Impact Investing Group

AMD (NASDAQ: AMD)

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Advanced Micro Devices (AMD) Introduction

Stock Price (2/27): $79.64

- Advanced Micro Devices, Inc. (AMD) is an American multinational semiconductor company based in Santa Clara, California, that develops computer processors and related technologies for business and consumer markets.

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- The company was founded in 1969 by Jerry Sanders and a group of other technology professionals. AMD's early products were primarily memory chips and other components for computers. The company later expanded into the microprocessor market, competing with Intel, its main rival in the industry.

Advanced Micro Devices (AMD) Introduction

- **Ryzen**: AMD's desktop and laptop processors. They are available starting at 4 and up to 64 cores. Because of their excellent performance, Ryzen processors are especially popular with gamers.
- **Epyc**: AMD's server processor. With 64 cores, it is a major competitor with Intel's Xeon processor, which only has a maximum of 28 cores. Therefore, one socket 64-core Epyc server can bring more processing power than a dual socket Xeon with 56 total cores.
- **Radeon**: AMD's GPU business. The company's major GPU competitor is Nvidia.
- **Instinct**: AMD's HPC coprocessor. Instinct is based on Radeon technology, but targeted at the data center for high-end computing.
- **FPGA**: AMD now has a complete line of FPGA processors thanks to its acquisition of Xilinx. FPGAs are particularly popular in compute situations where a simple task is done over and over at a very high speed. FPGAs are also reprogrammable to change how they function. AMD inherited three product lines from Xilinx: the Virtex (high-end), Kintex (mid-range) and Artix (low-end).
- **Data processing units (DPUs)**: as of this writing, AMD is entering the DPU market with the pending acquisition (May 2022) of Pensando. Its chips are used in SmartNICs, which employ intelligent network packet routing to offload the task from the CPU

Industry and Company Summary

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Investment Thesis

- Spinning off the Foundries business makes sense for AMD because it allows them to optimize their costs through supplier competition while allowing GlobalFoundries to focus on economics of scale
- AI is an emerging market that is heavily reliant on new and more performant chips
- Geopolitical tensions with China over Taiwan incentivize onshoring which benefits domestic semiconductor companies like AMD
- Expansion into new sectors as AMD chips are no longer only in the traditional gaming consoles or computers

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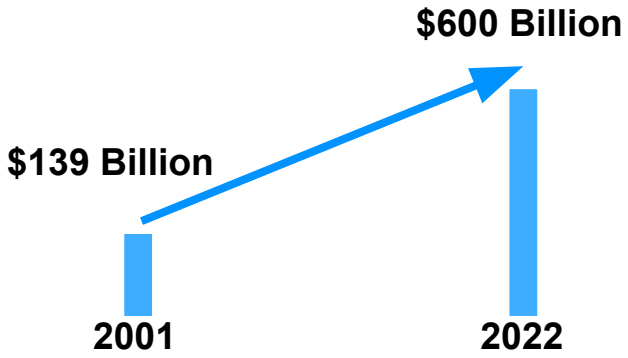
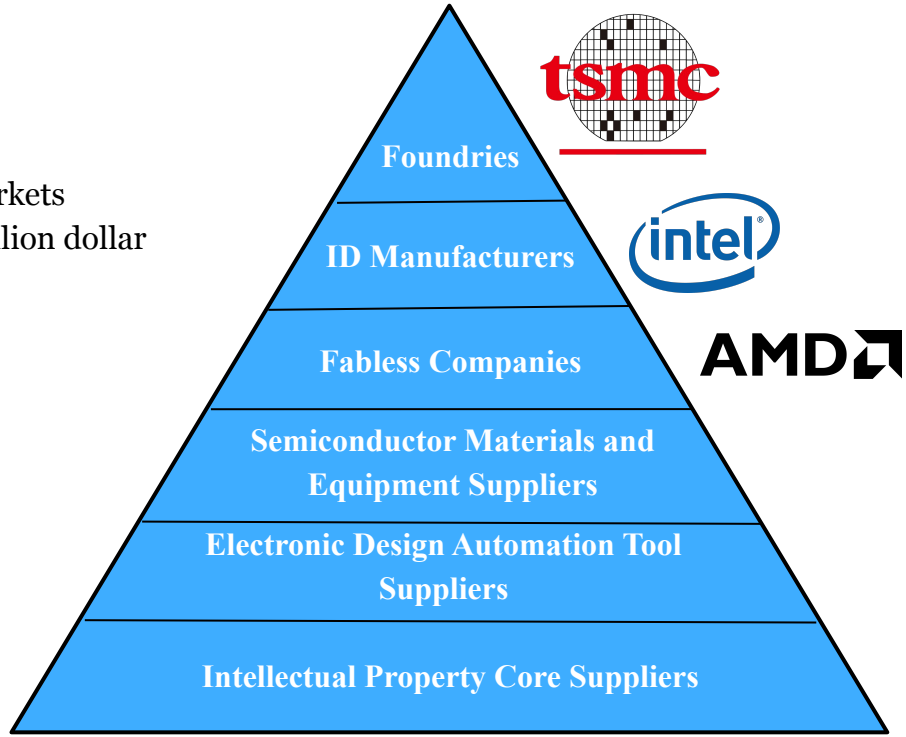
Semiconductor Ecosystem

- AMD → Fabless Chip Design
  - High-performance processors
  - GPUs
  - Recently, data center and cloud computing IC markets
- AI, Wireless Tech, IoT, and EVs provide tailwinds for trillion dollar semiconductor industry by 2030





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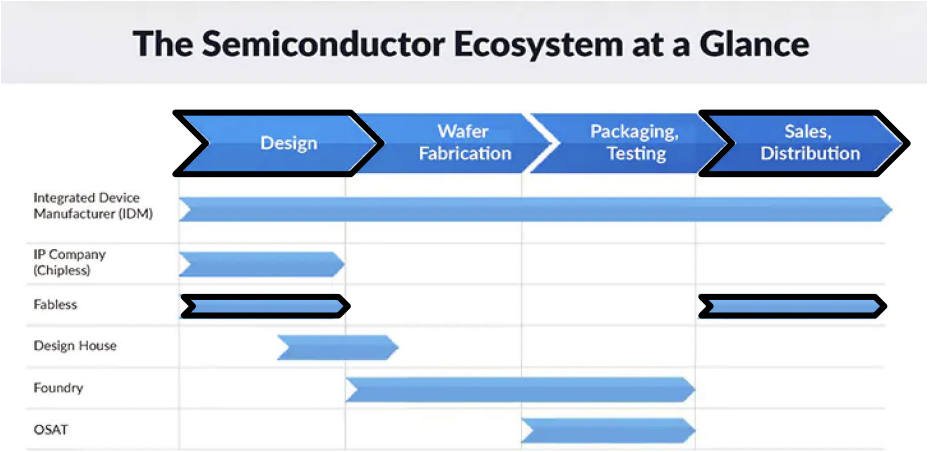
Fabless Company Introduction

- Key Market Players:
  - AMD, Qualcomm, Nvidia, MediaTek
- Work on Design and Sales Distribution
  - Chip designers hold intellectual property
  - Doesn't work in the manufacturing sector
- Often headquartered in costly industrialized countries
  - More robust IP rights



MEDIATEK

NVIDIA

Qualcomm

AMD

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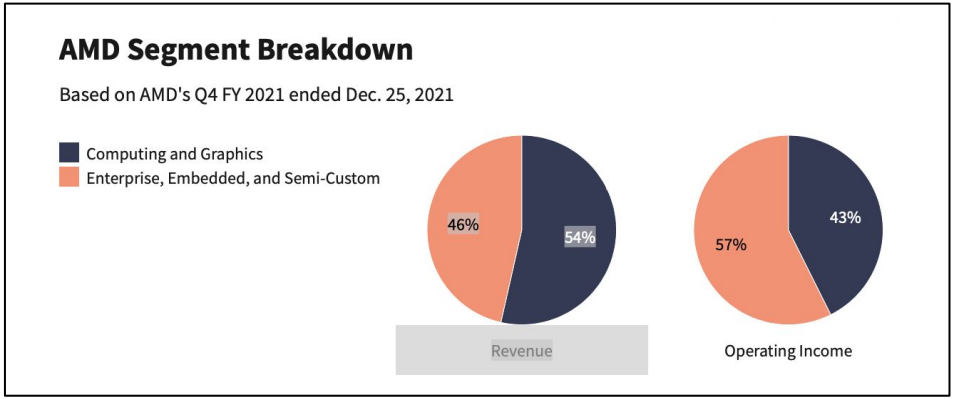
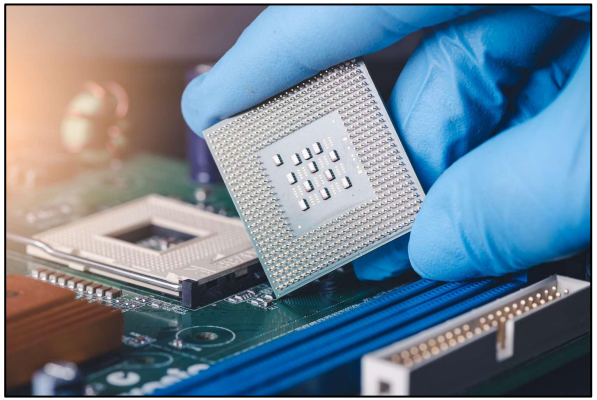
Fabless Business Model

- Engineers design ICs and have foundries manufacture them
  - Foundries have economies of scale
- Revenue is gained directly from consumers since fabless companies control sales and distribution



- AMD revenue streams:
  - Computing and graphics
  - Enterprise, embedded, semi-custom
- Main buyers:
  - Game console manufacturers
  - Server manufacturers (IBM+HP)
  - OEMs (original equipment manufacturers)+ODMs(original design manufacturers)



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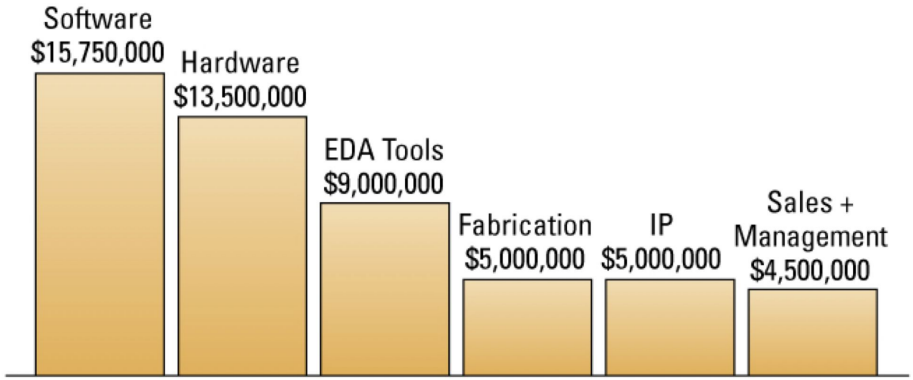
Fabless Business Model Cost Breakdown

- Design complexity is greatest cost determinant
  - i.e. SoC application processor used in cell phones is very costly
- Production costs (fabrication) are relatively lower since it's outsourced to foundries
- For AMD, Research and Development is greatest cost

Figure 1: Typical SOC Costs (Assumptions: Three years from start to break even for product, $150 thousand/engineer, 75 person company)



AMD 2022 10-K

	Year Ended December 31, 2022	December 25, 2021	December 26, 2020
	(In millions, except per share amounts)		
Net revenue	$ 23,601	$ 16,434	$ 9,763
Cost of sales	11,550	8,505	5,416
Amortization of acquisition-related intangibles	1,448	—	—
Total cost of sales	12,998	8,505	5,416
Gross profit	10,603	7,929	4,347
Research and development	5,005	2,845	1,983
Marketing, general and administrative	2,336	1,448	995
Amortization of acquisition-related intangibles	2,100	—	—
Licensing gain	(102)	(12)	—
Operating income	1,264	3,648	1,369

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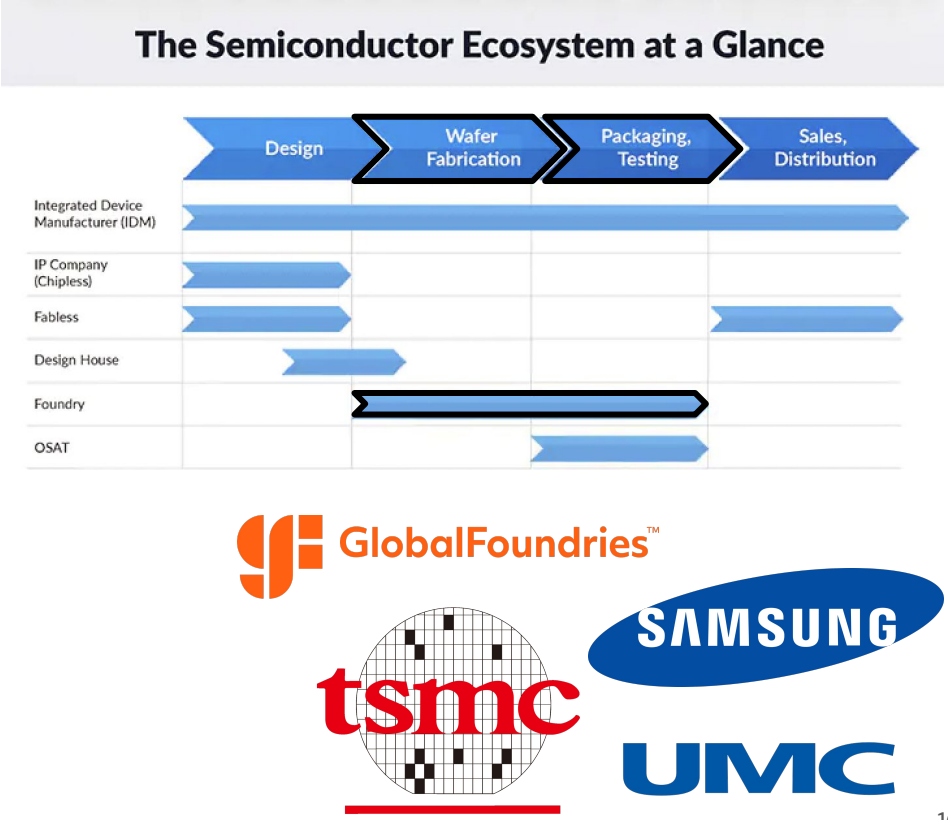
Foundry Company Introduction

- Work on Wafer Fabrication, Packaging and Testing
    - Manufacture silicon wafer chip wafer is fabrication plants (FABS)
- Uses COT-flow (Customer Owned Tooling) over proprietary development
- Typically headquartered in China and Taiwan, where skilled labor is cheap
- TSMC has been the largest independent manufacturer of silicon components since 1987
    - Controls 52% of global market
- Key Market Players: TSMC, UMC, Samsung, GlobalFoundries → AMD product



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Foundry Business Model

- Semiconductor design companies partner with the foundries
  - Semiconductor fabrications plant
  - Integrated design circuit operation
- The fixed costs from integrated design circuits are very high
  - Inefficiencies arise when facilities are not used at full capacity
  - Explained by R&D
- Foundries gain revenue from fabless company contracts
  - Minimizes inefficiency

Taiwan Semiconductor Manufacturing Company Limited

PARENT COMPANY ONLY STATEMENTS OF COMPREHENSIVE INCOME
(In Thousands of New Taiwan Dollars, Except Earnings Per Share)

	2021		2020	
	Amount	%	Amount	%
NET REVENUE (Notes 5, 19 and 30)	$ 1,574,745,881	100	$ 1,314,793,013	100
COST OF REVENUE (Notes 5, 10, 26 and 30)	786,116,844	50	632,788,990	48
GROSS PROFIT	788,629,037	50	682,004,023	52
OPERATING EXPENSES (Notes 5, 26 and 30)				
Research and development	123,417,275	8	108,613,789	8
General and administrative	30,967,600	2	26,312,285	2
Marketing	4,282,882	-	4,359,436	1
Total operating expenses	158,667,757	10	139,285,510	11
OTHER OPERATING INCOME AND EXPENSES, NET (Notes 12, 13 and 26)	(328,444)	-	746,994	-
INCOME FROM OPERATIONS	629,632,836	40	543,465,507	41

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Geopolitics of Semiconductors & CHIPS Act

CHIPS Act

- CHIPS: Creating Helpful Incentives to Produce Semiconductors for America Act or the CHIPS for America Act
- The bill was signed into law by President Biden on August 9, 2022 and aims to establish the groundwork for the next generation of semiconductors and microelectronics by providing and encouraging investment to accelerate investment for the design, development, and manufacturability of future semiconductors.
- The total impact of the new fabs, expansion of existing fabs, and equipment and materials supplier projects amount to **nearly $200 billion in company investments** and the creation of approximately 40,000 jobs throughout the U.S. semiconductor supply chain.
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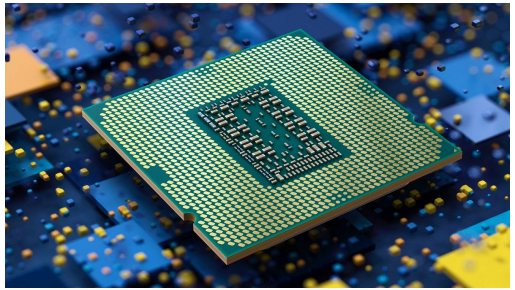
Geopolitics

- The geopolitics of the manufacture of semiconductors revolves around the fact that China now produces 25% of all semiconductors and is growing fast, while about 75% of all semiconductors are produced in East Asia (South Korea, Japan, China), most notably one Taiwanese company, the Taiwan Semiconductor Manufacturing Company (TSMC), accounting for 90% of all advanced semiconductors



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Artificial Intelligence (AI)

- AI and machine learning tools skyrocketing in popularity
  - Represents significant tailwind and opportunities for AMD
- According to TrendForce, ChatGPT-3 required over 20,000 GPUs to process its training data
  - This number grows rapidly with GPT-4
- AMD is improving its competitiveness with Ryzen, EPYC, and Radeon Vega platforms (AMD products)
  - Acquisition of Xilinx diversified AMD's products to include FPGAs, ICs used in AI applications that are faster and more energy efficient
- With this in mind, AMD has significant opportunity to capitalize on AI, data center, and cloud computing and increase its market share.

XILINX

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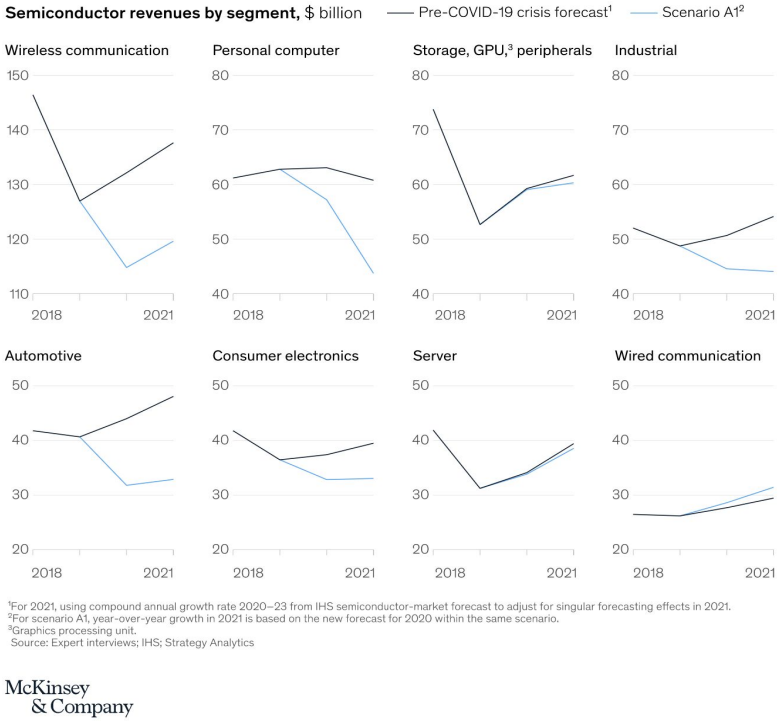
Supply Problems

- COVID-19
  - Significantly increased demand for electronics
  - Supply chain disruptions regarding raw materials and components (silicon and wafers)
  - Factory shutdowns, especially in China
- AMD avoided the worst of these issues
  - Forecasted demand years in advance
  - Targets high-end gaming and processings
  - Diversification of products



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Growth

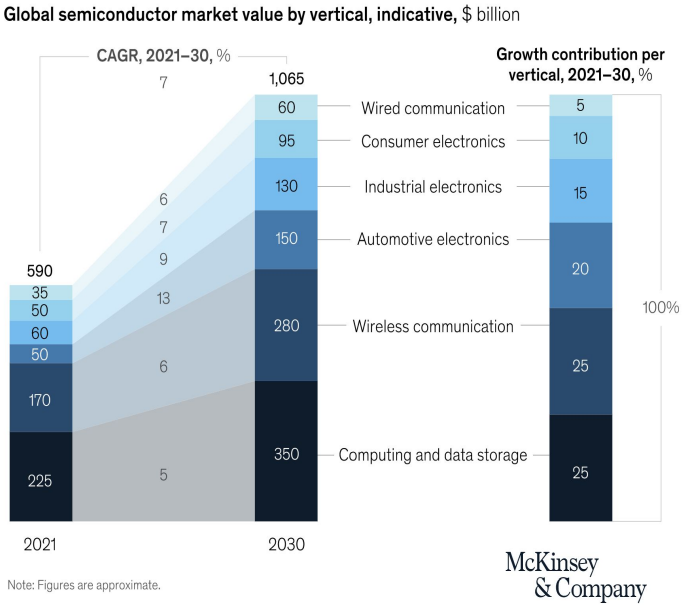
Industry

- Significant in the long-term
  - Recent downturns due to cyclical demand
- Integral to large emerging technologies, such as AI, IoT, and 5G
  - Applications in medicine, infrastructure, and climate solutions
  - 70% market value to be driven by the automotive, computation and data storage, and wireless industries

AMD

- Acquisition of Xilinx and Pensando Systems
  - Hyperscale data centers, 26% CAGR through 2027
  - Wireless equipment manufacturers, 71% CAGR through 2027
  - FPGAs in driver, entertainment, and navigation system

The overall growth in the global semiconductor market is driven by the automotive, data storage, and wireless industries.



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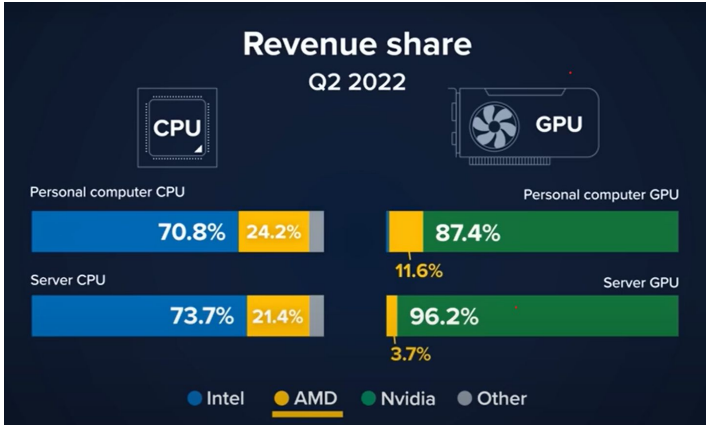
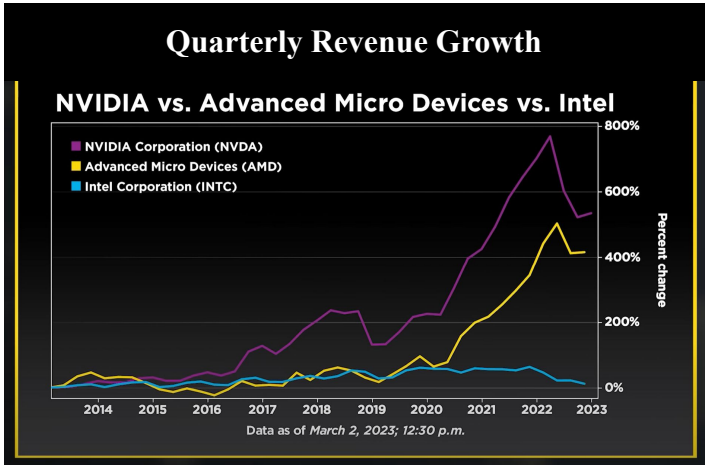
Overall Competitive Landscape

- AMD competes with Intel in central processing units (CPUs) and Nvidia in graphics processing units (GPUs)
- In computer processing, Intel historically dominates, yet AMD has steadily gained market share
    - As of Q4 2022, according to Statistica, AMD held a 35.2% share of the global x86 processor market while Intel held 62.8%
- AMD reported their Q4 2022 revenue increased 6.84% year on year due to embedded systems from their new acquisition, Xilinx
    - Competitors experienced contracted revenue by ~ -32%
    - However, AMD's profit margins are much lower





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Management

Lisa Su (CEO of AMD since October 2014)

- Currently serves on President Biden's council of advisors on science and technology
  - This group pushed hard for the passage of the chips act
- Has extensive electrical engineering experience
- Grew AMD from ~8,000 employees to 25,000
- Many attribute AMD's success in catching up to Intel technological advances to Lisa
  - For almost all 53 years, AMD has been designing chips for computers, data centers, and gaming consoles.
  - Under CEO Lisa Su, it has branched out to new sectors; AMD chips are in Tesla model S and X, industrial applications, healthcare, robotics, aerospace and defense.
- Strong supporter of fabless business model
  - Claims that what it takes to be world class in design takes a certain set of skills and what you need to do to be world class manufacturing is a different set of skills along with business models and capital models

Risks

Risks

1. Steeper decline in demand from the PC market
    a. AMD typically derives ~50% of its revenue from the core PC end market
2. Tension between China and Taiwan affecting supply chain
    a. AMD's chips are produced by Taiwan semiconductor manufacturing company TSMC
3. International revenue risk
    a. If Biden administration continue big bans in China, AMD revenue would be affected as 25% of its sales were to China last year

AMD's Responses to these Risks

1. When the sales of PC slumped in Q2 2022
    a. Even though AMD was also impacted by market forces like Intel, AMD's revenue increased by 14% and even beat intel in market cap in august 2022
2. Currently, TSMC is building a 12 billion dollar 5 nanometer chip fab outside Phoenix, AZ
3. These bans don't impact most of AMD's business
    a. It does affect some of their highest end chips that are used in AI applications. However, AMD was not selling these chips into china. So overall, the revenue impact from these bills have been small

ESG Applications

- The Lumi supercomputer in Finland, 3rd most energy efficient supercomputer, is powered by 3rd generation AMD EPYCTM CPUs and AMD MI250 InstinctTM GPUs (A+A)
- In 2020, $8,365,904 was donated to social organizations such as Cash and In-Kind Giving
- Established the COVID CARE Network: a centralized HPC facility that offers computational access to researchers and academics working to tackle COVID-related challenges
- Swiss hospital Bürgerspital Solothurn which has treated countless illnesses for over 600 years uses AMD Ryzen in their lean management system

Lumi Supercomputer


Bürgerspital Solothurn

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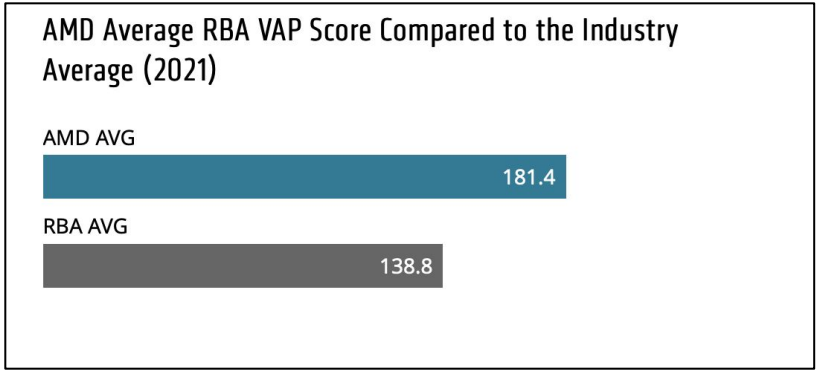
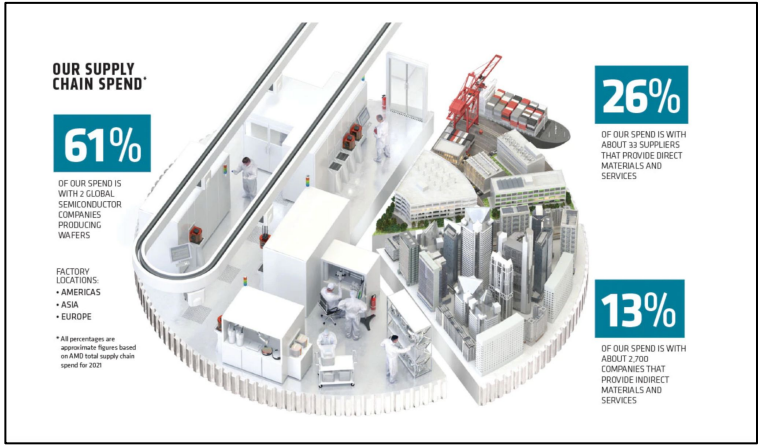
ESG Supply Chain Applications

- 64% of supplier manufacturing factories have a Responsible Business Alliance (RBA) audit or equivalence in 2021
- 3TG minerals (Tin, Tantalum, Tungsten and Gold) have been responsibly sourced from CAHRA (Conflict-Affected High-Risk Areas) by OECD Due Diligence Standards
- In 2021, 74% of manufacturing suppliers had public GHG goals
- In 2021, 74% of manufacturing suppliers sourced renewable energy
- The foundries they have partnered with reduced water and energy usage by 21% and 4% respectively between 2020 and 2021
- Carbon emissions in China were reduced by 25% between 2020 and 2021





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Valuation

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Base DCF

- The decline of demand from the PC market to affect 2023
- Demand will slowly improve revenues until 2027
- CHIPS Act helps but does not substantially change AMD's business
- Opex grows at a steady rate with revenue

UFCF Calculation	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue	6,731	9,763	16,434	23,601	25,961	31,673	39,274	50,271	67,363
% Change		*45.0%*	*68.3%*	*43.6%*	*10.0%*	*22.0%*	*24.0%*	*28.0%*	*34.0%*
(-) COGS	3,863	5,416	8,505	11,550	11,974	14,163	17,286	21,949	29,294
% of Revenue	*57.4%*	*55.5%*	*51.8%*	*48.9%*	*46.1%*	*44.7%*	*44.0%*	*43.7%*	*43.5%*
Gross Profit	2,868	4,347	7,929	12,051	13,987	17,509	21,988	28,321	38,069
Gross Profit Margin	*42.6%*	*44.5%*	*48.2%*	*51.1%*	*53.9%*	*55.3%*	*56.0%*	*56.3%*	*56.5%*
(-) Operating Expense	2,237	2,978	4,281	10,787	8,794	10,728	13,303	17,028	22,818
% of Revenue	*33.2%*	*30.5%*	*26.0%*	*45.7%*	*33.9%*	*33.9%*	*33.9%*	*33.9%*	*33.9%*
EBIT	**631**	**1,369**	**3,648**	**1,264**	**5,193**	**6,781**	**8,684**	**11,293**	**15,251**
Operating Margin	*9.4%*	*14.0%*	*22.2%*	*5.4%*	*20.0%*	*21.4%*	*22.1%*	*22.5%*	*22.6%*
(-) Effective Tax Rate	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*
NOPAT	**543**	**1177**	**3137**	**1087**	**4466**	**5831**	**7469**	**9712**	**13116**
(+) D&A	258	354	463	3,524	4,034	4,596	5,294	6,259	7,693
% of Revenue	*3.8%*	*3.6%*	*2.8%*	*14.9%*	*15.5%*	*14.5%*	*13.5%*	*12.5%*	*11.4%*
(-) CapEx	(217)	(294)	(301)	(450)	(526)	(679)	(889)	(1,197)	(1,684)
% of Revenue	*3.2%*	*3.0%*	*1.8%*	*1.9%*	*2.0%*	*2.1%*	*2.3%*	*2.4%*	*2.5%*
(-) Change NWC	(199)	(701)	389	(1,841)	(1,011)	(1,233)	(1,529)	(1,957)	(2,622)
% of Revenue	*3.0%*	*7.2%*	*-2.4%*	*7.8%*	*3.9%*	*3.9%*	*3.9%*	*3.9%*	*3.9%*
Unlevered FCF					6964	8515	10345	12817	16503
Period					*1*	*2*	*3*	*4*	*5*
Discounted UFCF					**6247**	**6853**	**7470**	**8302**	**9590**

Perpetuity Growth	
Long Term GDP Growth Rate	3.00%
Implied Terminal Growth Rate	2.00%
Implied Terminal Value	177780
(+) PV of Terminal Value	103305
(+) PV of Projected UFCF	38461
Implied Enterprise Value	**141767**
% of TEV from Terminal Value	72.9%
(-) Total Debt	2956
(+) Cash	5855
Implied Equity Value	**144666**
Diluted Shares Outstanding	1611.69
Implied Share Price	**$89.76**
Implied Upside	23.0%

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Bear DCF

- Assume the cyclical cycle of the PC market causes a larger decrease in demand, resulting in lower revenues
- Tension with China and Taiwan increases COGS due to supply chain disruptions
- TSMC, the chips manufacturer for AMD, is expected to raise its prices by 6% in 2023

UFCF Calculation	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue	6,731	9,763	16,434	23,601	25,489	29,975	35,730	43,734	55,630
% Change		*45.0%*	*68.3%*	*43.6%*	*8.0%*	*17.6%*	*19.2%*	*22.4%*	*27.2%*
(-) COGS	3,863	5,416	8,505	11,550	12,932	14,745	17,299	21,005	26,611
% of Revenue	*57.4%*	*55.5%*	*51.8%*	*48.9%*	*50.7%*	*49.2%*	*48.4%*	*48.0%*	*47.8%*
Gross Profit	2,868	4,347	7,929	12,051	12,557	15,230	18,431	22,729	29,019
Gross Profit Margin	*42.6%*	*44.5%*	*48.2%*	*51.1%*	*49.3%*	*50.8%*	*51.6%*	*52.0%*	*52.2%*
(-) Operating Expense	2,237	2,978	4,281	10,787	8,634	10,154	12,103	14,814	18,844
% of Revenue	*33.2%*	*30.5%*	*26.0%*	*45.7%*	*33.9%*	*33.9%*	*33.9%*	*33.9%*	*33.9%*
EBIT	**631**	**1,369**	**3,648**	**1,264**	**3,923**	**5,077**	**6,328**	**7,915**	**10,175**
Operating Margin	*9.4%*	*14.0%*	*22.2%*	*5.4%*	*15.4%*	*16.9%*	*17.7%*	*18.1%*	*18.3%*
(-) Effective Tax Rate	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*
NOPAT	**543**	**1177**	**3137**	**1087**	**3374**	**4366**	**5442**	**6807**	**8751**
(+) D&A	258	354	463	3,524	3,961	4,349	4,817	5,445	6,353
% of Revenue	*3.8%*	*3.6%*	*2.8%*	*14.9%*	*15.5%*	*14.5%*	*13.5%*	*12.5%*	*11.4%*
(-) CapEx	(217)	(294)	(301)	(450)	(516)	(643)	(808)	(1,041)	(1,391)
% of Revenue	*3.2%*	*3.0%*	*1.8%*	*1.9%*	*2.0%*	*2.1%*	*2.3%*	*2.4%*	*2.5%*
(-) Change NWC	(199)	(701)	389	(1,841)	(992)	(1,167)	(1,391)	(1,702)	(2,165)
% of Revenue	*3.0%*	*7.2%*	*-2.4%*	*7.8%*	*3.9%*	*3.9%*	*3.9%*	*3.9%*	*3.9%*
Unlevered FCF					5826	6906	8060	9508	11548
Period					*1*	*2*	*3*	*4*	*5*
Discounted UFCF					**5227**	**5558**	**5819**	**6159**	**6710**

Perpetuity Growth	
Long Term GDP Growth Rate	3.00%
Implied Terminal Growth Rate	2.00%
Implied Terminal Value	124403
(+) PV of Terminal Value	72289
(+) PV of Projected UFCF	29473
Implied Enterprise Value	**101762**
% of TEV from Terminal Value	71.0%
(-) Total Debt	2956
(+) Cash	5855
Implied Equity Value	**104661**
Diluted Shares Outstanding	1611.69
Implied Share Price	**$64.94**
Implied Upside	-11.0%

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Bull DCF

- Decline in demand from the PC market < growth in gaming industry (-30%, $326B
- EBITDA margins (25.74% vs 13.14%)
    - Intel operating margin (-21%)
- Acquisition of Xilinx and Pensando
    - FPGAs+AI
- Semiconductor demand projected to boom to $1 trillion in 2030 despite **Philadelphia Semiconductor Sector** index 27% plunge TTM

UFCF Calculation	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue	6,731	9,763	16,434	23,601	26,433	33,411	43,034	57,493	80,951
% Change		*45.0%*	*68.3%*	*43.6%*	*12.0%*	*26.4%*	*28.8%*	*33.6%*	*40.8%*
(-) COGS	3,863	5,416	8,505	11,550	10,973	13,447	17,047	22,593	31,683
% of Revenue	*57.4%*	*55.5%*	*51.8%*	*48.9%*	*41.5%*	*40.2%*	*39.6%*	*39.3%*	*39.1%*
Gross Profit	2,868	4,347	7,929	12,051	15,460	19,965	25,987	34,901	49,268
Gross Profit Margin	*42.6%*	*44.5%*	*48.2%*	*51.1%*	*58.5%*	*59.8%*	*60.4%*	*60.7%*	*60.9%*
(-) Operating Expense	2,237	2,978	4,281	10,787	8,954	11,318	14,577	19,475	27,421
% of Revenue	*33.2%*	*30.5%*	*26.0%*	*45.7%*	*33.9%*	*33.9%*	*33.9%*	*33.9%*	*33.9%*
EBIT	**631**	**1,369**	**3,648**	**1,264**	**6,506**	**8,647**	**11,410**	**15,426**	**21,848**
Operating Margin	*9.4%*	*14.0%*	*22.2%*	*5.4%*	*24.6%*	*25.9%*	*26.5%*	*26.8%*	*27.0%*
(-) Effective Tax Rate	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*	*14.0%*
NOPAT	**543**	**1177**	**3137**	**1087**	**5596**	**7437**	**9813**	**13266**	**18789**
(+) D&A	258	354	463	3,524	4,108	4,848	5,801	7,158	9,245
% of Revenue	*3.8%*	*3.6%*	*2.8%*	*14.9%*	*15.5%*	*14.5%*	*13.5%*	*12.5%*	*11.4%*
(-) CapEx	(217)	(294)	(301)	(450)	(535)	(716)	(974)	(1,369)	(2,024)
% of Revenue	*3.2%*	*3.0%*	*1.8%*	*1.9%*	*2.0%*	*2.1%*	*2.3%*	*2.4%*	*2.5%*
(-) Change NWC	(199)	(701)	389	(1,841)	(1,029)	(1,301)	(1,675)	(2,238)	(3,151)
% of Revenue	*3.0%*	*7.2%*	*-2.4%*	*7.8%*	*3.9%*	*3.9%*	*3.9%*	*3.9%*	*3.9%*
Unlevered FCF					8139	10268	12965	16817	22859
Period					*1*	*2*	*3*	*4*	*5*
Discounted UFCF					**7301**	**8264**	**9361**	**10893**	**13283**

Perpetuity Growth	
Long Term GDP Growth Rate	3.00%
Implied Terminal Growth Rate	2.00%
Implied Terminal Value	246254
(+) PV of Terminal Value	143094
(+) PV of Projected UFCF	49102
Implied Enterprise Value	**192197**
% of TEV from Terminal Value	74.5%
(-) Total Debt	2956
(+) Cash	5855
Implied Equity Value	**195096**
Diluted Shares Outstanding	1611.69
Implied Share Price	**$121.05**
Implied Upside	65.8%

Impact Investing Group

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