

## Semiconductors

### DeepSeek Sparks Investor Concerns On AI Spending Momentum; Past Innovation Cycles Suggest Efficiency/Technology Improvements Drive Further Adoption/Innovation

Following the launch of DeepSeek R1 last week, investors have expressed concerns regarding the intermediate and long-term implications for AI semiconductor spending given the company's claims regarding their compute efficiency in terms of cost and performance for training/inferencing AI models. According to the company, the training costs for the DeepSeek V3 model were around \$5.6 million, significantly lower than those for the frontier foundation models, questioning the sustainability of industry AI spending. Despite the impressive cost efficiency of DeepSeek's training and inference, several questions remain unanswered, including the complete training costs for R1 (such as the costs of prior model training/R&D/development/optimization) and the extent of reliance on larger open-source foundation models developed earlier (e.g., Meta's open-source Llama models). We believe it is crucial to validate these costs before drawing conclusions, as the specifics of the training data set, the "proprietary optimization" methodologies employed, and the overall development expenses for the model and framework have not yet been disclosed. Despite this, historically, new technology innovation cycles (especially compute efficiency) have driven increased proliferation/demand (Jevons paradox) which has resulted in more/higher value semiconductor demand as well. For example, in the semiconductor industry, x86 server virtualization in the 2000s (driving higher demand for CPUs, memory/storage), ARM adoption in smartphones and IoT (driving higher demand for more mobile/IoT products), and on-prem compute workload migration to the cloud (higher demand for compute, networking, memory/storage) have all led to greater compute/networking/memory silicon demand. For AI, recent efficiency gains demonstrated by DeepSeek will serve to shift (pull forward) the adoption/scaling curve for inferencing to the left (ie faster adoption curve - see Figure 1) and create a faster unlock of demand for more/higher performance AI semiconductor solutions. Furthermore, given the early days of AI, innovation in LLMs has spurred innovation on new foundational AI models (WFMs for physical AI by NVIDIA is a good example), and we anticipate further unlock of more use-cases for AI. Beyond optimizations in the foundation model and software stack, we believe there remains a strong opportunity for differentiation and efficiency unlock through internally developed custom ASIC silicon programs, as opposed to off-the-shelf merchant GPUs. As cloud providers and hyperscalers continue to build larger training/inferencing cluster sizes, we believe this trend will benefit custom ASIC suppliers like Broadcom and Marvell, given their cost and power performance advantages. The bottom line is that innovation does not stop; it catalyzes new opportunities. We reiterate our OW ratings on AVGO, MRVL, and NVDA.

- **Jevons paradox, increasing model complexity, new technology innovation cycles, and the pursuit of Artificial General Intelligence (AGI) should continue to drive long term compute demand.** The DeepSeek technical

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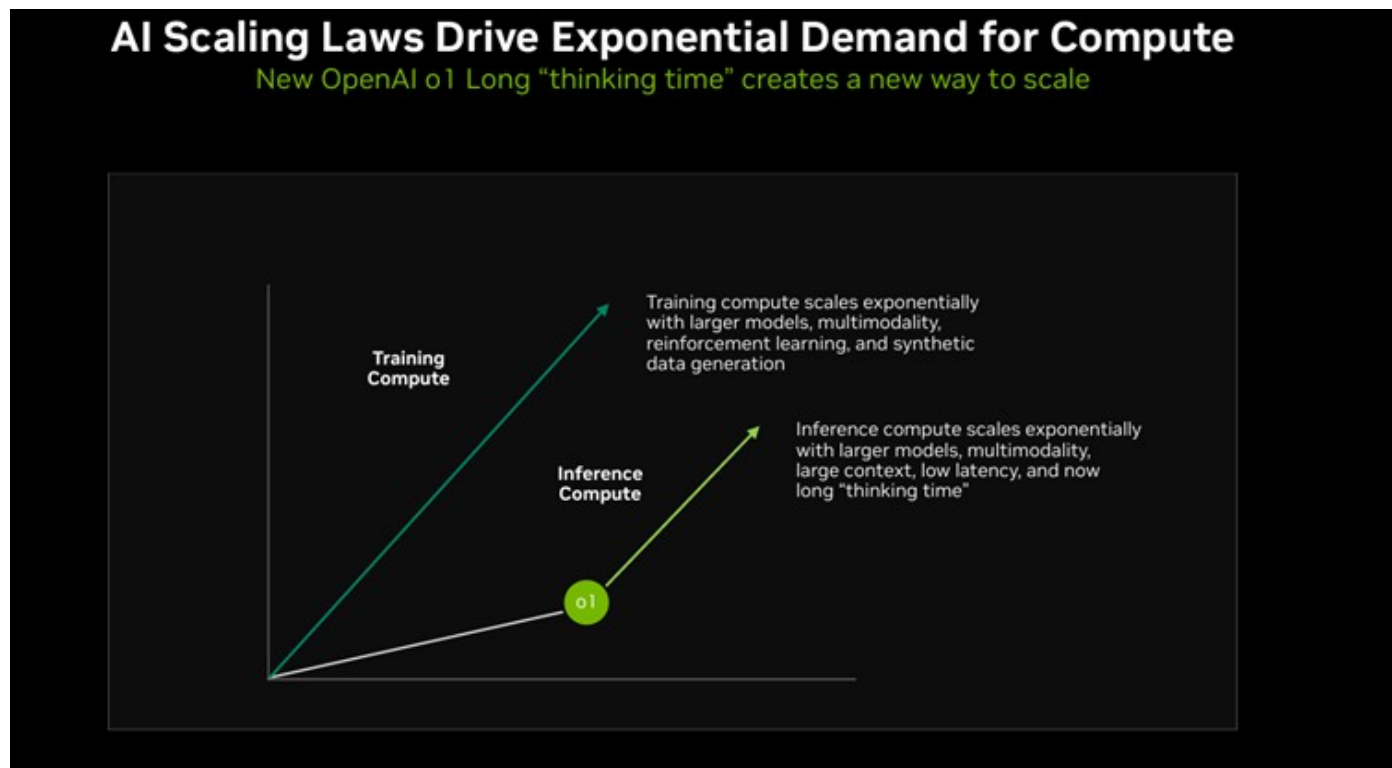
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paper claims that with greater computational capability, a more advanced model could have been trained, indicating that scaling laws remain relevant (ie more compute silicon capability will drive better model performance). This implies that future enhanced silicon capabilities could lead to even better models. The recent efficiency gains demonstrated by DeepSeek will serve to shift (pull forward) the adoption/scaling curve for inferencing to the left (ie faster adoption curve - see Figure 1) and create a faster unlock of demand for more/higher performance AI semiconductor solutions. As we are still in the early stages of this AI technology wave, it's important to recognize that there is much we have yet to learn, with numerous undiscovered techniques still to be explored. We believe that this new development does not hinder innovation; rather, it propels it forward. We believe companies are continuing to pursue the long term aspiration of Artificial General Intelligence (AGI) and closing the gap will require innovations in model efficiency as well as silicon performance.

- **Lower cost of compute drives more compute silicon demand.** We believe that AI efficiency gains, as demonstrated by DeepSeek, should spur greater demand and drive further innovation which should then catalyze more silicon consumption, as seen from past instances. For example, in the semiconductor industry, x86 virtualization in the 2000s was a significant breakthrough in computing efficiency, as it enabled multiple operating systems to run on a single physical machine. This advancement helped companies optimize their resource usage and improve the performance of their computing infrastructure. Virtualization drove HIGHER demand for higher-value x86 server CPU chips and requirements for more system memory. Other examples include the migration from on-premise computing to cloud computing (drove higher demand for servers, networking, storage infrastructure) and the adoption of ARM-based architectures. Arm's low power/efficient computing has unlocked high volume adoption in the mobile mkts, which then spread to other adjacent opportunities like IoT. For AI, recent efficiency gains demonstrated by DeepSeek will serve to shift (pull forward) the adoption/scaling curve for inferencing to the left (ie faster adoption curve - see Figure 1) and create a faster unlock of demand for more/higher performance AI semiconductor solutions.
- **Innovation in LLMs is driving innovations in new AI model architectures.** Nvidia has brought the promise of large language models (LLMs) to the market with their accelerated compute architecture, and these LLMs are now spurring the development of new types of models, such as world foundational models (WFMs - targeting physical AI applications). The NVIDIA team has recently launched their Cosmos platform which include world foundation models (WFM) to accelerate the development of physical AI systems such as autonomous vehicle and robotics. We believe the cost of training and the amount of parameters required are significantly higher in video-based LLMs vs text-based LLMs and more innovative algorithms could unlock more compute efficiency/performance gains and drive even more complex multi-modal architectures.
- **Custom ASICs is another area for strong cost/performance differentiation.** Beyond optimizations in the foundation models/software stack, we believe there remains a strong opportunity for differentiation and cost leadership through internally developed custom ASIC silicon programs versus off the shelf merchant GPU solutions. As the cloud/hypersclers continue to build out larger training/inferencing cluster sizes, we believe that should continue to benefit custom ASICs suppliers (Broadcom and Marvell) given the cost/power performance advantages.
- **DeepSeek claims and our initial thoughts.** DeepSeek-R1-Zero and DeepSeek-R1 have demonstrated performance comparable to OpenAI's o1-1217 across various reasoning tests, but with significantly reduced training and inference costs. The inference costs for DeepSeek-R1 are notably lower than those for OpenAI's o1 model, with costs per million tokens at \$0.55 for input and \$2.19 for output, compared to OpenAI's \$15 and \$60, respectively. According to the company, the training costs for the DeepSeek V3 model

were around \$5.6 million. Despite the impressive cost efficiency of DeepSeek’s training and inference, several questions remain unanswered, including the complete training costs for R1 (such as the training costs of prior models) and the extent of reliance on larger open-source foundation models developed earlier (e.g., Meta’s open-source Llama models). We believe it is crucial to validate these costs before drawing conclusions, as the specifics of the training dataset, the “proprietary optimization” methodologies employed, and the overall development expenses for the model and framework have not yet been disclosed.

Figure 1: Adoption/Scaling Curve For Inference Compute



Source: Nvidia Investor Presentation

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Broadcom Inc(AVGO/\$202.13/OW), Marvell Technology Inc(MRVL/\$100.33/OW), NVIDIA Corporation(NVDA/\$118.42/OW)

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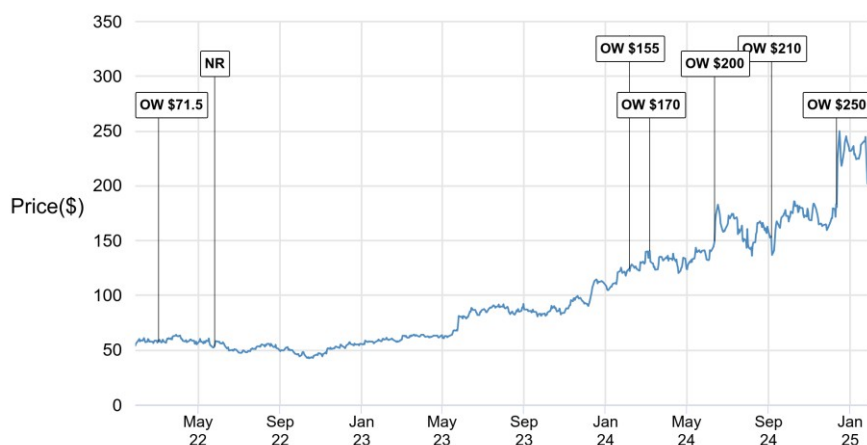
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Broadcom Inc (AVGO, AVGO US) Price Chart



Date	Rating	Price (\$)	Price Target (\$)
04-Mar-22	OW	57.86	71.5
26-May-22	NR	53.16	--
06-Feb-24	OW	124.31	155
08-Mar-24	OW	140.70	170
13-Jun-24	OW	149.55	200
06-Sep-24	OW	152.82	210
12-Dec-24	OW	183.20	250

Source: Bloomberg Finance L.P. and J.P. Morgan; price data adjusted for stock splits and dividends. Initiated coverage Nov 01, 2010. All share prices are as of market close on the previous business day.

Marvell Technology Inc (MRVL, MRVL US) Price Chart



Date	Rating	Price (\$)	Price Target (\$)
26-Aug-22	OW	55.09	85
28-Nov-22	OW	42.98	75
02-Dec-22	OW	45.40	72
03-Mar-23	OW	46.23	60
26-May-23	OW	49.47	70
08-Mar-24	OW	85.09	90
04-Dec-24	OW	95.91	130

Source: Bloomberg Finance L.P. and J.P. Morgan; price data adjusted for stock splits and dividends. Initiated coverage Oct 22, 2002. All share prices are as of market close on the previous business day.

NVIDIA Corporation (NVDA, NVDA US) Price Chart



Date	Rating	Price (\$)	Price Target (\$)
26-May-22	OW	16.98	28.5
08-Aug-22	OW	18.99	23
25-Aug-22	OW	17.22	22
23-Feb-23	OW	20.75	25
25-May-23	OW	30.54	50
24-Aug-23	OW	47.12	60
22-Nov-23	OW	49.94	65
22-Feb-24	OW	67.47	85
23-May-24	OW	94.95	115
29-Aug-24	OW	125.61	155
21-Nov-24	OW	145.89	170

Source: Bloomberg Finance L.P. and J.P. Morgan; price data adjusted for stock splits and dividends. Initiated coverage Apr 04, 2002. All share prices are as of market close on the previous business day.

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