

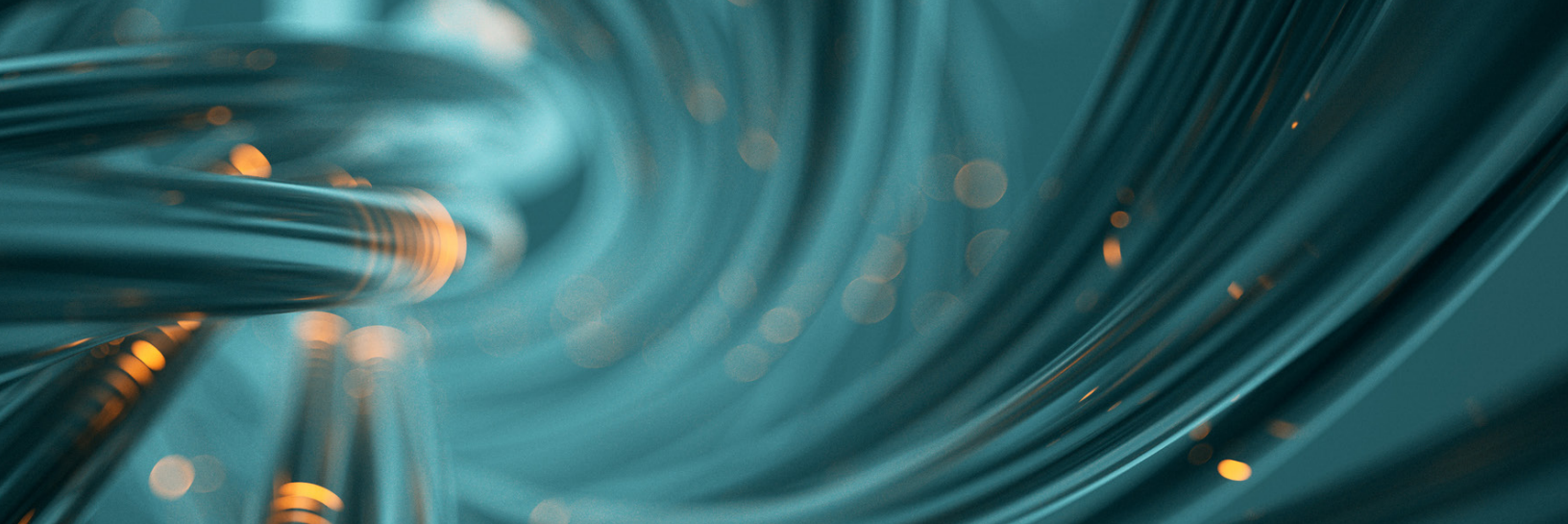


Structural Trends in the Technology Sector

Part 1

Market Insights

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Structural Trends in the Technology Sector

Part 1 - GenAI Infrastructure

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The value of a company's stock stems in large part from its ability to compound earnings growth. That's why we try to identify broad secular industry trends that will drive multi-year growth for the company. These thematic opportunities help us narrow our selection to a pool of growth compounders that are set to outperform the wider market. In the first instalment in this series, we'll discuss one of the biggest themes underpinning our technology selection universe.

Building out the rail lines

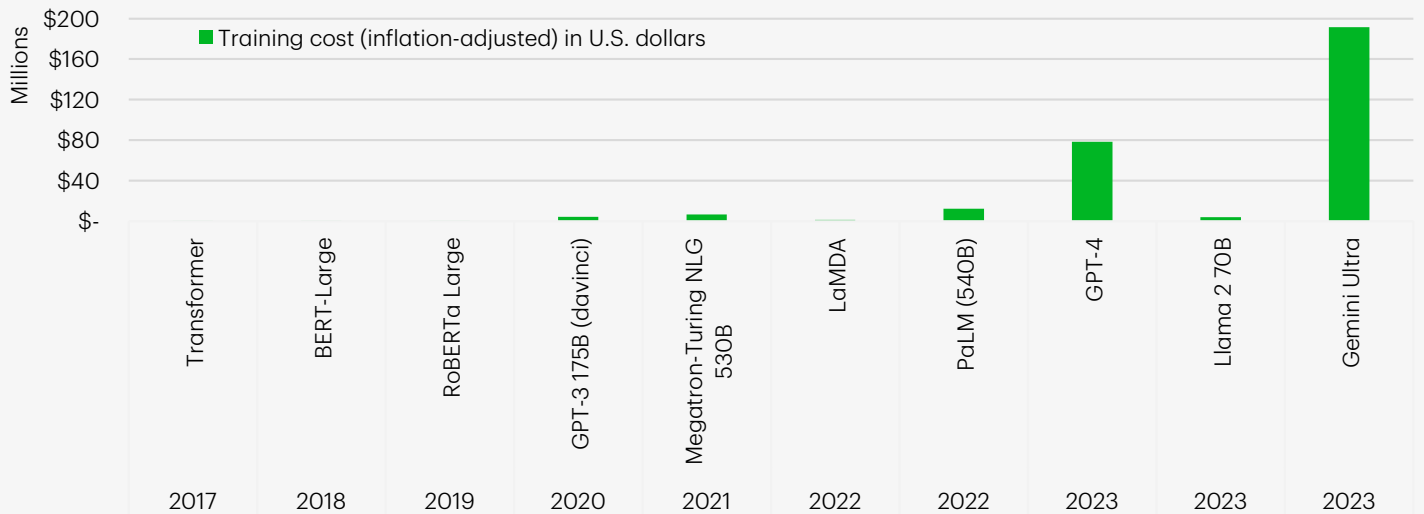
Like the advent of the internet, the adoption of generative artificial intelligence (GenAI) promises to deliver productivity gains across the economy. Both of these represent a breakthrough underlying technology that allows workers to become more efficient in their everyday tasks. For GenAI, that technology is the "foundation model," which is the core analytical engine that responds to user prompts by generating content (e.g., translating text, creating pictures, analyzing medical images).

The stage of development that GenAI is going through looks remarkably similar to that of early railroads at the end of the 19th century. The technology is still in the nascent stage of building out the infrastructure that will support the development of productivity-driving applications. Just like railroads needed the railway tracks to be laid down before trains started running across the country and triggering that era's productivity revolution, so too will GenAI need the hardware infrastructure of semiconductor chips (called "accelerators") to enable its potential.

The analogy also works for capex. The cost of laying down railroad tracks in the 19th century was vastly expensive, and so too is the cost of deploying GenAI hardware that will be used to develop ("train") foundation models. This infrastructure consists of networks of server clusters powered by 30,000 to 40,000 semiconductor accelerator chips. Since the price of each accelerator chip is \$25,000 to \$35,000, the total cost of deploying the GenAI infrastructure becomes prohibitive to most companies and countries alike. On the other hand, suppliers of accelerator chips (like NVidia) as well as the companies in our portfolio that supply custom-made components (Broadcom, Marvell) have been among the first to benefit.

For customers that are building out infrastructure using those chips, the costs are not limited to just hardware. Expenditures associated with the training of foundation models are rising rapidly (Figure 1). In 2023, they reached approximately US\$200 million, and as a result, only the largest, most profitable companies have been able to build the models that power GenAI functionality. Again, just as it was in the early days of the railroad revolution, the ownership of GenAI networks is limited only to the most profitable, cash-rich companies.

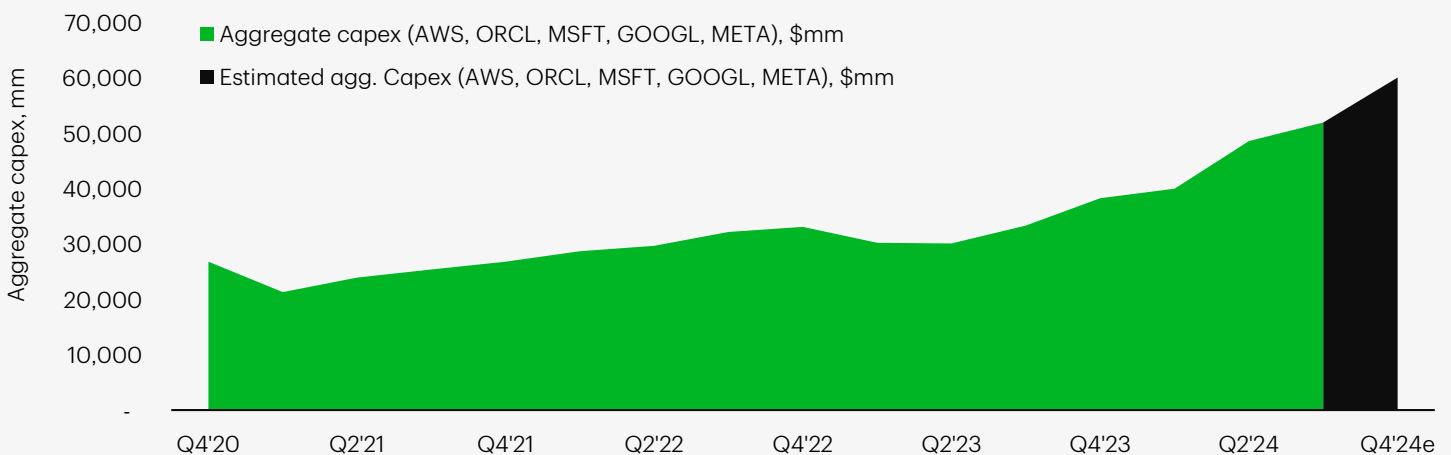
Figure 1: Cost of training an advanced GenAI model has risen exponentially



Source: Stanford HAI Artificial Intelligence Index Report 2024

So far, only Amazon, Microsoft, Alphabet, Meta and a few others have been able to own and operate these massive computer networks (Figure 2). Having deployed the infrastructure, these companies were in the position to develop and launch early products with GenAI functionality. What allows only a select few companies to do so is their unique position of having the access to the vast amount of proprietary, non-public content posted by users to their respective platforms. This data is the core ingredient in the process of training a foundation model, the core technology behind generative AI.

Figure 2: Quarterly GenAI capex for five tech giants to surpass \$60 billion in Q4 2024

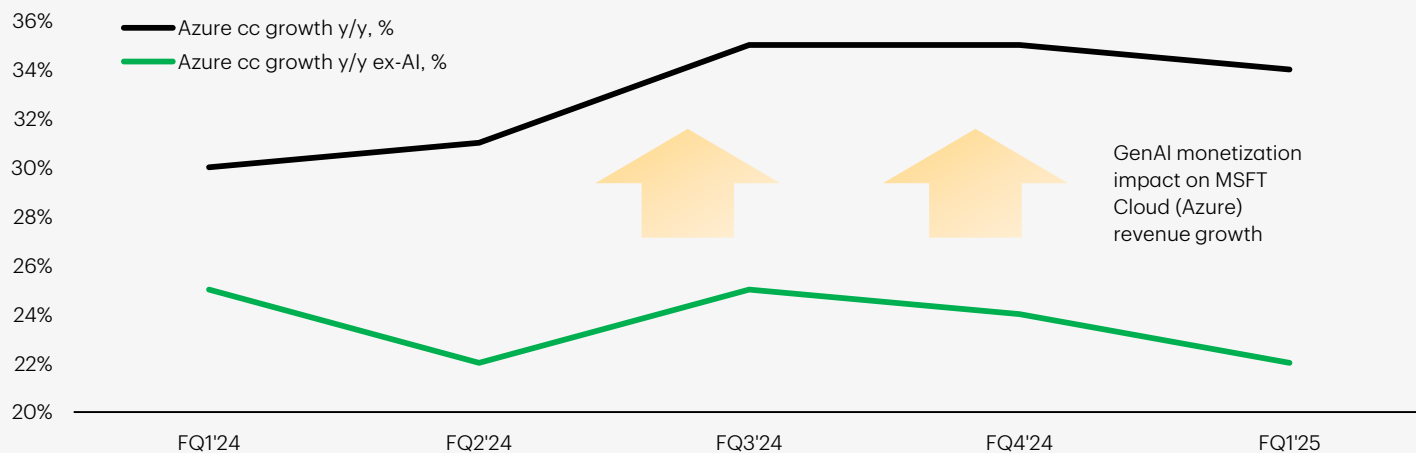


Source: FactSet, company data as of calendar Q3/24

Higher-level functionality, like multi-media content creation, requires more powerful GenAI models. As a result, these companies are in the process of building out larger, more powerful and more expensive computing clusters, increasing the barriers to entry. Also, their dominant market share in their traditional markets allows them to generate monopoly-like corporate-level profits. (Amazon, for instance, enjoys around 40% of the U.S. e-commerce market share.) These profits are then used to finance the capital expenditures required to build larger GenAI networks. It would be hard for any other company that is not in a similar position to enter this market and participate in it on a sustainable basis.

Most of the GenAI infrastructure owners have already started to monetize their investments (Figure 3). The early reported revenue comes from either renting out the infrastructure to those that want to build their own models or charging for the usage of pre-trained models. In either case, GenAI functionality is now commercially available to create broad content, including text, images and video, through a simple user prompt. The early use cases are limited to code generation, search, customer service agents and marketing campaigns, but the potential to replace a broader range of manual tasks promises to be much wider.

Figure 3: GenAI is a meaningful component to Microsoft Cloud revenue growth



Source: FactSet, company data as of calendar Q3/24

Limited competition makes the GenAI infrastructure services market attractive to equity investors. With new use cases driving the demand for model usage, a handful of large cloud-service providers stand to benefit from a potentially large revenue windfall and an extended period of sustained growth. As a result, some of these names will generate above-industry returns through the length of an economic cycle, making them a strategic holding in an investment portfolio.

Just like when the first railway tracks were built to allow trains to run from one end of the country to the other, GenAI infrastructure is now available to unlock the potential of this era's productivity revolution. In the second part of this series, we will discuss the enabling of what, to use our railroad analogy, may be described as the "railway cars of GenAI." These promise to further unlock the productivity potential of this new revolutionary technology.

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