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RESEARCH

# Fall 2023 Technology Outlook: Semiconductors



# Contents

## Semiconductors Overview

Industry Overview	5
CHIPS and Science Act	6
Industry Projections	7
Industry Structure	8
Industry Headwinds	9
Industry Tailwinds	10
M&A Activity	11
IPO Activity	12
Notable Deals	13

# Contents

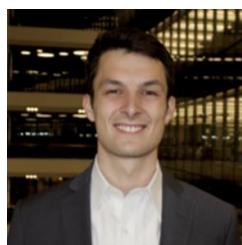
## Comparable Companies

Peer Universe	15
Profitability and Growth	16
Valuation and Growth	17
Liquidity and Leverage	18
Valuation Ratios	19

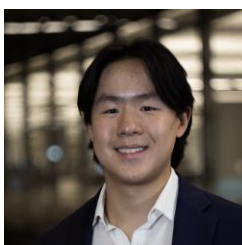
## Initiating Coverage

Nvidia Pitch	21
Qualcomm Pitch	22
Valuation Breakdown	23
Team Outlook	24

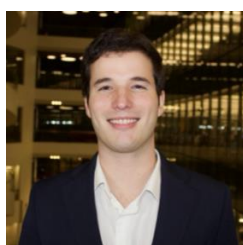
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# Semiconductors Overview





# Industry Overview

## General Overview

In the financial year to date, the NASDAQ-100 Technology Sector Index has grown 51.2% with a current index market cap of \$3.98 billion. The global technology sector has a total market cap of \$23.87 trillion, with industry leaders Apple (AAPL), Microsoft (MSFT), and Alphabet (GOOG) totaling earnings of over \$280 billion YTD. This sector is comprised of companies that provide information technology (IT) consulting, software/hardware development, and systems integration for large corporations. Within this sector reside various industry verticals ranging from companies that focus on hardware manufacturing to IT service providers who assist in software integration and information optimization. As of 2023, 29% of the companies listed on the S&P 500 belong to the IT Sector, representing the majority share of the index. Of this 29%, Software & Services encompass 12%, followed by Hardware & Equipment occupying 9%, and finally Semiconductors & Semiconductor Equipment at 8%. In this report, our team will focus on the semiconductor sector of the IT industry which engages in the design and fabrication of semiconductor hardware including semiconductor devices, transistors, and integrated circuits.

Over the last 3 years, the semiconductor industry has experienced a shortage caused largely by the Covid-19 virus and its detrimental impact on global supply and demand. Rising inflation rates and macroeconomic instability have prolonged a rebound from this shortage and destabilized projected industry progress in 2023. In 2022, global semiconductor industry sales reached an all-time high of \$574.1 billion (about \$1,800 per person in the US), an increase of 3.3% in comparison to 2021 with a total of \$555.9 billion (about \$1,700 per person in the US). With that said, sales slowed during the second half of 2022 with fourth quarter sales amounting to \$130.8 billion (about \$400 per person in the US), 14.3% less than fourth quarter sales in 2021. The short-term volatility of the semiconductor industry is caused by market cyclicalities and geopolitical turmoil, but the long-term outlook for semiconductors is increasingly strong as semiconductors are only growing in their vitality and applicability in countless other industries.

### XLK VS S&P 500 5 Year Monthly Returns



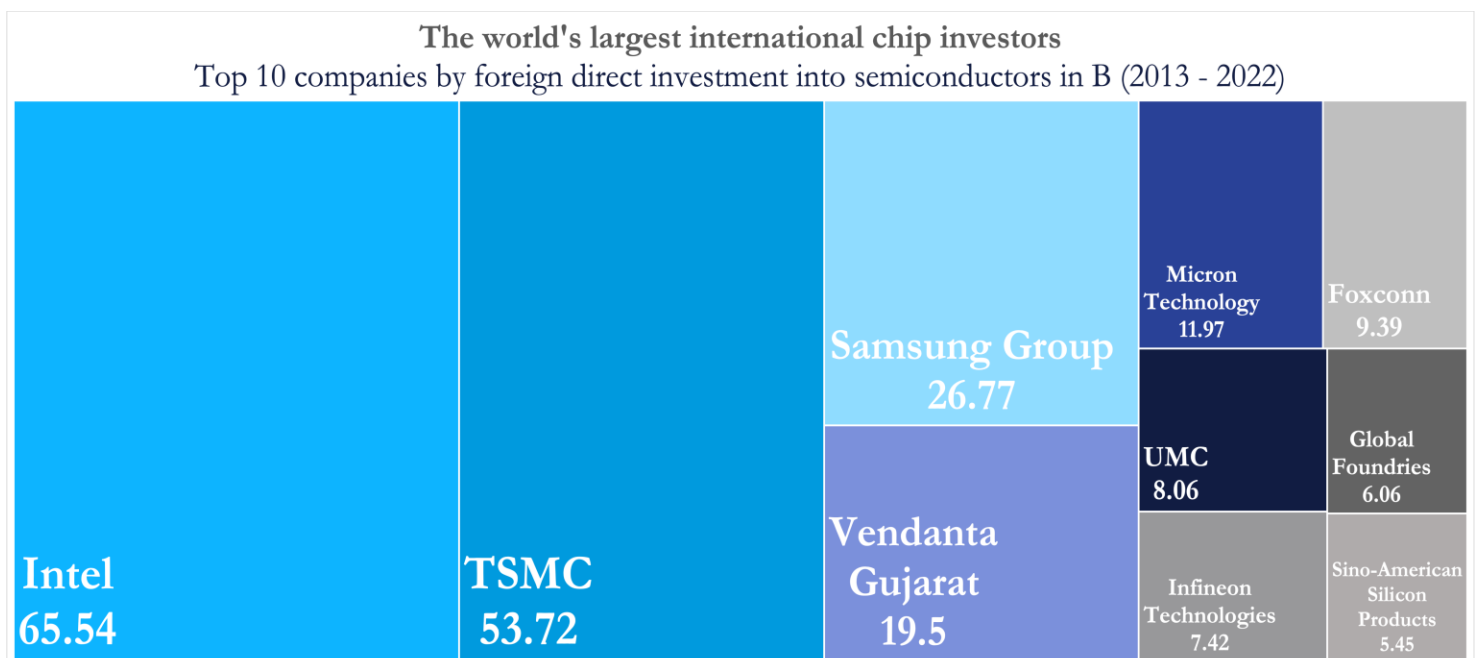
# CHIPS and Science Act

## CHIPS Act Overview

Semiconductor chips were invented in the US in 1874, yet today, the US produces under 10% of the global chip supply. In August 2022, President Biden passed the US CHIPS and Science Act to re-shore microchip manufacturing granting roughly \$53 billion to funding domestic research, manufacturing, and talent for semiconductor chips in the US. Additionally, this law incentivized investors by enabling a 25% tax credit for investments in US semiconductor manufacturing. Since the CHIPS Act's signing, the Semiconductor industry has been re-energized with investments. These investments have increased semiconductor production capabilities, allowing chip manufacturers to produce larger quantities bolstering the technology sector entirely. Funds allocated towards research and development have also aided STEM programs at various universities in efforts to shrink the US talent shortage within the industry. It has been 1 year since the institution of the CHIPS Act, and as US companies pour billions into domesticating chip manufacturing, long term outlook for the industry remains exceptionally strong.

## 1 Year Aftermath

August of 2023 marked the 1-year anniversary of the US CHIPS and Science Act. Since 2022, US companies have declared over \$165 billion in investments towards semiconductors. These investments have been allocated towards supporting US semiconductor manufacturing, protecting national security, and creating a stabilized chip workforce pipeline. The Department of Commerce has experienced an abrupt increase in interest towards microchips with more than 460 statements of interest for increased CHIPS funding from US companies across 42 states. As for closing the talent gap, there has been a stark increase in semiconductor interest from college students. According to Handshake, student applications to full-time positions posted by Semiconductor companies increased by 79% from 2022 – 2023, compared to only 19% from other industries. In addition, roughly 50 US community colleges in 19 states have announced expanded or entirely new programs to educate a larger US semiconductor talent pool in 2023. With more funding comes more opportunity, and as the Biden administration continues to support US chip manufacturing, the semiconductor industry will have no choice but to grow.



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## The World's Largest International Chip Investors

Top 10 Companies by Foreign Direct Investment Into Semiconductors in 2013 - 2022 (in \$B)



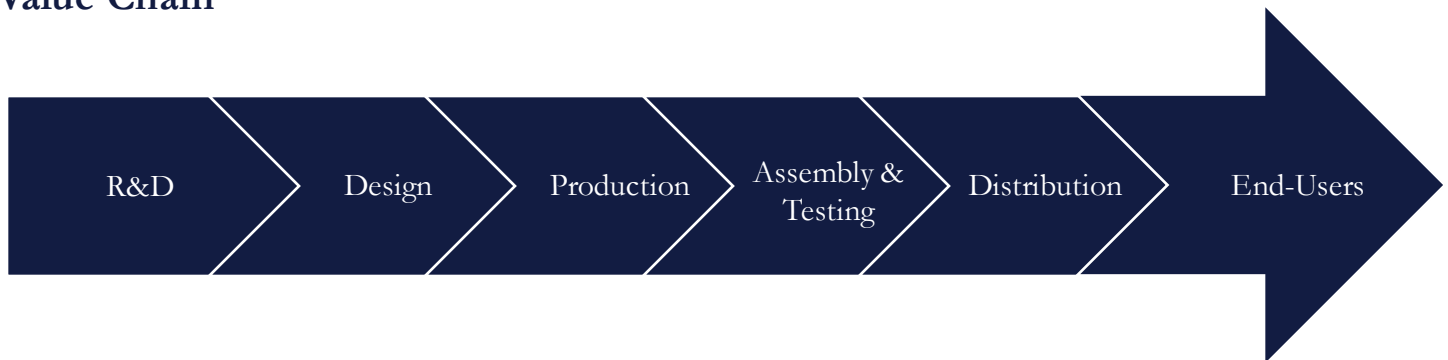
# Industry Structure

## Types of Players

There are four main types of companies in the semiconductor industry:

1. **Fabless:** designs semiconductor products but does not manufacture them. They outsource production to specialized foundries, allowing them to focus on innovation and research while reducing manufacturing costs.
2. **Foundry/fab:** a semiconductor manufacturing facility that produces integrated circuits for various clients. Foundries offer cost-effective, advanced manufacturing services and technology expertise.
3. **OSAT:** an Outsourced Semiconductor Assembly and Test company, specializes in packaging, testing, and sometimes assembly of ICs. They provide solutions for semiconductor manufacturers.
4. **Integrated Device Manufacturers (IDMs):** companies that design, manufacture, and sell their own semiconductor products. They handle all aspects, from design to fabrication, in-house, offering end-to-end control.

## Value Chain



The semiconductor value chain consists of six distinct phases that collectively bring semiconductor products to market. It begins with Research and Development (R&D), where innovative concepts and technologies are explored and developed. It is one of the most research-intensive industries, with around 15-20% of revenue. Following R&D, the Design phase translates these ideas into detailed semiconductor product designs. In the Production phase, specialized manufacturing facilities known as foundries or fabs take these designs and produce the physical semiconductor chips in bulk. After production, Assembly & Testing facilities (OSATs) handle packaging, assembly, and quality control to prepare the chips for use. The final phase is Distribution, where finished products are distributed to customers and end-users. Each phase in the semiconductor value chain plays a critical role in ensuring the successful development and delivery of semiconductor products to the market.

Due to the complexity that is making semiconductors, many companies opt to focus on one exclusive section of the value chain to try and differentiate, thus bringing in competitive advantage. Firms attempt to differentiate in a variety of ways, such as Micron (fabless), who focuses solely on designing NAND and DRAM memory chips. On the manufacturing side of things, the industry is extremely concentrated, with the top three foundries accounting for 78% of the global market in 2020. This is in part due to the extremely high CAPEX requirement. For example, in 2019 TSMC's CAPEX was US \$15 billion, which is over 26 times larger than of the fourth largest foundry, Global Foundries.



# Industry Projections

## General Projections

In recent years, the global landscape witnessed the conjuring and prolongation of significant geopolitical conflicts, most notably the Israel-Hamas and Ukraine-Russia wars. This coupled with the escalating trade tensions between the United States and China have catalyzed disruptions in the global supply chain, particularly impacting the technology sector and resulting in acute shortages of critical components. Critically, the semiconductor industry experienced a decline in revenues in 2023. However, there is a promising trajectory for a robust recovery and sustained growth in the coming years. This resurgence is underpinned by advancements in chip production rates and increased investments in reshoring initiatives, bolstering domestic infrastructure, and workforces.

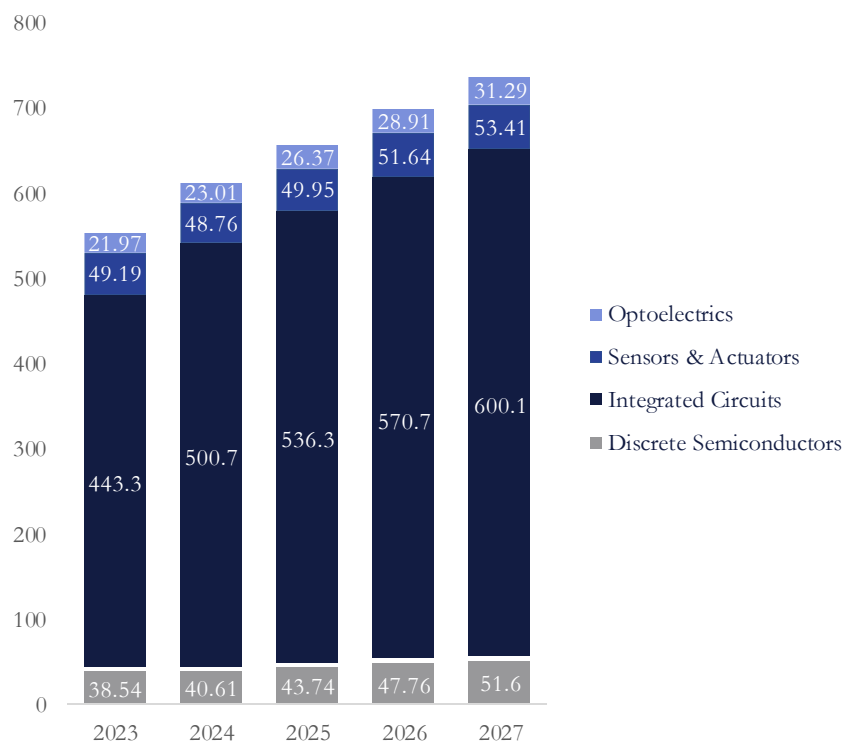
Significant concerns arising from the U.S.-China conflict are prompting companies to conduct internal reassessments, leading to decisions to re-shore their operations. Anticipated consequences include a projected 62% increase in capital expenditure (CAPEX) costs within the semiconductor industry in the next year, as highlighted by KPMG. This shift is expected to generate a 71% increase in companies' workforces, fostering greater employment opportunities. Concurrently, the move towards domestic production and investments in talent acquisition is forecasted to drive a 75% surge in research and development (R&D) spending, fostering economic growth and sectoral advancement.

This trend of repositioning workforces closer to home is also poised to yield tangible benefits in terms of lead times. In October 2022, lead times averaged 25.5 weeks, surpassing the normal range of 10-14 weeks. Reshoring efforts are expected to further decrease these lead times, improving operational efficiencies and agility in the industry.

Crucially, these industry shifts project a CAGR of 7.42% for the semiconductor industry. Revenues are anticipated to climb from \$553 billion to \$776.40 billion. This growth is particularly attributed to an increased emphasis on the production of discrete semiconductors, with volumes rising from 529 billion units in 2023 to 645.90 billion in 2027. Integrated circuits are also anticipated to witness a surge in volume, escalating from 406.30 billion units to 508.10 billion units in 2027. These trends underscore a sector-wide pivot towards more autonomous and high-tech semiconductor manufacturing, steering away from traditional sensors and actuators.

In the realm of market dynamics, the Asia Pacific region currently commands the largest market share for semiconductors, with over 90% dominance and a substantial concentration of over 60% in Taiwan alone. However, with the ongoing shifts towards reshoring, friend-shoring, and strategic technological advancements, it is envisaged that North America and progressively Europe will secure a significant foothold in the semiconductor market, heralding substantial changes in market share distribution.

Revenue By Segment (in billions USD)



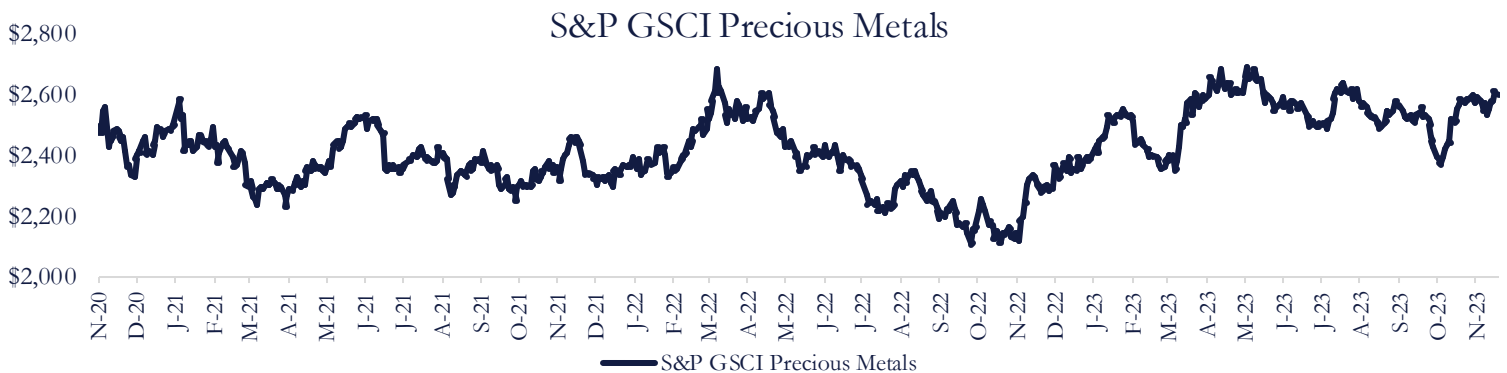
# Industry Headwinds

## Talent Shortages in Localized Manufacturing

The number one issue semiconductor companies are facing today is a widespread talent shortage. In 2021, 80% of chips were manufactured in East Asia, as they possess a skilled enough workforce to meet global demand nearly exclusively. The race between nations to localize chip manufacturing is increasing demand for semiconductor talent in regions that do not yet possess the workforce. Deloitte estimates that the semiconductor workforce, possessing 2 million workers in 2021, would need to grow by an additional 1 million skilled laborers to satisfy market growth by 2030. To foster new talent, chip companies are looking to expedite hiring for multi-skilled workers while investing in the onsite development of existing talent. US and European companies are also looking to enhance the flexibility of talent immigration laws to easily relocate skilled workers.

## Russia and Ukraine Driving Raw Material Price Volatility

In 2022, Russia was the global leader in palladium production with 88 metric tons, while Ukraine supplied 50% of the global supply of neon. These two raw materials are vital to the industry because neon is used in deep-ultraviolet lithography and palladium is used in plating applications, both of which are crucial steps in the manufacturing process. However, the war has led to raw material shortages and price volatility. S&P Global Market Intelligence recognizes the volatility in palladium and aluminum by illustrating dramatic price increases directly following the Russian invasion of Ukraine on February 24<sup>th</sup>, 2022. Palladium prices climbed to \$2,680 per ounce on February 24 from \$2,423 per ounce on February 23, and immediately dropped to \$2,320 per ounce the following day. As the war continues, raw material exports will remain unstable, and prices will be unpredictable.



## Israel and Hamas Congesting Supply Chains

Israel's influence on global chip manufacturing is overlooked in comparison to East Asian chip manufacturers. 8% of global chip designing talent resides in Israel, and this abundance of engineers has prompted a dramatic increase of Israeli technology startups. There are over 7,000 tech startups in Israel, making it the most concentrated region for tech startups and innovation globally. Israeli cities like Haifa and Kiryat Gat have been pivotal in supporting the technology industry, supplying a steady stream of skilled engineers and housing essential R&D outposts for industry leaders like Intel and NVIDIA. On October 7<sup>th</sup>, 2023, the Palestinian militant group, Hamas, launched an attack from the Gaza strip prompting an Israeli declaration of war. Rising geopolitical turmoil is forming a bottleneck in Israel, as fab facilities and raw material exporters struggle to navigate in war time. NVIDIA was forced to cancel its AI conference while also paying Israeli employees a war grant to support workers in times of conflict. As warfare persists, companies will continue to experience increased lead times as the Gaza blockade clogs exports.

# Industry Tailwinds

## Biden Promotes Competition with AI Executive Order

On October 30<sup>th</sup>, 2023, President Biden signed a landmark executive order regarding AI legislation., the first of its kind by the US government. While the increased regulations will harm AI developers, the semiconductor industry will benefit because the EO enforces the Secretary of Commerce to promote competition in the semiconductor industry specifically. To promote competition and innovation, Biden plans to fund commercial research and the development of new American semiconductor manufacturing facilities to create a fair and open AI ecosystem. This EO will allow manufacturers to utilize investment tax credits to lower costs and self-invest to remain innovative in the global market.

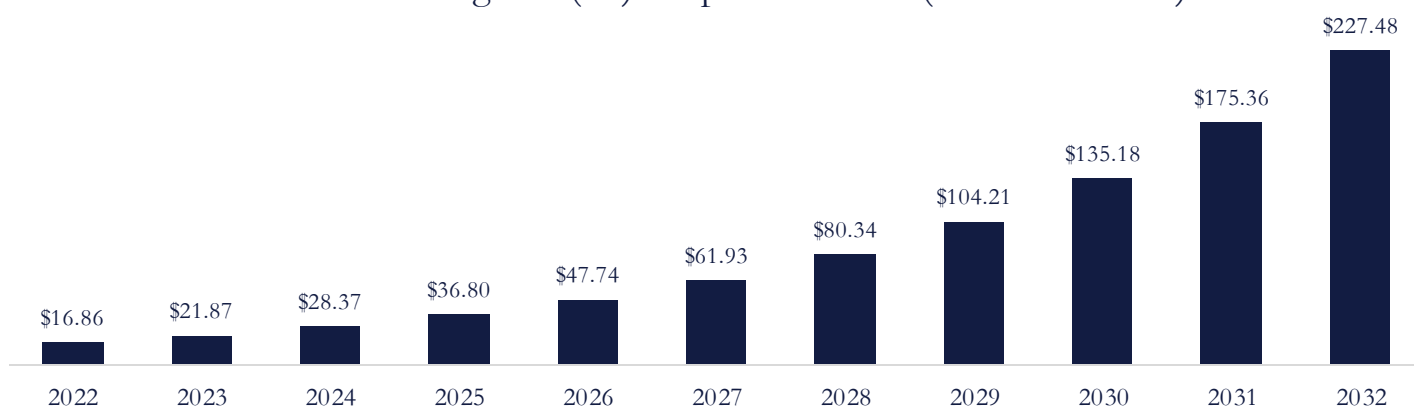
## Increasing Demand for Electric Vehicles

Products of the semiconductor industry allow electric vehicles (EV) to perform essential functions such as processing data in real time, connecting to external networks, and using high-speed chargers. The demand for EV's will grow due to their improved practicality and ability to replace traditional vehicles, along with increasing environmental concerns from governments and consumers. In turn, demand for semiconductors will grow due to the important role they play as an input in the production for EVs. For example, global spending on EV's exceeded \$425 billion in 2022, representing a 50% increase from 2021. In 2022, the market for EV's then saw global sales exceeding 10 million, and the International Energy Agency (IEA) projects sales of 14 million for 2023 and a 35% year-over-year increase.

## 5G & Cloud Computing

By 2025, the volume of global data is expected to increase 10x to 163 zettabytes; the rise of cloud computing and 5G networks will be essential to leveraging the benefits of all this information. As of 2022, the global cloud computing market was valued at \$483.98 billion with a projected CAGR of 14.1% from 2023 to 2030. The market for global 5G services exhibits even stronger projections with a CAGR of 59.4% from 2023 to 2030. As semiconductor-dependent industries, the growth of 5G and cloud computing will heavily increase demand for semiconductor products. After all, the successful deployment of a widespread, stable 5G network depends on high-functioning semiconductors to power a high-speed, low-latency communications infrastructure. On the other hand, cloud computing data centers are powered by energy-efficient chips that are also effective in processing the large and ever-increasing streams of information. As a result, the semiconductors industry finds itself at the forefront of technological innovation, with a very bright future ahead.

Artificial Intelligence (AI) Chip Market Size (in Billions USD)



# M&A Activity

\$8.2 Billion



Acquisition of



October 2023

\$1.5 Billion



Acquisition of



September 2023

\$1.3 Billion



Acquisition of



December 2022

\$5.66 Billion



Acquisition of



August 2022

\$5.74 Billion



Acquisition of



July 2022

\$35 Billion



Acquisition of



February 2022

# IPO Activity

**\$1.45 Billion**



**\$2.73 / Share**

May 2023

**\$1.59 Billion**



**\$4.95 / Share**

August 2022

**\$1.1 Billion**



**\$25.80 / Share**

January 2022

**\$2.59 Billion**



**\$47.00 / Share**

October 2021

**\$6.54 Billion**



**\$3.89 / Share**

July 2020

**\$5.25 Billion**



**\$34.08 / Share**

March 2020



# Notable Deals

## Onsemi Acquires Global Foundries' East Fishkill Plant

On December 31<sup>st</sup>, 2022, Onsemi announced its successful acquisition, for US\$ 1.3 billion, of GlobalFoundries' 300mm East Fishkill, New York fabrication plant. This transaction added more than a thousand skilled workers to Onsemi's team, along with taking the crown as the company's largest manufacturing fab. New York senator Schumer spoke on the ribbon cutting ceremony, announcing "we are bringing back manufacturing back to our country and strengthening our supply chains with investments like Onsemi's."

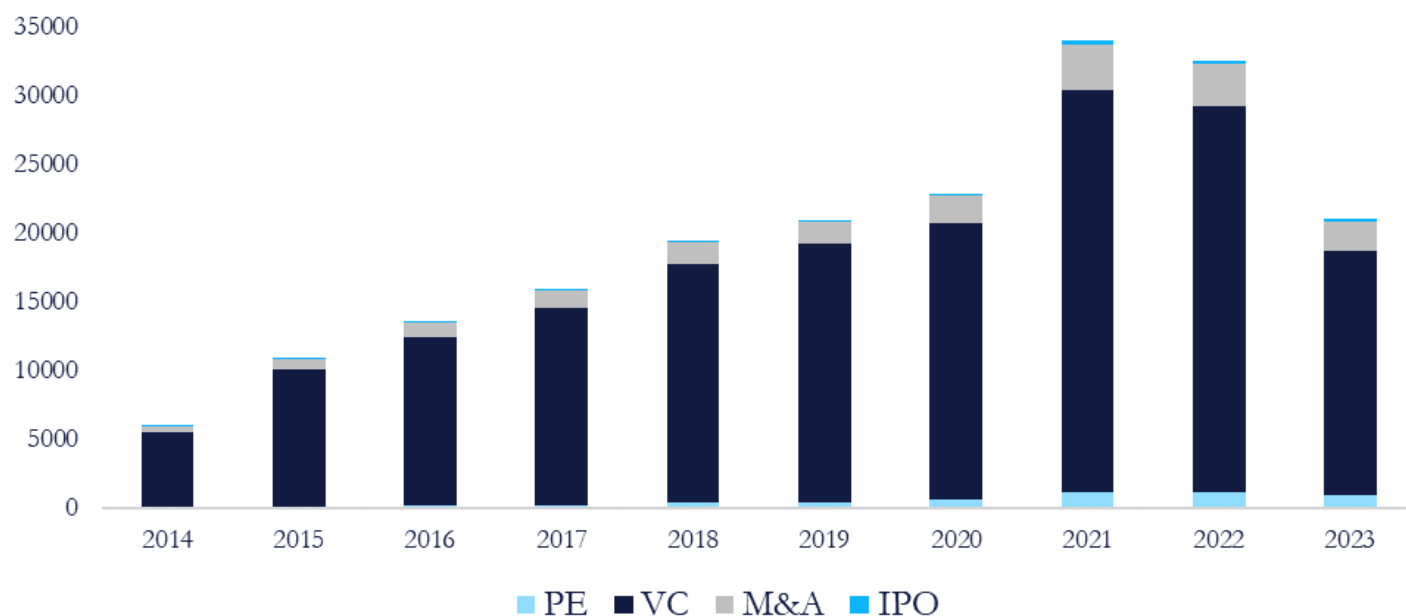
## AMD Acquires Silicon Valley Based Xilinx

On February 14<sup>th</sup>, 2022, AMD completed its acquisition of Xilinx in an all-stock transaction valued at \$35 billion. Xilinx stockholders received 1.7234 shares of AMD common stock and cash for fractional shares. This acquisition expands the combined Total Addressable Market (TAM) from \$80 billion to \$135 billion, making it an exciting development for shareholders. AMD's CEO, Dr. Lisa Su, is optimistic about the complementary nature of their products and technologies, which she believes makes this the largest and well-executed deal in semiconductor history.

## Nexchip Goes Public

On May 10<sup>th</sup>, 2023, Chinese foundry Nexchip went public, raising \$1.45 billion USD at \$2.75 per share. Nexchip is currently the third largest foundry in mainland China, behind only SMIC and Huahong Group. This IPO comes amidst increasing tensions in the US-China chip war and as China seeks to achieve self-sufficiency and decrease its dependence on foreign chipmakers. Nexchip focuses on the production of wafers, specializing in the 12-inch wafer business more specifically. On a global scale, Nexchip is also the ninth largest foundry in the world based on revenue.

## Deal Types in the Industry



The background of the slide is a dark blue, high-contrast image of a microchip or circuit board. The intricate patterns of the circuitry are visible, with a large, central square component that stands out. The overall aesthetic is technological and modern.

# Comparable Companies Analysis

# Peer Universe

Logo	Company	Ticker	Description	LTM Revenue (millions USD)
	Taiwan Semiconductor Manufacturing Company	TSMC	Leading semiconductor foundry, specializing in cutting-edge chip manufacturing technologies.	\$72,588
	Nvidia	NVDA	Global technology company known for its advanced graphics processing units (GPUs) and AI solutions.	\$32,681
	Intel Corp.	INTC	Multinational technology company known for its microprocessors and computing solutions.	\$52,864
	Qualcomm	QCOM	Prominent wireless technology leader pioneering advancements in mobile communications.	\$38,584
	Texas Instruments	TXN	Semiconductor company providing analog and embedded processing solutions.	\$18,112
	Broadcom	AVGO	Diversified technology company specializing in semiconductor and infrastructure software solutions.	\$35,454
	Advanced Micro Devices	AMD	High performance computing and technology with CPUs and GPUs.	\$21,876
	Applied Materials	AMAT	Provides materials engineering solutions for semiconductor and display manufacturing.	\$26,543
	Semiconductor Manufacturing Company	SMIC	Semiconductor foundry focusing on advanced chip production and services.	\$42,227

The selection of companies above provides a comprehensive representation of the semiconductor industry. This diverse group encompasses leading players across various segments, including manufacturing, design, and equipment supply. TSMC stands out as a global semiconductor manufacturing giant, while NVDA and AMD contribute expertise in graphics processing and CPUs, respectively. INTC and QCOM bring innovation in microprocessors and mobile technologies, while TXN is renowned for its analog and embedded processing solutions. AVGO offers infrastructure software solutions, and AMAT specializes in equipment. SMIC provides insight into the influence of Asian markets. These companies create a well-rounded comparable set, offering a holistic view of the industry's technological prowess, market reach, and diverse product portfolios.

# Profitability and Growth

(in millions USD)

Company	Revenue	EBITDA	Net Income	Total Assets	Total SH Equity	Profitability Ratios			Growth		
						EBITDA / Revenue	ROA	ROE	1 Year Revenue	3 Year Revenue	5 Year Revenue
TSMC	72,588	49,613	31,385	165,326	102,913	68%	19%	30%	42.6%	28.4%	18.3%
NVDA	32,681	16,155	13,072	49,555	27,501	49%	26%	48%	0.2%	35.2%	22.7%
INTC	52,864	13,063	2,508	188,837	105,686	25%	1%	2%	-20.2%	-4.3%	0.1%
QCOM	38,584	14,873	10,775	49,002	20,670	39%	22%	52%	-19.0%	15.0%	9.5%
TXN	18,112	9,563	7,052	31,638	16,631	53%	22%	42%	9.2%	11.7%	6.0%
AVGO	35,454	22,787	18,064	71,595	22,079	64%	25%	82%	21.0%	13.7%	13.5%
AMD	21,876	5,516	4,126	67,967	55,136	25%	6%	7%	43.6%	51.9%	34.7%
AMAT	26,543	8,384	6,757	30,410	15,093	32%	22%	45%	11.4%	20.7%	12.1%
SMIC	6,551	999	1,169	45,844	29,986	15%	3%	4%	-	-	-
<b>Lower</b>	19,994	6,950	3,317	38,741	18,651	25%	4%	6%	-14%	12%	7%
<b>Median</b>	32,681	13,063	7,052	49,555	27,501	39%	22%	42%	10%	18%	13%
<b>Mean</b>	33,917	15,661	10,545	77,797	43,966	41%	16%	35%	11%	22%	15%
<b>Upper</b>	45,724	19,471	15,568	118,461	79,025	59%	24%	50%	37%	34%	22%

TSMC and AVGO show outstanding performance with EBITDA margins close to 70%. TXN and NVDA follow close behind while INTC and AMD are clear laggards. NVDA shows promise in efficiency and profitability through similar ROA and ROE. AVGO is the clear outperformer in term of profitability metrics. The trailing growth of each company is shown for the past 5, 3, and 1 year. TSMC and AVGO are clearly accelerating, while NVDA had a stark drop off with no growth from 2022 to 2023. AMD, AMAT, and TXN accelerated from the past 5 years to 3 years but are experiencing a slow down since then. INTC and QCOM lost considerable market share in the past year. INTC has consistently had lower revenue each year in the past 5 years.

## Growth Rates

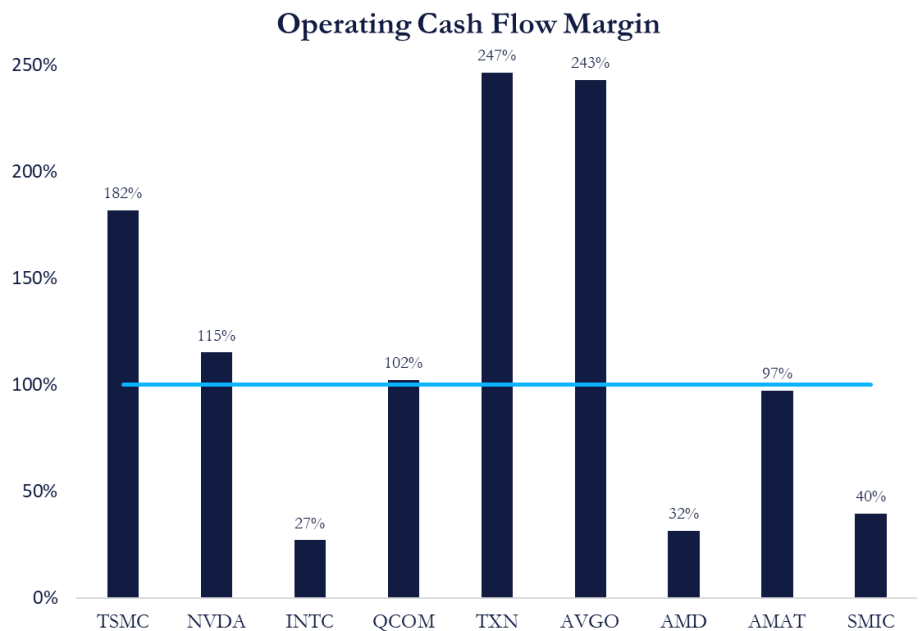


# Liquidity and Leverage

(in millions USD)

Company	Operating Cash Flow	Current Assets	Total Assets	Current Liabilities	Total Liabilities	Liquidity			Leverage		
						Current Ratio	Operating Cash Flow	Cash Position	Debt / Equity	Debt / Assets	Debt Ratio
TSMC	47,305	62,926	165,326	26,032	62,413	242%	182%	29%	0.29x	0.18x	0.38x
NVDA	11,899	28,797	49,555	10,334	22,054	279%	115%	32%	0.35x	0.22x	0.45x
INTC	7,757	43,811	188,837	28,614	83,151	153%	27%	13%	0.44x	0.26x	0.44x
QCOM	8,655	20,476	49,002	8,463	28,332	242%	102%	18%	0.70x	0.32x	0.58x
TXN	6,538	15,097	31,638	2,652	15,007	569%	247%	28%	0.66x	0.35x	0.47x
AVGO	17,840	18,333	71,595	7,345	49,516	250%	243%	17%	1.73x	0.55x	0.69x
AMD	2,397	16,505	67,967	7,572	12,831	218%	32%	9%	0.04x	0.04x	0.19x
AMAT	8,002	18,879	30,410	8,224	15,317	230%	97%	21%	0.38x	0.20x	0.50x
SMIC	3,230	16,185	45,844	8,148	15,858	199%	40%	27%	0.24x	0.21x	0.35x
Lower	4,884	16,345	38,741	7,459	15,162	208%	36%	15%	0.27x	0.19x	0.36x
Median	8,002	18,879	49,555	8,224	22,054	242%	102%	21%	0.38x	0.22x	0.45x
Mean	12,625	26,779	77,797	11,932	33,831	264%	120%	22%	0.54x	0.26x	0.45x
Upper	14,870	36,304	118,461	18,183	55,965	264%	212%	29%	0.68x	0.34x	0.54x

The current ratios of all the companies show that each has strong liquidity well above 100%. TXN and AVGO stand out with high operating cash flow margin at nearly 250%. TXN, NVDA, and TSMC also show strong financial stability relative to their peers demonstrated by the cash position ratio. TSMC is the outperformer in terms of liquidity with leading current ratio, operating cash flow margin, and cash position. AMD has low leverage and is the apparent leader with the lowest D/E, D/A, and Debt Ratio of 0.04x, 0.04x, and 0.19x, respectively. TSMC follows close behind with considerably low leverage. AVGO has the highest leverage across the three categories. NVDA, INTC, AMAT, and SMIC remain close to the median for all three metrics.





# Valuation Ratios

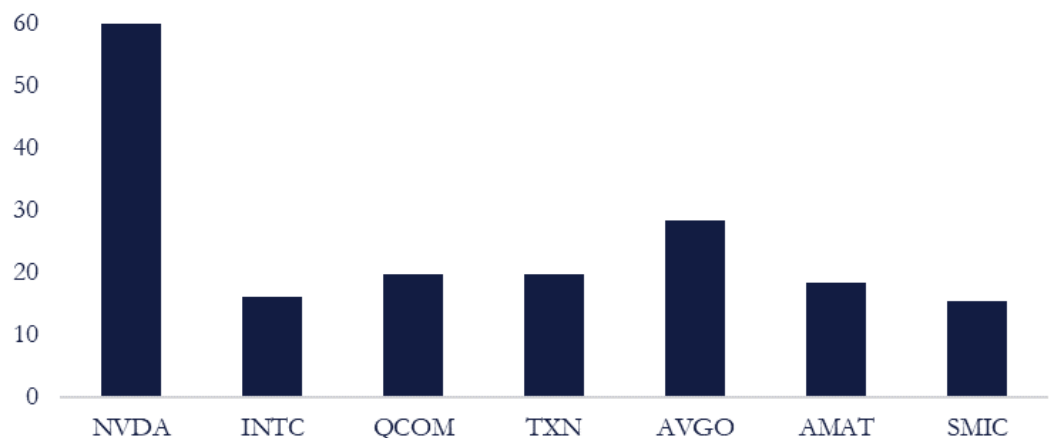
(in millions USD)

Company	Market Cap	Enterprise Value	Financial Data (LTM)				Valuation			
			Sales	EBITDA	EBIT	EPS	EV/Sales	EV/EBITDA	EV/EBIT	P/E
TSMC	425,940	408,198	72,588	49,613	35,045	\$1.21	5.62x	8.23x	11.65x	-
NVDA	1,007,266	1,002,197	32,681	16,155	14,574	\$4.14	30.67x	62.04x	68.77x	61.73x
INTC	153,884	181,606	52,864	13,063	2,687	-\$0.39	3.44x	13.90x	67.59x	16.00x
QCOM	121,644	128,457	38,584	14,873	13,036	\$9.53	3.33x	8.64x	9.85x	19.80x
TXN	127,602	131,248	18,112	9,563	8,399	\$7.72	7.25x	13.72x	15.63x	19.67x
AVGO	347,214	374,553	35,454	22,787	22,192	\$32.49	10.56x	16.44x	16.88x	28.49x
AMD	155,395	155,719	21,876	5,516	4,766	-\$0.04	7.12x	28.23x	32.67x	1111.11x
AMAT	109,611	110,246	26,543	8,384	7,876	\$7.58	4.15x	13.15x	14.00x	18.48x
SMIC	269,605	42,227	6,551	999	999	\$0.19	6.45x	42.27x	42.27x	15.36x
Lower	124,623	119,352	19,994	6,950	3,727	\$0.08	3.79x	10.89x	12.82x	16.62x
Median	155,395	155,719	32,681	13,063	8,399	\$4.14	6.45x	13.90x	16.88x	19.74x
Mean	302,018	281,606	33,917	15,661	12,175	\$6.94	8.73x	22.96x	31.03x	161.33x
Upper	386,577	391,376	45,724	19,471	18,383	\$8.63	8.91x	35.25x	54.93x	53.42x

The market cap and enterprise value are indicators of a company's value. Enterprise value, encompassing debt obligations, provides a more comprehensive assessment. NVDA stands out with 10x higher than the median in both market cap and EV. It is considerably overvalued, evident in its elevated ratios in EV/Sales, EV/EBITDA, and EV/EBIT at 30.67x, 62.04x, and 68.77x. NVDA, AVGO, and AMAT exhibit more consistent EV/EBITDA and EV/EBIT ratios, attributed to their outsourcing of chip production, unlike INTC, which manufactures in-house. Given the diversity in valuation metrics from expense variations among the companies, focusing on a single metric, such as EV/Sales, provides clarity. NVDA emerges as notably overvalued, surpassing its competitors by more than 5x the median in EV/Sales. AVGO, while also overvalued, does not exhibit the same degree of overvaluation as NVDA. On the contrary, INTC, QCOM, and AMAT are positioned at the lower end of the spectrum in terms of valuation.

## P/E Ratio

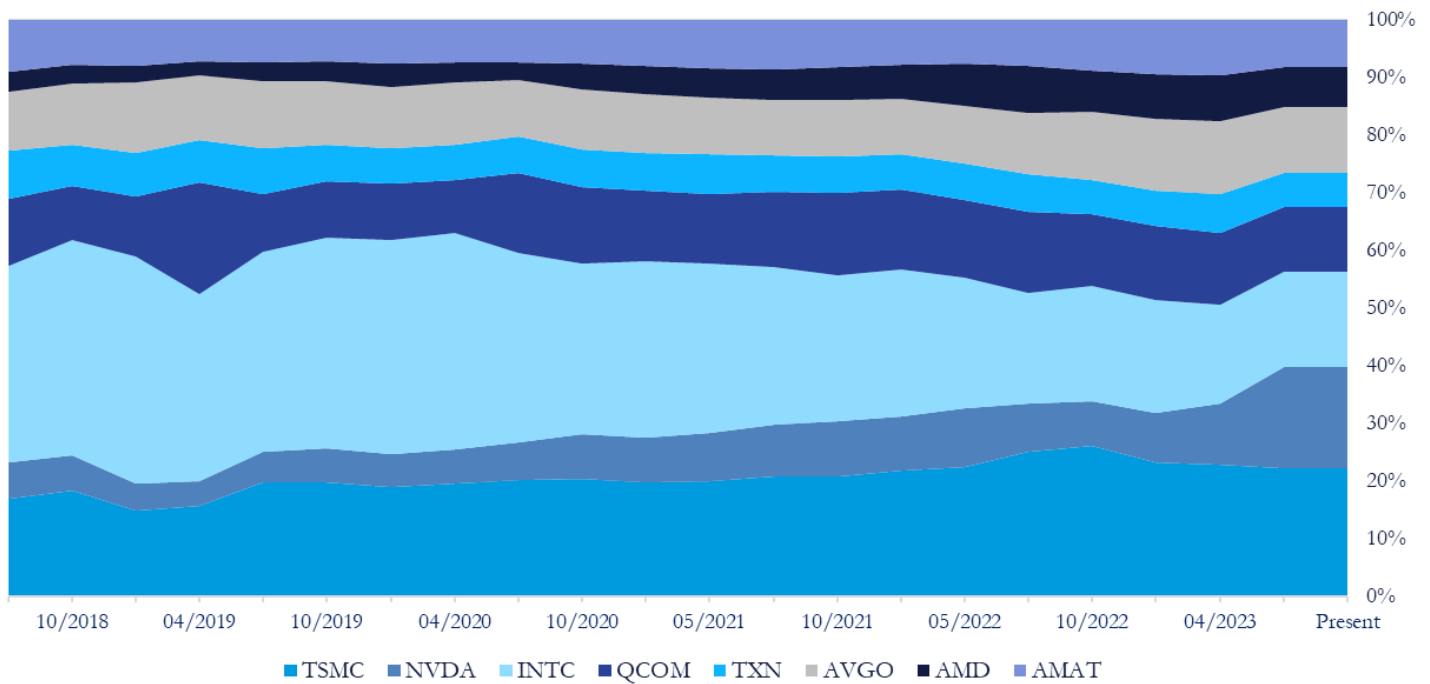
Looking at the P/E ratios, AMD stands out with an astonishing 1111x. NVDA maintains its inflated value at 61.73x. In contrast, INTC, QCOM, TXN, AMAT, and SMIC cluster close together within 15-20x. Note, TSMC did not have adequate data, and AMD is excluded from the chart.



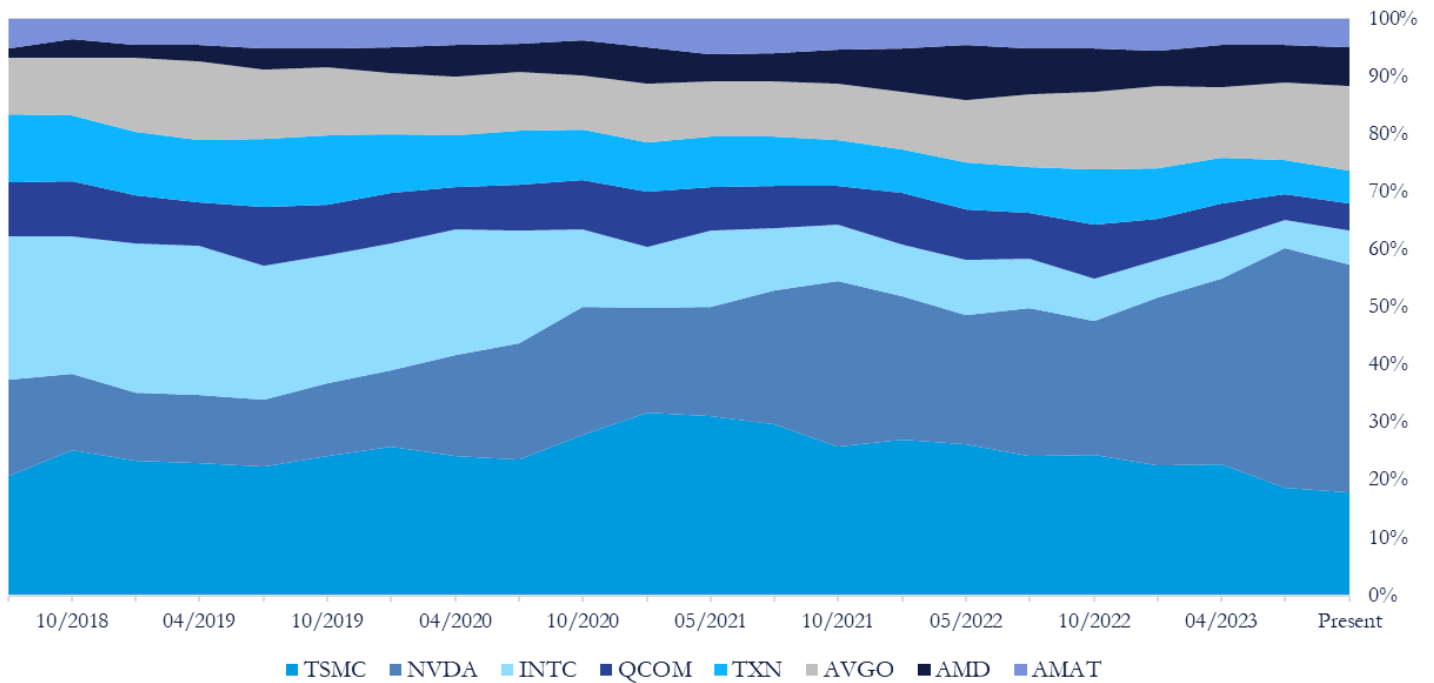
\*Share Price and P/E data from November 27, 2023. Rest of the data from early November, 2023.

# Valuation and Growth

## Revenue



## Market Capitalization



The two charts show the revenue and market cap of the comparable set, summed to 100, to show their positions relative to each other. NVDA has gained significant market share, but it greatly overvalued. INTC and QCOM are both shrinking but are undervalued. TSMC has maintained a steady position but its perceived value seems to be shrinking. This analysis is inconclusive as a growth investor will more than likely invest in NVDA due to the high demand for their chips, but a value investor will opt to keep their position in TSMC for long term value.

# Initiating Coverage

The background of the slide is a dark blue, high-contrast image of a microchip or circuit board. The central focus is a large, square, slightly raised component, possibly a microcontroller or a specific type of memory chip. This central square is surrounded by a dense network of fine, parallel lines that radiate outwards, resembling the intricate wiring of a printed circuit board (PCB). The overall aesthetic is technical and modern, with a monochromatic blue color scheme.

# Qualcomm

## Company Overview

Qualcomm leads global wireless tech development in 3G, 4G, and 5G connectivity, AI, and computing, impacting mobile, automotive, and IoT sectors. Revenue sources include Snapdragon® chips and IP licensing. They hold pivotal patents in wireless technology, such as CDMA and OFDMA, vital for device development. Their patents cover Wi-Fi, AI, and RF designs. Structured across segments like QCT (semiconductors), QTL (licensing), and QSI (investments), they drive innovation across sectors, with additional segments like QGOV and cloud computing initiatives. Additionally, their commitment to sustainability and responsible innovation underscores their influence in shaping a tech-driven yet environmentally conscious future.

## Latest News

- **OnePlus 12 with Qualcomm's Latest Chipset:** The Snapdragon 8 Generation 3 is Qualcomm's latest flagship chipset and the OnePlus 12 is the first phone that will be using this device. It is targeted to boost performance and become a competitor in the smartphone market.
- **Cloud AI 100 Ultra:** The newest product in the cloud AI inference cards. It is built for generative AI and large language models (LLMs), delivering four times the performance of the last model to achieve greater efficiency and return.
- **Qualcomm Terminates Iridium Agreement:** As of November 10, Iridium dropped close to 8% after the agreement was terminated for satellite messaging in phones.

## Market View

### Market Bull View:

- Qualcomm will generate loyalty revenue on every future smartphone sale
- Leading market position on 5G chipsets and has spread this technology into the automotive and IoT industries as a variety of wireless chips

### Market Bear View:

- Potential share loss with major customers like Samsung and Apple as they are starting to develop mobile processor IP designs in house to cut their costs
- Licensing business is continuing to face challenges in the United States, China, South Korea, and other areas, challenging their royalty revenue from smartphone sales
- QCOM and competitors are trying to diversify their products to gain market share

## Thesis

Qualcomm exhibits significant revenue growth and boasts a robust intangible asset portfolio, particularly valuable for licensing. Recognizing their dominance in a fiercely competitive market, the company allocates substantial resources to R&D. Furthermore, their financial strength, including solid leverage, a healthy cash position, and impressive ratios, stands out. Comprehensive analyses like Comps & Precedents and DCF indicate a substantial potential upside, corroborated by market consensus. Considering these factors, it's evident that Qualcomm stands as an essential inclusion for any value-focused investor.

Stock Rating: **BUY**

Price Target: \$234.73

Price (11/20/23): \$127.91

Upside: 85.8%

Ticker: QCOM

### Research Team

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Edward Sukernik

EV 146.76B

Market Cap 142.69B

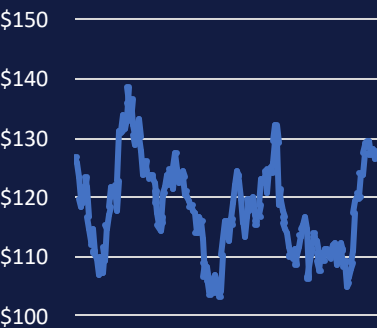
P/E 19.42x

EV/EBITDA 11.07x

P/BV 6.53x

P/FCF 15.66x

### QCOM 52wk Range



# Nvidia

## Company Overview

NVIDIA Corporation, founded in 1993, is a multinational technology company based in the United States. It operates in the "Semiconductors" sector and is renowned for its expertise in graphics processing units (GPUs) for gaming, professional markets, and data centers. Jensen Huang co-founded the company and has been serving as the CEO. While gaming and data centers remain the largest segment of revenue, accounting for 45% and 41% of total revenue, the company has expanded its focus to AI and professional visualization. NVIDIA's data center segment includes products such as GPUs, hardware, and software for AI, deep learning, and high-performance computing applications.

## Latest News

- New Cloud Platform: released DGX Cloud AI supercomputing service, which is expected to increase demand for cloud services.
- Nvidia outperforms on earnings: beat expectations amid rising investments in artificial intelligence, with 593% earnings growth and 206% revenue growth in Q3 2024.

## Market View

### Market Bulls View

- As the AI chip demand grows, so will Nvidia's revenue, with predictions of \$20 billion revenue in Q4, compared to \$18.12 billion in Q3, as well as maintaining strong margins, with GAAP and non-GAAP gross margins expected to come in at ~75%.
- Nvidia's strong partnerships allow the company to capitalize on the growing demand from enterprises looking to implement large-scale Generative AI. This includes the introduction of the AILighthouse program with ServiceNow and Accenture, which takes ServiceNow's enterprise automation platform and combines it with Nvidia's accelerated computing and Accenture's consulting and deployment services.

### Market Bears View

- As the longevity of AI demand remains the greatest question for investors, it is uncertain how many data centers are really needed and how long Nvidia will be able to capitalize on that revenue-segment, which, together with Generative AI, accounts for nearly half of total revenue
- A frail global economy could result in a weaker growth of Nvidia's sales. With the H100 advanced GPU's raking in a 1000% profit margin, global macro challenges could undermine growth in the long-term.

## Thesis

Despite Nvidia's meteoric rise and 90% market share in the AI GPU market, value is always a function of price, and at its November 20 share price of \$504 is detached from the financial realities of the company. Using a 60% weight to public comps and 40% weight to discounted cash flow valuation, we came to a price target of \$254, a downside of 49.6%.

Stock Rating: **SELL**

Price Target: \$254.22

Price (11/20/23): \$504

Downside: 49.6%

Ticker: NVDA

### Research Team

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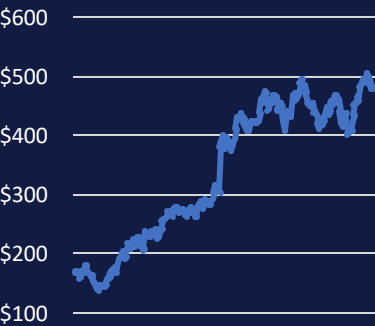
Angie Dulin

Raahil Gunaratne

Edward Sukernik

EV	1.003T
Market Cap	1.007T
P/E	61.73x
EV/EBITDA	62.04x
P/BV	36.61x
P/FCF	99.82x

### NVDA 52wk Range





# Valuation Breakdown

## Qualcomm

QCOM Valuation	EV/Revenue	EV/EBITDA	P/E	DCF	Weighted Average	Current Price (Nov 20)
Implied Enterprise Value	333,870	304,322	-	249,191		
Net Debt	4,614	4,614	-	4,614		
Implied Market Value	329,256	299,708	188,138	244,577		
Shares Outstanding	1,113	1,113	1,113	1,113		
Implied Value Per Share	\$295.83	\$269.28	\$169.04	\$219.75	\$234.73	\$129.51

## Nvidia

NVDA Valuation	EV/Revenue	EV/EBITDA	P/E	DCF	Weighted Average	Current Price (Nov 20)
Implied Enterprise Value	418,223	600,084	-	837,256		
Net Debt	(7,254)	(7,254)	-	(2,691)		
Implied Market Value	425,477	607,338	424,322	839,947		
Shares Outstanding	2,470	2,470	2,470	2,470		
Implied Value Per Share	\$172.26	\$245.89	\$171.79	\$340.59	\$254.22	\$504.09

Our valuations and price targets for both Qualcomm and Nvidia are based on a weighted average of comparable company analysis and discounted cash flow analysis (DCF). Within comparable company analysis, we used EV/Revenue, EV/EBITDA, and P/E ratios to value both companies. We used the mean ratios of the entire comparable company set to determine the implied enterprise value or market value to calculate an implied value per share. We used the median instead of the mean when valuing based on P/E ratios to remove the effect of NVIDIA's high outlier ratio. As for weighting between comparable company analysis and DCF analysis, we first took an average of all three ratio valuations to represent the comparable company valuation. Then weights were determined for DCF and comparable companies, with DCF being weighted 40% and comparable companies weighted 60% as DCF is considered less accurate because the valuation relies on many assumptions and projections and small changes can lead to significant variations in the valuation.

# Team Outlook

The semiconductor industry has been growing at a rapid pace domestically, after the shortage caused by COVID-19. In 2022, it reached an all-time sales high of \$574.1 billion, in part due to the CHIPS and Science Act. We expect the Israel-Hamas and Ukraine-Russia wars to create chip shortages and put a strain on the economy at large. Despite these difficulties the industry is expected to grow at a CAGR of 7.42%. Headwinds exist for the industry such as a talent shortage and the current conflicts. Tailwinds include increased demand for cloud computing, electric vehicles, and AI. Through an analysis of major players in the semiconductor industry, with a focus on Nvidia (NVDA) and Qualcomm (QCOM), a few trends appeared. With a great deal of government incentives and strong demand, the valuation ratios have spiked, creating overvalued securities. We believe that NVIDIA represents the most notable example of this, due to its strong performance, analysts have continued to rain optimism on its growth. It seems as this is often the case, hype has moved its price well away from its current value and represents an inefficiency in the market. Qualcomm represents the opposite, where it is selling at a discount of its intrinsic value. Semiconductors will continue to be one of the most watched industries of the next decade and will continue to drive technological progress.

# Let's Talk



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