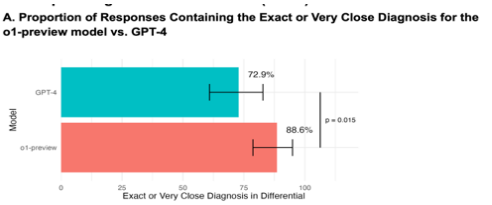
OpenAI's o1 model addresses problems that require planning/iteration



Source: One Useful Thing.

By spending more time (as in consuming more computational resource) during the inference phase (when the model generates responses) reasoning models are able to break down intricate problems into more manageable steps, enhancing accuracy and performance. For example, o1 is able to solve 83% of problems in the International Mathematics Olympiad compared to just 13% achieved by GPT-4o.[xxvi] It also surpassed human PhD experts in solving extremely hard physics problems[xxvii] while a 'bombshell of a medical working paper from Harvard' revealed that o1-preview (the earliest version of o1) "demonstrated superhuman performance in… diagnostic clinical reasoning".[xxviii]

Quality of o1 preview and GPT-4 differential diagnosis on NEJM clinicopathologic case conference (CPCs)

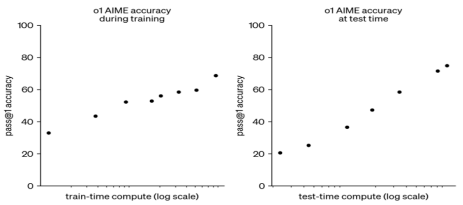


Source: Arxiv.

- **Test-time scaling**

Reasoning models predictably perform better the longer they are allowed to 'think' at test time, as the chart opposite shows. As such, so-called **test-time compute** represents a powerful new approach (vector) for advancing AI capabilities.

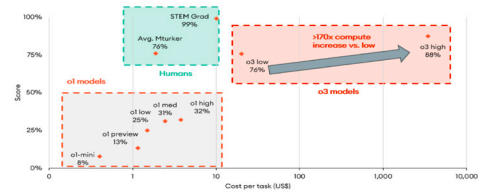
o1 performance smoothly improves with both train-time and test-time compute



Source: One Useful Thing.

We have already seen a rush of new reasoning models, fuelled by more reinforcement learning, including OpenAI's **o3** (launched only three months after o1), Anthropic's Claude 3.7 and, of course, DeepSeek's **R1**, while both OpenAI and Google have also introduced advanced reasoning capabilities (branded 'Deep Research') to their flagship models.

o3 outperforms o1 at ARC-AGI benchmarks, but consumes materially more compute to do so

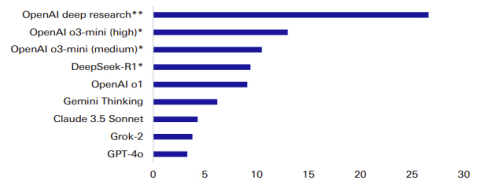


Source: NSR Analysis.

Remarkable gains already

It feels like yesterday that AI was heralded a 'search killer'. Today – and less than three years after the introduction of ChatGPT – OpenAI's o3 is able to solve c25% of problems on a Frontier Maths benchmark, where no other model has exceeded 2% previously.[xxix] **Even more remarkably, o3 achieved 76-88% on the ARC-AGI benchmark** (built to measure progress toward AGI). For context, it had previously taken four years for models to progress from 0% (GPT-3 in 2020) to c5% with GPT-4o in early 2024.

Open AI's deep research significantly outperforms earlier models in new Humanity's Last Earth (HLE) benchmark test



Source: OpenAI.

This performance comes at a steep cost, however, these costs are unlikely to remain prohibitive given the trajectory of (collapsing) inference costs.

If "GPT-4 offered us a glimpse of the future",[xxx] **reasoning models are surely early evidence of superhuman AI**. They also represent a critical step towards **agentic AI** (autonomous actions; solving multi-step problem) while accelerating the timeline towards **AGI** (human-level intelligence; adapts to new situations; demonstrates common sense and reasoning).

A robust model pipeline for 2025

We expect more "uneven leaps" in AI progress over the coming year".[xxxi] **GPT-5 is a key focus**, anticipated in mid-2025.[xxxii] We also expect other Gen3 models from leading LLM providers, marking a shift back towards more capital-intensive pretraining scaling. This will be fuelled by **substantial hardware improvements**, with new Blackwell chips from NVIDIA that deliver 4x training and 30x inference improvement.

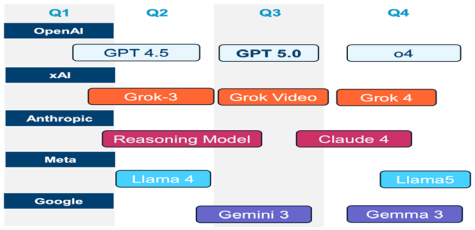
However, there may also be more market **fragmentation** as the race to Gen3 and Gen4 models becomes significantly more expensive. Cheap open source or distilled smaller models may look to address domain-specific opportunities while the **LLM frontrunners remain focused on multimodality and the AGI prize**.

As in previous years, we are most focused on the path to AGI and the transformative potential of AI.

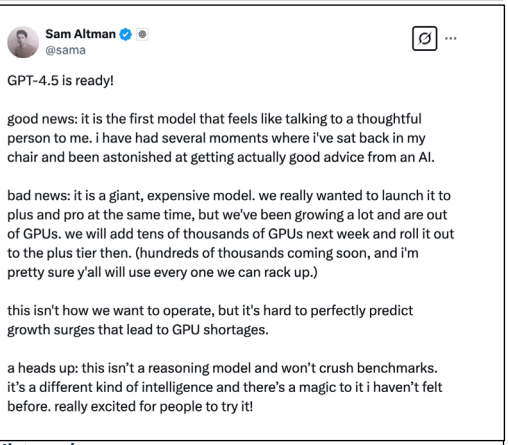
Jevons paradox

The concept that greater efficiency results in increased rather than decreased overall consumption of a resource was first articulated by William Jevons in 1865. He observed that improved efficiency in coal usage actually drove up coal demand instead of reducing it.

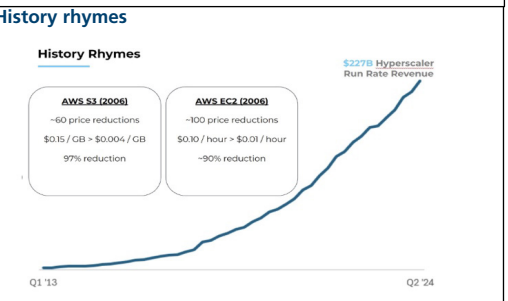
2025 model estimate release schedule



Source: Polar Capital, AI Fund presentation.

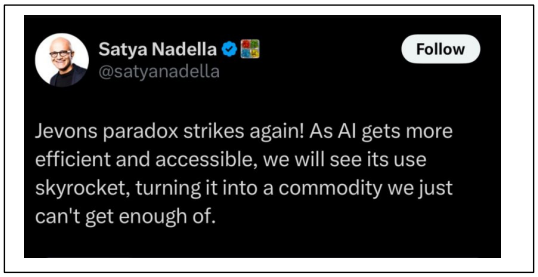


History rhymes



Source: Altimeter.

History is littered with examples of the Jevons paradox, particularly pronounced when efficiency improvements occur in general-purpose technologies. Notable examples include the steel industry transformed by the Bessemer process, the transition from DC to AC electricity and of course *Moore's Law*.



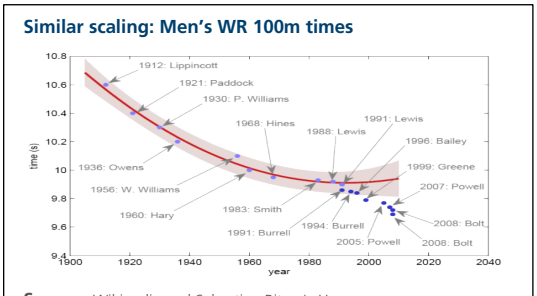
The DeepSeek moment was a perfect opportunity for AI maximalists to dust off Jevons; in the event that DeepSeek claims were true, **more efficient AI would presage far higher usage.** Microsoft CEO Satya Nadella exclaimed: "***Jevons paradox strikes again! As AI get more efficient and accessible, we will see its use skyrocket***". While infrastructure stocks plunged, perceived beneficiaries, including Apple and select software stocks, rallied on the prospect of cheap(er) and plentiful AI.

- **No pain, no gain**

For some, the harder work required to make additional progress will not be worthwhile. In today's AI race, some of the contenders may decide that the escalating costs and diminishing returns are no longer justifiable, leading them to exit the AI race. Others may consider the performance of recent 'fast follower' open source models like DeepSeek and conclude that the race was in fact over.

- **Small acorns, mighty oaks**

In sport, everyone knows that marginal improvements yield outsized gains with fractions of a second separating champions from the rest of the field meaning small refinements in training, technique and biomechanics can translate into historic performances. In elite sprinting, every 0.01 second improvement is the result of months, if not years of optimisation. A**t the cutting edge of performance, the compounding effect of marginal gains determines greatness.**



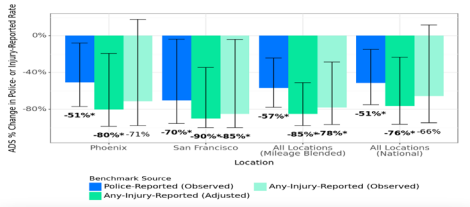
Source: Wikipedia and Sebastian Bitzer's Homepage.

The same is true for AI scaling

Today, AI has already equalled or surpassed human levels in numerous fields. These include image recognition, cancer screening and medical imaging.

However, prospect theory explains that "losses loom larger than gains"[xxxiii], an asymmetry that helps explain why adoption often happens later than it theoretically should. As such, **AI substitution (envisaged by agentic and AGI) is likely to require significantly higher levels of accuracy than a human baseline**.

Comparison of Waymo RO Crash Data to human benchmarks at 7.1M miles



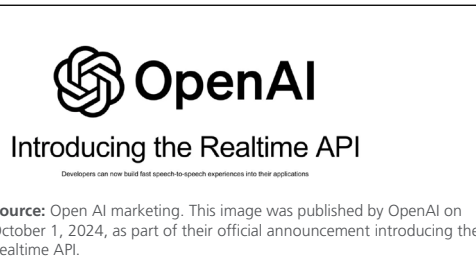
Source: Waymo LLC, 2023.

In the case of autonomous vehicles (AV), surveys suggest that mainstream adoption will only happen once electric vehicle (EV) makers can demonstrate safety at least one order of magnitude above human drivers.[xxxiv] For the record, that does not look too far away; recent studies show Waymo's safety record is already 57%-85% better than human benchmarks on an incident per million miles basis.[xxxv]

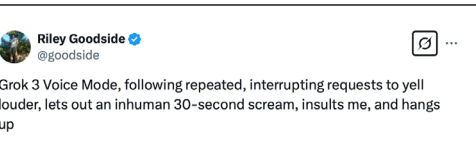
Today, most AI applications operate in contexts where humans are in the loop (AI as a tool) meaning that a few percent error is acceptable or can be mitigated by human oversight. **However, for AI to become a trusted infrastructure layer** – *to replace humans* – **models may need to achieve 99%+ accuracy**. This is what is envisaged by both agentic and AGI which is **why leading AI labs will press on**, looking to bridge the final gap between 'occasionally superhuman' and 'consistently near perfect'.

Multimodality: critical for AGI

In October 2024, OpenAI launched its *Realtime API* which utilises GPT-4o to "handle audio inputs and outputs directly, enabling natural and dynamic conversational experiences *without the need for intermediate transcription steps*".[xxxvi] The same technology powers OpenAI's **Advanced Voice Mode** (if you have not tried it, you really should). In February, Grok3 (the Robbie Williams to OpenAI's Gary Barlow) launched a voice mode too. By interpreting tone, nuance and context in real time **AI is making significant progress in emotional intelligence** as it also continues to close the gap with human intelligence.



Source: Open AI marketing. This image was published by OpenAI on October 1, 2024, as part of their official announcement introducing the Realtime API.



Likewise, a new generation of AI-enabled **wearables** and **novel human/machine interfaces** may also require AI models that can seamlessly process and fuse multiple data types. Traditional single-mode approaches, like text-only LLMs, are likely to prove insufficient for interpreting complex multimodal signals instantly. Instead, wearable AR (augmented reality) systems will likely rely on AI architectures capable of ingesting and analysing image, audio and location data in real time to deliver contextually rich intelligence, be it live translations, object recognition or situation-aware prompts to the user.

As such, the ability to deliver real-time intelligence across data types is likely to remain the preserve of models that have been "**built from the ground up for multimodality",**[xxxvii] such as Google Gemini, Grok3 and OpenAI's GPT-4o (the 'o' standing for 'omni' to reflect its multimodality). This is because they will need to be able to process and generate multiple modalities of data *simultaneously*.

Today, the greatest risks posed by inexpensive, excellent single or bimodal AI models is pressure on inference pricing and whether they cause one or more of the leading players to rethink (or just slow) their frontier model strategies. They may also lead to **market fragmentation** with smaller models able to address distinct use cases that do not require multimodality, making it impossible for one (frontier) model to ever rule them all.

The AI opportunity and the race to AGI

1. Revisiting the AI opportunity

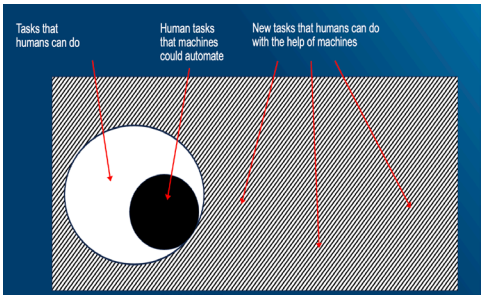
- **Vast market potential**

The AI opportunity is vast: according to Bernstein, information workers represent c34% of the global labour force and contribute c$20trn to GDP..[xxxviii] McKinsey estimates GenAI could automate 30-50% of tasks in about 60% of occupations by 2030. In the longer term, the opportunity is likely to be significantly greater should AI begin to substitute rather than augment human labour. In this scenario, tech budgets that today account for between 3-6% of corporate revenues could begin to address corporate operating spend, a much larger opportunity. This could see IT spending trend from c$5trn this year towards in excess of $40trn expected to be spent on global wages.

From the perspective of **economic growth,** forecasts vary widely. McKinsey estimates up to $4.4trn annually,[xxxix] while IDC predicts a cumulative global economic impact of $19.9trn through 2030, driving 3.5% of global GDP in 2030..[xl] IDC also believes that AI – as a general purpose technology – will have "profound economic consequences, reshaping industries, creating new markets and altering the competitive landscape."[xli]

- **Employment impact**

AI's impact on work may be even more profound. The IMF expects c40% of worldwide jobs to be impacted (more like 60% in developed markets given AI's disproportionate impact on higher-skilled work). Half of these jobs may benefit from AI augmentation (driving productivity) while AI is likely to prove disruptive to the other half as it executes key tasks currently performed by humans.[xlii] The IDC *Future of Work Employees Survey* revealed that most people expect some of their work to be automated by AI *over the next two years*, although only 3% expect their jobs to be fully automated by AI.[xliii] This aligns with our long-held view that disruption should remain moderate during the initial phase of AI adoption.



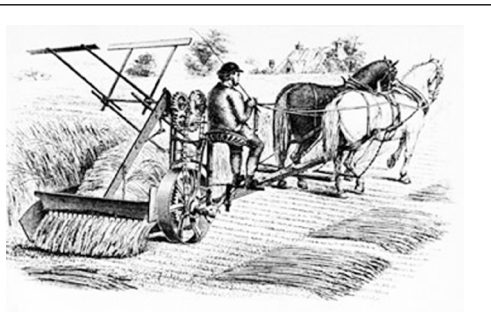
Source: Erik Brynjolfsson, Daedalus

Longer term, AI's impact is likely to prove more pernicious to existing work. Despite this, we continue to adhere to the Brynjolfsson view – while focus will inevitably fall on jobs 'lost' to AI, many more will be made possible by the union of human and machine.

This will manifest both through the **creation of entirely new industries** (invisible markets today) and by **enabling humans to focus on higher-value tasks** within existing markets.

- **Productivity gains**

We are also excited about the potential for as yet **unknowable positive externalities** driven by AI-enabled productivity. We have previously written about 19th century agricultural mechanisation and the dramatic impact it had on US agricultural output, staple grain prices and labour force participation in agriculture (which fell from c58% in 1860 to c27% by 1920). However, *before these impacts were widely felt,* Cyrus McCormick's horse-pulled reaper (1831) had already transformed the grain harvest six-fold, increasing the amount of wheat each person (and horse) could harvest in a day to c12-15 acres compared to around two acres previously using hand-held tools.


Source: The Reaper – Oklahoma Farm & Ranch, Wikipedia.

This not only helped the US wheat crop quadruple between the 1830s and the 1860s,[xliv] but mechanised agriculture and the surpluses it produced (that could be stored or traded), led to higher living standards and greatly improved **food security**. While the Great Irish Famine (1845-49) proved a tragic exception, peacetime famines had largely been eradicated in the US and Europe by the late 19th century.

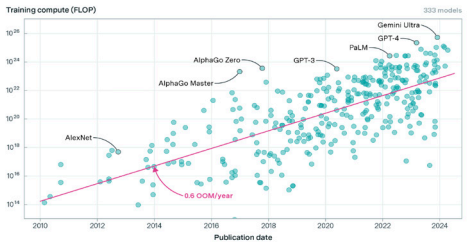
We **expect AI to unlock similar productivity gains and unknowable positive externalities** while enabling individuals and businesses to reduce their dependency on human scaling, allowing them to "*reap as much as they can sow*".

- **Zooming through the OOMs**

AI is scaling much faster than Moore's Law which even "in its heyday…was comparatively glacial"[xlv] improving at between 1-1.5 orders of magnitude (OOMs) per decade. In contrast, AI scaling has been progressing at around one OOM per year[xlvi] or 5-6x faster than Moore's Law.[xlvii] Its exponential scaling is apparent in the **cost of AI** which, for a constant level, "falls by about 10x every 12 months" as compared to Moore's Law which "changed the world at 2x every 18 months".[xlviii]

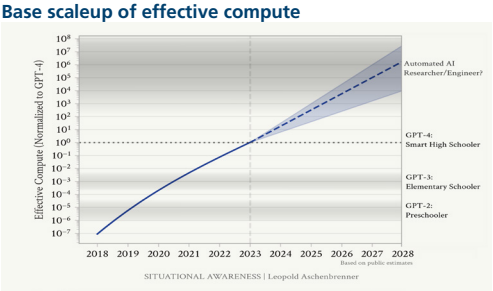
As one AI commentator puts it: **"We are racing through the OOMs,** and it requires no esoteric beliefs, **merely trend extrapolation of straight lines, to take the possibility of AGI…by 2027 extremely seriously".**[xlix]

Training compute of notable deep learning models over time



Source: Epoch AI.

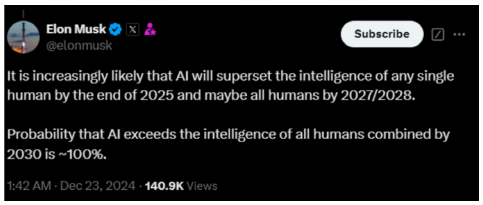
Base scaleup of effective compute



Source: Situational Awareness paper.

3. Shortening timeline to AGI?

Although AGI means different things to different people, the idea that within a few years AI might be "able to understand, learn and apply knowledge across a range of cognitive tasks at a human-like level"[l] feels increasingly possible. Altman has said "systems that start to point to AGI* are coming into view"[li] with *superintelligence* possible "in a few thousand days".[lii]

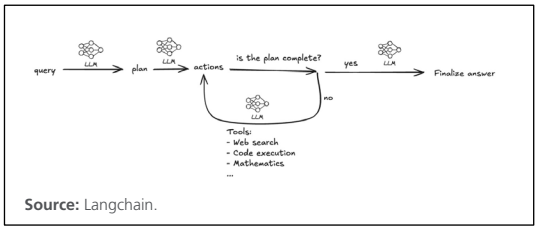


Elon Musk believes "AI will superset the intelligence of any single human being by the end of 2025".[liii] Computer scientist Ray Kurzweil, who popularised the idea of the *Singularity*, says he is sticking to his original prediction made in 1999 that AI will match and then surpass human intelligence by 2029.[liv] This is broadly in line with Musk's view that the "probability that AI exceeds the intelligence of all humans combined by 2030 is c100%".[lv] Metaculus (a community-driven forecasting platform) believes the first general AI system will arrive by 2030, a year ahead of its forecast last year.[lvi]

To be clear, there are still many dissenting voices around the AGI timeline: Gartner (still) believes AGI is more than 10 years away while Amodei has said that while "it could come as early as 2026…*there are also ways it could take much longer*".[lvii]

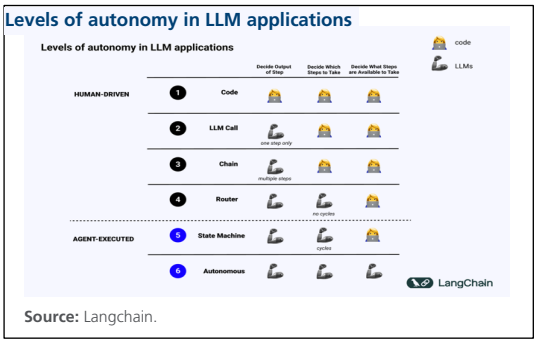
4. Agentic AI

The next step on the AGI journey is **agentic AI,** with 2025 billed as the "year of agents".[lviii] Like AGI, agentic definitions vary, reflecting a spectrum of agentic capabilities not dissimilar to levels of autonomy in electric vehicles (EVs). There have already been a flurry of 'agentic announcements' from the likes of Salesforce and ServiceNow.



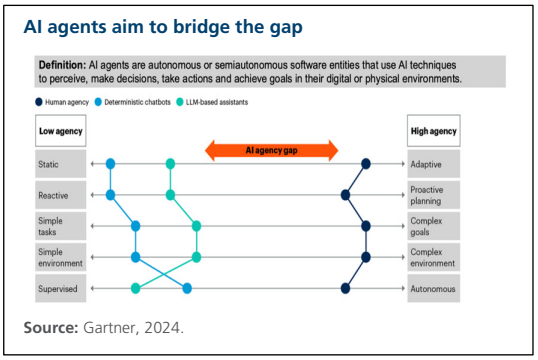
Source: Langchain.

Agentic AI are compound AI systems that chain together multiple task-specific models. The diagram opposite represents a typical workflow where the LLM decides the control flow of an application – processing queries, creating plans and executing actions iteratively until a final answer is reached.[lix] It follows a structured decision-making loop, incorporating external tools when necessary.



Source: Langchain.

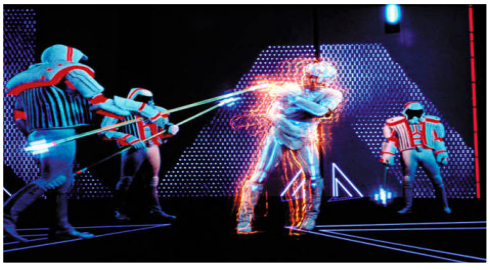
There have already been a number of early agentic product previews, including OpenAI's *Operator*, 'an agent that can use its own browser to perform tasks for you'. The agent is able to use a cursor to point and click, type, browse the web and perform actions on various websites.



Source: Gartner, 2024.

These agents **transform AI from a passive tool to an active participant in the digital ecosystem.**[lx] Gartner predicts that by 2028, one-third of all GenAI interactions will use agents like these.[lxi]

Over time, these agents are likely to gain increasing autonomy, shifting decision-making away from the human in the loop toward the underlying LLM itself. At this stage, they might more closely resemble the programs depicted in *Tron*, which independently operate and compete on behalf of their users, marking a significant evolution from today's human-guided 'copilot' systems.



Source: Tron.

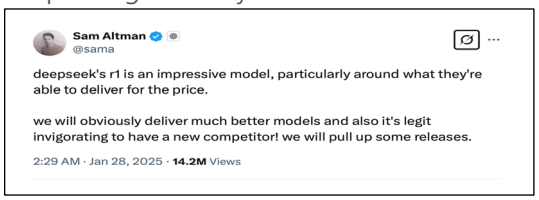
- **Could the internet 'go dark'?**

One final thought is that **autonomous agents** could fundamentally reshape the internet as we know it. There are already debates about how AI-powered search and chatbots are reducing website traffic which in turn weakens the incentive to create and share new content online. As these agents scale, seek out market inefficiencies and arbitrage opportunities for their users, they may increasingly resemble **high frequency trading (HFT) algorithms** - scanning order flows and executing trades in milliseconds. In response to the dominance of HFT, institutional investors have turned to **dark pools** – private, off-exchange trading venues – where large blocks can be executed without immediate public disclosure. Today, dark pools account for c40% of US stock trades[lxii] meaning a significant portion of the market operates beyond public view.

Just as dark pools shield orders from HFT algorithms, could autonomous agents ultimately undermine price transparency? For centuries, published prices have guided buyers dating back to the 17th century when Quaker businesses championed ethical and transparent pricing practices. However, as agentic systems take over price discovery, humans may play less of a role in setting or understanding market prices.

5. Sputnik, China and the AI race

DeepSeek was heralded as AI's '**Sputnik moment'** marking a turning point that sent shockwaves through Western AI labs as well as stock markets. Previously, China's AI efforts led by their cloud companies had significantly trailed the US-led industry. However, DeepSeek significantly closed the performance gap – to perhaps six months[lxiii] – exploding the myth of US dominance. DeepSeek was followed by a flurry of other Chinese models from startups, as well as more established companies such as ByteDance and Alibaba making it clear that DeepSeek was no fluke.



- **A new space race or another *Manhattan Project*?**

Naturally, **China's AI breakthroughs have intensified the ongoing debate over AI supremacy and national security – the latter could drive even more prohibitive restrictions**, with DeepSeek putting the open source AI approach under fresh scrutiny. Several countries have already banned DeepSeek due to concerns over data storage on Chinese servers, while the US Commerce Department is assessing its national security implications.

However, Trump – never hesitant to rewrite the rules of engagement when it suits US interests – has so far declined to tighten restrictions. Instead, he has framed DeepSeek as a "wake-up call" for American AI labs, signalling that the US must accelerate its own development efforts rather than simply hinder China's progress.

If this mindset prevails, **we could be witnessing the start of a new AI 'space race'.** The original *Sputnik moment* led to the creation of NASA in 1958, with US space spending soaring from 0.1% of GDP in 1958 to over 4.4% by 1966,[lxiv] culminating in the 1969 moon landing. A similar trajectory may now unfold in AI, as sovereign investments surge. January saw the announcement of the $500bn *Stargate* initiative, alongside the Bank of China's trillion-yuan, five-year AI investment plan. In February, France followed suit with a €109bn commitment to AI-related advancements. If history is any guide, government-backed R&D and strategic funding could accelerate innovation and the pace of model improvement while raising the stakes in the race for AI leadership.

6. AI risks

There are myriad risks to our constructive AI view. The most critical of these relate to **AI model progress** failing to maintain its current trajectory. R**egulation** also poses a significant threat to AI progress should it escalate sharply. While export controls aimed at slowing China's AI progress may become more effective as scaling continues, additional restrictions could stifle innovation while insufficient oversight could accelerate AI proliferation. If the industry continues to make rapid progress towards AGI, the likelihood of *Manhattan Project*-type regulatory intervention rises, with possibilities ranging from nationalising AI labs to banning larger models. However, such measures could simply slow US progress while shifting leadership to more permissive nations rather than mitigating risks.

Beyond regulation, **AGI itself presents existential risks**, given that general intelligence could confer decisive economic and military dominance. Former Google CEO Eric Schmidt has framed this as a matter of "the free world's very survival". While OpenAI's stated mission is to ensure AGI benefits all of humanity, achieving this safely may require trade-offs, such as deliberate slowdowns, restrictions on open-source AI or international governance frameworks.

Yet history has shown that groundbreaking technologies are nearly impossible to contain, raising concerns that AGI could emerge in unregulated environments, controlled by rival nations or bad actors.

The **economic and social disruptions** caused by AGI could be just as profound. Like the transistor, AI is poised to scale exponentially and embed itself in every industry – but unlike past technologies, it may replace rather than enhance human capital. The commoditisation of core knowledge could erode expertise, making society increasingly dependent on AI-generated consensus (the tyranny of the majority) rather than deep intellectual engagement. Furthermore, if AGI advances faster than our ability to unlock new market opportunities, it could lead to widespread workforce displacement and rising inequality.

While these risks are substantial, we remain AI optimists, echoing Keynes' view that *"There is no country and no people…who can look forward to the age of leisure and of abundance without a dread."* [lxv]

Final thoughts

It is remarkable how far the AI story has progressed. Model gains have been remarkable, while China has entered the AI race in dramatic fashion – DeepSeek has added (unwanted) complexity to the AI story. Likewise, more mixed recent AI news flow may have tripped up stocks but none of the individual data points derail the AI story. That said, we expect volatility to remain elevated relative to previous years, reflecting the third year of a technology cycle and consistent with our mid-1990s parallel.

As we continue to scale AI exponentially, we expect current hurdles to be cleared just as earlier ones were. Diminishing returns to scale may shake out the also-rans, but incremental improvements are likely to have a far greater impact than people expect. Reasoning models have led to significant gains though all models still fail on some very easy tasks which is why progress towards AGI is likely to take the form of Mollick's 'jagged frontier'. We may not even notice as AI subtly crossed thresholds that "irrevocably change aspects of our lives". [lxvi]

Agentic AI represents the next stage of AGI. It should provide us with early evidence of how the automation of knowledge work and limitless scaling leads to volume explosions that existing frameworks of thought struggle to capture, but that we know accompany general purpose technologies. We could not be more excited about this.

All the evidence suggests the timeline to general intelligence is shortening. This may bring new challenges (potentially in the form of greater regulation) as the implications of AGI come into focus. However, this should be ameliorated by the desire to *win the race*: safety matters, but winning matters more.

Despite the remarkable gains to date, we are still very early in the AI story. In our opinion, it is a story without parallel, a general purpose technology that will transform the work we do and the world around us. However, the pursuit of "making AI smarter than almost all humans at almost all things will require millions of chips [and] tens of billions of dollars" [lxvii] at least.

We struggle to concisely convey our excitement about this rare moment of discontinuous technology progress. So we shall leave it with Sam Altman who said: "Many of the jobs we do today would have looked like trifling wastes of time to people a few hundred years ago, but nobody is looking back at the past, wishing they were a lamplighter. If a lamplighter could see the world today, he would think the prosperity all around him was unimaginable. **And if we could fast forward a hundred years from today, the prosperity all around us would feel just as unimaginable**".

Ben Rogoff

[ii] AMZN 4 → 6 (2022) , MSFT 4 → 6 (2023), IBM 5 → 6 (2023), GOOG 4 → 6 (2023), META 4 → 5 (2022), ORCL 4 → 5 (2023) – see table.

[iii] Bain

[iv] Bain, see chart

[v] https://forgeglobal.com/uk/insights/reports/ai-influence-private-market-performance-takes-off/#footnote3

[vi] https://forgeglobal.com/uk/insights/reports/ai-influence-private-market-performance-takes-off/#footnote3

[vii] https://www.ey.com/en_us/insights/ipo/ipo-market-trends#:~:text=The%20US%20IPO%20market%3A%202024%20in%20review&text=Overall%2C%202024%20US%20IPO%20activity,and%20seven%20deals%20topping%20USD1b.

[viii] https://www.ey.com/en_us/insights/ipo/ipo-market-trends#:~:text=The%20US%20IPO%20market%3A%202024%20in%20review&text=Overall%2C%202024%20US%20IPO%20activity,and%20seven%20deals%20topping%20USD1b.

[ix] (Empirical 7/10/24)

[x] https://indexes.morningstar.com/insights/analysis/blt81d5614b4c2ccd2b/unicorns-and-the-growth-of-private-markets

[xi] https://indexes.morningstar.com/insights/analysis/blt81d5614b4c2ccd2b/unicorns-and-the-growth-of-private-markets

[xii] https://www.nber.org/system/files/working_papers/w12011/w12011.pdf

[xiii] FT: **AI frenzy leads US venture capital to biggest splurge in three years (9/3/25)**

[xiv] https://www.fabricatedknowledge.com/p/lessons-from-history-the-rise-and

[xv] https://www.fabricatedknowledge.com/p/lessons-from-history-the-rise-and

[xvi] https://www.morningstar.co.uk/uk/news/259984/microsoft-earnings-solid-quarter-as-ai-growth-shines.aspx

[xvii] ***** and last year's strat

[xviii] GS July CIO survey / see chart

[xix] GS July CIO survey / see chart

[xx] See chart

[xxi] All stats from UCITS presentation Feb 2025

[xxii] https://www.techradar.com/tech/people-are-increasingly-swapping-google-for-the-likes-of-chatgpt-according-to-a-major-survey-heres-why

[xxiii] https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai

[xxiv] See chart

[xxv] This benchmark evaluates a model's ability to understand and process text, images, audio, and video.

• **GPT-4 (2023):** Scored 34.9%.

- **GPT-4o (2024):** Improved to 69.1%.
- **Gemini 2.0 Pro (2024):** Slightly higher at 72.7%.

[xxvi] https://ai-pro.org/learn-ai/articles/the-next-ai-frontier-gpt-o1-preview/#:~:text=Performance%20Benchmarks&text=International%20Mathematics%20Olympiad%20(IMO)%3A,%2Dlevel%20problem%2Dsolving%20challenges.

[xxvii] https://www.oneusefulthing.org/p/something-new-on-openais-strawberry

[xxviii] https://arxiv.org/pdf/2412.10849

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When considering all locations together, the any-injury-reported crashed vehicle rate was 0.41 incidents per million miles (IPMM) for the ADS vs 2.78 IPMM for the human benchmark, an 85% reduction or a 6.8 times lower rate. Police-reported crashed vehicle rates

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- **Capital is at risk and there is no guarantee the Fund will achieve its objective. Investors should make sure their attitude towards risk is aligned with the risk profile of the Fund before investing.**
- **Past performance is not a reliable guide to future performance. The value of investments may go down as well as up and you might get back less than you originally invested as there is no guarantee in place.**
- The value of a fund's assets may be affected by uncertainties such as international political developments, market sentiment, economic conditions, changes in government policies, restrictions on foreign investment and currency repatriation, currency fluctuations and other developments in the laws and regulations of countries in which investment may be made. Please see the Fund's Prospectus for details of all risks.
- The Fund invests in the shares of companies and share prices can rise or fall due to several factors affecting global stock markets.
- The Fund uses derivatives which carry the risk of reduced liquidity, substantial loss and increased volatility in adverse market conditions, such as failure amongst market participants.
- The Fund invests in assets denominated in currencies other than the Fund's base currency. Changes in exchange rates may have a negative impact on the Fund's investments. If the share class currency is different from the currency of the country in which you reside, exchange rate fluctuations may affect your returns when converted into your local currency. Hedged share classes may have associated costs which may impact the performance of your investment.
- The Fund invests in a relatively concentrated number of companies and industries based in one sector. This focused strategy can produce high gains but can also lead to significant losses. The Fund may be less diversified than other investment funds.
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