

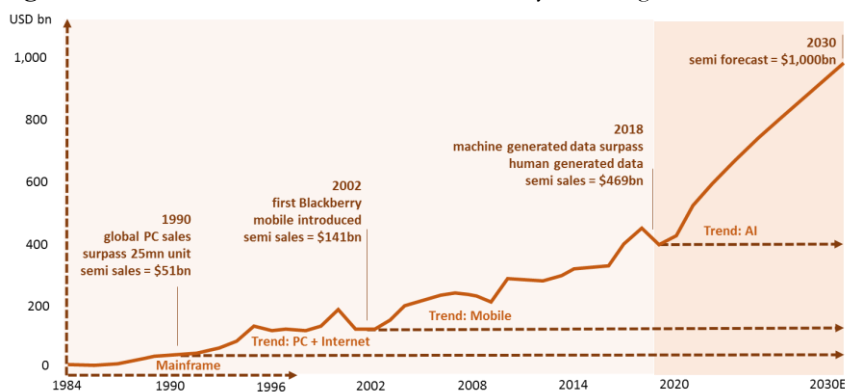
## Investment in Asia: Opportunities in the Global AI Supply Chain

*“During the gold rush, sell shovels.”*

### Generative AI investing and AI enablers

As the investment theme of generative AI came into focus in 2023, the trend has spread exceptionally fast across industries around the world. Similar to the 1980s, when the Internet began to transform our lives by enabling all the applications that are now essential, we expect generative AI to sustainably change business efficiency and user habits in the future and steadily increase investment interest in this area. To understand how tech-megatrends can drive supply chain demand, *Figure 1* illustrates semiconductor sales over decades. The first milestone was triggered by personal computer and internet, boosting semiconductor sales over USD 50 billion, followed by the trend of mobiles that almost tripled the demand. With the massive increase in daily data volumes, the irreversible trend of big data processing has become more important than ever. All tech-megatrends in the past have triggered strong semiconductor demand in waves lasting about a decade. We believe we are at the beginning of the era driven by generative AI and expect demand to increase in the long term.

**Figure 1:** Global semiconductor demand boosted by tech-megatrends



Source: BofA, Berenberg

### Nvidia's suppliers in Asia

To gain an insight into the generative AI supply chain in terms of semiconductors and server hardware, we take the Nvidia H100 as an example. It was introduced in 2022 to further extend Nvidia's AI leadership. Compared to its already advanced A100, the H100 has up to 4x faster training and 30x higher AI inference performance on large language models, which is also a result of the more sophisticated components with higher costs. *Figure 2* breaks down the important components and suppliers of Nvidia's AI chip and server. The GPU chip functions like the brain, controlling and processing tasks, are mainly fabricated by TSMC in Taiwan. High Bandwidth Memory (HBM) servers as the short-term memory, holding crucial data for quick access, are mainly supplied by Korean company SK Hynix. In a broader sense of AI server, the GPU module refers to an independent GPU component, which can be combined in tandem to boost computing power. The baseboard works like the spine, providing support to hold various GPU modules. And the motherboard

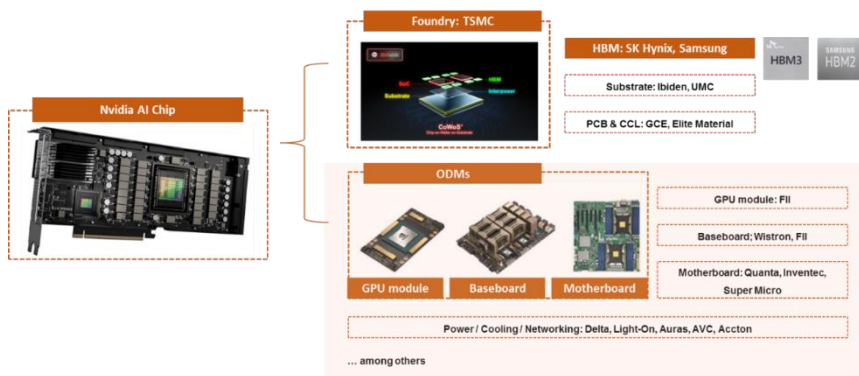
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functions as the skeleton. It's the primary framework, hosting and interconnecting all system components. As for ODMs, all big players such as FII, Wistron, Quanta and Inventec are based in Taiwan or China. Last but not least, power supplying and cooling function mimic the metabolic system, regulating energy usage and temperature, while networking is to communicate with the outside world. Similarly, the main suppliers are Taiwanese companies. Each component in the AI supply chain works synergistically, much like the organs and systems within the human body, to perform complex computing tasks efficiently and effectively.

**Figure 2:** Examples of Nvidia's suppliers

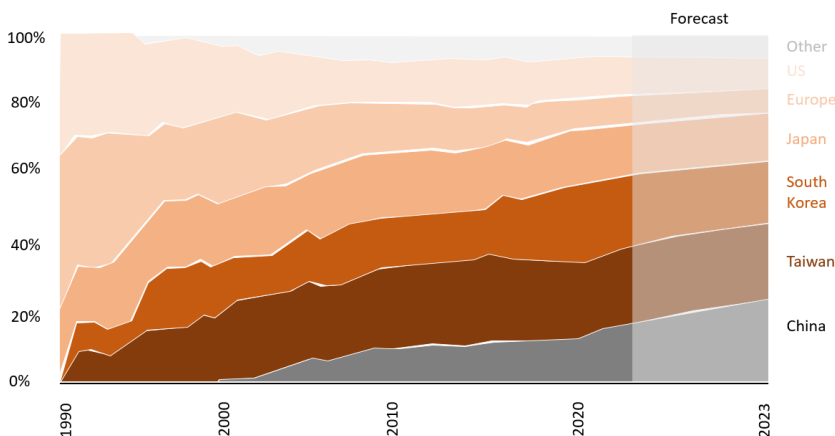


Source: NVIDIA, TSMC, SK Hynix, Samsung, Berenberg

### The AI ecosystem

Reflecting on generative AI investing opportunities, we at Berenberg believe there are three tiers. The first tier is semiconductor and server hardware suppliers, with most companies based in Asia, who upgrade their product capacities to enable AI computing. A lot of investors are not aware of how important Asia is for the AI supply chain, *Exhibit 3* sheds some light with more than 70% semiconductors are manufactured by Asian companies, of which South Korea, Taiwan and China account for ca. 60%. Looking ahead, Asia will gain importance among peers based on its leading technology and low cost curve in the AI supply chain.

**Exhibit 3:** Global semiconductor manufacturing concentrated in Asia

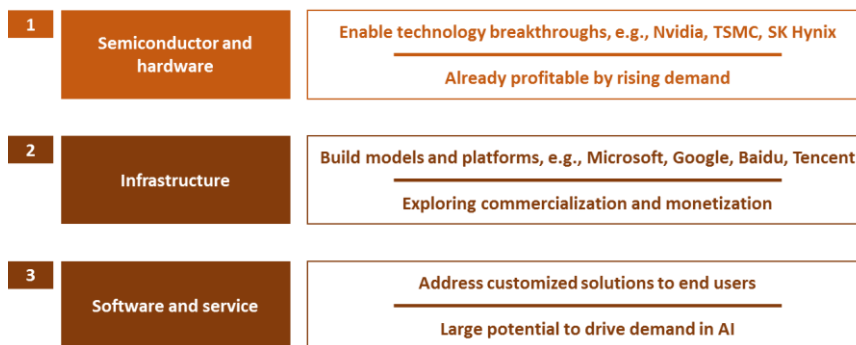


Source: Morgan Stanley



The second tier is infrastructure builders, e.g., Microsoft, Google, Amazon and Meta in the US, as well as Baidu, Tencent and Alibaba in Asia, who develop large language models to drive AI adoption and penetration. The third tier is software and service providers that focus on customized AI applications. *Exhibit 4* shows a summary of the aforementioned framework. In the current market, suppliers have already seen a surge in demand for semiconductors and server hardware. Tech giants are focusing on modeling and its commercialization. There is still great potential for developing platforms and applications to benefit businesses and users on a large scale. And all future developments would, in turn, drive demand along the AI supply chain.

#### Exhibit 4: The AI ecosystem



Source: Morgan Stanley, Berenberg

#### What stocks to own

In Berenberg Emerging Asia Focus Fund, we prefer companies who sell shovels during the AI gold rush, with around 30% of the portfolio weight in semiconductors and server hardware suppliers from Taiwan and South Korea. In the following case studies, we briefly introduce our holdings in two big-cap semiconductors, namely TSMC and SK Hynix, and two mid-cap hardware suppliers, i.e., GCE and Accton. Through a disciplined bottom-up stock selection, we see great business opportunities and attractive risk-adjusted return potentials in these stocks over the long term.

#### Case study of AI beneficiaries in Asia

##### Taiwan Semiconductor Manufacturing Co. (TSMC) – Semiconductor, Taiwan

Founded in 1987 with a current market cap of around USD 429 billion, TSMC dominates the semiconductor foundry business with over 60% global market share. It provides a wide range of applications for end markets such as high-performance computing, smartphones, Internet of Things (IoT), automotive and consumer electronics. TSMC is the major manufacturer of AI chips and has strong technology leadership, large capacity, stable yield, and trustworthy supply support at advanced process nodes, such as 7nm, 5nm and 3nm.

##### SK Hynix – Semiconductor, South Korea

Founded in 1983 with a current market cap of around USD 62 billion, SK Hynix develops semiconductors, telecommunications equipment and multimedia components. SK Hynix is one of the world's largest manufacturers of memory semiconductors such as dynamic random-access memory (DRAM) and NAND flash memory. An example to understand the functionality, DRAM helps run programs on the device, whereas NAND



stores results like files and images. For AI chips, the high-end DRAM, i.e., HBM, is the key component to enable the high computing power.

#### **Gold Circuit Electronics (GCE) – Hardware, Taiwan**

Founded in 1981 with a current market cap of around USD 3.3 billion, GCE has strong production capabilities in manufacturing double-sided and multi-layer printed circuit boards (PCBs) used in server, networking switch and narrowband (NB) applications. For a simple understanding, more layers in PCBs require more advanced technology, and accordingly achieve much higher selling prices applied to more sophisticated devices. As an example, GCE can produce a maximum of 56 layers in PCBs, compared to 20-30+ layers needed for AI server and networking boards, 14-20 layers for regular server boards, and 8-12 layers for traditional NB boards.

#### **Accton – Hardware, Taiwan**

Founded in 1988 with a current market cap of around USD 8.7 billion, Accton focuses on the design and manufacture of networking solutions. It leads in the switch business, which helps data transmission from server to server. Besides, it also cooperates with global players in the production of smart networking interface cards (NICs) that accelerate and secure the networking process. Accton benefits from the structural trend of increasing computing power, which also requires higher transmission speed and security. For an easier understanding, switches enable connected devices to talk to each other, sharing and processing information from datacenters to daily operations.

#### **Conclusion: A long and prosperous journey**

In our view, this is the start of a decade-long cycle in generative AI. The AI paradigm has changed, and Asia is very well positioned to profit from this structural megatrend, as almost 70% of semiconductors and server hardware are produced in Asia. This trend will be a long-term revenue catalyst for semiconductor and hardware companies as they are the critical technology enablers. We identify companies that are best positioned to fully capitalize on this technology trend. Faithful to our investment philosophy we want to be invested in companies that have a structural competitive edge in their specific fields, who are generating revenues from generative AI and have the possibility to sustain or even expand their margins and profitability. TSMC, SK Hynix, GCE and Accton to name a few, generate above average profitability and are already clear winners within the generative AI framework. Specially in the mid-cap space in Asia, we see the biggest potential because of a strong long term profitability growth in its specific niches and lower valuations. We prefer companies who sell shovels during the AI gold rush, with around 30% of the portfolio weight in semiconductors and server hardware suppliers that are generating AI related revenues. We are totally aware that the performance will come in waves and there will be tactical pullbacks, but for the next 5 years, we see generative AI as one of the most interesting structural themes to be invested in.



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