CMB INTERNATIONAL
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# Technology (Hardware/Semi)

## Thematic investment and megatrend: Riding the AI wave into the next phase

**Near-term: strong demand with visibility into 2024, supply chain ramp-up in progress.** Hypercalers, AI related chip providers and supply chain channel all confirmed demands remain strong, with visibility into 2024. Current bottlenecks are CoWoS and HBM. Suppliers are ramping up capacity to meet the demand (already observed signs of shortage easing recently). Per Financial Times, "*TSMC is on track to deliver 550k H100 GPU to Nvidia this year targeting 1.5mn to 2.0mn next year*", "TSMC planned to expand CoWoS capacity to 20k/m in 1H24 or reaching 25-30k/m with new additional machinery orders from 12k/m now per United Daily News."

**Mid- to long-term: focusing on cost and monetization; positive catalysts bring hope for true AI adoption.** As mentioned in our previous report (link), we had concerns on AI demand sustainability in mid- to long-term: 1) hyperscalers' capex is at historical highs, 2) double-ordering concerns, 3) rising interest rates. etc. We think there is limited upside for cloud capex, unless the monetization of generative AI could come faster-than-expected or significant cost reduction of operating AI infrastructure can be achieved with either hardware or software optimization. Recent news suggests positive progress in monetization of AI products: 1) OpenAI ARR exceeded US$1.3bn, 2) Microsoft, Google and Adobe all plan to charge subscription fees for AI-powered features. However, it is still difficult to achieve profitability due to current high cost of running AI infrastructure.

**Nvidia is likely to maintain its dominance in AI datacenter in the near term; however, we expect intensified competition from both its competitors and clients in the future.** Nvidia is the clear winner of the AI arms race so far, with dominant share in the surging AI GPU market. AMD's technically superior MI300 series will enter the market and compete with Nvidia soon (shipment is expected in 4Q). Considering high costs of Nvidia's chips, specialized AI accelerators may suit industry-specific infrastructure/models more efficiently. Many Nvidia's largest clients are speeding up their own AI chip developments to cut costs and reduce dependency on Nvidia. Acknowledging that, Nvidia revealed their product roadmap into 2025 in their October investor presentation, showing confidence in maintaining their leadership with new slate of products (H200, B100, X100, etc.).

**Other AI beneficiaries: investors are actively looking for other names as Nvidia is already a crowded trade.** We identified several companies will also benefit from the AI boom and hyperscaler's AI-capex growth. Selected overseas names include: AMD (AMD US), Broadcom (AVGO US), Super Micro Computer (SMCI US), Marvell (MRVL US), Fabrinet (FN US),and Micron (MU US). Selected Asia names: SK Hynix (000660 KR), Innolight (300308 CH), LuxNet (4979.TT), Suzhou TFC (300394 CH), Yoke Tech (002409 CH), and Shannon Semi (300475 CH).

**Future catalysts:** 1) geopolitical risks: If US further tightens curbs on AI chip export to China (an update is expected in October), this may negatively impact the revenue for many companies like Nvidia, AMD, Broadcom, etc; 2) Nvidia 3Q earnings on 21 Nov 2023; 3) Cloud capex guidance for 2024; 4) sales of AMD's MI300 series; 5) progress on monetizing generative AI (e.g., Microsoft's launch of Office 365 copilot).

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**Related Reports**

1. "Hardware – Optical transceivers : Investors expect spectacular results in the AI infrastructure arms race" – 14 Aug 2023 (link)
2. "Hardware – Optical transceivers: Implications from Coherent 2Q23 results and guidance" – 18 Aug 2023 (link)
3. "Investors focusing on 800G transceivers ramp-up after 1H23 results" – 28 Aug 2023 (link)

## Contents

# Near-term: Nvidia is likey to maintain dominancy, while AMD may have share gain opportunity

## Demand is strong, with visibility into 2024

In the near term, we expect AI GPU demand will remain very strong, considering 1) current generative AI enthusiasm and Cloud companies will make hefty investments in the early stage to gain competitiveness in this AI arms race (demand); 2) supply is tight and Cloud companies are likely to overbook to secure their orders (supply). According to the latest earnings and news, **hypercalers, AI GPU providers and the supply chain all confirmed the demand for AI was very strong, with visibility into 2024.**

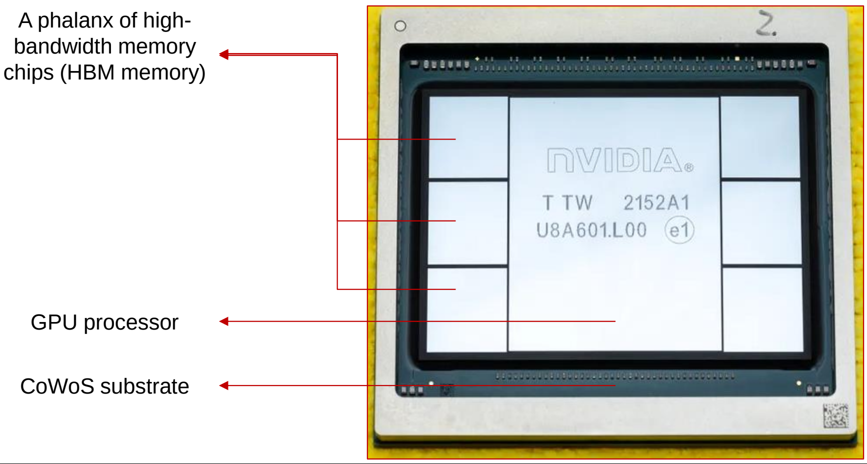
**Figure 1: Hypercalers, AI GPU providers and the supply chain all confirmed the AI demand was very strong**

| Companies | Recent AI comments & developments |
|---|---|
| **Nvidia** | **NVIDIA is confident in the sustainability of demand for generative AI in the hyperscaler spending market.** They highlight a significant transition in data centers worldwide, with a shift towards accelerated computing and generative AI. |
| **AMD** | **AI cluster engagements grew by more than seven times sequentially.** CEO Lisa Su says interest in new AI chip is shifting into sales; expected “a very strong second half of the year for the data-center business”. |
| **TSMC** | The company **will increase their capacity as quickly as possible.** Their capacity, especially CoWoS, is very tight and hard to fulfill 100% of the customers’ needs. |
| **Microsoft** | **Every customer is asking not only how but how fast they can apply next-generation AI** to address the biggest opportunities and challenges they face and to do so safely and responsibly. |
| **Marvell** | **“Accelerating demand for optical products to meet the continuing expansion of cloud AI deployments.”** Revenue from both Cloud AI and standard cloud infrastructure grew sequentially with AI growing faster. |

Source: Company filings, Bloomberg, public info, CMBIGM

**Near-term bottlenecks for AI GPU are CoWoS and HBM.** The suppliers are working hard to ramp up capacity to meet the demand. In the latest TSMC’s earnings call (20 Jul), the company said they will increase their capacity “*as quickly as possible… and expect these tightening will be released in next year, probably towards the end of next year.*” In terms of the CoWoS capacity expansion, the company answered that “*probably 2x of the capacity will be added.*”

**Figure 2: Near-term bottlenecks for AI GPU are CoWoS and HBM**




Source: CNET, CMBIGM

**We have already observed signs of shortage easing, given recent positive developments in the supply chain.** According to the latest news from Financial Times: “*TSMC is on track to deliver 550,000 H100 GPUs to Nvidia this year targeting 1.5mn to 2.0mn next year.*”

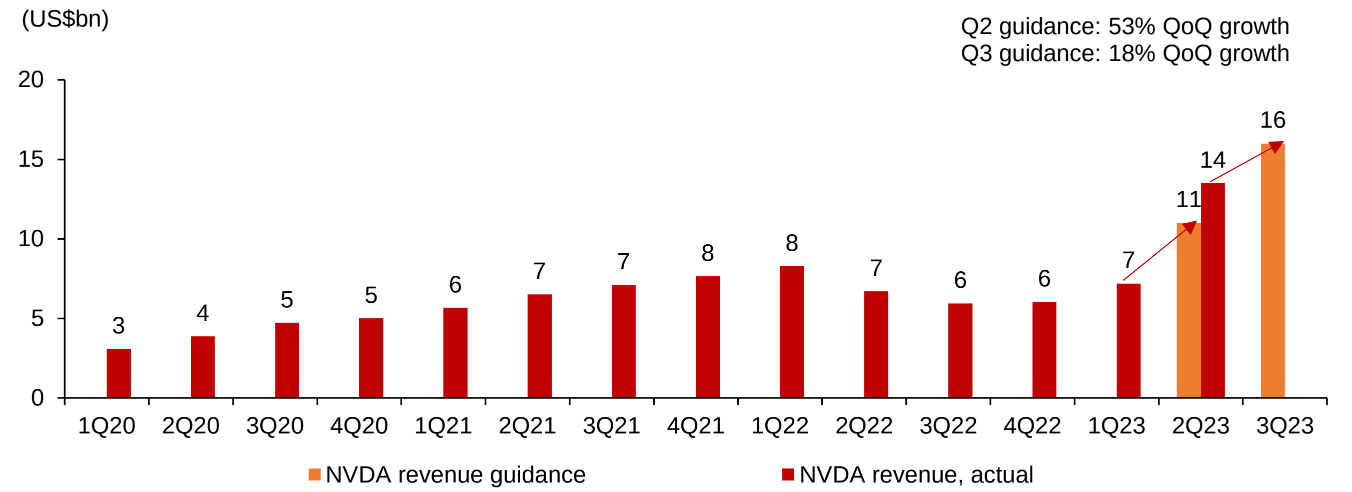
## Nvidia is expected to maintain dominance in AI GPU market

**Nvidia is the most visible winner of the AI arms race, with dominant share in AI GPU market.** The company gained their leading position with competitive advantages in ecosystem and early-entry advantage. Their well-established CUDA development environment and extensive function libraries make developers reluctant to abandon their stable systems.

**As the key beneficiary of hypercalers' AI arms race, the company has secured massive order backlogs**. According to Nvidia's latest earnings, "*purchase commitments and obligations of inventory and capacity were $11.15 bn and prepaid supply agreements were $3.81 bn… commitment increases largely reflect long-term supply needs for data center products.*"

**This is expected to support Nvidia's revenue growth for at least the next few quarters.** Nvidia guided 3Q revenue to grow 18% QoQ (vs. 2Q guidance/actual: 53%/88% QoQ). The earnings upside was largely driven by datacenter revenue (segment revenue accounted for 76% in 2Q vs. 60% in 1Q). **The market expects Nvidia to beat and raise guidance again in the upcoming earnings call.**

**Figure 3: NVDA's earnings guidance for 2Q and 3Q**

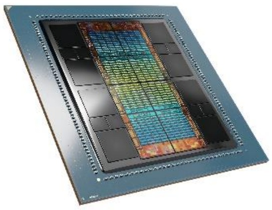
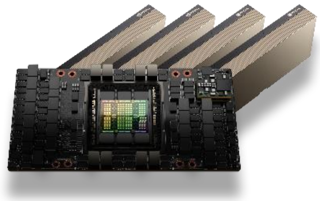



Source: Company info, CMBIGM estimates

## AMD is likely to have share gain

The demand for AI infrastructure is exploding and the current supply of AI GPU is in great shortage. AMD's technically superior MI300 series will enter the market and compete with Nvidia soon (shipment is expected in 4Q). We expect AMD to build up momentum and gain share in the GPU market with its MI300 series while Nvidia's next generation of AI GPU is expected to release in 2H24. AMD's CEO is confident with their MI300 line and expects these products to make the company "the industry leader for inference solutions".

**Figure 4: In contrast, MI300 excels in hardware and computing power compared to Nvidia's current series**

| | AMD MI300A | AMD MI300X | Nvidia H100 SXM |
|---|---|---|---|
| |  |  |  |
| Release data | 2023 | 2023 | 2022 |
| Processor | CPU+GPU | GPU | GPU |
| Technology node | TSMC (5nm + 6nm) | TSMC (5nm + 6nm) | TSMC 4nm |
| Memory | HBM3 128GB | HBM3 192GB | HBM3 80GB |
| Memory bandwidth | 3.28TB/s | 5.2TB/s | 3.35TB/s |
| Number of transistors | 146 billion | 153 billion | 80 billion |
| TDP | 600W | Est. 750W | 700W |
| Software | ROCm | ROCm | CUDA |
| Current status | Sample testing | Est. shipment in 2H23 | Shipped |

Source: Magnifier.cmoney, CMBIGM

The market believes CUDA is Nvidia's hardware moat, as they offer superior software choices. However, AMD is also enhancing their software capabilities.

- Lamini, one AI platform that helps enterprises build their own large-language models, revealed recently that the company has been running LLMs on AMD's graphics processors for a year now, and said AMD's ROCm software had now achieved "parity" with Nvidia's CUDA.
- Microsoft CTO Kevin Scott predicted that AMD's GPU chips would become "more and more important to the marketplace in the coming years".
- AMD announced the signing of a definitive agreement on 10 Oct 2023 in relation to the acquisition of Nod.ai to expand the company's open AI software capabilities.

We observed that there are mixed views on AMD. We think AMD has window opportunity for their technologically superior MI300x products and the popularity of their software ecosystem may be better-than-expected.

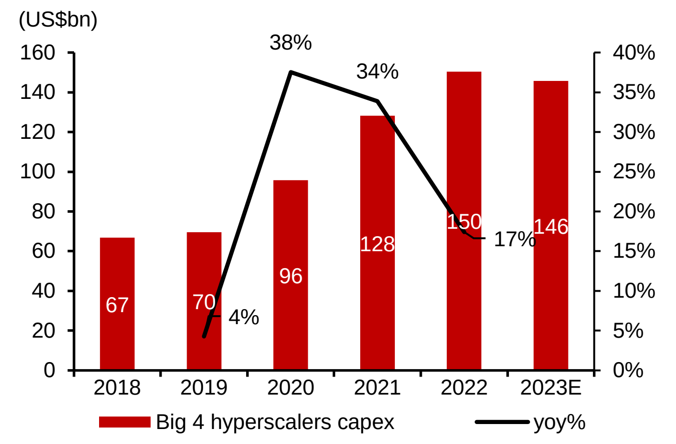
# Long-term: Focusing on cost and monetization; positive catalysts bring hope for a true AI adoption

## Demand sustainability for AI infrastructure: Limited upside for Cloud capex unless significant progress on monetization of generative AI applications emerges

We are in the period of AI arms race currently as companies are rushing (Fear of Missing Out) to build up AI infrastructure and develop/test their AI based services/products. **However, will the launch of AI based service/products bring sufficient cash flow to support further infrastructure build out?** The demand looks good now but there could be overbooking risk. Will we see demand start to lag capacity materially 12 or 18 months from now?

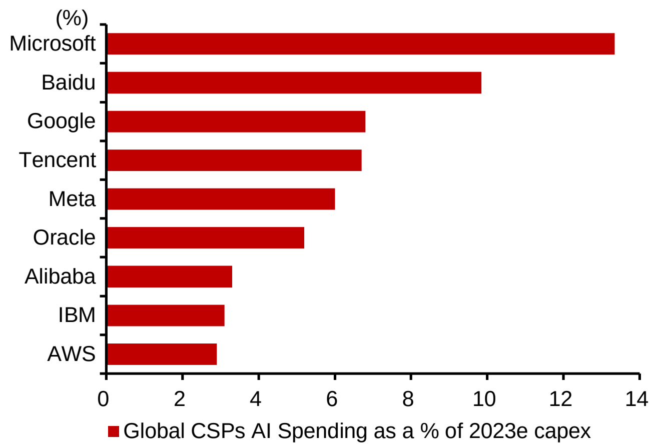
We believe most of AI infrastructure demand is from hyperscalers. Therefore, **it is prudent to scrutinize the sustainability of their capex deployment for the future.** The capex of big 4 hyperscalers (Microsoft/Google/Amazon/Meta) already grew at 38%/32%/19% YoY during 2020-22 (figure 6), reaching US$150bn in 2022. **Given current interest rates in the US, how much higher could it go?**

**Figure 5: Capex of big 4 hyperscalers (Microsoft/Google/Amazon/Meta) grew 38%/32%/19% YoY during 2020-22**



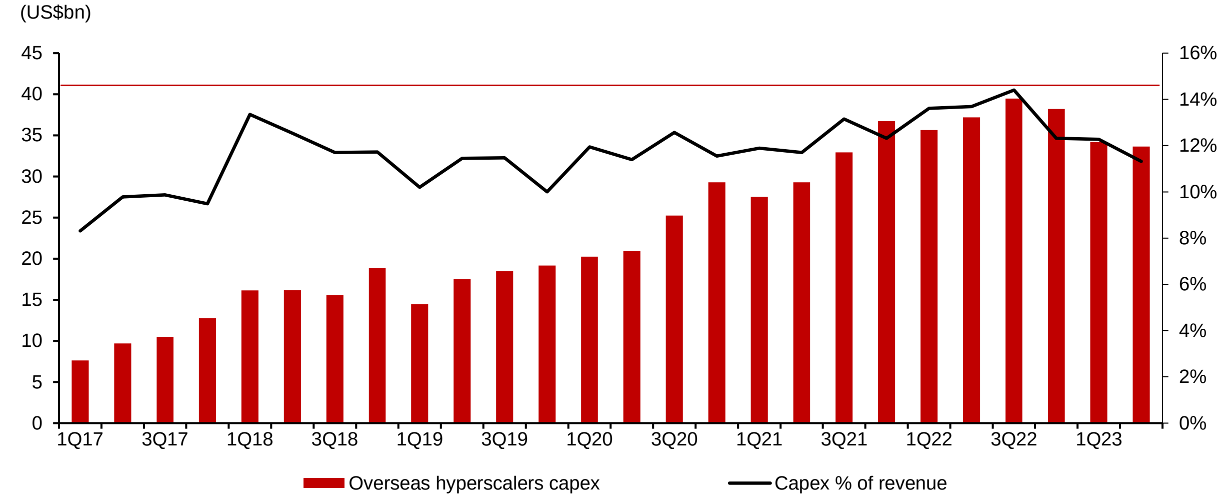

Source: Company filings, TrendForce, Digitimes, Bloomberg, CMBIGM estimates

**Figure 6: Global cloud service providers' AI spending**




Source: Counterpoint, CMBIGM estimates

**Figure 7: Capex to revenue ratio for big 4 hyperscalers (MSFT/GOOG/AZMN/META)**

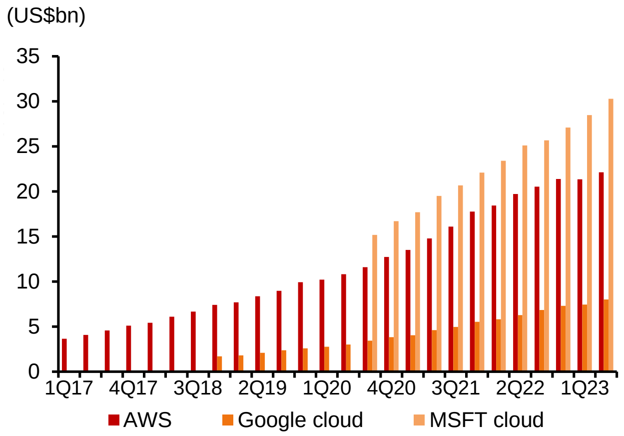



Source: Company info, CMBIGM estimates

**Although the hyperscalers pointed out a shift to AI in their capex allocation, we believe the upside for overall Cloud capex is limited, unless there is a significant progress on monetization of generative AI applications.** For example, Microsoft illustrated how they think of the capex going forward: "111 billion Commercial Cloud business growing at… 22% YoY. And then… capex growth which is around the same number, 23%, 24%. So, in some sense, it is sort of replacement capital plus some new capital that is going to drive new growth."

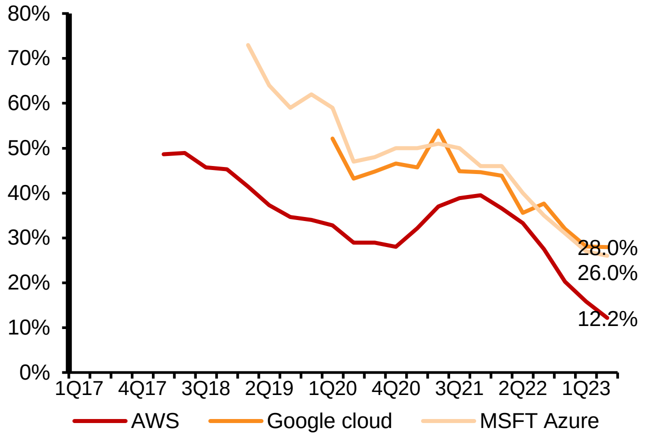
This means **the Cloud companies will adjust their capital investments considering their revenue growth.** Turning to Cloud business growth, **the hyperscalers are experiencing a slowdown in revenue growth.** Microsoft Azure/Google Cloud/AWS's revenue growth declined to 28%/26%/12% in 2Q23. Can the downstream applications drive such demand? Will the launch of LLM based service/products bring sufficient cash flow to support ongoing capex at this level?

**Figure 8: Hyperscalers' cloud revenue (1Q17-2Q23)**




Source: Company data, CMBIGM estimates

**Figure 9: Hyperscalers cloud revenue growth (1Q17-2Q23)**




Source: Company data, CMBIGM estimates

**For hyperscalers, we think there is limited upside for cloud capex, unless the monetization of generative AI could come faster-than-expected or a significant cost reduction of operating AI infrastructure can be achieved with either hardware or software optimization.**

**Recent news suggests this may be realistic**: 1) OpenAI ARR exceeded US$1.3bn per The Information, 2) Microsoft, Google and Adobe are all charging additional fees for AI-powered features per WSJ. **However, it is still difficult to achieve profitability due to high cost of running AI infrastructure.**

**Figure 10: Overseas hyperscalers' cloud business outlook and capex forecast for 2023**

| Company (Products) | AI monetization strategies |
|---|---|
| **Microsoft** (OpenAi) | **Microsoft launched its Microsoft Office 365 Copilot, which is set to be priced at $30/month for enterprise customers starting in November.**<br>**OpenAI: 1) OpenAI generates most of its revenue from licensing fees for its models and products. Fees are based on usage, such as charging per image for Dall-E or per token for language models. 2) Subscriptions: OpenAI introduced ChatGPT Plus, a $20 per month premium subscription, providing users with enhanced access to compute resources.** |
| **Meta** (Instagram, WhatsApp) | **Ad targeting and optimization:** Meta leverages AI to enhance ad targeting. Machine learning algorithms analyze user data and behavior to help advertisers reach their target audiences more effectively.<br>**AI-driven ad tools:** Meta offers AI-driven advertising tools like Advantage+ to marketers. These tools automate various aspects of the ad creation and optimization process. |
| **Alphabet** (YouTube, Google) | **Consumer-facing AI:** Google integrates AI-generated answers into search results, utilizing its dominant market share for adoption and potential targeted advertising.<br>**Enterprise AI:** Google Cloud is a leader in AI services, benefiting from its ecosystem and cloud platform. |
| **Amazon** (AWS) | **Generative AI for advertising:** AWS demonstrates the use of generative AI for ad creative generation, creating hyper-personalized images and taglines. This helps tailor ads to specific audiences and demographics.<br>**Shoppable video:** AWS provides solutions for shoppable video experiences, allowing viewers to shop within content seamlessly, enhancing engagement. |
| **Baidu** (Ernie Bot) | Ernie Bot is a generative dialogue product launched by Baidu, based on the Wenxin pre-trained Model (PTM). During its launch event, Baidu demonstrated Ernie Bot's capabilities, which include literary creation, business copywriting, mathematical and logical deduction tasks, Chinese comprehension, and multimodal generation (text, pictures, speech, dialect, and video).<br>Baidu has already established partnerships with over 650 companies across various industries, including media, finance, automotive, and enterprise software. Local banks like CITIC Bank and PSBC have partnered with Baidu's Ernie LLM to apply human-computer dialogue AI technology in financial scenarios. |
| **Iflytek** | Education, healthcare, 2C, Auto industry, etc. |

Source: Company info, CMBIGM

**As for smaller Cloud companies, they are not the major players to make large-scale Cloud investments,** given their weaker financial strength and cash positions. Furthermore, the current high interest rate environment will also weigh on other smaller cloud companies' capex plans. They may find the AI arms race unaffordable to participate.

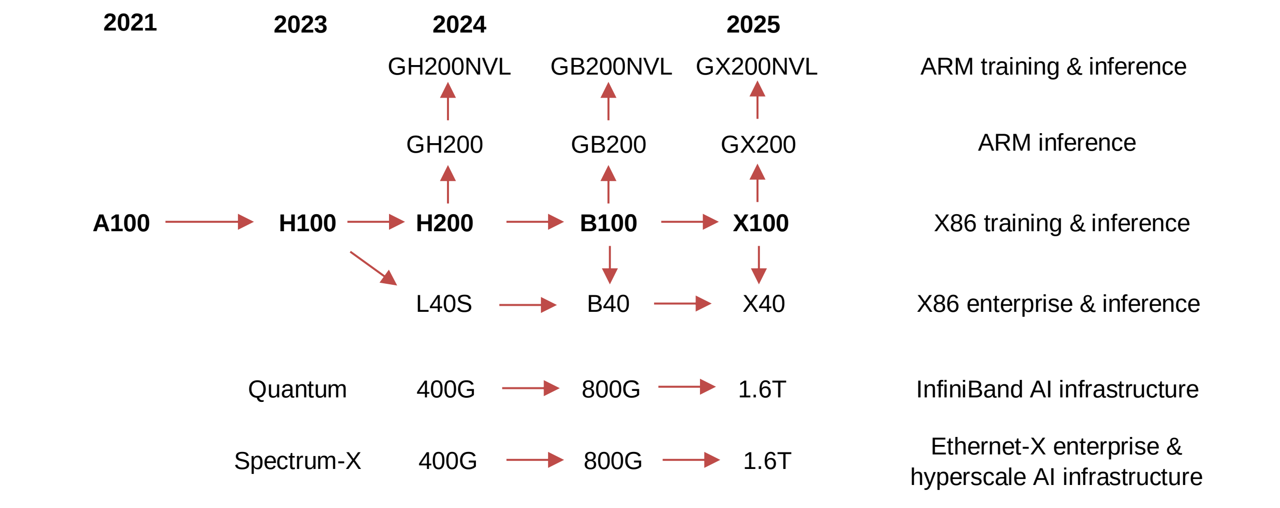
**Therefore, there is strong incentive for the hypercalers to keep investing significant amount of resources on their specialized AI accelerators to improve efficiency and lower costs.**

## Demand sustainability for Nvidia's GPUs is still a concern as competitors are trying to catch up and Cloud companies are seeking for alternative options

Nvidia is the clear winner of the AI arms race so far, with dominant share in growing AI GPU market. We think **Nvidia's dominance in AI datacenter is likely to continue in the near term.**

Nvidia also revealed their product roadmap into 2025 in their recent October presentation, showing confidence in maintaining their moat and leadership in the field.

**Figure 11: NVDA's roadmap of AI infrastructure upgrade (2023-2025)**




Source: Company info, CMBIGM

However, **we expect intensified competition from both its competitors and clients in the future**. AMD is also bringing MI300 series to compete with Nvidia (expected shipment in 4Q). Considering high price tags of Nvidia's AI chips and some specialized AI accelerators may suit industry-specific infrastructure/models more efficiently, many Nvidia's largest clients are speeding up the development of their own AI chips to reduce the dependency on Nvidia.

- AMD MI300X
- Amazon Trainium2 Inferentia
- Google TPUv5
- Intel Gaudi 3
- Microsoft Athena

**Overall, we think Nvidia's AI GPU will maintain market dominancy, given its head start advantage and well-established CUDA ecosystems. In mid- to long-term, there are some uncertainties in the competitive landscape. We think Nvidia's dominancy may face challenges and high margin (70% GPM in 2Q) which may be difficult to sustain in the mid- to long-term.**

## Other AI beneficiaries

Investors are actively looking for other names as Nvidia is already a crowded trade. We identified several companies that can also benefit from strong AI demand and hyperscaler's AI-capex growth.

- Selected overseas names include: AMD (AMD US), Broadcom (AVGO US), Super Micro Computer (SMCI US), Marvell (MRVL US), Fabrinet (FN US), and Micron (MU US).
- Selected Asian names: SK Hynix (000660 KR), Innolight (300308 CH), LuxNet (4979.TT), Suzhou TFC (300394 CH), Yoke Tech (002409 CH), and Shannon Semi (300475 CH).

**Figure 12: Beneficiaries: comps table**

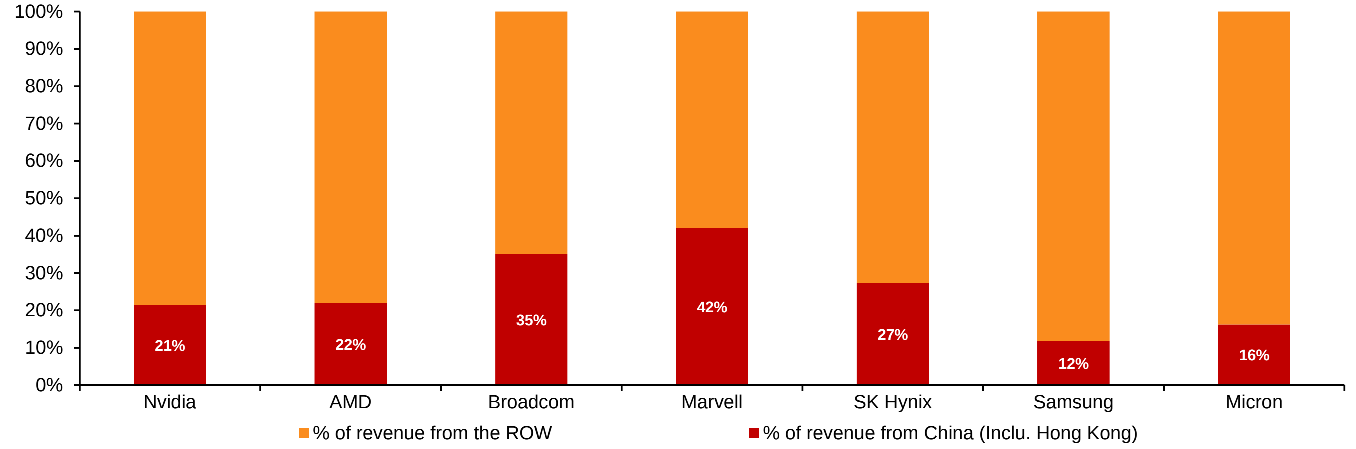
| | | Mkt Cap | Price | P/E (x) | | ROE (%) | | Dividend Yield (%) | | EPS (US$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Company | Ticker | US$(mn) | (LC) | FY23E | FY24E | FY23E | FY24E | FY23E | FY24E | FY23E | FY24E |
| **Other identified AI beneficiaries** | | | | | | | | | | | |
| Nvidia | NVDA US | 1,122,887 | 454.6 | 139.3 | 42.1 | 29.7 | 76.2 | 52.3 | 28.2 | 3.3 | 10.8 |
| AMD | AMD US | 169,791 | 105.1 | 38.1 | 25.3 | 6.0 | 9.1 | 3.1 | 3.0 | 2.8 | 4.2 |
| BROADCOM | AVGO US | 364,520 | 883.2 | 21.0 | 19.1 | 72.5 | 72.4 | 15.7 | 14.1 | 42.1 | 46.3 |
| SUPER MICRO COI | SMCI US | 15,089 | 285.2 | 25.4 | 16.4 | 36.3 | - | 7.7 | - | 11.2 | 17.4 |
| MARVELL | MRVL US | 45,401 | 52.6 | 24.8 | 34.1 | 8.8 | 7.8 | 2.9 | 2.9 | 2.1 | 1.5 |
| FABRINET | FN US | 6,268 | 173.2 | 22.7 | 21.8 | 20.6 | 19.0 | 4.3 | 3.7 | 7.6 | 8.0 |
| MICRON TECH | MU US | 75,995 | 69.2 | - | - | (11.4) | (5.1) | 1.7 | 1.8 | (4.5) | (1.6) |
| SK HYNIX INC | 000660 KS | 66,701 | 124,700.0 | - | 16.4 | (12.8) | 9.6 | 1.6 | 1.5 | (8.0) | 5.6 |
| ***Peers Avg.*** | | | | ***45.2*** | ***25.0*** | ***18.7*** | ***27.0*** | ***11.2*** | ***7.9*** | ***7.1*** | ***11.5*** |
| ***Peers Median*** | | | | ***25.1*** | ***21.8*** | ***14.7*** | ***9.6*** | ***3.7*** | ***3.0*** | ***3.0*** | ***6.8*** |
| **China A-share AI beneficiaries: optical modules** | | | | | | | | | | | |
| INNOLIGHT | 300308 CH | 10,991 | 102.4 | 48.0 | 23.2 | 12.6 | 20.9 | 5.9 | 4.7 | 0.29 | 0.59 |
| EOPTOLINK | 300502 CH | 4,005 | 42.9 | 32.9 | 19.8 | 15.5 | 21.4 | 5.2 | 4.2 | 0.17 | 0.29 |
| ACCELINK | 002281 CH | 3,503 | 32.0 | 37.7 | 30.5 | 9.6 | 10.9 | 3.5 | 3.2 | 0.12 | 0.15 |
| SUZHOU TFC | 300394 CH | 4,508 | 82.2 | 60.1 | 40.9 | 18.4 | 22.4 | 11.0 | 9.1 | 0.19 | 0.28 |
| ***Peers Avg.*** | | | | ***44.7*** | ***28.6*** | ***14.0*** | ***18.9*** | ***6.4*** | ***5.3*** | ***0.2*** | ***0.3*** |
| ***Peers Median*** | | | | ***42.8*** | ***26.9*** | ***14.0*** | ***21.2*** | ***5.6*** | ***4.5*** | ***0.2*** | ***0.3*** |

Source: Bloomberg as of 15 Oct 2023, CMBIGM

**Future catalysts:**

- Geopolitical risks: As the US may tighten measures to restrict China's access to advanced semiconductors and chip makers, companies with higher exposure to China's market may face geopolitical risks. According to Reuters, "*The United States last year shook relations with Beijing when it unveiled new restrictions on shipments of AI chips and chipmaking tools to China, seeking to thwart its military advances. Those rules are set to be tightened in the coming days. A person familiar with the situation said the measure could be included in those new restrictions.*" We think further curbs on the AI chip exports may negatively impact the revenue for many companies like Nvidia, AMD, Broadcom, etc.

**Figure 13: AI peers revenue breakdown: % of revenue from China**




Source: Bloomberg, Company data, CMBIGM estimates

- Nvidia 3Q earnings on 21 Nov 2023
- Cloud capex guidance for 2024
  - Microsoft next earnings call on 24 Oct 2023
  - Google next earnings call on 24 Oct 2023
  - Meta next earnings call on 25 Oct 2023
  - Amazon next earnings call on 26 Oct 2023
- Progress on monetizing generative AI.

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| | |
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