

Investment Implications of Generative Artificial Intelligence (AI)



At T. Rowe Price, we believe there are compelling reasons why investors should embrace Artificial Intelligence (AI) as a long-term investment theme even if some popular AI stocks may appear a little frothy in the short term.



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2023: An Exceptional Year for Global Tech

Looking back, twelve months ago our global equity managers held an optimistic view of global tech in 2023. We retain our positive view on the sector for 2024, not just for AI but for the broader technology sector in general. Many of the global tech stocks that our analysts cover are experiencing accelerating organic earnings growth and operating margin expansion which appears set to continue in 2024. AI has been and may continue to be cyclical, yet we also believe that its S-curve trajectory has likely been underestimated by the market.

AI: Investing in the Future, today

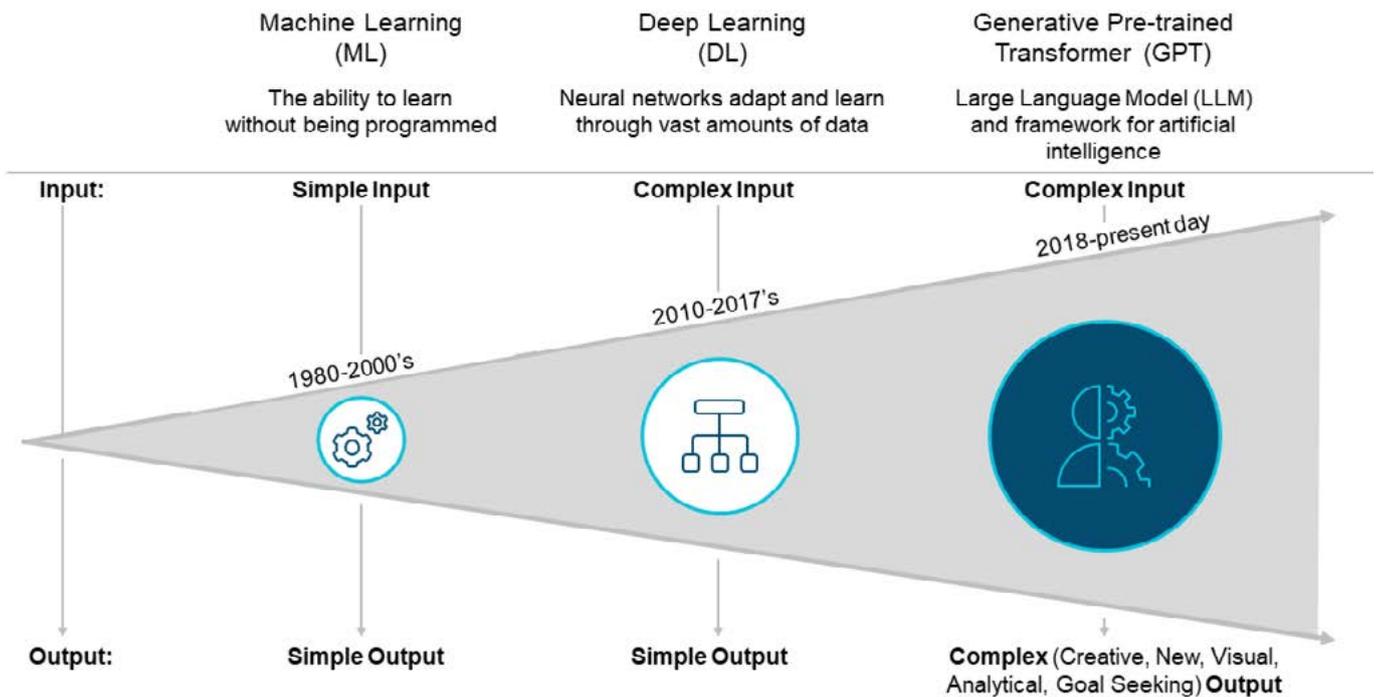
Generative AI is incredibly semiconductor intensive due to its immense parallel processing requirements. One of the best ways to visualize the opportunities is in Figure 2 below, which represents AI beneficiaries graphically as a pyramid with four different levels. Among the first to benefit, forming the base of the pyramid, are the companies involved in the chip ecosystem for advanced semiconductors and semiconductor capex, such as NVIDIA, TSMC, ASML, Lam Research etc. One of the best ways to take advantage of Generative AI in this mega-trend has been via the “picks and shovels” and other parts of the infrastructure layer.

The second layer of the pyramid comprises the AI infrastructure providers (Amazon, Apple, Alibaba Cloud etc) and AI enablers (IT services companies such as Accenture, Microsoft Azure). At the third pyramid level are the foundational large language models

AI S-curve trajectory has likely been underestimated by the market.

FIGURE 1: Generative AI Constitutes a Huge Breakthrough

Rapid jump from Machine Learning to Deep Learning to ChatGPT



As of 30 June 2023

like Open AI's GPT-4, or Meta's LLaMA. Finally, at the top of the pyramid are the customized AI applications, where currently there is less visibility as to who the eventual winners are likely to be.

While the adoption of AI is still in its early stages, it appears to be exceptionally rapid compared to previous IT booms such as PCs and smartphones, thanks in part to Generative AI and Large Language Models, which have encouraged tech and non-tech companies in many industries and sectors to experiment with early adoption, driven more by the recognition of potentially large efficiency gains than by FOMO (fear of missing out).

Global Tech Opportunities in 2024

Globally, the outlook for technology in 2024 appears quite robust, with continued growth in Generative AI and a cyclical rebound in the broader-based semiconductor market including PCs, smartphones, etc. Of course, this favorable view of tech has to be balanced against broader macro risks and concerns such as a potentially slowing in US consumer demand, the slow Chinese economic recovery, and escalating geopolitical uncertainties in the Middle East, Ukraine and other regions.

We think it is likely, however, that the AI boom has enough momentum to continue in 2024, outweighing broader macroeconomic worries, many of which are not new but were also present throughout 2023. We continue to see many interesting areas of opportunity for global technology investors in 2024, including the following:

- Semiconductors overall could continue to be a source of strength. The demand for semiconductors is likely to stay strong, driven by accelerating AI demand, as exemplified by AMD's latest assessment of the global accelerator chip market being worth USD400 billion by 2027. The company increased their market growth outlook from a 50% CAGR to a 70% CAGR from 2023 to 2027. We could also see a bottoming in other areas such as industrial semiconductors by H2 2024.
- Cloud computing and enterprise software is expected to continue to grow due to the increasing demand for flexible and scalable IT solutions. AI development is poised to give a further boost to this and so we think the outlook for datacenter spending is likely to stay strong. In particular, companies need to get their data "ready" for AI. This means more companies investing in middle office and back-office

Three key facts that define the AI boom



Generative AI is not a bubble. It is genuine breakthrough (as depicted in Fig 1) and a business upcycle due to AI is already underway.



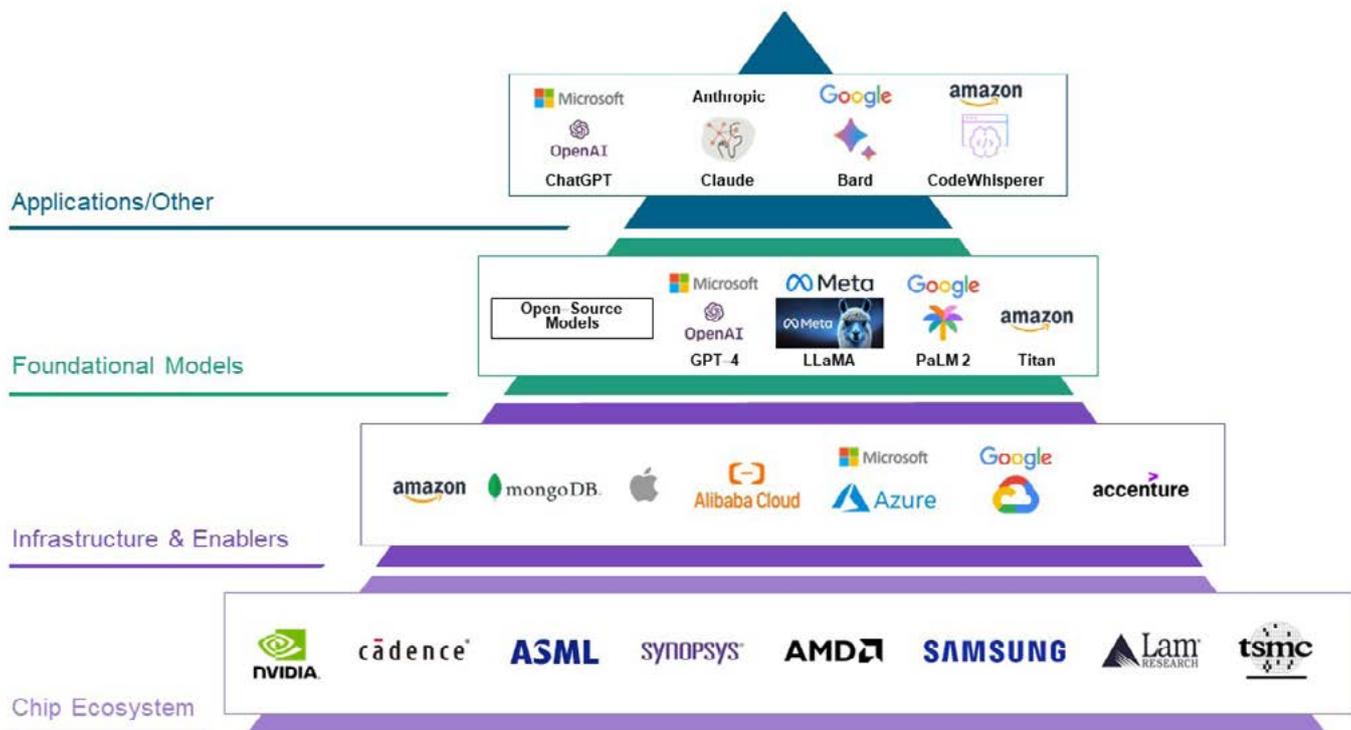
It is the maturity of past IT innovation in terms of decentralized, superfast computing via the Cloud, powerful smartphones etc. that has enabled the great leap forward in AI that we are currently witnessing.



AI requires a robust combination of computing power, talented software and hardware engineers, vast troves of data, and hordes of new customers. In the IT sector, this benefits existing mega-scale internet platform companies. This means that AI, at least initially, is not a 'disruptive' technology.

FIGURE 2: Visualizing AI As a Pyramid

The Layers of AI



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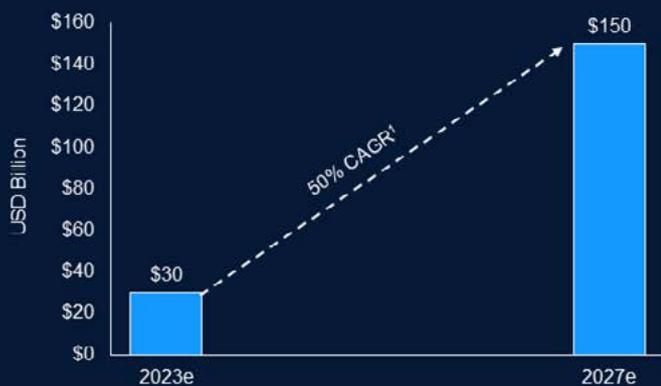
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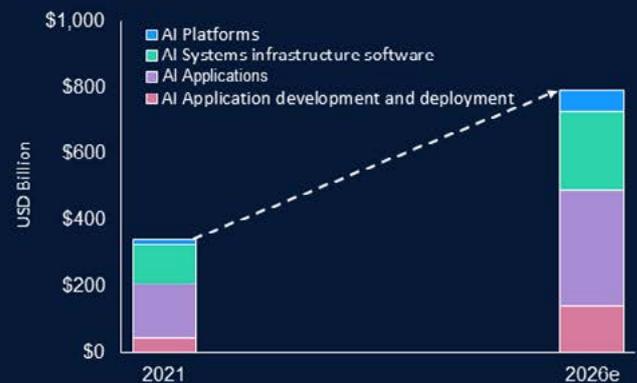
FIGURE 3: Rapidly Growing Global AI Markets

Global AI chip & software markets in USD billion.

AI Chip Total Addressable Market



Worldwide AI Software Forecast— 2021–2026



Needs for AI compute and software – driving exponential growth

As of 30 June 2023

There is no guarantee that any forecasts made will come to pass.

¹ Compound Annual Growth Rate.

Source: AI Chip Market—AMD Data Center and AI Technology Premier; Software Forecast—William Blair Research based on data from IDC; Worldwide Semiannual Artificial Intelligence Tracker, 2H21.

software such as Workday, SAP, and Service Now.

- Areas of Fintech could also be strong, hence our continuing involvement in the sector. E-commerce continues to accelerate post the COVID deflation and fintech companies are being more disciplined in their operating expenditure.

Balancing Risks and Opportunities

With such powerful dynamics, we are cognizant of the risks of a potential bubble forming, resulting in excessive valuations for popular AI stocks. As asset managers, we believe it is our job to navigate the rapidly changing AI environment responsibly, by adhering to T. Rowe Price’s long-established bottom up investment framework and not overpaying for ‘hot’ AI stocks.

We have to balance the opportunities against potential risks, which currently we see being linked more to broader macro concerns than to sub-sector specific issues within the technology space.

- On the economic front, while the Fed seems to be managing a decent glide path in the US, there remains the risk of a slowdown, which combined with the current weakness in the Chinese economy could dampen global demand for technology products and services.

- On geopolitics, while there has been some recent easing in US-China tensions, we have to be alive to the possibility of it flaring up again, with potential impacts on demand as well as the IT supply-chain.
- Finally, regulatory risk also remains a challenge for the industry. As governments try to adapt to the increased adoption of AI, and the broader availability of data, the risk to AI remains of increased government regulations around data privacy, antitrust issues and national security concerns, as well as potential increases in compliance burdens and costs for technology companies.

Concluding Thoughts

We continue to believe the artificial intelligence (AI) story is bigger than many investors realize and could lead to exponentially greater returns and capital expenditures than the market is anticipating. We plan to navigate this mega trend responsibly, while also monitoring the wider technology landscape and look to pick up alpha where we can outside of AI. Above all this will always be done by staying true to our framework: finding companies that sell linchpin (or indispensable) technology, innovating in secular growth markets, with improving fundamentals and reasonable valuations.

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