Investment Manager's Report

This report forms part of the Strategic report section

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Market Review

Equity markets delivered strong returns during the Trust's fiscal year as inflation trended back towards target, unemployment remained low and economic growth surprised to the upside. The MSCI All Country World Net Total Return Index in Sterling returned +18.1% during the fiscal year, while the S&P 500 and the DJ Euro Stoxx 600 indices returned +23.3% and +9.0% respectively. The 'goldilocks' combination of disinflation and strong economic growth was entirely at odds with investor pessimism and bearish positioning at the start of the fiscal year, which reflected a torrid 2022, adverse financial conditions, above-average valuations and the allure of significantly higher risk-free rates. Investors poured \$1.3trn into money market funds during 2023, 10x more than flowed into equity funds.

The fiscal year began amid the fallout from the collapse of Silicon Valley Bank and Credit Suisse. Decisive policymaker actions prevented contagion and reminded investors that *in extremis* the so-called 'Fed put' (an assumption that if necessary the Fed will step in to support financial markets) was alive and well. Global markets rebounded from lows in March to almost recover their December 2021 highs by the end of July 2023, supported by resilient consumer spending and strong labour markets, even as central banks hiked rates aggressively. Inflation trended down ('core PCE' declined from 5.2% in 2022 to 4.1% in 2023 and is forecast to reach 2.6% in 2024) without triggering a recession or even an increase in the unemployment rate, which remained below pre-pandemic levels in many countries. Strong equity market returns depended on the (surprising) fact that aggressive rate hikes did not derail the economy. Instead, US real GDP growth of 2.5% in 2023 (and expectations for 2.7% in 2024) significantly exceeded expectations at the start of 2023 (1.4% and 1.0% for 2023 and 2024 respectively). This 'goldilocks' scenario was tested during the fiscal year, however, as US bond yields touched 5% in October 2023 on a narrowly-averted US government shutdown, increased US Treasury issuance, a ratings agency downgrade and emerging 'higher for longer' interest rate commentary from central bankers.



Source: IMF, April 2024

The rise in yields proved short-lived and they retraced to c3.9% by the end of the calendar year, spurring a cross-asset rally. Favourable seasonal trends were buoyed by investors' growing hopes of a soft landing (where inflation comes down without a significant increase in unemployment). Markets took dovish commentary from Fed policymakers and supportive inflation data as a signal that the Fed had completed its hiking cycle and began to price the first rate cut in March, with expectations for six or seven 25-basis-point interest rate cuts by the end of 2024.

The New Year (and final third of the Trust's fiscal year) presented challenges as US 10-year Treasury yields rebounded to c.4.6% in April as labour markets and economic data remained firm, and inflation readings came in a little hotter than expected. This pushed out market expectations of the timing of the first Fed cut from March to November and put upward pressure on real yields (government bond yields adjusted for inflation), which moved from 1.7% coming into the year to c.2.2% by the end of April.

Despite still being incomplete, the rise and fall of inflation has been remarkable, demonstrating that credible central banks can contain inflation by controlling inflation expectations, rather than just slowing down the economy. The Fed also enjoyed notable tailwinds including productivity gains, benign weather and a tepid Chinese recovery. We have previously argued (in our 1945-1947 inflation parallel) that many Covid-related imbalances would probably have resolved themselves eventually, but the historic path taken by the Fed reflected the uniqueness of the post-pandemic episode. Larry Summers, a former Treasury Secretary, described the Fed's actions in the two years after 2021 as a "less than 1% probability set of actions relative to what the market expected".

An inescapable feature of equity markets during the fiscal year was the dominance of a select group of mega-cap technology stocks, the so-called 'Magnificent Seven' - latterly the 'Fab Four' (or Five) - which returned +60% combined in USD terms, according to Bloomberg. These returns emerged following a disastrous calendar 2022 when the group declined -45%, and FY24 returns were driven almost entirely by positive estimate revisions. Their dominance of equity returns (and indeed profit pools) has been felt more widely across the market as large cap stocks (Russell 1000) outperformed small cap (Russell 2000) by 10ppts during the fiscal year, 32ppts over the past 3 years and 50ppts over the past 5 years.



Source: Bloomberg

Technology Review

The technology sector led global equity markets higher during the Trust's fiscal year as the Dow Jones Global Technology Index returned +38.9% against the MSCI All Country World Net Total Return Index's +18.1%. Technology outperformance was driven by a number of factors: better than expected growth, positive earnings revisions, improved margins, and the increasing likelihood of an economic 'soft landing'. However, the most important technology theme during the year was the proliferation, evolution, and investment implications of Generative AI (GenAI). Our previous fiscal year saw the launch of ChatGPT in November 2022, followed by Microsoft's \$10bn investment in OpenAI in January 2023. However, GenAI became impossible for investors to ignore in May 2023, when NVIDIA delivered remarkable Q1 results accompanied by the largest guidance beat (\$11bn vs. \$7.15bn) in the history of the semiconductor industry.

At the stock level, companies exposed to AI computing (where demand for servers, chips and related components increased significantly) delivered positive returns during the fiscal year, led by NVIDIA which gained a staggering +213%. This helped the Philadelphia Semiconductor Index (SOX) return +58.7% over the same period, led by AI-related chip makers and semiconductor capital equipment companies, as cloud providers invested aggressively in the new technology.

Strength in Al-related data centre spending 'crowded out' non-Al spending in areas such as CPU and cloud servers, reinforcing the divergence between Al and non-Al returns. Non-Al semiconductor fundamentals were mixed: communications infrastructure spending remained weak, PC and smartphone inventory cycles appeared to bottom, while automotive and industrial end markets softened significantly before potentially bottoming towards fiscal year end.

Apple had a challenging year amid China market share loss concerns while the distinct lack of a positive AI narrative weighed on Apple's multiple.

The software sector delivered reasonable absolute returns as the Bloomberg Americas Software Index returned +23.8%, but significantly lagged the technology sector on a relative basis. This was due to a lack of positive revenue growth revisions (revenue growth in the software sector overall has been decelerating since mid-2021) and the deterioration of the narrative around Al's impact on existing application software vendors. Enterprise IT budgets remained fairly tight and continued to consolidate around the largest vendors as a more ROI-focused 'best of suite' approach overtook the 'best of breed' buying behaviour more generous technology budgets enabled during covid. Microsoft was the clearest beneficiary of this trend, topping almost every CIO 'spending intentions' survey.

Infrastructure software companies generally struggled as the fiscal year progressed, despite the fact that public cloud aggregate revenue growth (to which their growth is often tethered) reaccelerated to +21% in Q4 2023 and +24% in 1Q 2024, as customer 'optimisation' activities attenuated. AI was called out as a meaningful contributor at Microsoft and Amazon, but this has yet to translate into improved performance in cloud consumption stocks. Cybersecurity stocks fared better, reflecting robust budgets, spend consolidation and the likelihood of AI-enabled cyberattacks requiring new tools. Ransomware attacks reaccelerated to +70% yoy in 2023 as hackers begin to use GenAI tools to help them create malware faster than ever before. The average cost of a breach reached \$4.5m in 2023, a 3-year CAGR of +15%, and United Health's \$1.6bn ransomware attack was the first >\$1bn breach.

The NASDAQ Internet Index returned +37.2% following a challenging FY23 (+1%), during which consumerfocused internet companies were hurt by post-pandemic normalisation trends and concerns about an imminent recession. The recession in the US never arrived and the largest e-commerce and advertising platforms (such as Amazon, Google and Meta) dominated returns in FY24. These companies consolidated market share gains and delivered strong results as the online consumer remained resilient. Newfound expense discipline helped deliver significant upside to earnings estimates for the megacap internet companies. Furthermore, a higher cost of capital decimated smaller peers - a dynamic which helped other 'vertical leaders' such as Uber Technologies and DoorDash. The AI narrative around the largest internet platforms oscillated during the fiscal year. Concerns around longerterm disruption weighed against near-term revenue benefits from better AI-driven ad targetting, product

enhancements and strategic advantages from their data assets, scale, distribution, compute and technical expertise. Smaller players struggled, especially those with weaker balance sheets or aggressive online Chinese competition, such as Match.com and Etsy.

Long-duration assets and second-liners struggled for footing against a backdrop of high yields, mixed fundamentals and limited exposure to AI. This resulted in unusual performance divergence among technology funds and trusts, with those striving to discover the 'next' Microsoft, Meta and NVIDIA largely missing out on returns generated by the existing ones. As important as early AI enablers and beneficiaries, the absence of these stocks from portfolios meant many failed to capture AIdriven returns during the year. The IPO market tentatively reopened during the fiscal year, as the high profile ARM IPO raised c\$5.2bn. There was a smattering of other noteworthy technology IPOs (Instacart; Klaviyo; Kokusai Electric), but capital markets activity remained fairly subdued overall.

Large-cap technology stocks once again significantly outperformed their small and mid-cap peers as the Russell 1000 Technology Index and Russell 2000 Technology Index delivered returns of +43.5% and +29.8% respectively. Returns were led by the largest technology companies, which in part explains why the S&P 500 Information Technology Sector saw its valuation premium to the S&P 500 Index expand to 1.36x from 1.21x at the start of the calendar year, against a 10-year average of 1.1x. However, this valuation expansion was not experienced beyond the US; the Dow Jones Global ex-US Technology sector (W2TEC) which has no mega-cap constituents, significantly underperformed (+1.8%).

Portfolio Performance

The Trust outperformed its benchmark with the net asset value per share rising +40.8% during the fiscal year versus an increase of 38.9% for the Dow Jones Global Technology Index. The Trust's share price advanced by 50.5%, reflecting the additional impact of the discount narrowing from 13.4% to 7.4% during the period. We continue to monitor the discount and the Trust bought back 5.66m shares during the fiscal year, at an average discount of 12.3% to NAV.

While the zeitgeist of 2023 was captured by a select group of mega-cap stocks, returns during the Trust's fiscal year were less uniformly positive for the so-called *Magnificent 7*. Instead, returns were dominated by the proliferation, evolution and investment implications of generative AI (GenAI) following NVIDIA's remarkable quarter and record guidance delivered in May.

The Trust benefited from our decision to rotate decisively towards AI as a primary investment

theme, as outlined in our interim report. This was largely focused on the semiconductor and component subsectors, including memory-related assets, advanced packaging, testing and EDA software. In addition, we made a series of investments in smaller Asian component and materials companies that we expect to play a more significant role in AI computing than they did during the Cloud era. While the Trust was broadly neutral NVIDIA (which returned a staggering +213%), it benefited from a slew of other AI-related assets, including chipmakers AMD (+78%), ARM (+98%) and Micron (+76%), datacentre spending beneficiaries Arista Networks (+61%), Fabrinet (+83%) and Pure Storage (+122%), as well as semiconductor capital equipment makers Disco (+158%) and KLA (+79%).

While software sector fortunes were more mixed, select Trust holdings such as ServiceNow (+52%) and HubSpot (+44%) benefited from spend consolidation and a supportive AI narrative. The same dynamic drove returns in the cybersecurity subsector as tool consolidation and the need for scaled data assets to defend against more sophisticated AI-powered attacks supported spending. The Trust benefited from strong performance in a number of its cybersecurity holdings including CrowdStrike (+145%), Cloudflare (+87%), CyberArk (+93%), Palo Alto Networks (+60%) and Zscaler (+93%).

In the internet subsector, the Trust enjoyed strong returns from its exposure to dominant franchises in ecommerce and streaming that delivered strong revenue growth and improved profitability amid a more benign competitive landscape. These included Amazon (+67%), DoorDash (+112%), Netflix (+68%), Shopify (+47%), Spotify (+111%) and Uber (+114%).

The Trust also benefitted from the decision to reduce and/or exit companies we believed would prove limited beneficiaries or eventual losers from AI. The most significant of these was Apple (+1%) that meaningfully underperformed during the year due to smartphone market headwinds and a limited AI narrative. Our underweight Apple position was responsible for 336bps of positive contribution to the Trust's relative performance during the year. Performance also benefited from not holding Intel (-1%), which had execution issues in its business model transition, non-AI related semiconductor companies that experienced inventory digestion as well as an underweight exposure to EV-related assets. We extended this underweight EV position during the year following the sales of On Semiconductor (-2%) and Infineon (-4%) amid deteriorating automotive datapoints.

In terms of negatives, liquidity proved the largest headwind to performance as cash (4.5% average) cost 249bps and Nasdaq puts an additional 76bps. While meaningful, our cash and put positions are designed to ameliorate our portfolio beta (which is considerably higher than our benchmark) in the event of a market setback. They also inform portfolio construction, emboldening us to hold larger positions in higher beta stocks than we might otherwise. Relative performance was also negatively impacted by further large-cap outperformance with the Russell 1000 Technology Index (large cap) and Russell 2000 Technology Index (small cap) returning +43% and +30% respectively. On a three and five-year basis, the gap has extended in favour of large caps to 62% and 138% respectively. During the fiscal year, this was largely transmitted via underweight positions in Meta (+80%) and Alphabet (+52%), which comprised more than 10% of our portfolio but dragged on relative performance given they made up 13% of the benchmark.

While AI drove the Trust's performance during the year, there were also some negative offsets including an underweight position in chipmaker Broadcom (+109%), which dragged on our relative performance by 120bps. In addition, there were some smaller AI positions to which we arrived late and/or failed to capture the upside from, including Gold Circuit, Unimicron and Rambus. Earlier hopes that infrastructure software would benefit from AI-related application development also proved premature with a lack of revenue reacceleration or AI participation weighing on holdings such as MongoDB (-19%), Snowflake (+5%) and Teradata (-4%).

Trust performance was also negatively impacted by exposure to more rate-sensitive areas such as fintech and alternative energy. Within fintech, our holdings in Mastercard (+19%) and Visa (+17%) both generated strong positive returns but fell well short of our benchmark. Smaller fintech companies fared meaningfully less well, although our exits of Adyen (-24%) and Flywire (-29%) helped reduce this impact. Our modest exposure to alternative energy proved an additional drag, again ameliorated by several stock sales including Enphase Energy (-33%) and First Solar (-3%). Smaller Trust holdings in factory automation and robotics-related companies such as Harmonic Drive Systems (-16%), Keyence (+0%) and Cognex (-12%) were negatively impacted by China weakness. Our decision to modestly add back to some longer-duration stocks such as Roblox (+0%) and Tesla (+12%) towards the end of 2023 also proved premature as yields rebounded in early 2024, leading to sustained underperformance from this group.



IT'S HAPPENING AGAIN: The railway buildout lasted decades, providing the foundational infrastructure for US productivity growth; AI infrastructure will support productivity growth for knowledge work.

The railroads played a crucial role in the development of the US economy from the industrial revolution in the Northeast (1820s – 1850s) to the settlement of the West (1850s-1890s). Between 1830-1839, US railroad investment increased from 0.2% of GDP to just above 0.9% by 1839 (a 31% CAGR) in nominal terms. After a digestion period, investment reaccelerated, averaging 1.7% of GDP between 1850 and 1859 to reach a peak 2.6% of GDP in 1854.

Polar Capital Technology Trust plc Annual Report and Financial Statements 30 April 2024

At the height of the equivalent UK railroad boom, investment averaged 7% of GDP for three years. Current AI investments do not (yet) suggest a bubble. US cloud companies' capital expenditure on AI infrastructure may reach >\$156bn in 2024 (c0.54% of GDP) and is on track to reach >\$1trn collectively over the next 5 years. The railway buildout ended in a bubble, but at much higher levels of GDP than the AI build today, having remained elevated for more than a decade.

2.6% vs. 0.5%

Share of US GDP spent on railways in 1854 versus Al infrastructure in 2024

>\$1trn

Estimated size of AI datacentre opportunity

Market Outlook

If the market surprise of 2022 was how high inflation remained for so long, 2023's revelation was how little impact the fastest monetary tightening cycle in a generation had on the real economy. Various explanations include: a delay in the 'transmission' of higher rates given the high proportion of mortgages and corporate debt which had been fixed at very low rates during the 'zero-rates' era; the benefit of interest income on 'excess consumer deposits' in supporting consumer spending; corporate unwillingness to let go of the workers they had fought hard (and paid up) to attract and retain. In contrast with prior years, our base case for 2024 is broadly in line with consensus on many of the key near-term debates (inflation, rates, valuations) and our belief is that where we do differ, the range of outcomes is narrower. Some of the other 'known' risks are more binary in nature (e.g. US presidential elections).

In its April 2024 update, the IMF projected 3.2% global growth in 2024, 30bps higher than its October 2023 forecast, and 3.2% in 2025. This outlook is described as "surprisingly resilient, despite significant central bank interest rate hikes to restore price stability". The persistence of US growth is striking, now expected to accelerate modestly from 2.5% in 2023 to 2.7% in 2024, against expectations for a deceleration to 2.1% for both years in the IMF's January 2024 update. Despite strong economic growth, the disinflation process remains broadly on track and "monetary policy should ensure that inflation touches down smoothly": global headline inflation is expected to fall from 6.8% in 2023 to 5.9% in 2024 and 4.5% in 2025.

Our base case remains that central banks have won the battle on inflation. Much of the earlier excess inflation proved to be supply-side driven including covid disruptions (e.g. container freight rates increased 5x between 2020 and late 2021) and exogenous commodities price shocks from Russia's invasion of Ukraine. Demand imbalances have also played a part, including government stimulus and demand swings for goods versus services. Common causes have seen common solutions: disinflation dynamics have been reasonably homogeneous across countries. Goods disinflation has been widely observed while services has proven stickier, around c3-5% in developed economies.

For its part, the Fed kept long-term inflation expectations 'well-anchored' and prioritised credibility above all else; the '5yr5yr' – a market-implied expected average inflation rate over a five-year period that begins five years from today - remained in a 2-2.5% range despite headline CPI inflation in the high single-digits. This proved sufficient to deliver a 'soft landing' most thought impossible, judging by the c75% of economists who expected a recession coming

into 2023, and the Fed futures curve which anticipated the Fed would have to cut rates by the second half of 2023. We expect the Fed to manage the balance between keeping rates restrictive enough to ensure inflation returns to target and cutting early enough to prevent a recessionary outcome.

The path of inflation is the key determinant of Fed policy, and it will (rightly) remain 'data dependent', but policymakers are clearly cognizant of the need to manage *de facto* tightening from higher 'real' rates as inflation trends lower and policy rates sit unchanged. Indeed, real rates are already around c2%, versus an average 3% level at which the Fed has historically started cutting, and other central banks including Sweden's Riksbank, the ECB and the BoE have either begun cutting or signalled they will soon. The 'maximum employment' aspect of the Fed's 'dual mandate' will also likely receive more attention, and arguably Chair Powell introduced a form of 'labour market put' at the January FOMC press conference: "*If we saw an unexpected weakening in... the labor market, that would certainly weigh on cutting sooner. Absolutely.*"

Equities tend to rally after the Fed begins a cutting cycle, although the returns are (unsurprisingly) better in non-recessionary scenarios. Deutsche Bank found that the S&P 500 has returned +7% in the 12 months following the first rate cut in recessionary scenarios, and +18% in non-recessionary scenarios. Longer-term, Goldman Sachs found a c50% positive return over 2 years absent a recession and negative mid-teens returns when a recession occurred. Interestingly, the overall level of the market coming into the rate cutting cycle has made little difference historically. Since 1980, there have been 20 times when the Fed has cut rates when the S&P 500 was within 2% of all-time highs, and the market has been higher a year later on all 20 occasions.

Equities tend to rally after the Fed starts to cut... Median across each sample



Source: Goldman Sachs Global Investment Research

Investors should also be comforted by central banks' increasing ability and confidence in using their balance sheets to deal with sector or asset-class specific issues. Indeed, one of the great challenges last year was understanding how an aggressive Fed tightening cycle did not cause a spike in unemployment or a recession. In addition to the reasons suggested above, liquidity provided by years of Quantitative Easing plus covid-era balance sheet expansion (from 18% of GDP in 2019 to 28%) mollified the impact of monetary tightening from rate cuts. In addition, central banks have been very willing to use their balance sheets to support the economy and the debt and labour markets (and, by extension, risk assets), as seen with the Fed's Bank Term Funding Program (BTFP) and the Bank of England's successful intervention during the LDI crisis. We expect balance sheet operations to remain a permanent part of the landscape.

Valuations appear extended, but not unreasonable. Equity market valuations have rebounded since June and October 2023 lows (c15.5x) and the S&P now trades on 21x 2024 consensus earnings and 18.5x 2025, based on +11% and +9.5% EPS growth. Historically, equity valuations have expanded following the end of Fed hiking cycles, but multiple expansion is typically accompanied by a decline in bond yields. Economic growth appears positive but moderating (total revenue growth tracks nominal GDP growth normally), which suggests upside to revenues (absent AI-related areas) might be limited. S&P profit margins are back to pre-GFC highs and elevated versus history, having troughed in Q4 2022. Several incremental headwinds to further margin expansion suggest profit growth could be more similar to revenue growth in 2024, although analysts are still assuming significant operating leverage with S&P 500 expected earnings growth (+11%) ahead of revenue growth of 4.9%. However, we are optimistic longer-term that AI could drive sufficient labour productivity for knowledge workers to make a material difference to the c\$53trn global wage bill (c54% of GDP). Our valuation base case is that significant further multiple expansion is unlikely from this point, and equity returns should better track EPS growth absent a recession or bull case scenario.

Market Risks

The most significant risk to the market outlook is the prospect of a **recession** or 'hard landing'. Past economic downturns have seen S&P 500 EPS decline by 11% peak-to-trough and the index level fall by -24%, although prices and valuations typically bottom faster than earnings. The median forecasted probability of a US recession in the next 12 months fell steadily from 65% to 30% during the fiscal year. However, there remains a possibility that the 'long and variable lags' of the fastest monetary tightening cycle in a generation will ultimately push the economy into recession. Cracks in commercial real estate have caused concern, but the office market accounts for just 2-3% of banks' loan portfolios while office investment is only 0.35% of GDP.

We believe the odds of a US recession are still relatively low, despite warnings from several traditional leading indicators such as the yield curve (still inverted) and the Conference Board's Leading Indicator, which has never experienced such a large 6- month decline without a recession. On the monetary side, the money supply has never contracted this fast without some sort of negative outcome – even in our favoured parallel the post-WW2 'recovery loop', there was a brief recession in 1948-49 as the economy transitioned from a wartime to a peacetime footing. Central bankers may have more data (and some other tools) to help the economy adjust, but if there is an asset quality problem rather than a liquidity problem, there is only so much they can do.

The most bearish market view is any challenge to the idea that the Fed actually has managed to get inflation sustainably under control, and the threat from a '**second wave' of inflation** could necessitate further tightening. There was a second (and third) wave of high inflation in the 1970s related to geopolitical developments (Vietnam war, energy crisis, deficit spending). This would hurt equity performance: markets were flat between 1967-1980 and credit outperformed significantly as yields averaged >7%.

A longer-term issue which could contribute to a higher neutral interest rate and lower equity multiples is the growth in **public debt**, which has reached record levels as a percentage of GDP in many countries. Historically (e.g. 1919, 1946, 1995), peak government debt-to-GDP has been resolved by a combination of lower fiscal deficits (or surpluses) and an acceleration in GDP. This has not (yet) occurred; since the 2020 peak, GDP growth has been strong, but the federal deficit in FY23 was c\$2trn (7% of GDP), doubling from \$1.0 trn in FY22.To date, this increased deficit has been of limited concern to the bond market but our working assumption is that it 'cares' about deficits in a non-linear way, and perhaps 5% on the 10-year US treasury might mark a potential 'break point'. However, we also acknowledge that being the reserve currency of the world may allow for ongoing structural US deficit financing with limited penalties.

Beyond a recession, we are most concerned about **geopolitical risk**, a topic we covered in depth last year. This risk is heightened in what is an election-heavy year, where countries accounting for >60% of global GDP are holding elections – US, India, and UK among them – but also because there is an emerging narrative about the reversal of the post 1980s 'peace dividend' which has supported global growth, trade, stability, and asset values. The emerging 'multipolar' world could reverse

this feedback loop as trade and supply chains decouple, higher inflation and higher deficits become embedded – the '1970s scenario'. **China** represents its own category of geopolitical and economic risk. A bearish view might consider the 'success' of China's initial lockdown as its zenith as a global power before the inherent limitations of an investment-led growth model and/or totalitarian leadership were laid bare. China's nominal GDP growth has decelerated to the lowest level since the 1970s which helps explain the weakness in Chinese equity and property markets. This could reflect a new normal for China after three decades of double-digit nominal GDP growth.

In terms of **US-Sino relations**, there are several paths that a deterioration might take in 2024. These include further outbound investment restrictions, export controls, and even the revocation of 'Most Favoured Nation' status, something of which Trump is in favour. China may also be at risk of exporting deflation to the rest of the world but the economic impact to the US should be contained (exports to China make up 0.6% of US GDP), and a direct effect of a 1% shock to Chinese growth on US GDP is estimated at less than 0.01%.

A far greater risk comes from the potential for an escalation in tensions surrounding **Taiwan** as President Xi described unification as "a historical inevitability" in his 2024 New Year's address. A second **Trump presidency** would bring an added element of uncertainty and higher likelihood of a miscalculation. A recent 'war game' simulation estimated the potential impact on the global economy of a war in the Taiwan Strait at c\$10trn or c10% of global GDP, significantly larger than the GFC or the pandemic. As it relates to PCT, Taiwan accounts for 60% of global semi shipments and >90% of leading-edge semi manufacturing capacity. For context, OPEC has about 40% of global oil capacity. It might take 5 years + to rebuild Taiwan's semiconductor capacity and would undoubtedly set the evolution of AI back materially.

Increasing **market concentration** has been a feature of the post-GFC market, with the largest 10% of stocks' accounting for a portion of the overall stock market (c.75%) not seen since the Wall Street Crash of 1929. This is not just a technology sector phenomenon as large caps are outpacing small caps nearly everywhere, even on a sector-neutral basis. The rejuvenation of small caps has been long called for by active managers (including us), but the case for broadening is not straightforward.

A more supportive rate environment should help small cap outperformance as we saw in Q4 2023, when yields dropped sharply back to c3.8% and small and mid-caps led the market higher. As we saw then, the upside from a small cap rally can be explosive as Russell 2000 bull markets have produced average gains of 131%, with 7 of 11 bull markets producing triple-digit gains. However, the earnings picture is complicated as large-cap market dominance has reflected higher EPS estimates, in contrast with small-caps where earnings have trended lower since the start of 2022. Absent an earnings recovery, it is hard to argue for structurally higher small-cap multiples.

The risk profile of small caps is also less appealing: the Russell 2000 has a record percentage of unprofitable companies with significantly more debt to refinance in the next few years, in stark contrast with strong balance sheets at larger corporates. Finally, the dominance of large caps may simply reflect the changing nature of the economy as larger companies have enjoyed increasing returns to scale, formerly having been subject to diminishing returns. This reflects a number of structural changes including the increasing relative importance of network effects, globalisation and potentially large cap companies' ability to develop and exploit proprietary software. In fact, returns on capital for large companies were generally lower than for smaller companies in the 1980s and 1990s, but since 2000 they have become significantly higher for larger companies. The gap may also reflect different attitudes to investment. For example, total capex and R&D spending for the Magnificent Seven this year is expected to total c\$350bn and the Magnificent 7 reinvests c60% of their operating cash flow back into capex and R&D, or about 3x rate of the other 'S&P 493'. Our view is that while a broadening of the market is certainly possible and would be welcome, change of leadership often require a break in the cycle.

There is risk to equity markets from **competition from other asset classes**. Yields on equities, high grade bonds, T-bills and REITs recently converged for the first time in 20 years. As such, there is far greater competition for capital with investors able to collect the same earnings yield as the S&P 500 at varying risk/return profiles. If rates trend lower as expected, we should expect some rotation into US equities, although equity ownership as a percentage of total assets is already at record highs.

Our broader conclusion remains unchanged from our interim report: whether there is a recession or not and what equity markets do over the next six to 12 months perhaps misses the point. Astounding new innovations such as AI augur well for a longer-term innovation-led growth and prosperity cycle. Markets appear fully valued if we think the timeline to AI's economic impact is 5+ years away, but much more reasonable if that timeline is sooner. The shortening timeline to Artificial General Intelligence (AGI) – the ability to understand, learn, and apply knowledge across a broad range of tasks and domains at a level comparable to human intelligence– presents a further upside scenario.

NEW MARKETS

IT'S HAPPENING AGAIN: Just as the sewing machine changed the relationship between people and clothes, we expect AI to create new markets by radically altering the speed and volume of knowledge work.

Singer's sewing machine (1855) was an historical 'copilot' which increased the number of stitches a seamstress could produce by 22x. This allowed for the mass production of clothing, making it more affordable and changing the way people dressed. Before Singer's machine, most clothing was made by hand, which meant people typically had a very limited wardrobe with perhaps one 'best' set and one 'everyday' set of clothes. The sewing machine collapsed the cost and time of making clothes, greatly increasing the variety and quality of clothing that the mass market could afford and giving birth to the 'ready to wear' apparel industry.

Just as the sewing machine changed the relationship between people and clothing, we expect AI to change the relationship between people and ideas, with copilots and other knowledge work productivity tools significantly reducing the 'time to first draft', while improving quality, creativity and range – a 'machine tool for the mind'.

14.5 → 1 hour

Time taken to produce a shirt before and after the sewing machine

>\$1trn

Size of the global apparel market built on the back of the sewing machine

Technology Outlook

Earnings outlook

Having stabilised in 2023 with growth of 3.5% y/y, worldwide IT spending is expected to reach \$5.1trn this calendar year representing an increase of 8% y/y, in current dollar terms. This represents a notable acceleration and an upward revision from the +6.8% forecast in January. While Gartner believe it will take until 2025 to translate into enterprise budgets, it is clear that **AI has already become a corporate imperative** with c45% of CIOs planning to adopt AI within 12-24 months. Strength expected in datacentre spending (+10% y/y) suggests that the digital groundwork for AI is being built ahead of enterprise adoption, led by hyperscalers. Likewise, an expected rebound in devices, following two very weak consecutive prior years, is predicated on AI-related product cycles.

Table 1. Worldwide IT Spending Forecast (Millions of U.S. Dollars)

	2023 Spending	2023 Growth (%)	2024 Spending	2024 Growth (%)
Data Center Systems	236,179	4.0	259,680	10.0
Devices	664,028	-9.1	687,943	3.6
Software	914,689	12.6	1,042,174	13.9
IT Services	1,385,120	6.1	1,519,928	9.7
Communications Services	1,487,161	3.3	1,551,288	4.3
Overall IT	4,687,177	3.8	5,061,013	8.0

Source: Gartner, April 2024

For 2024, the technology sector is expected to deliver revenue growth of 9.3%, while earnings are expected to increase by 18% **which would represent the best year for earnings since 2021**. These forecasts are well in excess of anticipated S&P 500 market growth, where revenues and earnings are pegged at 4.9% and 11% respectively. The technology sector's outperformance is expected to continue in 2025 with early forecasts for 10.8% / 13.8% comfortably ahead of market expectations (5.8% / 9.5%). While macroeconomic conditions may create crosscurrents, we believe technology fortunes this year will be determined by the path of AI progress.

Valuation

The forward P/E of the technology sector has expanded during the past year. A year ago, valuations had recovered to c24x forward P/E, having ended 2022 at c.19x. Since then, valuations have increased further as technology earnings and stock performance (especially Mag-7) 'crowded out' the broader market. At time of writing, technology stocks trade at 26.5x, well ahead of five (23.9x) and ten-year (20.3x) averages. This reflects the arrival of AI as an investment theme and a much improved inflationary backdrop. The premium enjoyed by the sector expanded during the past year with excitement around AI resulting in the sector making post-bubble highs (1.4x the market multiple), levels last seen briefly during the pandemic period. At time of writing, this premium has fallen back to c.1.3x - at the high end of the post-bubble range. While this suggests less valuation upside in the nearterm, we believe that AI represents a unique moment for the technology sector such that the post-bubble range (between 0.9-1.3x) may no longer be valid.





Magnificent 7

However, the valuation question is greatly influenced by a select group of mega-cap stocks that – as well as driving returns last year – also dominate technology indices. As such, this year we present some high-level thoughts on the so-called 'Mag-7' given the implication for future returns, prospects of a broadening market and, of course, our own positioning.

While 2023 proved a remarkable year for the group, returns are highly sensitive to the starting point; since the beginning of 2021, Mag-7 - at time of writing - has only outperformed the S&P 500 by 10%. At time of writing, the group sports a premium valuation; a forward P/E of 29.6x as compared with 20.9x for the overall index and 18.6x for the remaining 493 S&P 500 (SPX) companies. However, Mag-7 accounts for c.29% of SPX market cap and is expected to generate c.22% of SPX net income. One might argue a little extended, but very clearly far from bubble territory. Moreover, the group is expected to deliver three year compound annual revenue growth of 12% versus 3%, higher margins (22% vs. 10%) and a greater re-investment ratio (61% vs. 18%) than the SPX493. This superior profile has shown little sign of abating as in Q1 2024, expected S&P 500 earnings growth of +6% y/y is expected to come from Magnificent 7 earnings growth tracking to +48% y/y while the remaining 'S&P 493' are forecast to deliver -2% y/y. These metrics reflect the group's uniqueness, with each member dominating large markets, enjoying scale advantages or natural monopoly status while investing heavily in new opportunities to avoid the so-called innovator's dilemma. Most also have strong AI stories in our opinion, and all are what we consider non-fungible companies and stocks. As such, we expect to retain sizeable positions in the largest stocks in the benchmark over the coming year, assessing each on its own merits and not defaulting to a market broadening narrative, even if we (and other active managers) strongly desire it.





Next generation / longer-duration stocks

Next-generation valuations have also expanded as we predicted in last year's Annual Report when we suggested it was 'highly likely' that we had already seen the lows. Since then, an improved inflation outlook and moderating cloud optimisation headwinds have seen software valuations recover to c.7.0x forward EV/sales, having bottomed at around 5.1x (and peaking at 16x in 2021). According to KeyBanc, this leaves them ahead of five and ten-year pre-covid averages of 6.1x and 7.2x respectively. Higher growth stocks have experienced a greater valuation recovery with companies growing revenues above 20% today trading at 10.9x forward EV/sales; down 62% from highs but well ahead of pre-COVID five-and ten-year averages of 7.8x and 7.0x respectively. In contrast, unprofitable growth stocks have recently made new valuation lows, trading at less than 3.0x forward EV/sales.

Survival of the fittest

The partial recovery in software valuations (and related lack of market interest in unprofitable growth stocks) reflects a slower growth environment ameliorated by higher industry margins. This year, the median software growth rate is forecast at 14-15% as compared to 17% in 2023, and 26-27% in 2022. However, the adoption of the so-called *PE playbook*, as highlighted last year, has become the norm for most software companies and has been rewarded by the market. Unlike prior downcycles, the recalibration was rapid, reflecting unique post-pandemic challenges bloated and disconnected workforces, waning product and corporate relevance, the end of 'free money' and, more recently, the birth of genAI. The focus on more profitable growth has seen the median software company's free cashflow margin expand by a remarkable 1500bps from c.5% in 2019 to c.19-20% in 2024E. This recalibration has seen the best companies become better versions of themselves. For instance, while CrowdStrike stock has more than recaptured 2021 highs, over the past c.3 years it has grown revenues from \$1.1bn to \$2.9bn while expanding operating margins (OMs) from 10% to 19%. ServiceNow - recently at all-time highs - has grown revenues from \$5.5bn to \$8.5bn while expanding OMs from 25% to 29%. In addition, both companies should be able to use AI to deliver further margin improvement as well as monetise the technology via AI-enhanced product lines.

Against this backdrop, **unprofitable companies are not merely anachronistic – they represent a pool of companies unwilling or (more likely) unable to deliver margin expansion**. They are former pandemic / WFH winners, derivative plays on now unloved themes, SPACs, or companies that might have changed the world in 2040 had zero interest rates prevailed. They are the broken toys used by equity investors to play themes that didn't last or never happened. Some may yet reinvent themselves, but history suggests most will disappear, to be combined, reconstructed, or dismantled by private equity. As such, we continue to tread tentatively in longer-duration stocks, doing our best to avoid the siren call of 'cheaper valuations'.

More M&A activity likely

Following a dismal 2023 for M&A, this year has got off to an encouraging start. After a notable absence of **strategic** M&A, 2024 has already seen HP announce the \$14bn acquisition of Juniper Networks, while Synopsys and Ansys are set to combine in a \$35bn stock and cash transaction. More recently, IBM scooped up Hashicorp for \$6.5bn, representing c.8.5x EV/CY25 revenues and a 42% one-day premium, while in the UK, there was recently a bidding war between Viavi and Keysight for Spirent. In addition, **private equity** is likely to remain active with c.\$2.5trn in 'dry powder' having acquired Alteryx, New Relic and most recently, Darktrace. We expect AI to play a part in greater M&A too, as point solution companies continue to struggle versus platforms with LLMs likely to prove highly disruptive to pre-GenAl vintages. Nonetheless, a recovery in M&A activity should provide some downside support to current valuation multiples.

US Software M&A with EV Greater then \$100M



Cloud / AI Update

Cloud reacceleration

After decelerating for ten quarters, public cloud revenue growth finally reaccelerated in Q4'23 reflecting the combination of waning optimization activity and ramping Al workloads. In Q1'24, aggregate cloud revenue growth reaccelerated 3ppts sequentially to +24% y/y – remarkable given a greater than \$210bn industry revenue run-rate. We are hopeful that the post-COVID optimization process is largely complete, a view supported by CIO surveys that suggest cloud spending should more closely track consumption from here. More importantly, AI workloads are beginning to 'move the needle' with AI called out as a meaningful contributor at Microsoft (7pts of Azure revenue growth in its most recent guarter) and Amazon ("multibillion-dollar revenue run rate" in AWS). We expect these tailwinds to grow stronger as the **public cloud** remains a key conduit for accessing AI. Foundation models with ever greater parameter counts require larger clusters of connected AI servers, while the compute requirements of AI applications are said to double every 3.5 months; both needs fit well with cloud flexibility and scalability.

A new architecture for AI

The hyperscalers also have the 'deep pockets' required to invest in AI infrastructure, which due to extreme performance required by AI training is heralding a **significant shift in IT architecture from serial to parallel compute**. We consider the architectural break far more significant than the transition to cloud from on-premise compute. This is apparent from an AI server bill of materials (BOM) said to be 25x greater than a general purpose cloud server. A useful parallel for this might be comparing a Toyota Prius with Formula 1; both are cars, but one is designed for general purpose and efficiency (cloud), the other for extreme performance (AI).

Unprecedented growth

The nascent 'AI war' that began a year ago (when Microsoft looked to leverage its OpenAI relationship to challenge Google's search business) has given way to something far more significant, accompanied by an **unusual urgency that feels reminiscent of the 1990s.** Having increased by c.5% during 2023, datacentre capex will materially accelerate this year with all of the US hyperscalers raising future spending intentions in both Q4'23 and Q1'24. At time of writing, hyperscaler capex is expected to exceed \$170bn in 2024, representing growth of 44% y/y. This is sharply higher than earlier expectations

of +26% after Q4 results, and +18% at the beginning of the calendar year. According to Gartner, AI servers will account for nearly 60% of hyperscaler total server spending in 2024.



Source: NewStreet Research - Company Report

To date, the greatest beneficiary of AI infrastructure spending has been Nvidia as its GPU chips sit at the epicentre of the new AI architecture. In its most recent quarter, the company registered datacentre revenues of \$18.4bn, a remarkable 409% y/y increase. Growth at this scale is extremely unusual in technology history, leading many to suggest that AI spending is a 'bubble'. We strongly disagree and consider instead that we are **early in the accelerated** buildout of a general purpose technology.

Building the AI rails

Sizing the AI infrastructure opportunity is difficult to say the least - in last year's paper we had the temerity to suggest that AI capex "might exceed \$100bn". Since then, Jensen Huang, CEO of Nvidia, has sized the AI market at \$1Trn while Dr Lisa Su, CEO of rival AMD, has suggested the market for AI chips will reach \$400bn by 2027, which including other component, system and networking costs implies an \$800bn opportunity. At face value this suggests that AI spending could increase at a 70% CAGR through 2027 by which time it would reach c.0.8% of global GDP.

This would be extraordinary, but not unprecedented given that between 1830-1839, US railroad investment increased from 0.2% of GDP to just above 0.9% by 1839, corresponding to a 31% CAGR in nominal terms. After a digestion period, railroad investment reaccelerated, averaging 1.7% of GDP between 1850 and 1859. This astonishing period included a blow-off (bubble) phase after 1850, with investment peaking at 2.6% of GDP in 1854. At the height of the equivalent UK railroad boom, investment averaged 7% of GDP for three years. More recently, the dotcom period witnessed telecom companies spend \$1trn (in today's money) building out the Internet during the five years following the Telecommunications Act of 1996. While both historic parallels are useful

reminders that infrastructure builds often end badly, current AI spending appears to us to be in its infancy.



Source: The College of William & Mary, December 2014

The biggest opportunity

Underpinning AI spending is the scale of the AI opportunity, reflecting its would-be general purpose technology (GPT) status. Because it addresses knowledge work, economist Erik Brynjolfsson has described AI as "the ultimate GPT - the most general of GPTs". Accenture estimates that as much as 40% of all working hours will be supported or augmented by language-based AI while McKinsey believe that generative AI could automate 30-50% of tasks in about 60% of occupations, adding the equivalent of between \$2.6-4.4trn in economic output annually by 2030.



Source: The Generative AI Handbook

These longer-term opportunities are buttressed by early **AI monetisation**. Less than four years after launching a 'capped profit' arm in 2019, OpenAI is said to have reached a \$2bn revenue run-rate with more than 92% of the Fortune 500 as customers. Meta has also demonstrated its ability to monetise GenAI by improving advertiser ROI and reducing the cost of customer acquisition.

REAL-TIME INTELLIGENCE

IT'S HAPPENING AGAIN: The internet enabled the aggregation of vast bodies of knowledge. Like the telegraph, Artificial Intelligence makes that knowledge usable in real time.

Invented by Samuel Morse, the telegraph is today celebrated as the precursor of modern, pervasive communications technologies that followed. However, the telegraph represented a communication revolution that by 1850 allowed information to be conveyed in seconds that would have previously taken days, weeks or even months. The first telegraph sent by Morse in 1844 – 'What hath God wrought' – reflected the technology's significance as well as the unknowable limits of its reach. In just a few years, the real-time intelligence enabled by the telegraph had transformed shipping, news, stock and commodity markets, as well as troop movements and diplomatic relations.

Today's Large Language Models (LLMs) have been trained on vast datasets well beyond the scope of humans. This unprecedented access to information, together with the ability to comprehend and generate natural language is enabling AI to deliver real-time intelligence. Today, AI is already able to write c.50% of the code used to create software, draft c80% of police incident reports, and said to outperform doctors at clinical reasoning. These remarkable early successes point to AI's significance, and, like the telegraph, its vast but unknowable potential.

10trn

Estimated number of words used to train GPT-4

40%

Estimated percentage of police officer time spent writing reports

Enterprise adoption of copilots (AI-powered companion software) and premium AI-enabled products has also been encouraging. These tools enable knowledge workers to be more productive; Github Copilot (launched by Microsoft in collaboration with OpenAI in 2022) is helping software developers code up to 55% faster by writing 46% of the code. Lexis+ AI – a legal GenAI assistant from RELX – allows users to "draft clauses, legal documents.. and summarise case law.. (and) the reasoning behind the case". Law enforcement technology provider Axon recently announced 'Draft One', AI-powered software capable of auto drafting police reports based on body-camera footage, saving officers an hour per day on paperwork; in Colorado, police experienced an 82% decline in time spent writing reports. Payment provider Klarna also announced it had replaced 700 full-time contact centre employees with Al agents saving the company \$40m per annum. These are early glimpses into AI innovation and disruption, less than two years after the launch of ChatGPT.

Happening now

Rapid adoption and monetisation of nascent AI tools points to a faster than expected diffusion rate. History shows that the delay between invention and widespread use of new technologies has fallen significantly over time, while analysis of earlier GPTs by the Brookings Institute suggests that implementation lag halves with each successive GPT: 80 years for steam, 40 years for electricity, and 20 years for ICT. We expect AI to take less than 10 years to diffuse widely as it 'stands on the shoulders of giants' – technologies such as cloud, internet, leading edge semiconductors and billions of smartphones. Key Al breakthroughs did not happen overnight; the Cloud is nearly 20 years old. NVIDIA has been designing GPUs since 1999. Billions of smartphones and other connected devices have created vast datasets for training AI models and a near-ubiquitous channel for its distribution.

The idea of rapid AI diffusion is visible in real-world developments that include growing recognition among policymakers of the importance of AI and the need to address it through **legislation** with the number of AI-related bills passed into law increasing from just one in 2016 to 37 by 2022. The **Hollywood writers' strike** in May 2023 was another notable development as 11,500 film and television writers began industrial action amid concerns around the AI's role in scriptwriting, fearing that AI-generated scripts could undermine writers' work and compensation. While some investors may be concerned about the risk of slower AI diffusion, the actions of those

most exposed to the technology and legislators charged with controlling it suggest otherwise.



Source: Comin and Mestieri, 2017

A model of improvement

Diffusion, monetisation, and corresponding capex are highly dependent on continued AI model progress. We believe the advent of the **transformer model** in 2017 represented a key breakthrough which is why we describe it as the **'Bessemer moment for AI'**. As with steel in 1856, this breakthrough has resulted in **discontinuous technology progress**; the parameter count of OpenAI's GPT-4 (2023) is rumoured to be one million times larger than the DeepMind model that beat Lee Sedol at *Go* just seven years ago. Higher parameter counts have significantly increased the learning capacity of AI models, enabling them to handle a broader range of general-purpose tasks.



Source: The Atlantic, March 2023

Recent model progress includes multimodality (able to analyse images and audio) and far larger token context windows (the amount of information that can be processed in any prompt). In February, OpenAI announced *Sora*, a remarkable AI 'text-to-video model' able to generate video based on descriptive prompts with "*an emergent grasp of cinematic grammar*". The furious pace of model improvement recently saw Google's *Gemini Ultra* become the **first model to exceed the 'human expert performance' threshold** on MMLU, an AI benchmark which measures knowledge across 57 subjects. Improved performance is also helping ameliorate earlier technology challenges with newer LLMs such as GPT-4 experiencing lower hallucination rates (incorrect model outputs). The expected launch of OpenAIs GPT-5 over the summer as well as the launch of Meta's 425bn-parameter *Llama 3* and Amazon's 2trn parameter *Olympus* will serve as important waypoints to assess continued AI model progress.



Source: OpenAI, 2020

Our confidence in continued AI progress is underpinned by scaling laws which have so far predicted improvements in model performance based on increasing model size, the amount of training data and computing power applied. This is a complex topic to tackle here, but to us it is highly reminiscent of Moore's Law, which famously stated that the number of transistors on a microchip would double approximately every two years. Humans struggle to model non-linear change, but Moore's Law held true for many decades, predicting the exponential progress of semiconductors that followed. We believe that for as long as they hold, scaling laws predict a continued non-linear pace of AI model improvement and ever-greater investment required to stay on the curve. In a recent interview, Mark Zuckerberg defended Meta's decision to significantly increase AI spending with reference to scaling laws:, "I think it's likely enough that we'll keep going. I think it's worth investing the \$10bns or \$100bn+ in building the infrastructure."

General intelligence

Zuckerberg's excitement (and capex plans) reflects an apparently shortening timeline to artificial general intelligence (AGI), a point where AI might achieve the cognitive abilities of humans across a wide range of tasks. This would have seemed remarkable -crazy even - just a few years ago, but within the AI community, AGI is widely considered attainable in the near future. Founder of DeepMind Demis Hassabis has said AGI could be less than a decade away, while Shane Legg, Google's chief AGI scientist, believes there is a 50% chance of general intelligence by 2028. Sam Altman also believes it could be reached within the next four or five years. A shortening timeline to AGI might make sense of a series of peculiar recent AI developments including the late 2023 debacle at OpenAI when Altman himself was fired and rehired in a matter of days, as well as decision by Geoffrey Hinton ('The Godfather of AI') to leave Google in May 2023 so he "could talk about the dangers of AI". It might also explain why Altman has mooted the idea of raising \$7trn - twice the size of UK GDP - to 'reshape the semiconductor industry'. After all, if we are indeed close to achieving AGI, the world is going to need a lot of chips.

Welcome to the Al-era

We expect AI to profoundly change the world. At a prosaic level, AI should deliver a **significant productivity boost**, as was the case with prior GPTs. Current expectations for US productivity to average c.1.4% this decade look mismodelled; GS believe that AI could increase US productivity by 1.5% annually over the next decade, while Erik Brynjolfsson expects US productivity to average "at least 3%".



Source: Kendrick, 1961, Syverson, 2013

Risk to jobs

If so, the coming decade could be "the best ever" although we acknowledge that **concerns about AI risk to jobs** is understandable given its scope and pace of AI improvement. However, history demonstrates that **humans have adapted well to prior technology disruption**; in 1850, agriculture explained two-thirds of US jobs before mechanisation steadily reduced this to just 4% by 1970. Despite this, and subsequent technology innovations, median G7 unemployment has "oscillated based on economic cycles, rather than any technological waves" since 1750.

Proportion of Private Sector US Employment by Sector -Technological innovation in Agriculture allowed the world to move from subsistence farming to productivity-enhancing new sectors.



Source: Haver Analytics, US Census, Deutsche

While knowledge work is in the crosshairs of this new GPT, we expect the first wave of AI to complement rather than substitute human work, as is the usual pattern of technology change. Even when AI adoption becomes more disruptive all is far from lost, as the agricultural experience demonstrates. While focus will inevitably fall on jobs 'lost to AI' there should be many more made possible by the union of human + machine.

Unfortunately, we cannot know what new opportunities will be made possible by AI. However, we do know that earlier tools and GPTs created opportunities that were previously unthinkable. For instance, the **sewing machine** changed the relationship between humans and clothing. Previously, clothes were prohibitively expensive; Singer's sewing machine (1855) transformed this by increasing stitches per minute 22-fold, reducing the time it took to produce a shirt from 14 ¹/₂ hours to c.1 Today, apparel is a \$2trn industry. Likewise, the **telegraph** – the precursor of all modern communication systems – "freed communication from transportation". By changing the relationship between information and distance, the telegraph (1837) challenged price arbitrage, changed the way wars were waged, created the 'information industry' (news agencies such as Reuters and AP) and gave life to the first 'fintech' application – wire transfer – introduced by Western Union in 1871.

Hopefully these two lesser known case studies help explain why **we know AI will create massive new markets**, **and challenge existing relationship that exist today**. However, we cannot yet know what form these will take, just as Morse – who tried to sell his telegraph system to the US government for \$100,000 - did not fully understand its commercial potential.

Idea Generation

We know that earlier technology tools and GPTs have changed relationships. **Our early bet is that AI changes the relationship between people and ideas**. Transportation technologies (horse, canals, railroads, containers, aviation etc) tamed distance by transforming the movement of physical goods (freight, people). Communication technologies (telegraph, telephone, internet etc) tamed distance by changing the velocity of information. We suspect **AI will transform the speed of knowledge creation** after years of declining research productivity. The ability to inject limitless AI into research should meaningfully **accelerate scientific progress**, and **unlock new ideas**, just as the telegraph acted as "an agency for the alteration of ideas".



Source: Bloom et al, 2020



IT'S HAPPENING AGAIN: We expect AI to follow the pattern of mechanisation which significantly impacted agricultural employment while driving productivity and creating new jobs to replace those disrupted.

From the late 19th century agriculture mechanisation epitomised by gasoline-powered tractors and harvesters eliminated much of the labour requirement in harvesting, presaging a significant reduction in labour input per acre farmed. US jobs explained by agriculture fell from 66% in 1850 to just c.4% by 1970. Despite this and subsequent innovations, history shows that humans have adopted well to technology disruption; since 1750, median G7 unemployment has "oscillated based on economic cycles, rather than any technological waves".

Concerns about the risk posed to jobs by AI is understandable given its scope and the pace of improvement. However, the agricultural experience suggests the focus on jobs 'lost to AI' may understate the value of new work made possible by the union of human and machine. Just as mechanisation led a near quadrupling of UK wheat yields between 1945-2005, we expect AI to significantly increase the quality and volume of knowledge work, driving a productivity boom not captured in forecasts.

66% → 4%

Decline in share of US jobs explained by agriculture between 1850-1970.

60%

Percentage of workers today are employed in occupations that did not exist in 1940.

Technology Risks

Given its centrality to sector fortunes, the key risk posed to technology stocks relate to AI. A complex and fluid topic, the most important of these is that the **AI monetisation** timeline disappoints, perhaps because early productivity gains prove limited. Greater availability of AI chips might also lead to a less intense demand environment, leading to concerns about industry growth. Other potential Alrelated risks include greater antitrust scrutiny and other legal challenges relating to data use. We remain sanguine that **regulation** designed to slow AI proliferation will prove manageable as countries talk a better story than they implement given the strategic importance of AI. We also note that better provision of guardrails could actually accelerate AI diffusion, just as improved safety following the regulation of the aviation industry acted as a tailwind for consumer adoption. We should also remind investors that should AI become a GPT that there are likely to be far more losers than winners from today's cohort of companies within and beyond the technology sector. However, the most significant AI risk relates to model improvement failing to keep up with scaling laws which would negatively impact hyperscaler capex plans and our (AGI-related) bull case.

Beyond AI, there are many **macroeconomic risks** that are covered elsewhere in this report. As previously highlighted, the most important of these relate to inflation (failing to return to pre-pandemic levels) and recession (brought on by higher interest rates or sharply higher energy prices). As such, the timing and magnitude of interest rate cuts is likely to remain a key focal point for investors. In addition, there is likely downside risk to technology spending should CEO confidence meaningfully deteriorate. Similarly earnings estimates will remain subject to macroeconomic turbulence with less scope for cost cutting now technology margins have recovered to 25.6% in Q1'24, up from 22.4% a year ago. While we hope this would be disproportionately felt by non-AI segments, it might also result in weaker consumption trends and a disappointing recovery trajectory for cloud spending.

Valuation remains a key risk too, particularly following the absolute and relative re-rating in technology stocks. Heightened sensitivity to earnings disappointments during Q1 earnings season is symptomatic of elevated valuations and investor expectations. While we believe the re-rating is appropriate given the arrival of AI as a key investment theme, higher risk-free rates and/or diminished prospects of interest rate cuts could challenge this view. We are also dismissive of the notion that AI stocks are in a **bubble**, akin to the dotcom period in the late 1990s. While there are features of today's market that rhyme with that earlier period, we do not believe investors are really considering trillion dollar market opportunities, scaling laws and an accelerated path to AGI. Factors that would challenge this view include much higher valuations (tech traded above 2x the market multiple in 2000), a 'hot' IPO market dominated by immature AI companies and the application of new valuation metrics necessary to justify elevated valuations. None of these conditions exist today.

As in prior years, **regulation** beyond AI remains a key risk too, with potentially adverse outcomes in outstanding antitrust cases against Alphabet and Amazon likely to impact other natural monopolies within our sector. In Europe, large 'gatekeeper' technology platforms will be forced to comply with the Digital Markets Act (DMA) designed to foster greater competition, with fines of up to 10% of global revenues for non-compliance. However, we believe worstcase outcomes will continue to be averted, in part because many of these companies represent the vanguard in the emerging AI battleground with China. Instead, deteriorating US-Sino relations may represent a more significant risk, given that Taiwan represents a critical geopolitical fault line and could potentially impact a significant portion of our portfolio.

Concentration risk

In addition, it would be remiss of us not to again remind shareholders about the **concentration risk** both within the Trust and the market-cap weighted index around which we construct the portfolio. After another year of large-cap outperformance, this risk remains elevated. At year end, our three largest holdings – NVIDIA, Microsoft, and Alphabet – represent c. 27% and c.35% of our NAV and benchmark respectively while our top five holdings (which additionally includes Apple and Meta) represent c37% and c53% of our NAV and benchmark respectively. We continue to believe that this concentration risk is justified because they are unique, non-fungible assets that capture the zeitgeist of this technology cycle and appear well positioned for AI given their significant scale advantages.

That said, we remain unafraid of the idea of moving to materially underweight positions in the largest index constituents should we become concerned about their growth or return prospects, or should we find more attractive risk-reward profiles elsewhere in the market. This past year, we have meaningfully reduced our Apple position to c820bps underweight at the end of the fiscal year. However, the timing of a more concerted move away from mega-caps remains highly uncertain, not least because in aggregate the stocks continue to enjoy strong relative earnings revisions while valuations remain far from ebullient.

In the meantime, we should remind shareholders that while PCT is able to hold up to a full benchmark weight subject to a maximum limit of 15%, we are unlikely to hold positions much above 10%. When we do so, it is likely to be via smaller equity positions held in combination with a slither of call options designed to ameliorate upside risk in exchange for a modest premium. In the end, we struggle with the notion that we are reducing risk by making the portfolio ever more concentrated. Instead, we continue to believe that a diversified portfolio of AI-exposed growth stocks capable of outperformance, but also constructed to withstand investment setbacks, should deliver superior returns over the medium term, particularly on a risk-adjusted basis.

Conclusion

We hope this (long) outlook section adequately conveys our excitement about Generative AI. We truly believe the AI **story is just beginning.** Where others may predict steady diffusion, we expect AI adoption to follow the pattern of electrification which was "sweeping and widespread". For now, we (and the Trust portfolio) are heavily focused on the companies helping build the AI 'rails': chips, systems, storage, networking. We believe these are the most direct beneficiaries of an infrastructure build-out that is only a few guarters old. After decades of understandable investor focus on software enabled by the cloud, AI has turned the spotlight back to hardware; the c.25x higher bill of materials of an AI server epitomises an architectural shift away from general purpose cloud in favour of high-performance compute. In addition to large holdings in NVIDIA, AMD and Broadcom, we have added a series of Asian suppliers (PCBs, systems, testers and more) that we expect to benefit from higher ASPs and growing AI share of their revenue mix. We are also intrigued by **edge AI opportunities** in traditional technology segments such as PC and smartphone – markets we typically eschew as growth investors. While we will tread



Company vs Benchmark Weighting

Source: Polar Capital

carefully in these otherwise mature areas, AI has the potential to steepen innovation curves, shorten replacement cycles and render massive PC and smartphone installed bases obsolete. Combined with Cloud and several infrastructure software companies, these **AI enablers** explain around two-thirds of the Trust portfolio today.

In time, there should be other software winners too; for now we have gravitated towards the largest incumbents, particularly those with large, unique, and critical datasets such as Microsoft, SAP, and ServiceNow that are able to monetise their domain expertise via copilots or premium-priced products. Longer-term, we remain unsure about how the *deterministic*, packaged software industry of today will coexist with the *probabilistic* nature of AI models. <u>How will software</u> innovation and codified 'best practice' contend with recursive AI able to *adapt, learn* and *iterate*?

While this question is longer-term and more theoretical in nature, there is already genuine investor debate about whether Adobe (not held) – a truly remarkable software company – is a 'winner' or 'loser' from Al less than two years after the launch of ChatGPT. This speaks to the pace of model improvement, as well as the reach and disruptive capabilities of Al. We expect this debate and the shadow cast by Al to extend within software and other technology subsectors as AI becomes ever more capable. This is why we introduced a socalled 'AI lens' to our investment process last year; not only to help us identify potential AI winners, but to ensure that we have properly considered and debated the risks posed by the nascent General Purpose Technology (GPT).

Our approach may appear premature and at odds with the current consensus view that AI will take a reasonably long time to diffuse. History also suggests we might be early given that incumbents can benefit from the early adoption stage of a new GPT as it creates incremental opportunities to leverage existing (if soon to be obsolete) investments, particularly while the new technology is inferior, expensive, or limited in scope. However, if we are right about rapid AI diffusion and model improvement (our base case), investors may have less time than they think to avoid the potential losers from AI. Our experience investing during the internet, cloud and smartphone cycles reminds us it is considerably easier to spot early losers from disruptive new technologies than it is to identify the early winners.

The combination of accelerated infrastructure build-out and concomitant model improvement, together with potential for more rapid disruption elsewhere explains why we have pivoted the portfolio towards AI during the past year. While this may result in somewhat greater daily volatility, our enthusiasm for AI will continue to be matched by a pragmatic (and highly liquid) approach to portfolio construction given heightened levels of uncertainty and opportunity associated with AI disruption and a new computing stack.

Following a number of thematic 'false-starts' in recent years, we understand why some investors might default to bubble at times like this. However, we believe AI represents the next general purpose technology. If so, relationships between computers and humans, humans and ideas, are likely to be upended. One of the biggest impediments to the development of AI has been Polanyi's paradox, that "we know more than we can tell"; tasks which humans can intuitively understand how to perform but cannot verbalise or formally encode. Generative AI may have solved this riddle by finding the unknown relationships across vast bodies of data. In the near future, AI may tell us more than we can know today. At times like this, it may be tempting to seek shelter from the uncertainty that discontinuous technological change brings. Instead, we attempt to embrace the unknown, taking comfort from the fact that many of the smartest people who ever lived were unable to know in advance- as Samuel Morse exclaimed in 1844 in his first telegram -'what hath God wrought'.

Ben Rogoff & Alastair Unwin Polar Capital Technology Trust 16 July 2024*

*Data and statistics referenced within the Investment Manager's report may have changed between the financial year end and the date of publication.