February 16, 2024

Nvidia: Underwriting the Market's Great Expectations

On February 21, 2024, Nvidia will release what has become the most highly anticipated earnings report in quite some time. This paper will assume that analysts' lofty expectations for the February earnings release are accurate, as they will serve as the baseline for the analysis. All data is as of 2/16/2024, unless otherwise noted. All financial statement information sourced from Bloomberg.

Summary

The transformative capabilities of AI are real, and the market is rightfully excited. But history has shown that even transformative technological innovation takes time, meaningfully impacts all sectors/industries, and is rarely, if ever, monopolized by one company in perpetuity. Barring an as-yet-undiscovered accounting irregularity or a rapidly deteriorating economic environment, we expect Nvidia to continue its current growth trajectory in the near term. However, it is our opinion that the growth expectations that are currently priced into Nvidia's valuation are overly optimistic, particularly when they are considered in the context of the following risks:

- ~50% of Nvidia's revenue is generated from 12 enterprise clients, many of whom are developing in-house solutions to reduce their reliance on Nvidia GPUs.
- In 2023 Nvidia led or participated in $5.2B of new Equity capital raises for Venture-backed AI businesses that rely heavily on Nvidia GPUs which, in our opinion, may account for a material portion of Nvidia's rapid revenue growth.
- The early stage of the AI life cycle requires more processing power today *(during the development phase)* than will be required in the future, as AI models mature.
- The geopolitical climate continues to hang over the narrative and will remain a risk for Nvidia so long as exports to China and other countries are restricted.

What Does Nvidia Do?

Nvidia is an American semi-conductor company based in Santa Clara, CA and is currently the world's leading Graphics Processing Units *(GPU)* chip developer for AI hardware & software. The "AI Arms Race" has benefitted Nvidia immensely, as they currently offer the best-in-class GPUs for AI development, specifically with their H100 chip. Following the launch of OpenAI's ChatGPT in late 2022, Nvidia has become the posterchild for AI innovation, and has experienced frenzied demand for its integral products.

	11/30/2022	2/16/2024	% Change
Market Capitalization *($M)*	$416,306	$1,793,541	331%
Share Price	$169.23	$726.13	329%
Weight in S&P 500	1.23%	4.26%	246%
Revenue *($M)*	$26,974	$59,314	120%

Source: Bloomberg Analyst Forecasts for February Earnings Release (2/16/2024)

Since the launch of OpenAI's ChatGPT on November 30, 2022, Nvidia's stock price is up +329% *(up almost +47% YTD)* and has accounted for ~1/5 of the S&P 500's +25.1% return over that period.

Revenues are expected to have increased by 120% over the past 2 years *(in February earnings release)*, and according to Reuters, it has become the most actively traded stock on Wall Street[1].

Nvidia's Valuation

Last week, Nvidia's market capitalization surpassed $1.8T, making it the 3rd most valuable company in the world. To add context, $1.8T is larger than the Energy sector within the S&P 500, as well as the entire Chinese stock market. Nvidia has achieved this market capitalization with Sales expected to be ~$59B and FCF expected to be ~$26B for the previous 12 months in the upcoming earnings release.

If we take the most basic framework that a stockholder is buying the value of a company's future Free Cash Flow *(FCF)*, then the current price of the stock can tell us how much growth is needed to justify the current valuation. Doing so does require some assumptions in the calculation, particularly in the discount rate that is used, which is why valuing companies is so difficult. The following valuation methodology is overly simplified and is NOT a comprehensive price target. It is merely meant to illustrate the type of growth that is currently priced into Nvidia's valuation:

- Let's assume that Nvidia continues its parabolic growth for the next 10 years, at which time it will continue to grow FCF at a rate that is 50% higher than GDP *(long-term average is ~3%)* in perpetuity.

- Now we need a discount rate, which for Nvidia's Equity Valuation is the "Cost of Equity." We can estimate Nvidia's "Cost of Equity" using the Capital Asset Pricing Model *(CAPM)*. CAPM requires the stock's Beta, a Risk-Free rate, and a market rate of return.

- Nvidia's annual Beta to the S&P over the past 10 years has been 4x, and in the longer-term it has been 2x, so we will use a Beta of 3x.

- Market expectations for a terminal Fed Funds rate is 3%, so that will be our Risk-Free rate.

- Historically the S&P has averaged ~8% per year, which will be our market return.

- All of this gives us a discount rate of 18%. But seeing as the discount rate can have a material impact on the valuation *(and opinions can vary)*, we will apply a discount rate of 13% to be generous.

- So, with all these assumptions, how much does Nvidia need to grow FCF over the next 10 years to justify a $726.13 stock price? We plug in all the inputs and solve for "g":
    - Stock Value = [(FCF*(1+**g**)^10) / (Cost of Equity – Terminal Growth Rate)] / ((1+Cost of Equity)^10)
    - $726.13 = [($10.47*(1+**g**)^10) / (13% – 4.5%)] / ((1.13^10)
    - **Solving for g gets us 34.9%, meaning that over the next 10 years FCF needs to grow by 20x *(annualized 34.9% growth)* to ~$518B. For context, $518B is more than the 2023 FCF generated by AAPL, MSFT, GOOGL, AMZN, & META combined *($326B).***

According to this VERY simplified valuation methodology with generous assumptions, Nvidia will need to maintain near monopolistic market share for the next 10 years[2], growing revenues to nearly $1T *(global semi-conductor sales were $574B in 2023)*[7], while maintaining net income margins of 50% or better *(Nvidia's*

Net Income margin has averaged ~25% over the last 10 years) to generate the FCF necessary to justify the current valuation.

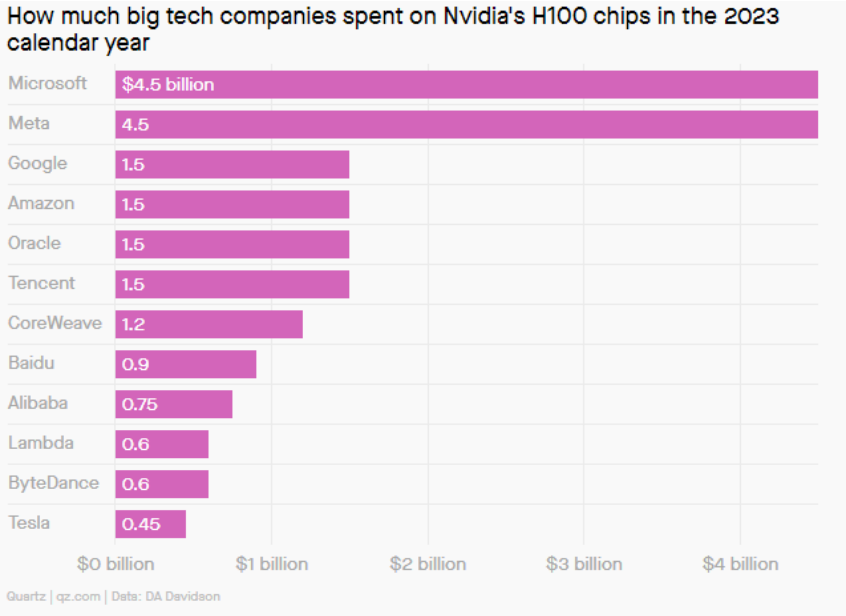
The table below compares select Nvidia financials to its $1T market cap peers:

	(Analyst Expected)						
In Millions	NVDA	Avg $1T US Stock	*MSFT*	*AAPL*	*AMZN*	*GOOGL*	*META*
Total Market Cap	$1,793,541	$2,042,474	*$2,964,068*	*$2,815,209*	*$1,760,765*	*$1,631,000*	*$1,041,327*
Revenue *(T12M)*	$59,314	$326,074	*$227,583*	*$385,706*	*$574,785*	*$307,394*	*$134,902*
Price/Sales	30.2	7.3	*13.0*	*7.3*	*3.1*	*5.3*	*7.7*
Net Income *(T12M)*	$30,874	$66,997	*$82,509*	*$100,913*	*$30,748*	*$75,769*	*$45,047*
Net Income Margin	52%	25%	*36%*	*26%*	*5%*	*25%*	*33%*
Free Cash Flow *(T12M)*	$25,857	$63,975	*$67,445*	*$106,869*	*$32,217*	*$69,495*	*$43,847*

Source: Bloomberg (2/16/2024)

Who Are Nvidia's Biggest Customers?

Nvidia's October earnings report shows significant concentration among their largest customers, with 27% of their 9-month revenue coming from two separate "end customers"[3]. According to a report published by DA Davidson, Microsoft & Meta purchased $9B in H100 chips during 2023, with Google & Amazon purchasing a combined ~$3B[4].



Source: Quartz (1/30/2024); DA Davidson

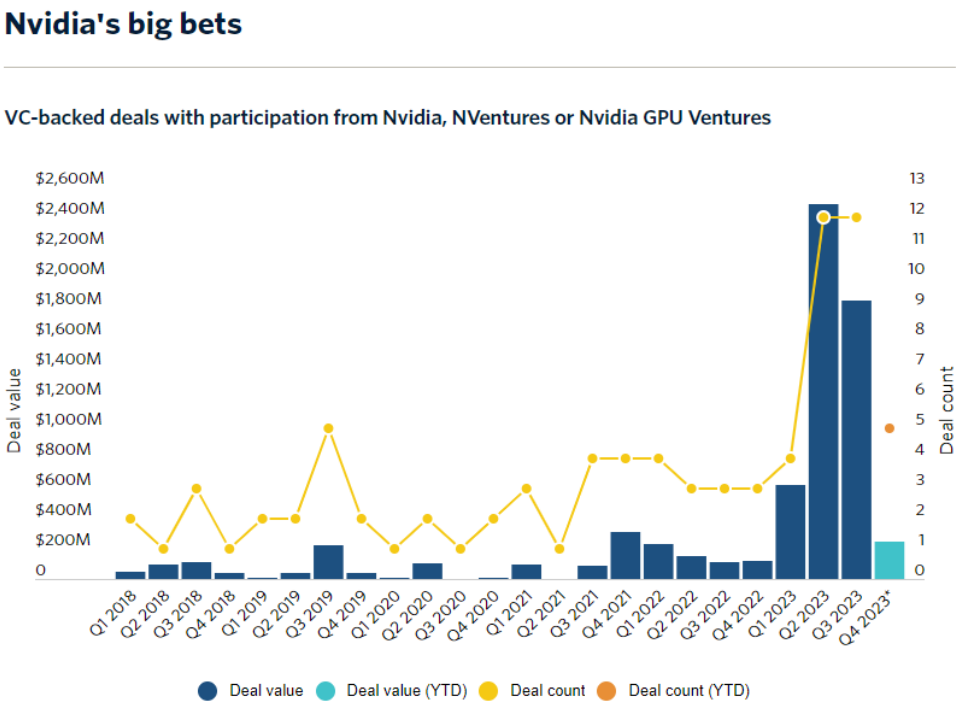
Using the figures from Nvidia's October earnings and DA Davidson's January report, it's fair to estimate that Microsoft, Meta, Google, & Amazon account for at least 1/3 of Nvidia's revenue *(and possibly more)* either directly, or as an end-customer. During 2023, each of these companies revealed their own AI chips that were in various stages of development.[4]

Microsoft unveiled two chips in November of last year *(Azure Maia AI Accelerator & Azure Cobalt CPU)* that will be rolled out in early 2024 for use in the company's data centers. Microsoft's VP of Cloud & AI said, *"At the scale we operate, it's important for us to optimize and integrate every layer of the infrastructure stack to maximize performance, diversify our supply chain and give customers infrastructure choice."*[5]

In the "AI arms race" there is a competitive advantage to be gained by reducing reliance on the common supplier, and Nvidia's largest clients are actively pursuing strategies to diversify away from Nvidia's GPUs. In addition to in-house solutions, innovation from Nvidia's current competitors *(such as AMD or Huawei)* remains a risk as well.[11]

As recently as October, the lead time on Nvidia's GPUs was 8-11 months, however, it has recently been reported that delivery times have been reduced to 3-4 months. Nvidia has worked to diversify its supply chain and existing partners *(such as TSMC)* have reportedly expanded their production capacities. However, the cause for the decreased lead time has yet to be disclosed, and it is possible *(though this is speculation)* that the US's export restrictions to China are beginning to weigh on demand.[11]

Nvidia Partially Financing "Organic Growth"



Source: Pitchbook (10/29/2023)

While the demand for AI is real, and Nvidia currently manufactures the best AI GPUs in the world, some portion of Nvidia's spectacular 2023 revenue growth can be attributed to the company's investment activity.

In 2022 Nvidia and its subsidiaries participated in 13 Venture Capital deals *(NVentures is Nvidia's Venture Investing arm)*, totaling ~$618M in deal value. Through the first 10 months of 2023, Nvidia participated in 33 deals, often as a lead investor, which have raised over $5.2B in Equity capital for the portfolio companies.[6] Each of these companies is involved in AI technology *(machine learning, SaaS, cloud computing, etc.)*, and each of these companies rely heavily on Nvidia GPUs, meaning that Nvidia is helping to finance the purchase of their own inventory. One such company backed by Nvidia *(as early as 2021)*, CoreWeave, has grown into one of Nvidia's largest customers *(purchased $1.1B of Nvidia GPUs in 2023 alone)* and raised $2.3B of debt financing in August 2023 that was secured by their Nvdia H100 GPUs.[9]

It is not uncommon for Venture backed firms to use hard assets as collateral for debt financing, but it is worth noting that the GPUs in question have a finite life, as the next generation of Nvidia GPUs *(GH200)*

will be coming to market in less than a year. While the transition will not be instantaneous, it does mean that the collateral backing the $2.3B in debt will materially depreciate in a relatively short period of time.

What does CoreWeave do?

CoreWeave provides access to their cloud computing infrastructure, which scales the processing power of Nvidia's GPUs. It can be less expensive for companies to lease the computational power of Nvidia's GPUs via CoreWeave's cloud infrastructure than to purchase and maintain the GPUs themselves. Even a company like Microsoft *(Nvidia's largest customer)* has looked to CoreWeave as a cost-effective source for flexible processing power.[15]

Why would a company need "flexible processing power?"

The earlier stages of AI development, known as "AI Training", require significantly more processing power than later stages, as the models search for complex relationships within massive data sets. The need for this much computational power eventually lessens over time, as AI models apply existing training to new data sets. As Tech companies race to build out their generative AI models *("AI Training")*, CoreWeave's cloud infrastructure can supply the short-term need for substantial computational power. Nvidia has also diverted chip delivery away from large enterprise customers *(like Microsoft, Amazon, etc.)* and toward CoreWeave *(and other Nvidia investments)*, which has also aided the demand for CoreWeave's cloud infrastructure.[8]

Why does this matter?

We will use CoreWeave as the extreme example of how Nvidia can finance seemingly organic revenue growth:

- Nvidia invests in CoreWeave -> CoreWeave uses capital to buy Nvidia GPUs to build data centers for cloud infrastructure
- Nvidia diverts GPU delivery to CoreWeave over potential competitors-> Increasing the near-term demand for CoreWeave's cloud infrastructure
- CoreWeave raises $2.3B in debt secured by Nvidia GPUs -> CoreWeave uses capital to purchase more Nvidia GPUs

Is this illegal? So far… No

It is not uncommon for corporations to invest in startups as part of their long-term strategy, but what it does call into question is the sustainability of Nvidia's rapid revenue growth. Venture firms and start-ups are risky investments with high cash burn rates and often launch with unsustainable business models. It is very likely that many of these companies' only hard assets are Nvidia GPUs. Capital raising is easy when the demand for AI is so new, however, as the competitive landscape begins to take form *(and some of these companies fail)*, the fresh capital that flowed so willingly into these upstart AI companies will eventually slow.

<u>The Dangers of Overpaying for Future Growth</u>

There is an adage that at the right price, any asset can be a good investment *(Powell[16])*, and at the wrong price, a great asset can be a bad investment. We are not the first to cite Cisco's run during the Tech Bubble as a potential analog for the current behavior of Nvidia's stock, but it is a helpful reminder of what happens when investors are overly optimistic about growth prospects of one innovative company.

The 16 months leading up to the Tech bubble crash in March 2000 provide an interesting comparison to Nvidia today:

Cisco	11/30/1998	3/27/2000	% Change
Market Capitalization *($M)*	$170,640	$551,631	223%
Share Price	$18.84	$80.06	325%
Revenue *($M)*	$7,298	$15,004	106%
Price/Sales	23.4	36.8	57%
Free Cash Flow *($M)*	$1,751	$4,598	163%

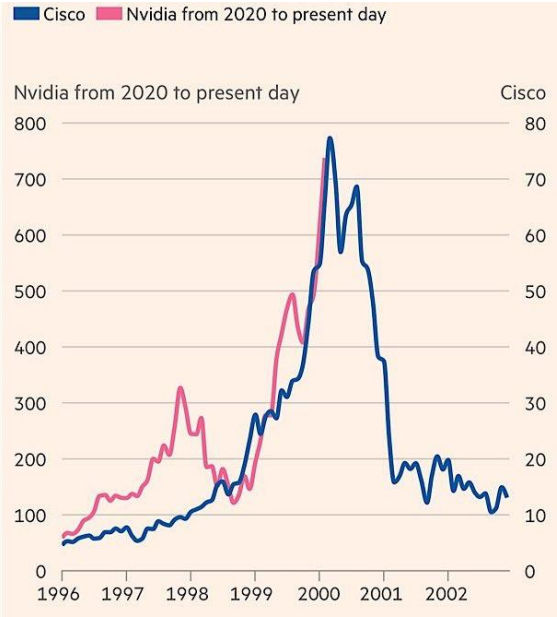
Source: Bloomberg (2/16/2024)

What Exactly Happened to Cisco?

In the late-90's Cisco's CEO John Chambers famously said that "the internet would change the way we work, live, learn and play." He was right in making this statement, and Cisco helped pioneer the internet that we use today. Cisco made the internet accessible to telecom companies and the public at large through routers and switches and was the only viable router company available at the time, granting it total market dominance. The demand was so significant that Cisco developed a "global, virtual outsourced supply chain" to decrease the lead time in delivering its products. Cisco's models did not account for the possibility of decreasing demand, which came in the form of slumping telecom companies in 2000 & 2001. Cisco eventually wrote off $2.2B in inventory, and the stock fell to $8.60 per share by October 2002 *(a fall of -89%).*[12; 13; 14]

Cisco currently trades at $48.44 per share and has never recovered its peak on March 27, 2000.

But in a way, investors were right to be bullish on Cisco. Since its peak in March of 2000, Revenue has grown to $57B, and Free Cash Flow has grown to $13.6B. Cisco is a good company, with growing and stable earnings. The myopic growth expectations at the time, however, were entirely too optimistic, and investors who bought in at the height of the frenzy have never recovered.[16]



Source: Financial Times (2/14/2024); LSEG[10]

Sources

[1]Randewich, Noel *(February 20, 2024)*. "Nvidia Dethrones Tesla as Wall Street's Most Traded Stock". Reuters. https://www.reuters.com/technology/nvidia-dethrones-tesla-wall-streets-most-traded-stock-2024-02-20/

[2]McCrum, Dan *(February 16, 2024)*. "Nvidia is Nuts, When's the Crash?". Financial Times. Nvidia is nuts, when's the crash? (ft.com)

[3]NVIDIA Corporation - Form 10-Q For the Quarterly Period Ended October 29, 2023. https://investor.nvidia.com/financial-info/quarterly-results/default.aspx

[4]Cheng, Michelle *(January 30, 2024)*. "Nvidia's Biggest Customers are Also the AI Chip Maker's Biggest Threat". Quartz. https://qz.com/nvidia-generative-ai-google-microsoft-meta-1851206854

[5]Cheng, Michelle *(November 16, 2023)*. "Microsoft is Making its own AI Chip So It's Less Dependent on Nvidia". Quartz. https://qz.com/nvidia-generative-ai-google-microsoft-meta-1851206854

[6]Bradbury, Rosie *(October 29, 2023)*. "Nvidia Bets on Next-Gen Chips Manufacturing in its VC Spending Spree". Pitchbook. https://pitchbook.com/news/articles/nvidia-nventures-semiconductors-ai-manufacturing-seurat

[7]Semiconductor Industry Association *(February 5, 2024)*. "Global Semiconductor Sales Decrease 8.2% in 2023; Market Rebound Late in Year". Semiconductor Industry Association. https://www.semiconductors.org/global-semiconductor-sales-decrease-8-2-in-2023-market-rebounds-late-in-year/

[8]The Mad King *(September 10, 2023)*. "Nvidia – Don't believe the Hype". Macro Instincts FZCO. NVIDIA - Don't Believe The Hype - The Mad King

[9]Hu, Krystal *(August 3, 2023)*. "CoreWeave Raises $2.3B in Debt Collateralized by Nvidia Chips". Reuters. https://www.reuters.com/technology/coreweave-raises-23-billion-debt-collateralized-by-nvidia-chips-2023-08-03/

[10]Yoon, June *(February 14, 2024)*. "AI Hype Has Echoes of the Telecoms Boom and Bust". Financial Times. AI hype has echoes of the telecoms boom and bust

[11]Zuhair, Muhamad *(February 18, 2024)*. "Nvidia Drastically Reduces Delivery Times of Its AI GPUs As Supply Chain Witnesses Improvement". Wccftech. https://wccftech.com/nvidia-drastically-reduces-delivery-times-of-its-ai-gpus-as-supply-chain-witnesses-improvement/#:~:text=The%20news%20comes%20from%20UBS,hasn't%20been%20disclosed%20yet.

[12]Kerravala, Zeus *(December 4, 2014)*. "30 Years of Cisco: The Networking Giant's Boldest Predictions Over the Years". Network World. https://www.networkworld.com/article/933314/30-years-of-cisco-the-networking-giants-boldest-predictions-over-the-years.html

[13]Berinato, Scott *(August 1, 2001)*. "What Went Wrong at Cisco in 2001". CIO. https://www.cio.com/article/266552/it-organization-what-went-wrong-at-cisco-in-2001.html'

[14]Lakenan, Bill; Boyd, Darren; Frey, Ed *(July 1, 2001)*. "Why Cisco Fell: Outsourcing and Its Perils". Booz & Company. Sourced from Business.com. https://www.strategy-business.com/article/19984

[15]Novet, Jordan *(June 1, 2023)*. "Microsoft Signs Deal for A.I. Computing Power With Nvidia-Backed CoreWeave That Could Be Worth Billions". CNBC. Microsoft inks deal with CoreWeave to meet OpenAI cloud demand (cnbc.com)

[16]Powell, Jamie *(March 8, 2021)*. "Investors Should Not Dismiss Cisco's Dot Com Collapes as a Historical Anomoly". Financial Times. https://www.ft.com/content/81a03045-86f7-4e57-afbd-5ff83679615f