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Artificial Intelligence Driving Change in Financial Markets

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ABSTRACT

This paper explores the recent growth of companies within the AI sector, focusing on financial performance and the reasons behind heavy investments from major corporations, such as Nvidia and Microsoft. As AI technologies continue to grow, the sector has witnessed a disproportionate rise in stock valuations, leading to concerns that current growth in AI stocks resembles speculative investor behavior, reminiscent of the dot-com bubble. However, this paper argues that the AI industry's financial standing and technological advancements differentiate it from past investment bubbles. By examining key metrics and financial data, this paper demonstrates that the rapid growth of companies in AI is not driven solely by speculation but is supported by the foundational successes of these companies. This analysis also delves into Nvidia's dominance in the GPU market, driven by its CUDA software, the network effects that reinforce its position, and geopolitical factors that influence the global semiconductor industry. The paper concludes with an optimistic outlook on AI's potential to improve productivity across a variety of sectors, therefore sustaining long-term growth and justifying continued investment in the industry.

Introduction

Recent market trends have shown that companies in the AI sector have risen at a disproportionate rate relative to other stocks. Many argue that current gains in AI stock valuations are driven by speculation, similar to investor behavior during the dot-com bubble of the early 2000s. This paper examines the stock growth of AI companies in a positive light, arguing that their success is likely to be sustained over the long term. The AI industry has seen remarkable growth in recent years, driven by advancements in technology. Companies in the AI ecosystem, such as Nvidia and Microsoft, have seen significant increases in their stock prices and market valuations. Smaller companies have also undergone notable growth, but to a lesser degree than industry giants such as Microsoft and Nvidia. This paper analyzes financial performance from annual reports, quarterly earnings, and other financial documents from leading AI companies to gather data on stock prices, earnings, and other key metrics. By examining market trends and strategic insights from these AI companies, this paper argues for sustained growth and investments in the industry.

Nvidia's Success

The majority of Nvidia's customers include Microsoft, Meta, Google Cloud, and AWS. As Microsoft Copilot continues its relationship with OpenAI, Microsoft will continue to purchase NVDA chips to build out their AI capabilities.

Over the next five years, approximately one trillion US dollars are expected to be invested in data centers.[1] This surge in investment will lead to increased semiconductor orders, significantly benefiting Nvidia.

Although there are other competing companies, Nvidia's success is largely based on its software ecosystem centered around CUDA, which is a barrier to entry.[2] As more people adopt Nvidia products, they use CUDA, causing it to grow through network effects, when the value of the product or service increases as more people use it.[3] This creates a self-reinforcing cycle, where each additional user subsequently makes the product more valuable by increasing demand. Network effects grow disproportionately because of the exponential impact of adding just one connection. As these effects increase, they boost supplier power and propel commerce growth. Conversely, when companies lose connections, they experience negative network effects, leading to an exponential decline in connections that can gradually cause them to fail.

One reason for Nvidia's rapid growth is because of its position as the leading GPU supplier and its high multiples, which cause its stocks to rise faster but also make the company more volatile. Nvidia's earnings multiple (or P/E ratio) is currently 71.02x (Table 1) and is expected to decrease to 32.5x[4] by 2026. Nvidia would need to double their earnings by 2026, as this value is calculated by dividing the current stock price by earnings per share. High multiples can increase stock volatility, so if Nvidia is unable to double its earnings to reduce its multiple, its stock could take a hit due to high volatility. Nvidia's ability to gain market share amid rising demand for AI data centers has played an important role in its ability to constantly grow its value. Similar to Apple's success, Nvidia has been able to dominate its market by creating CUDA, a non-graphics software that uses Nvidia's specialized chips designed for labor-intensive applications like 3-D graphics. CUDA has enabled different types of computing tasks on Nvidia's GPUs, such as AI software, allowing Nvidia to capitalize on booming growth in recent years. CEO Jensen Huang has highlighted the importance of their "full-stack computing" strategy, where Nvidia builds everything from chips to software systems. CUDA now contains more than 300 libraries, 600 AI models, and supports 3,700 GPU applications used by around 40,000 companies,[5] as revealed at Nvidia's June shareholders meeting.

Startups attempting to develop alternatives to CUDA are also receiving significant investments, and major tech companies are exploring their own alternatives to Nvidia chips. For instance, Groq, a startup that leverages open-source software, has recently announced a $640 million investment from Cisco and Samsung, at a $2.8 billion valuation to build chips that compete with Nvidia.[6] However, these rivals face the challenge of convincing customers to switch from Nvidia's system, which some have been using for over 15 years. The accelerated pace of Nvidia's product release also plays a significant role in its high valuation and earnings multiple. For example, Nvidia recently announced that it will shorten its product cycle to just one year, moving from the Hopper to the Blackwell architecture

[1] Ondrej Burkacky, Julia Dragon, and Nikolaus Lehmann, "The Semiconductor Decade: A Trillion-Dollar Industry," McKinsey & Company, April 1, 2022, https://www.mckinsey.com/industries/semiconductors/our-insights/the-semiconductor-decade-a-trillion-dollar-industry.

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[3] Tim Stobierski, "What Are Network Effects?," Harvard Business School Online, November 12, 2020, https://online.hbs.edu/blog/post/what-are-network-effects.

[4] "NVIDIA Corporation (NVDA) Valuation: Price-Earnings & PEG Ratios.," Seeking Alpha, n.d., https://seekingalpha.com/symbol/NVDA/valuation/price-earnings-peg-ratios.

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[6] Christopher Mims, "Why Every Big Tech Company Has Failed to Dethrone Nvidia as King of AI," The Wall Street Journal, August 9, 2024, https://www.wsj.com/tech/ai/ai-nvidia-apple-amd-jensen-huang-software-bb581f5a#.

in CY2024, then introducing an even newer generation in CY2025.[7] This rapid technological advancement has also made a difference in the data center market, creating a notable increase in Nvidia's data center revenue, as well as expanding their share of data center revenue.[8]

Why This Time is Different

Drawing a parallel between the rise in value of AI companies and the dot-com bubble offers valuable insights when predicting the future of said AI companies. During the dot-com bubble, nearly every company involved–including many startups–received investments and high valuations, regardless of their revenue.[9] Some argue that companies involved in areas like data centers and AI semiconductors are seeing speculative growth, similar to the excessive growth experienced by companies during the dot-com bubble of the 1990s and 2000s. However, today's leading AI companies show consistent revenue growth, supporting their valuation.

Another similarity between these two periods is the value chain they both follow. During the dot-com bubble, there was an interconnected ecosystem (Fig. 1) allowing all the companies to profit from each other's success. For instance, content providers such as Yahoo[10] and AOL worked closely with service providers like Amazon and eBay, as well as with web hosting and search engine companies like GeoCities, Google, and Lycos. Infrastructure companies, including Cisco and Nortel, provided the technology and hardware needed for connectivity and data transmission to the rest of the companies in the ecosystem. The current semiconductor ecosystem (Fig. 2) follows a similar trend, where each company contributes to developing AI and technology. On the design side of the value chain, fabless companies such as Nvidia and Qualcomm design chips and outsource their manufacturing to foundries, like TSMC.[11] Once the chips are designed and manufactured, they are often purchased by AI data centers such as Amazon AWS, Microsoft Azure, and Google Cloud, which provide services to end users and form the middle of the value chain. Examples of these companies include Apple, Microsoft, Google, and Amazon. Both the dot-com era and the rise of AI companies have seen a "bubble" effect, with inflated valuations on the infrastructure side of their ecosystem, resulting in the exponential rise of companies like Global Crossing and WorldCom in the past,[12] and now, Nvidia.

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[7] Kristin Uchiyama, "NVIDIA Blackwell Platform Arrives to Power a New Era of Computing," NVIDIA Newsroom, March 18, 2024, https://nvidianews.nvidia.com/news/nvidia-blackwell-platform-arrives-to-power-a-new-era-of-computing.

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Figure 1. Dot-Com Bubble Company Ecosystem Diagram

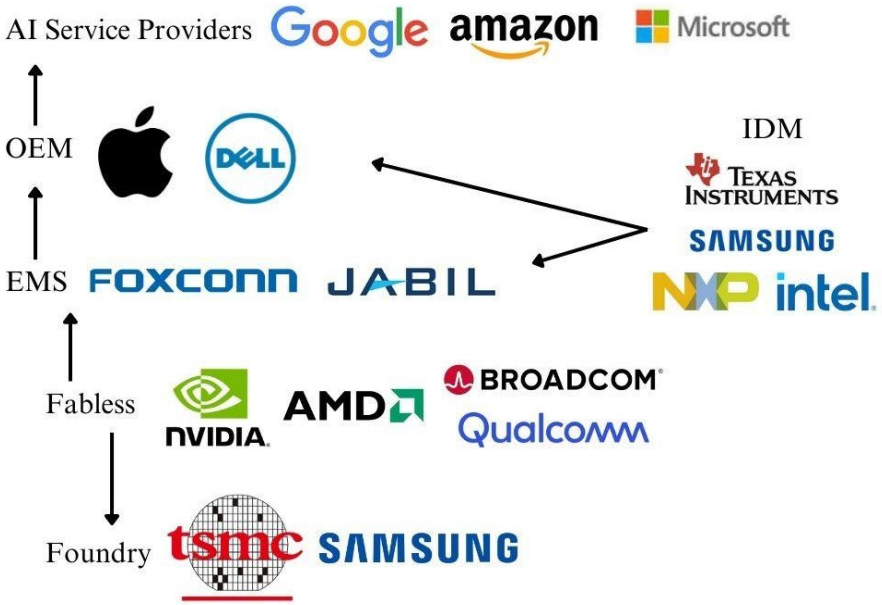

Figure 2. Semiconductor Ecosystem Diagram

Today's AI industry shares some characteristics with companies involved in the dot-com bubble of the late 1990s and early 2000s. In both cases, the speculation around groundbreaking technologies led to the creation of numerous companies, many of which lacked sustainable business models.[13] The network effect–where value increases as more participants join–played a key role in driving up valuations in both periods. However, the challenge remains

[13] Peter Robert Wheale and Laura Heredia Amin, "Bursting the Dot.com "Bubble': A Case Study in Investor Behaviour," Technology Analysis & Strategic Management 15, no. 1 (March 2003): 117–36, https://doi.org/10.1080/0953732032000046097.

distinguishing between genuine value creation and speculative hype. Sustainable success relies on the ability to create real value and maintain competitive advantages, as demonstrated by companies from the dot-com era and successful AI firms today.

A relevant comparison can be made between Pets.com, a company synonymous with the rise and fall of the dot-com bubble, and OpenAI, which leads the groundbreaking work in generative AI today. While they both received valuations that exceeded reasonable numbers for their revenue, OpenAI's ChatGPT app reached 100 million users in record time, demonstrating actual demand. In contrast, dot-com companies like Pets.com went bankrupt because they lacked viable business models, demand, and profitability.[14] Other companies, like Nvidia, are growing and remain profitable, suggesting that they are positioned to survive, even if stock and revenues were to plateau.

Additionally, a similar comparison can be made between Global Crossing, a telecommunications company during the dot-com bubble, and modern data center giants like Microsoft Azure and Amazon AWS. In the late 1990s, Global Crossing poured their resources into building fiber-optic networks to meet the anticipated future demand for internet connectivity. Despite their ambitious visions, Global Crossing lacked the financial stability to sustain their rapid investments, ultimately leading to bankruptcy.[15] Today, companies like Microsoft and Amazon have similarly heavily invested in chips and AI infrastructure, but their financial strength enables them to support these research endeavors without risking collapse. This important difference highlights the idea that today's companies are more likely to survive and thrive in the long term, unlike many of the companies that faltered during the dot-com bubble.

Geopolitical Implications

Geopolitical issues pose challenges in AI, especially in chip manufacturing. The majority of manufacturing occurs in Asia, while chip design prominently takes place in the West. As tensions rise between China and the U.S., AI and semiconductor companies are directly affected. Both the Trump and Biden administrations imposed trade restrictions on China, limiting its access to leading-edge chips.[16] Moreover, Taiwan accounts for 90%[17] of chip manufacturing worldwide, which has posed national security concerns, causing the U.S. Congress to enact the CHIPS and Science Act of 2022.[18] This legislation was put in place to bring chip manufacturing companies back to the U.S. by offering billions in subsidies.

The CHIPS and Science Act was only one tactic used in the U.S.-China trade war. While both nations are battling over intellectual property and chip production, the U.S. is developing domestic manufacturing while also enforcing sanctions. Huawei, a Chinese technology conglomerate, has suffered revenue loss because of the U.S.-China

[14] John M. Coulter and Thomas J. Vogel, "Pets.com, Inc.: Assessing Financial Performance and Risks in the E-Commerce Industry," Issues in Accounting Education 19, no. 4 (November 1, 2004): 567–82, https://doi.org/10.2308/iace.2004.19.4.567.

[15]Edward S. Adams, "Corporate Governance after Enron and Global Crossing: Comparative Lessons for Cross-National Improvement," Indiana Law Journal 78, no. 2 (2003): 3, https://www.repository.law.indiana.edu/ilj/vol78/iss2/3.

[16] Chris Miller, *Chip War: The Fight for the World's Most Critical Technology* (Simon and Schuster, 2022).

[17] Eric Cheung and Will Ripley, "Everyone Wants the Latest Chips. That's Causing a Huge Headache for the World's Biggest Supplier," CNN (CNN, March 23, 2024), https://www.cnn.com/2024/03/22/tech/taiwan-tsmc-talent-shortage-training-center-intl-hnk/index.html#:~:text=Sometimes%20called%20the%20most%20important.

[18] The White House, "FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China," The White House, August 9, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/.

trade war.[19] These trade restrictions also act as barriers to entry for Nvidia, limiting its ability to compete with Chinese companies, thus affecting its global market presence and revenue potential. Additionally, geopolitical tensions and sanctions make it difficult for Nvidia to expand internationally and maintain a competitive edge against competitors in China and other regions. It is worth considering how China might attempt to take control over chip manufacturing, and what tools the U.S. could utilize to counter this.

While demand is crucial to this industry's growth, the supply side must be strong enough to ensure they can keep up with demand. The CHIPS and Science Act's investment in domestic chip manufacturing is driven by both economic and national security concerns. Unlike companies during the dot-com bubble, today's AI corporations benefit from government subsidies, emphasizing their immense strategic value. However, bringing chip manufacturing onshore poses questions as to whether U.S.-based foundries can succeed. TSMC's success is partly due to its location in Taiwan, where labor costs and other costs are lower, and where a unique industry culture has formed. Replicating this culture in a U.S.-based foundry poses significant challenges.[20]

The Future of AI

As technology advances, Generative AI (GenAI) will continue growing, alongside increased demand. Although there is ongoing speculation regarding its true value to consumers and businesses, AI shows promising results for increasing productivity. Uses for GenAI cut across various sectors, and as more people adopt AI, demand will continue to be sustained. To justify further investments in AI companies, productivity gains must be evaluated at a macroeconomic level: how will AI continue benefiting consumers and businesses, and can it contribute to GDP growth? Quantifying the benefits of AI is essential to show cause for continued investment at such a large scale, as consumers and businesses will pay if there is value.

For example, AI can accelerate the drug discovery process for pharmaceutical companies, increasing productivity and reducing costs. Additionally, businesses can use AI to run analytics and maintenance, preventing system breakdowns. Quantifying these benefits can provide reason enough for businesses to continue to invest in AI solutions., creating a positive cycle of economic benefit for companies within the AI ecosystem. As AI technology evolves, new use cases emerge, driving further demand. As one company adopts the use of AI, others will invest in AI as well, leading to widespread adoption, strengthening the AI ecosystem for continued growth and integration.

One key question posed in building successful platforms is similar to the chicken and the egg dilemma: Which comes first, building scale or pricing? Many new platforms attempt to build scale first by offering promotions or free access before introducing pricing models. OpenAI adopted this strategy by launching their app for free, reaching 100 million downloads in record time.[21] Once they developed GPT-4, they monetized it by adding a pricing plan ($20 per month), leveraging its large user base to monetize their product. This strategy is likely to become more prevalent in the future as platforms will use scale as a foundation for monetization. The development of AI and digital platforms will create the potential to continue to capture a large user base early on, providing immediate revenue potential. Furthermore, the rise of network effects makes prioritizing scale increasingly valuable, ensuring a platform's long-term viability and competitive advantage. Balancing the timing of monetization with scaling is crucial for new companies, and more companies are following OpenAI's success with GPT-4.

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[19] Alexander Bukhvalov, "IMPACT OF ECONOMIC SANCTIONS ON THE FINANCIAL PERFORMANCE OF A COMPANY: HUAWEI CASE," May 30, 2022, https://dspace.spbu.ru/bitstream/11701/40931/2/Nikita_Timakov_Master_Thesis.pdf.

[20] Kathrin Hille, "TSMC: How a Taiwanese Chipmaker Became a Linchpin of the Global Economy," www.ft.com, March 24, 2021, https://www.ft.com/content/05206915-fd73-4a3a-92a5-6760ce965bd9.

[21] Dan Milmo, "ChatGPT Reaches 100 Million Users Two Months after Launch," The Guardian, February 2, 2023, sec. Technology, https://www.theguardian.com/technology/2023/feb/02/chatgpt-100-million-users-open-ai-fastest-growing-app.

Table 1. Balance Sheet for Leading AI Companies

Breakdown	NVDA	AAPL	MSFT	GOOGL	AMZN
TTM	28-Apr	30-Jun	30-Jun	30-Jun	30-Jun
Cash Balance	25.98	61.56	75.53	110.92	86.78
Debt Balance	12.12	145.31	125.29	81.81	164.92
Operating Cash Flow	40.52	113.04	118.55	105.06	107.95
Earnings	42.60	101.96	88.14	87.66	44.42
Research & Development	9.52	30.91	29.51	47.13	--
P/E Ratio [as of 15-08-2024]	71.02	34.05	32.30	22.94	41.49

Source: Yahoo Finance
Note: All values (except for "P/E Ratio") are in billions of USD.

Many leading companies, including Google, Microsoft, and Apple, benefit from their dominant market positions and substantial cash reserves. These companies can continuously invest in new research and development (R&D) to expand and preserve their market share. The strong balance sheets of these large companies, combined with their operating cash flows, demonstrate their financial health and ability to invest billions in R&D (Table 1), especially in long-term AI projects. Although the scale of AI investments has raised concerns, the CEOs of multiple big tech companies have defended their company's spending. Google's CEO, Sundar Pichai, said that the "risk of under-investing (in AI infrastructure) is dramatically greater than the risk of over-investing."[22] While overinvestment may affect short-term profit loss, underinvestment can potentially give competitors an advantage. For instance, Intel underinvested in R&D, enabling AMD to surpass them in key areas.[23]

Conclusion

The rapid expansion of the AI industry has some parallels with the dot-com bubble of the late 1990s and early 2000s, particularly in the growth of company valuations driven by speculative investment and technological advancements. However, there are significant differences suggesting that the AI industry's growth is more sustainable. Companies like Nvidia and Microsoft, which have capitalized on the demand for AI, were already financially strong prior to recent trends. Nvidia's success, like Apple's, is fortified by its robust software ecosystem, CUDA, which creates high barriers to entry for competitors and benefits from strong network effects. Furthermore, geopolitical factors, like U.S.-China trade tensions and the enactment of the CHIPS and Science Act, play a crucial role in impacting the future of AI, especially in the semiconductor industry.

The continued evolution and advancement of AI is contingent on its ability to enhance productivity across industries, sustaining demand and justifying continued investments. The future success of AI companies depends on their ability to maintain competitive advantages (like Nvidia's market share dominance), innovate continuously, and navigate complex geopolitical challenges. This analysis presents a positive outlook for the growth in the AI sector, distinguishing it from the speculative bubbles in the past.

[22] Aditya Soni, "Microsoft's Costs in Focus as Fears Rise over Slow Payoff from AI," Reuters, July 29, 2024, https://www.reuters.com/technology/artificial-intelligence/microsofts-costs-focus-fears-rise-over-slow-payoff-ai-2024-07-29/.

[23] Bluesea Research, "Intel: Losing R&D Leadership (NASDAQ:INTC)," Seeking Alpha, March 17, 2023, https://seekingalpha.com/article/4588172-intel-losing-r-and-d-leadership.

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