SEMICONDUCTOR INDUSTRY ASSOCIATION

2020 2021 **2022** 2023 2024

DATABOOK

SEMICONDUCTOR INDUSTRY ASSOCIATION ANNUAL DATABOOK

REVIEW OF GLOBAL AND U.S. SEMICONDUCTOR COMPETITIVE TRENDS

The semiconductor industry has fundamentally transformed the world's industrial structure. By providing the "building blocks" of the microelectronic revolution, semiconductor technology fuels development and productivity in crucial industrial sectors, including consumer electronics, telecommunications, factory automation, and defense electronics. Advancements made possible by the semiconductor industry and related "downstream" electronics industries have visibly impacted the economic, social, and political structures of the United States and other countries throughout the world.

The importance of the semiconductor industry has generated widespread interest on the part of business, government, and the academic and financial communities in statistics that offer insight into the industry's performance. This report provides a series of critical indicators of the U.S. semiconductor industry's financial and operating performance since 2001.

The 2022 Semiconductor Industry Association Databook (hereafter, The Databook) comprises more than 50 historical data series that document key trends in the U.S.-based semiconductor industry. Included in this report are measures of operating performance, employment, cost structure, productivity, and profitability. The Databook is intended to provide industry observers with insights into its historical evolution. The impact of the "Silicon Cycle" is examined, as well as long-term industry trends.

DESCRIPTION OF DATA SOURCES

The principal source of data for the charts and tables presented in this report are the World Semiconductor Trade Statistics (WSTS) program from 2001 to 2021, SIA annual financial surveys from 1998 to 2007, and the 10K and 10Q filings of U.S. semiconductor companies with the U.S. Securities and Exchange Commission (SEC). U.S. export data is official trade data from the U.S. Government provided by the U.S. International Trade Commission (USITC).

The Databook accounts for over 95 percent of total U.S.-based semiconductor sales revenues. Because of this high rate, total U.S. industry performance trends may be readily inferred from WSTS and 10K/10Q data except where noted (such as in the discussion of capital expenditures).

REVIEW OF GLOBAL AND U.S. SEMICONDUCTOR COMPETITIVE TRENDS

ORGANIZATION OF REPORT

The following is a brief outline of the trends covered in the SIA Databook.

Section 1: Global Industry Overview

Section 2: U.S. Industry Overview

Section 3: Global Market

Section 4: U.S. Industry Business Profile

Section 5: Capital and R&D Investment

Section 6: Jobs

Section 7: Productivity & Profitability

DESCRIPTION OF RESULTS

The majority of charts and tables present historical trends in a ratio format, and include "mean" and "median" data. Mean values are determined by first totaling both the ratio numerator and denominator for firms and dividing these totals to determine the "average" industry result. Computed in this manner, the result is weighted by the relative size of each firm: large firms impact the ratio in greater proportion than small firms. However, the median value is not weighted by firm size, because one half of the respondents report a higher ratio, and one half report a lower ratio.

In some cases, total sales, market shares, or investments levels are presented. Sales and market share data are derived from the WSTS. Total industry outlays for investment and research and development (R&D) are inferred from the expenditure rates of survey respondents, the respondents' share of the U.S.-based industry, and the 10K/10Q filings of U.S. semiconductor companies to the SEC.

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SEMICONDUCTOR INDUSTRY ASSOCIATION

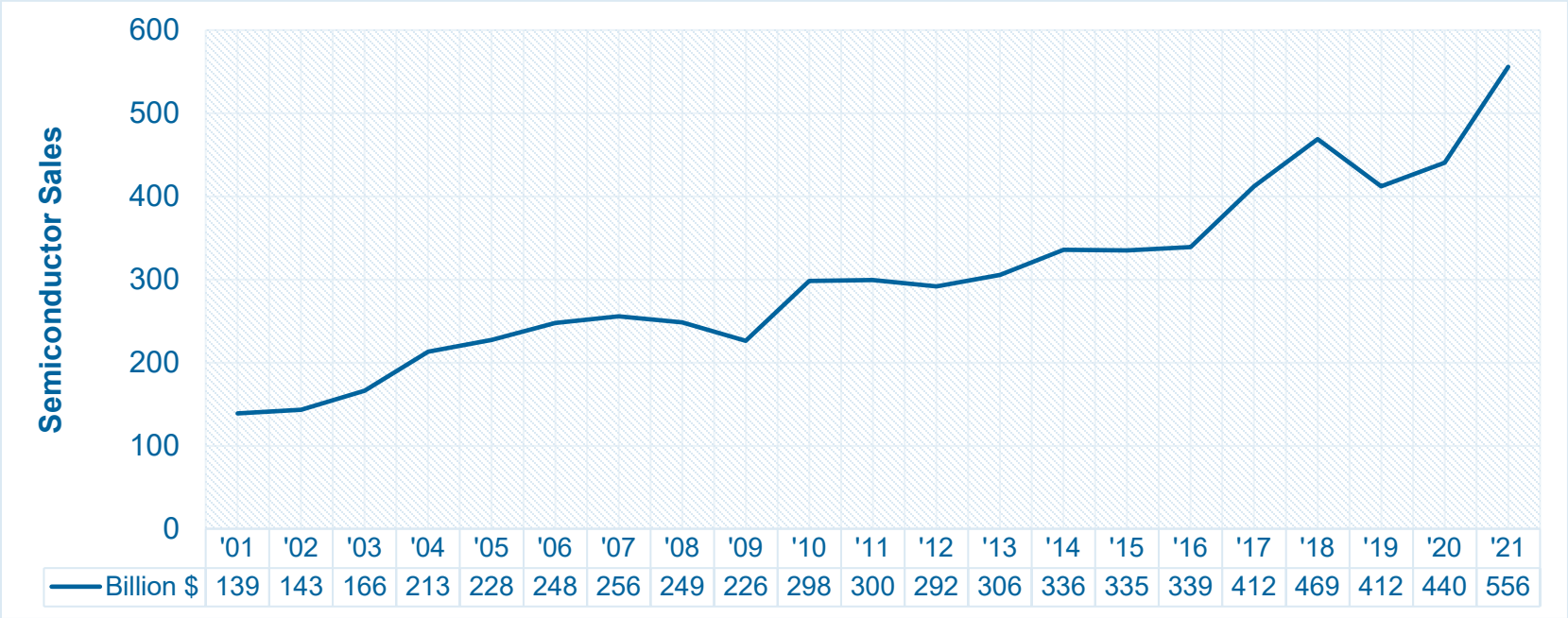
Section 1
GLOBAL INDUSTRY OVERVIEW

SECTION 1: GLOBAL INDUSTRY OVERVIEW

THE GLOBAL SEMICONDUCTOR INDUSTRY HAS BEEN ONE OF THE FASTEST GROWING INDUSTRIAL SECTORS IN THE GLOBAL ECONOMY

Worldwide semiconductor sales increased from $139.0 billion in 2001 to $555.9 billion in 2021, a compound annual growth rate of 7.18 percent per year. According to the World Semiconductor Trade Statistics (WSTS) Fall 2021 Semiconductor Industry Forecast, worldwide semiconductor industry sales are forecasted to reach $601 billion in 2022 and 633 billion in 2023.*

*WSTS, Fall 2021 Semiconductor Industry Forecast



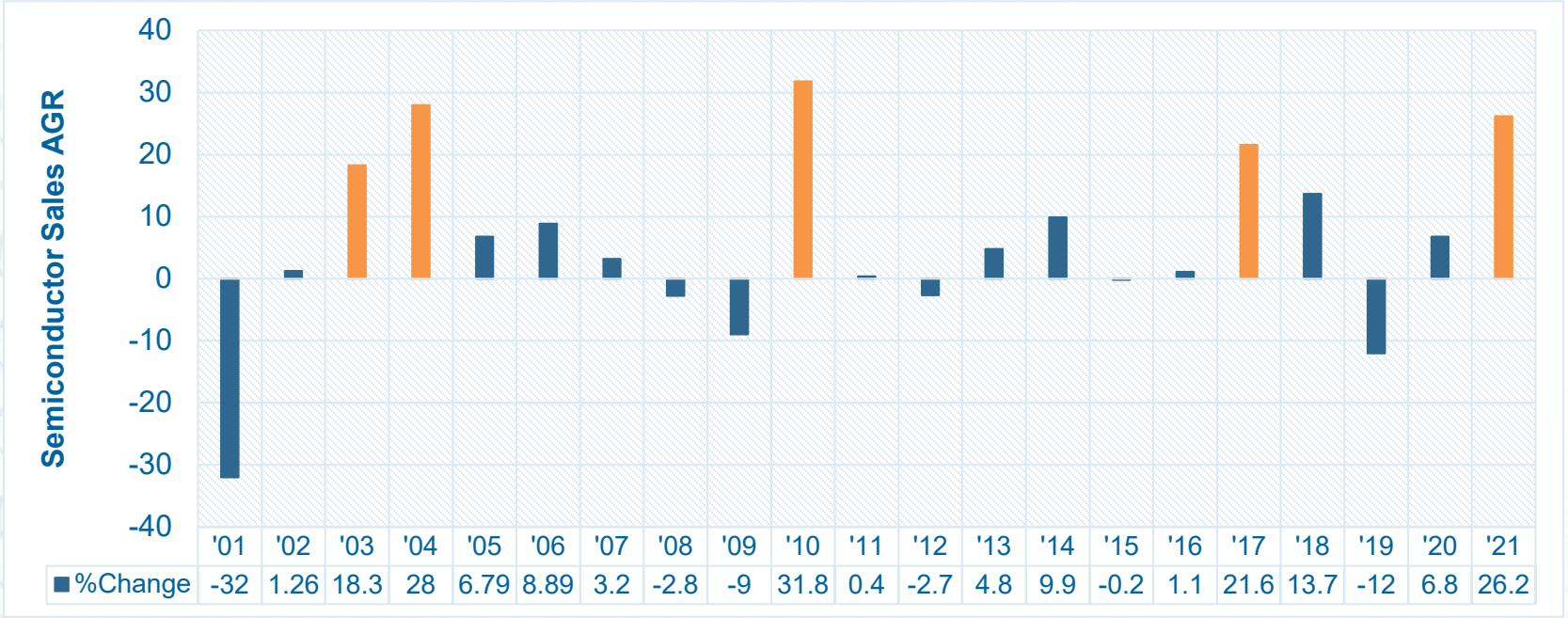
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Billion $	139	143	166	213	228	248	256	249	226	298	300	292	306	336	335	339	412	469	412	440	556

Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 1: GLOBAL INDUSTRY OVERVIEW

ANNUAL GROWTH RATES OF WORLDWIDE SEMICONDUCTOR INDUSTRY SALES HAVE BEEN CYCLICAL AND VOLATILE

Worldwide sales exhibit a distinctive boom/bust cycle. Since 2001, there have been four growth cycles in which sales grew over 20 percent per year. Following each growth cycle, the industry experienced a two-to-six-year period of flat to lower revenues. 2001 and 2009 were down years for semiconductor sales – a reflection of global financial and economic turmoil. Growth returned in 2010. However, it remained flat in 2011-2012 but returned in 2013 and continued to increase in 2014. In 2015 and 2016, the softening demand, strength of the dollar, and normal market trends and cyclicality led to a slight decrease and flat growth compared to the 2014 total. Strong overall performance, particularly in the memory sector, led to double-digit annual growth in 2017 and 2018. In 2021, the market grew by 26.2% due to a global surge in semiconductor demand.



	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
%Change	-32	1.26	18.3	28	6.79	8.89	3.2	-2.8	-9	31.8	0.4	-2.7	4.8	9.9	-0.2	1.1	21.6	13.7	-12	6.8	26.2

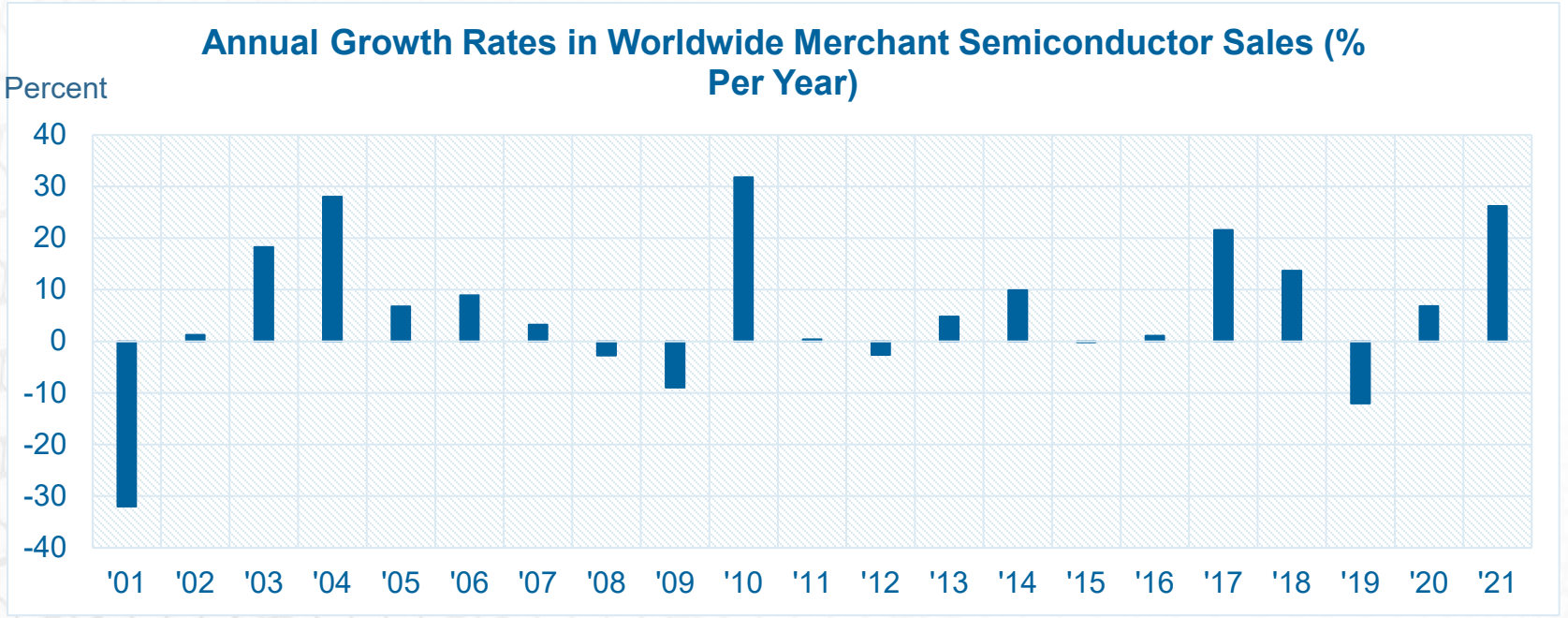
Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 1: GLOBAL INDUSTRY OVERVIEW

THE SEMICONDUCTOR INDUSTRY HAS BEEN CHARACTERIZED BY SHORT-TERM SALES VOLATILITY

INDUSTRY PEAKS & TROUGHS: THE "SILICON CYCLE"

Despite the exceptionally high long-term growth rate of the industry, there has traditionally been considerable short-term volatility in semiconductor worldwide sales. Since 1998, there have been five expansionary cycles in which worldwide sales grew at rates in excess of 20 percent per year -- 2021 was the most recent one. Interspersed between boom periods have been distinct "troughs" in the Silicon Cycle when sales either declined or remained stagnant.

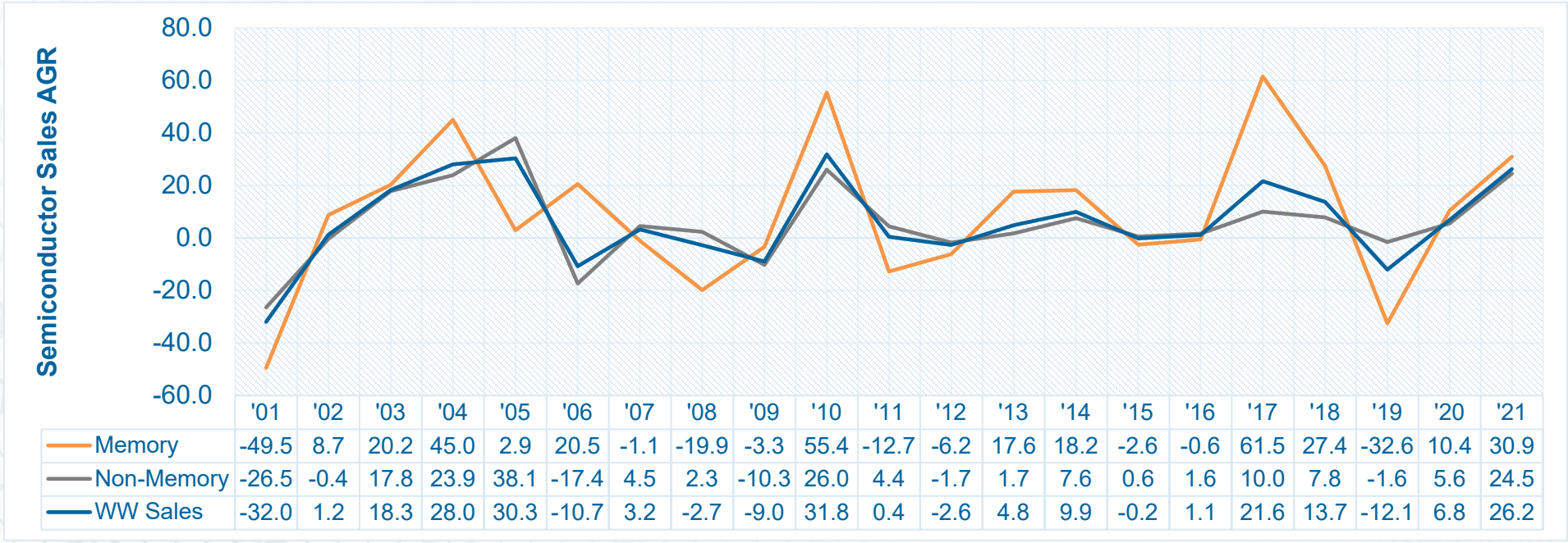


Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 1: GLOBAL INDUSTRY OVERVIEW

ANNUAL GROWTH RATES FOR WORLDWIDE SALES OF MEMORY SEMICONDUCTORS HAVE HISTORICALLY BEEN MORE VOLATILE THAN NON-MEMORY SEMICONDUCTORS

Sales of memory semiconductors have historically been more volatile than sales of non-memory semiconductors. This is because memory semiconductors act more like a commodity product and are therefore more price sensitive than non-memory semiconductors. Breaking down the annual growth rates of worldwide semiconductor industry sales into memory and non-memory segments shows that over time the non-memory segment has behaved more in line with the total semiconductor sales, i.e., the changes in annual growth rates have been less dramatic than in the memory segment.



	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Memory	-49.5	8.7	20.2	45.0	2.9	20.5	-1.1	-19.9	-3.3	55.4	-12.7	-6.2	17.6	18.2	-2.6	-0.6	61.5	27.4	-32.6	10.4	30.9
Non-Memory	-26.5	-0.4	17.8	23.9	38.1	-17.4	4.5	2.3	-10.3	26.0	4.4	-1.7	1.7	7.6	0.6	1.6	10.0	7.8	-1.6	5.6	24.5
WW Sales	-32.0	1.2	18.3	28.0	30.3	-10.7	3.2	-2.7	-9.0	31.8	0.4	-2.6	4.8	9.9	-0.2	1.1	21.6	13.7	-12.1	6.8	26.2

Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

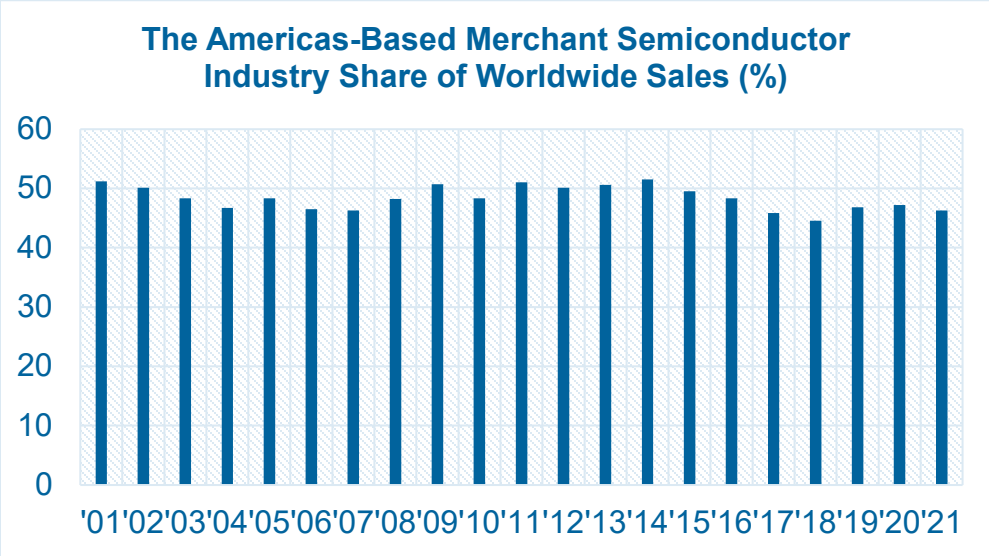
SEMICONDUCTOR INDUSTRY ASSOCIATION

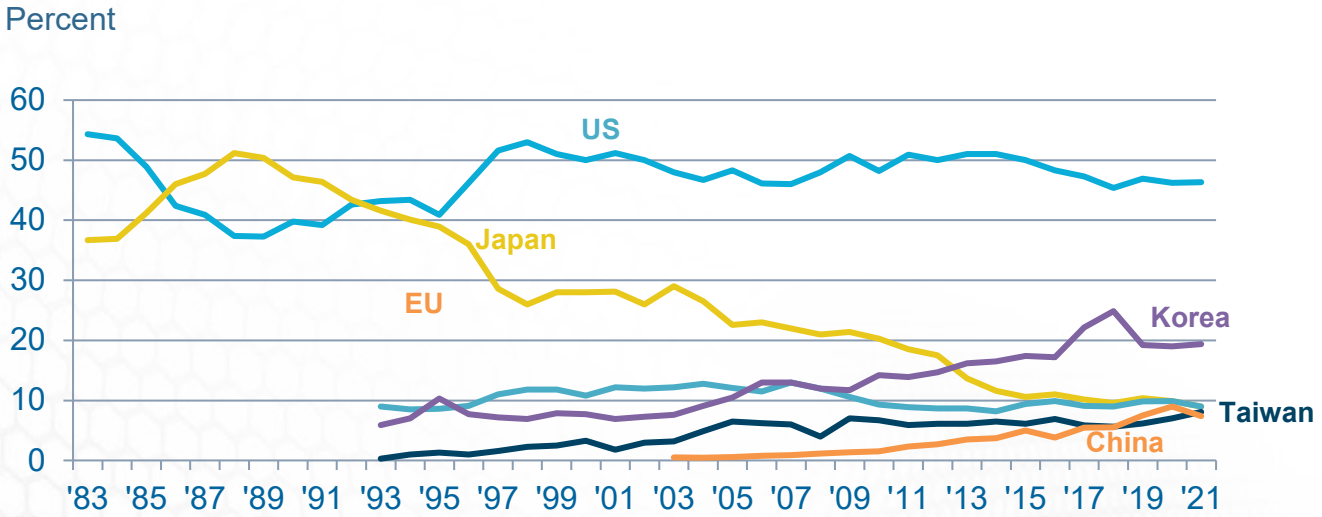
Section 2
U.S. INDUSTRY OVERVIEW

SECTION 2: U.S. INDUSTRY OVERVIEW

THE U.S. SEMICONDUCTOR INDUSTRY HAS NEARLY HALF OF THE GLOBAL MARKET SHARE

The U.S. semiconductor industry maintains market share leadership with 46.3 percent of the global market. In the early 1980s, the U.S. industry held more than 50 percent of worldwide semiconductor sales. However, due to intense competitive pressure from Japan-based firms, the effect of illegal "dumping", and a severe industry recession in 1985 to 1986, the industry lost a total of 19 worldwide market share points and its market share lead. Since the late 1980s, the industry in the Americas has rebounded strongly and maintained annual market share leadership. While largely exiting the DRAM market, its firms have maintained their competitive edge in microprocessors and other leading-edge devices. Strong growth in these sectors has enabled the industry to increase its market share to roughly half of the world market annually. Firms in Asia and Europe have grown in terms of their importance as suppliers as well.



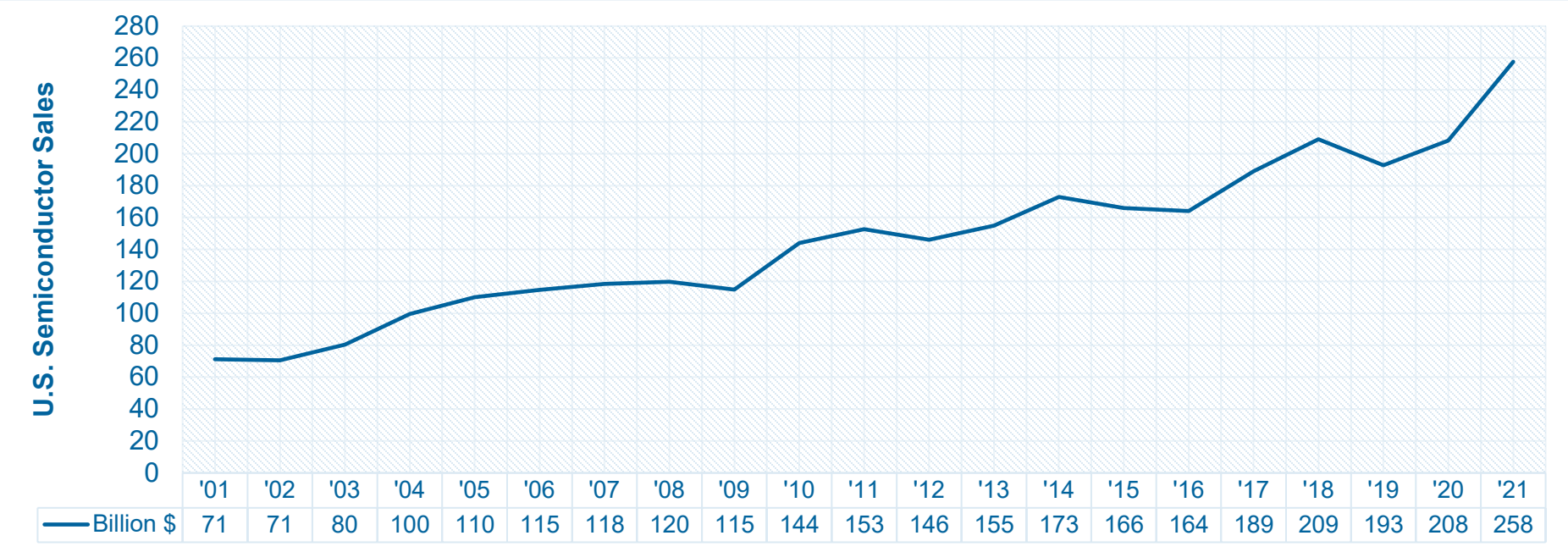


Source: World Semiconductor Trade Statistics (WSTS), Omdia, and SIA Estimates

SECTION 2: U.S. INDUSTRY OVERVIEW

U.S.-BASED INDUSTRY SEMICONDUCTOR SALES HAVE DISPLAYED SIMILAR STEADY ANNUAL GROWTH AS THE OVERALL GLOBAL INDUSTRY

Sales by U.S. headquartered semiconductor firms grew from $71.1 billion in 2001 to $257.5 billion in 2021 -- a compound annual growth rate of 6.65 percent. Sales growth for U.S. headquartered companies shows the same cyclical fluctuations characterized by the industry as a whole.



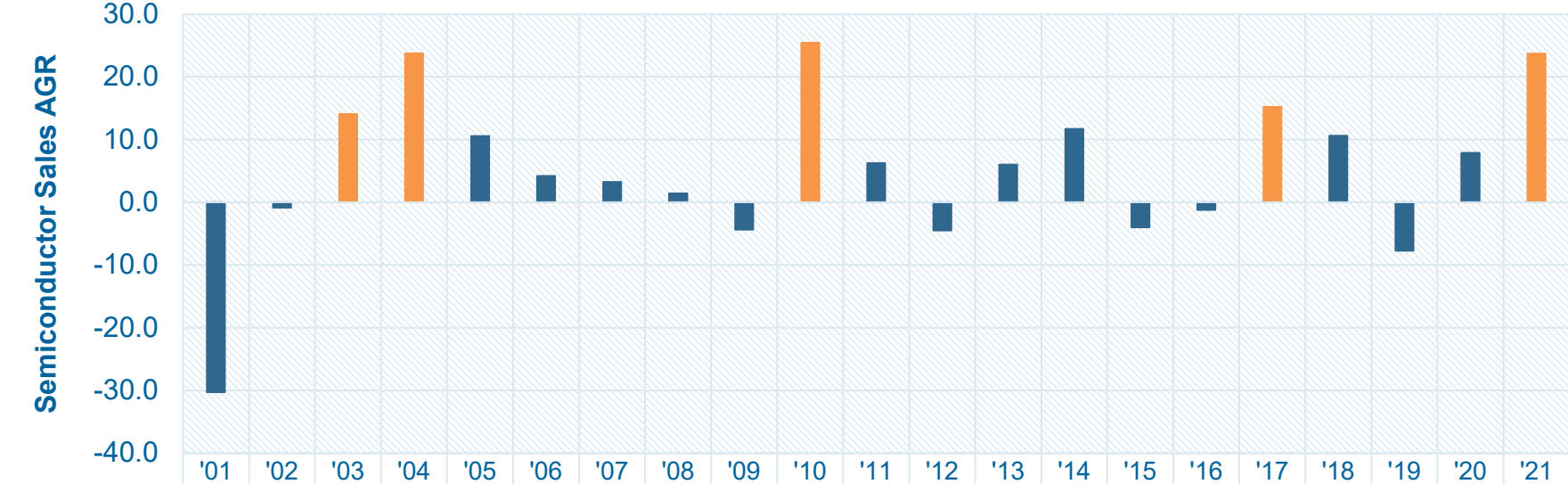
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Billion $	71	71	80	100	110	115	118	120	115	144	153	146	155	173	166	164	189	209	193	208	258

Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 2: U.S. INDUSTRY OVERVIEW

ANNUAL PERCENTAGE CHANGES IN U.S.-BASED SEMICONDUCTOR INDUSTRY REVENUES HAVE BEEN CYCLICAL

Sales of the Americas-based semiconductor industry demonstrate clearly defined cyclical patterns. The industry has experienced four growth cycles since 2001. In between each of these cycles was a period where revenues stagnated or fell. Rapidly expanding markets in key U.S. end-use sectors (notably computers and telecommunications) were the primary contributors to the unusual strength in sales. The 2001 decline was caused by weakness in these same sectors. In 2003 and 2004, the growth was driven primarily by the personal computer and wireless sectors, with solid sales in consumer products also fueling growth. In 2010, consumer demand, especially in the mobile device market, continued to drive growth.



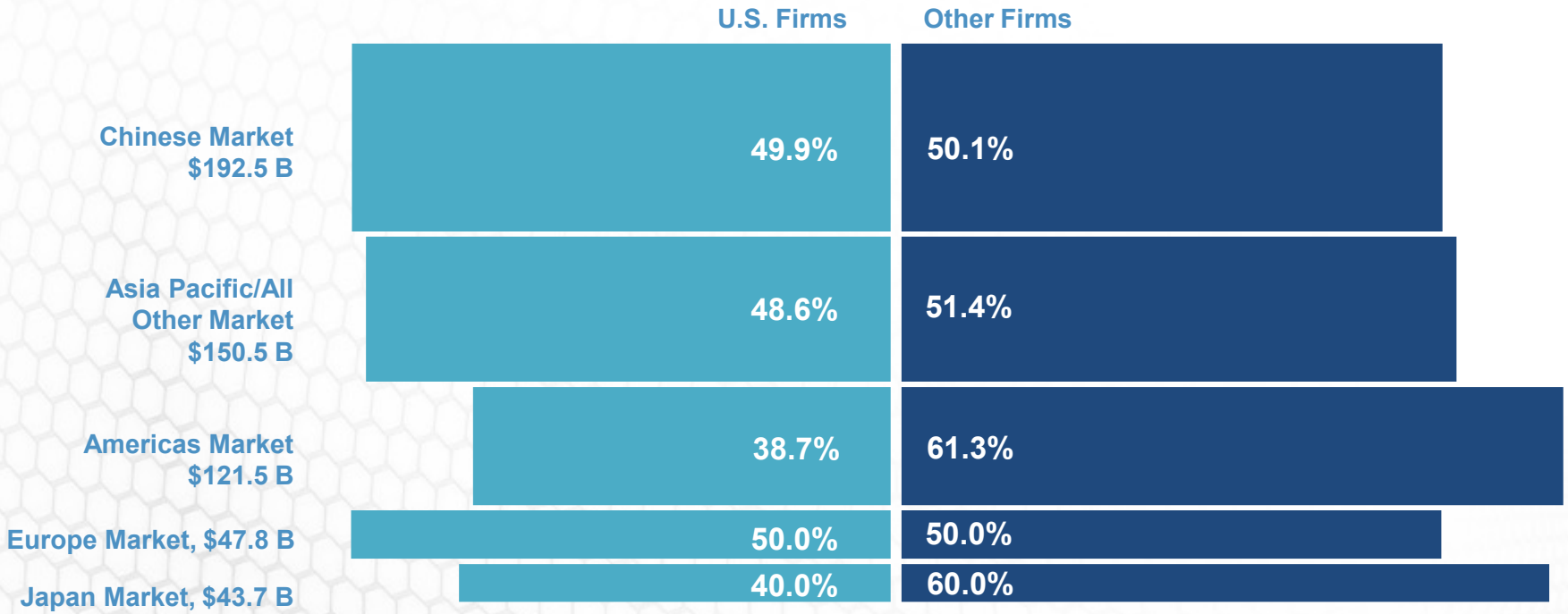
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
%Change	-30.	-0.8	14.0	23.8	10.6	4.2	3.2	1.4	-4.3	25.4	6.3	-4.5	6.0	11.7	-4.0	-1.2	15.2	10.6	-7.7	7.9	23.7

Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 2: U.S. INDUSTRY OVERVIEW

U.S.-BASED SEMICONDUCTOR COMPANIES MAINTAIN MARKET SHARE LEADERSHIP IN MOST MAJOR REGIONAL SEMICONDUCTOR MARKETS

In 2021, semiconductor firms based in the U.S. held 46.3 percent of the total semiconductor market share, the most of any country's semiconductor industry. In all major country and regional semiconductor markets, U.S. headquartered companies also held sales market share leadership.

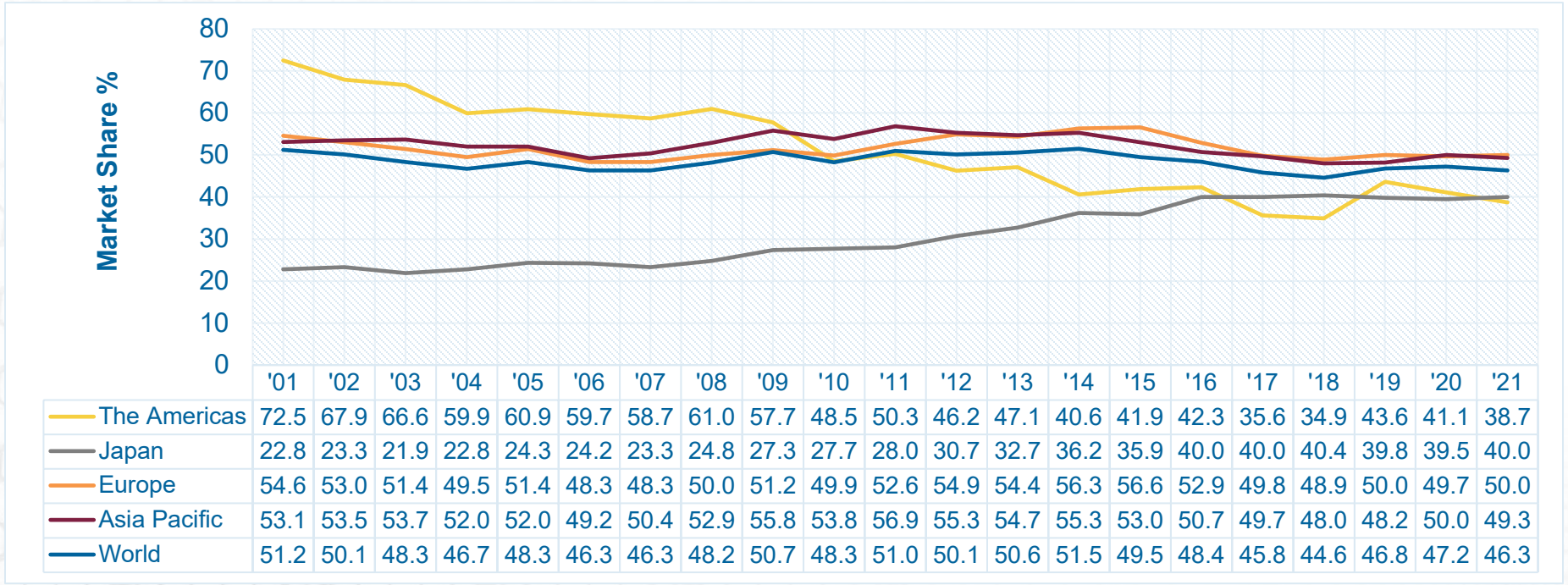


Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 2: U.S. INDUSTRY OVERVIEW

U.S.-BASED SEMICONDUCTOR COMPANIES MAINTAIN NEARLY 50 PERCENT OF GLOBAL SEMICONDUCTOR MARKET SHARE AND LEAD IN MOST MAJOR REGIONAL MARKETS

Due in part to the market opening measures put in place through the U.S.-Japan Semiconductor Trade Agreements, the Americas firms' share of the Japanese market has risen stably from 21.1 percent in 1999 to 40 percent in 2021. Due to the rapid growth of the Asia Pacific region, especially China in recent years, the Americas-based semiconductor industry has taken close to 50 percent share in this market. However, the Americas-based semiconductor industry has experienced an erosion of its market share in the U.S. market since 2001. The U.S. share of the worldwide market is now 46.3 percent – the largest share in the world.



	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
The Americas	72.5	67.9	66.6	59.9	60.9	59.7	58.7	61.0	57.7	48.5	50.3	46.2	47.1	40.6	41.9	42.3	35.6	34.9	43.6	41.1	38.7
Japan	22.8	23.3	21.9	22.8	24.3	24.2	23.3	24.8	27.3	27.7	28.0	30.7	32.7	36.2	35.9	40.0	40.0	40.4	39.8	39.5	40.0
Europe	54.6	53.0	51.4	49.5	51.4	48.3	48.3	50.0	51.2	49.9	52.6	54.9	54.4	56.3	56.6	52.9	49.8	48.9	50.0	49.7	50.0
Asia Pacific	53.1	53.5	53.7	52.0	52.0	49.2	50.4	52.9	55.8	53.8	56.9	55.3	54.7	55.3	53.0	50.7	49.7	48.0	48.2	50.0	49.3
World	51.2	50.1	48.3	46.7	48.3	46.3	46.3	48.2	50.7	48.3	51.0	50.1	50.6	51.5	49.5	48.4	45.8	44.6	46.8	47.2	46.3

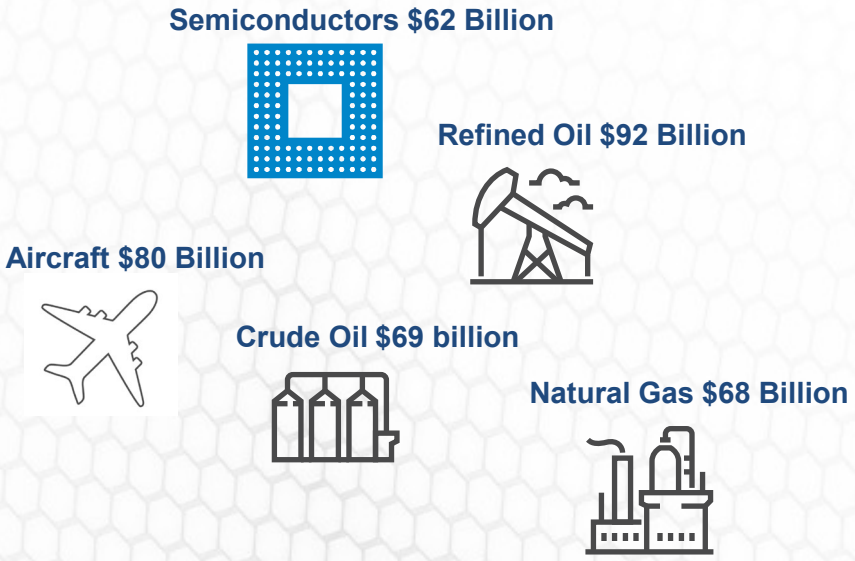
Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 2: U.S. INDUSTRY OVERVIEW

SEMICONDUCTORS ARE ONE OF AMERICA'S TOP EXPORTS

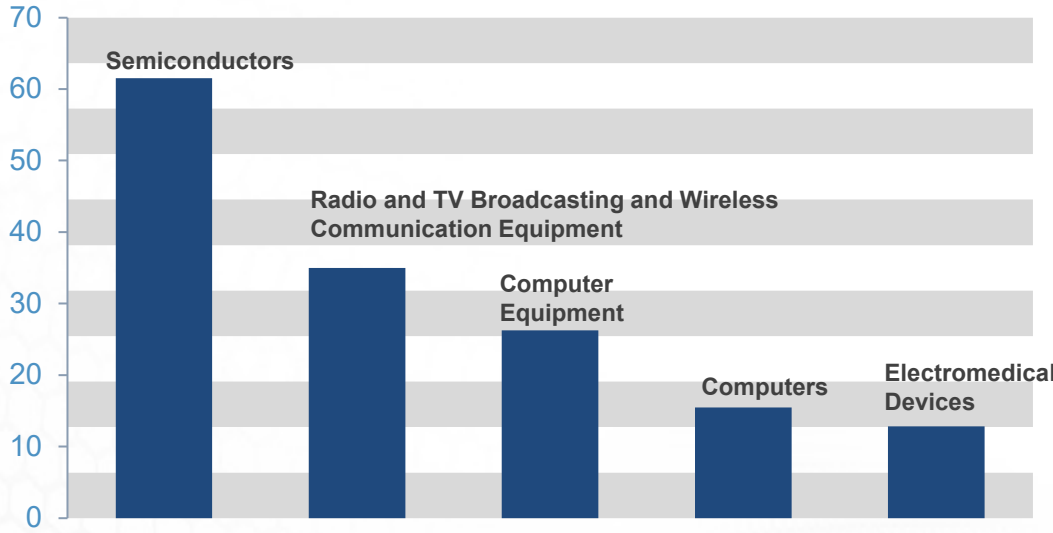
U.S. exports of semiconductors were worth $62 billion in 2021, fifth-highest among U.S. exports, behind only refined oil, airplanes, crude oil, and natural gas. Semiconductors constituted the largest share of U.S. exports of all electronic product exports.

Top 5 U.S. Exports in 2021 ($ Bn)



Source: U.S. International Trade Commission. Industry defined by NAICS codes: 334413 (Semiconductors); 33641X (Aircraft); 324110 (Refined Oil); 211130 (Natural Gas); 211120 (Crude Oil)

#1 U.S. Electronic Product Export in 2021 ($ Bn)



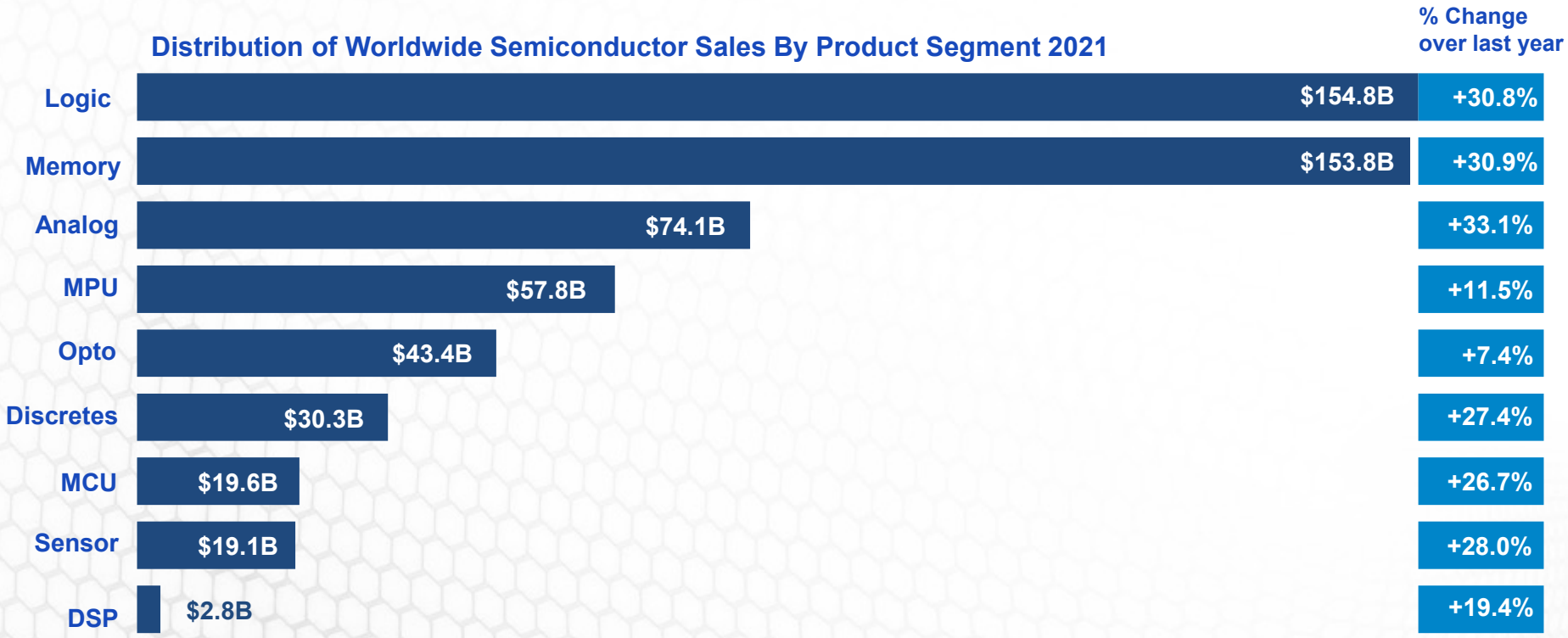
Source: U.S. International Trade Commission. Industry defined by NAICS codes: 334413 (Semiconductors); 334220 (Radio and TV Broadcasting and Wireless Communications Equipment); 334118 (Computer Equipment); 334111 (Computers); 334510 (Electromedical Devices).

Note: Some subproducts within NAICS 334413 that are made by different industries and serve different markets (e.g. solar cells) are excluded.

Section 3
GLOBAL MARKET

GLOBAL SEMICONDUCTOR SALES ARE DIVERSIFIED BY TYPE OF PRODUCT SOLD

Semiconductor technology has rapidly evolved as the industry develops more advanced products and process technologies for applications in end-use industries. In recent years, the largest segments of the worldwide semiconductor industry have been memory, logic, analog, and MPU. In 2021, these products accounted for 79 percent of semiconductor industry sales.



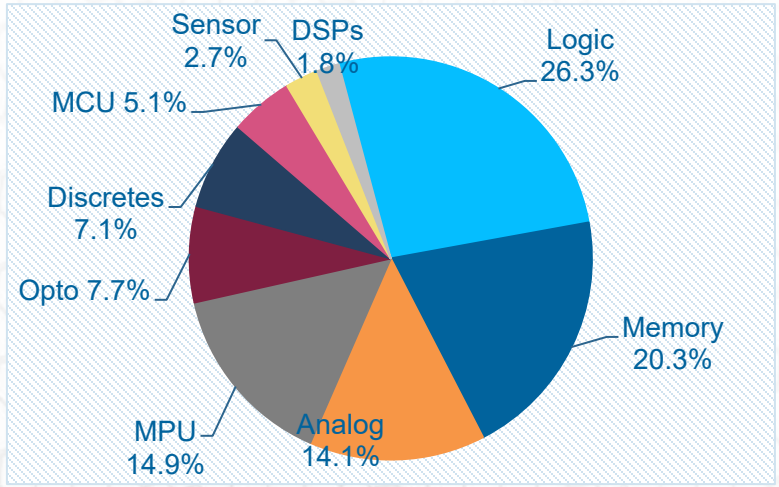
Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SECTION 3: GLOBAL MARKET

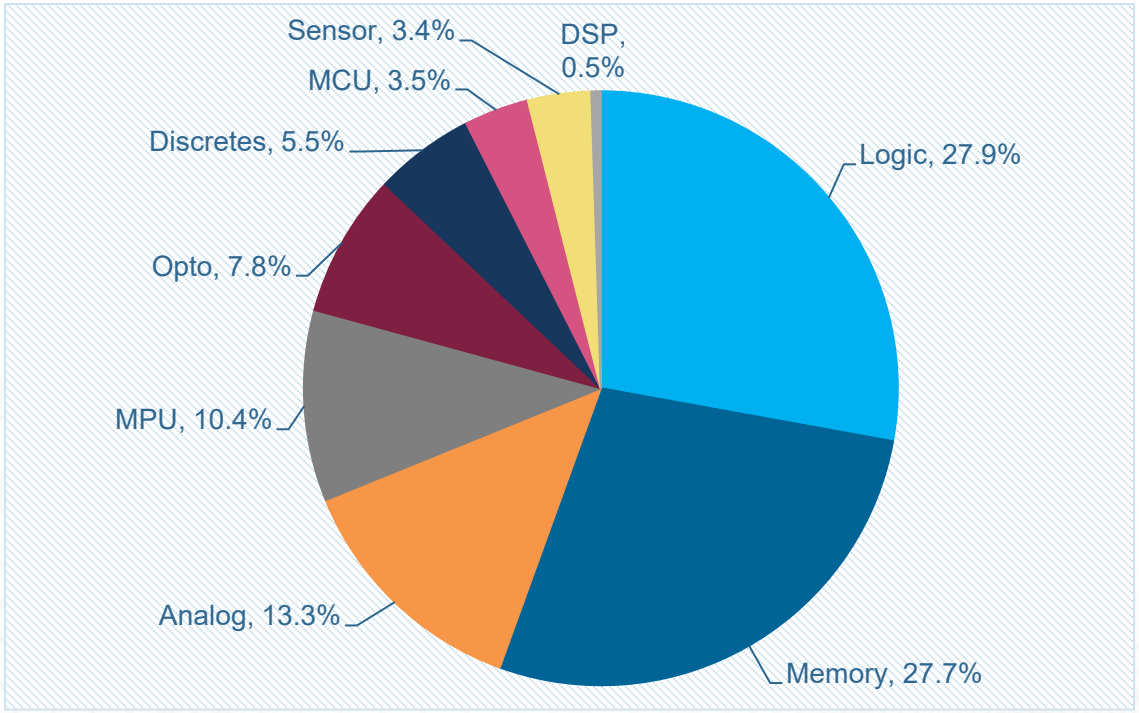
WHILE THE TYPE OF SEMICONDUCTOR PRODUCTS SOLD HAS NOT CHANGED MUCH OVER TIME, THE SHARE OF EACH PRODUCT OF TOTAL SEMICONDUCTOR SALES HAS SHIFTED

The two pie charts below compare the percent share of total semiconductor sales by major semiconductor product segment in 2011 versus 2021. While the main product segments have not changed, the percent share of each product segment has shifted. These shifts often have reflected changes in overall market demand.

2011 $299.5 Billion



2021 $555.9 Billion

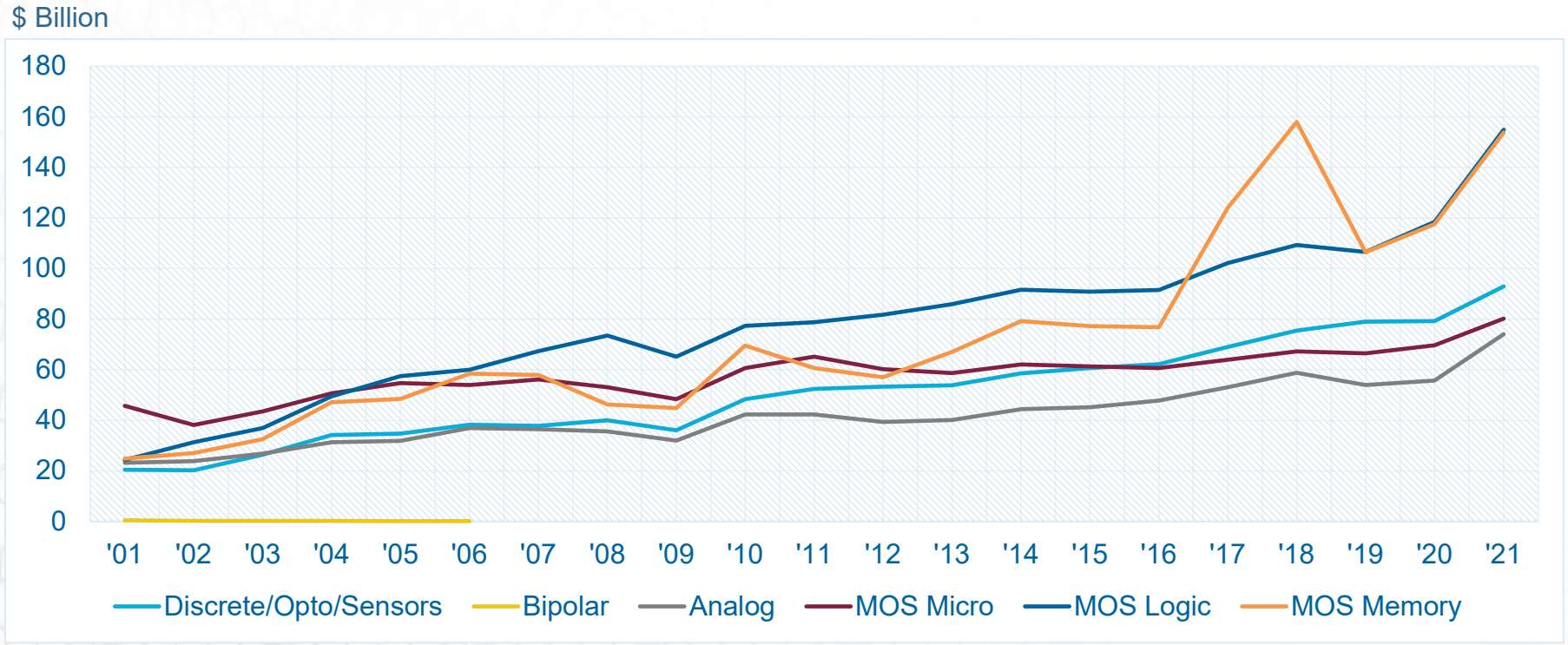


Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.
Note: Figures are rounded to the nearest tenth.

SECTION 3: GLOBAL MARKET

LOGIC SEMICONDUCTORS REPRESENT THE LARGEST SHARE OF GLOBAL SEMICONDUCTOR SALES BY MAJOR PRODUCT SECTOR

When viewed by major product sectors, MOS memory and micro devices together have historically accounted for the largest share of the market. However, since 2005, logic had surpassed the other two and accounted for the largest share of worldwide sales until 2017, when memory overtook it. Driven by multi-camera smartphones and IoT applications, optoelectronics and sensors have enjoyed rapid growth over the past decade. In 2021, memory and logic sales were tied for the largest share of global semiconductor sales by major product, with logic sold lightly more.

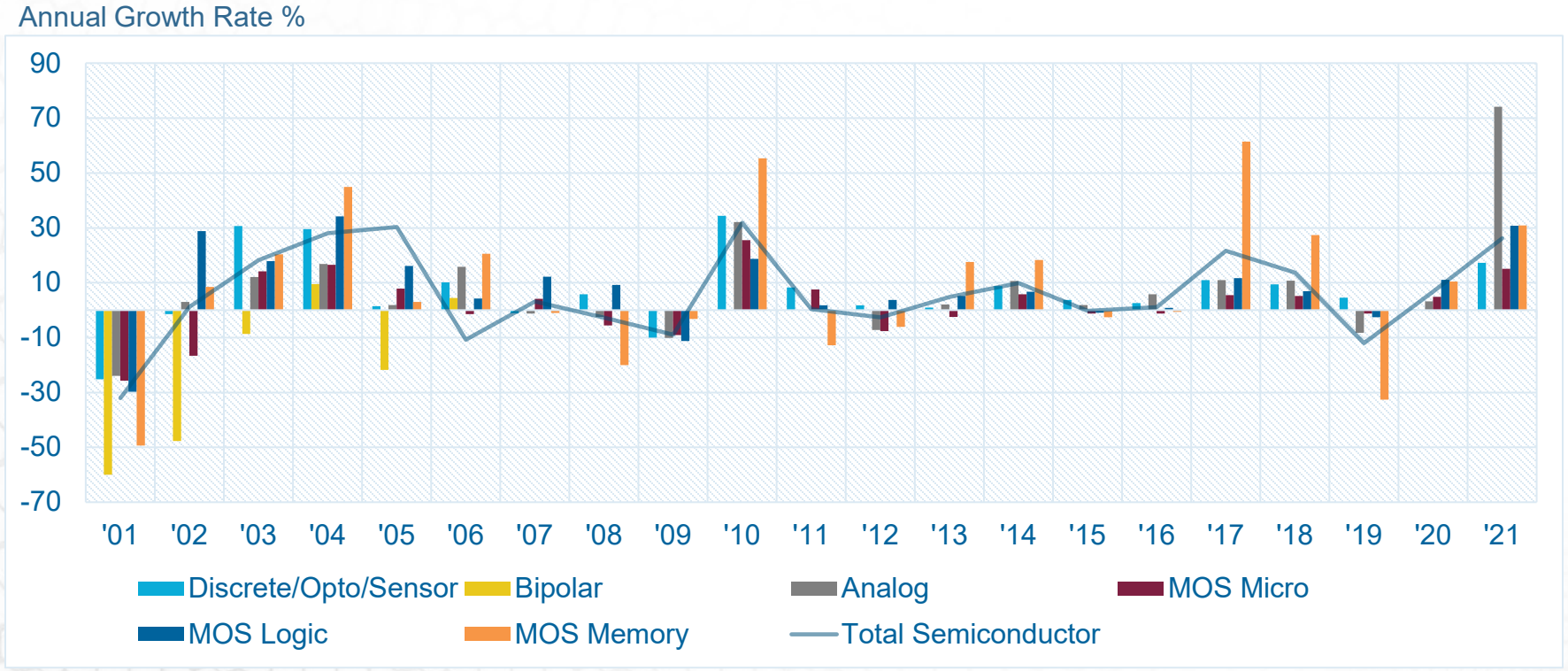


Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.
Note: Logic includes bipolar from 2007 to present.

SECTION 3: GLOBAL MARKET

HISTORICALLY, MEMORY SEMICONDUCTORS HAVE DISPLAYED THE MOST VOLATILE GROWTH RATE OF ANY MAJOR SEMICONDUCTOR PRODUCT SECTOR

When viewed by major product sectors, MOS memory device sales are most impacted by the Silicon Cycle. It is not uncommon for sales in this sector to fluctuate by more than 40 percent per year. Dominated by Dynamic Random Access Memory devices (DRAMs) and NAND Flash, this sector is subject to extreme pricing pressure as well as volatility in unit sales and inventory swings. In 2021, driven by soaring demands amid the global chip shortage, analog firms reported a record 74.1% annual growth.

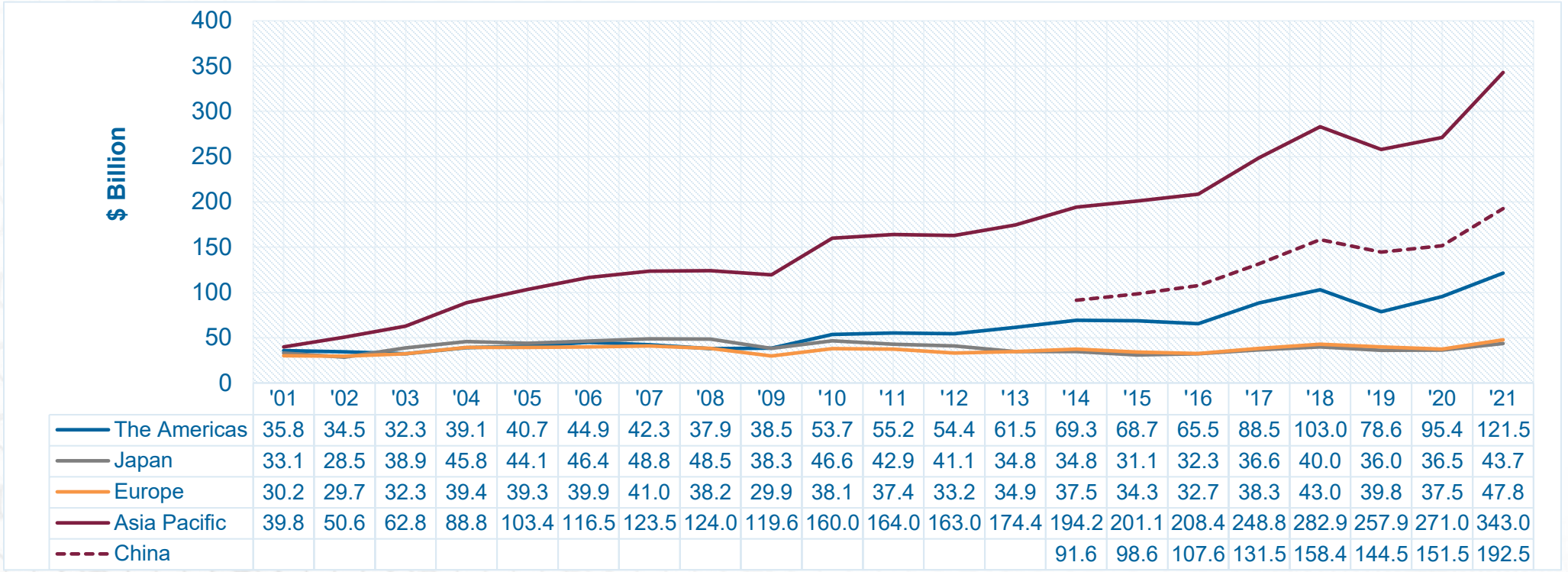


Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.
Note: Logic includes bipolar from 2007 to present.

SECTION 3: GLOBAL MARKET

TODAY, ASIA PACIFIC IS BY FAR THE LARGEST REGIONAL SEMICONDUCTOR MARKET

The size of the Americas market surpassed Japan in 1993 due to the strength of its computer and telecommunications sectors. In 2001, the Asia Pacific market surpassed all other regional markets in sales as electronic equipment production shifted to the region. Asia Pacific has increased by nearly 7 times since 2001 – from $39.8 billion to over $343 billion in 2021. This data reflects sales of semiconductors to electronic equipment makers only – final products are then shipped for consumption around the world.



	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
The Americas	35.8	34.5	32.3	39.1	40.7	44.9	42.3	37.9	38.5	53.7	55.2	54.4	61.5	69.3	68.7	65.5	88.5	103.0	78.6	95.4	121.5
Japan	33.1	28.5	38.9	45.8	44.1	46.4	48.8	48.5	38.3	46.6	42.9	41.1	34.8	34.8	31.1	32.3	36.6	40.0	36.0	36.5	43.7
Europe	30.2	29.7	32.3	39.4	39.3	39.9	41.0	38.2	29.9	38.1	37.4	33.2	34.9	37.5	34.3	32.7	38.3	43.0	39.8	37.5	47.8
Asia Pacific	39.8	50.6	62.8	88.8	103.4	116.5	123.5	124.0	119.6	160.0	164.0	163.0	174.4	194.2	201.1	208.4	248.8	282.9	257.9	271.0	343.0
China														91.6	98.6	107.6	131.5	158.4	144.5	151.5	192.5

Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.
Note: Sales in the China market from 2014 is a subset of Asia Pacific and should not be added to the total.

SECTION 3: GLOBAL MARKET

LEADING REGIONAL SEMICONDUCTOR MARKETS HAVE SHIFTED OVER TIME, WITH THE ASIA PACIFIC CURRENTLY THE LARGEST MARKET

There have been several notable changes in the relative size of regional markets from 2001 to 2021. The Americas returned to the position of largest consumer of semiconductor devices from 1993-2000. Because of rapid growth of domestic consumption and the increased portion of electronic equipment production done in Asia - especially China - the Asia Pacific market became the largest in 2001 and now accounts for over 60 percent of world semiconductor consumption, over twice the share of any other region.

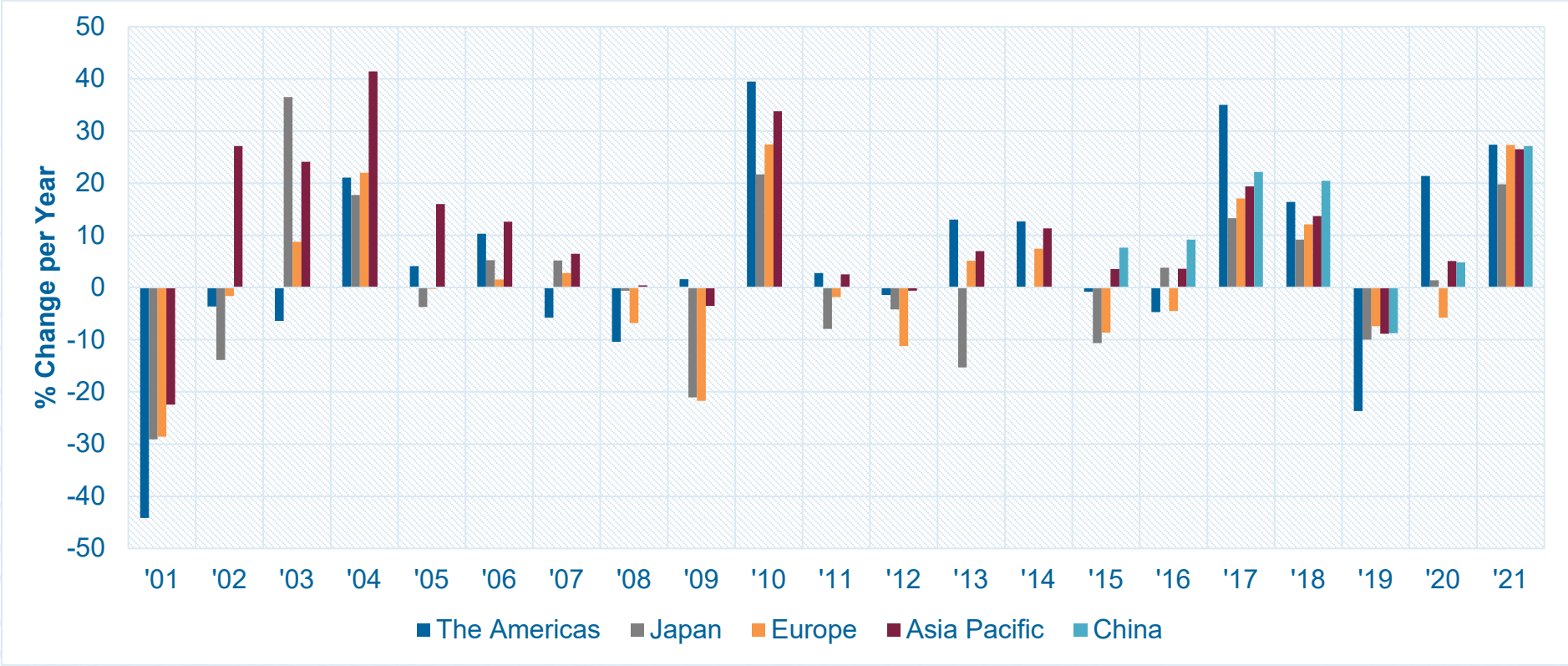
	Americas	Japan	Europe	Asia Pacific (including China)	China
Sales ($B)					
2001	35.8	33.1	30.2	39.8	N/A
2011	55.2	42.9	37.4	164.0	66.2
2021	121.5	43.7	47.8	343.0	192.5
Share of World Consumption					
2001	25.7%	23.9%	21.7%	28.7%	N/A
2011	18.4%	14.3%	12.5%	54.8%	22.1%
2021	21.9%	7.9%	8.6%	61.7%	34.6%
CAGR 2001-2011 Growth Rate	4.43%	2.63%	2.16%	15.21%	N/A
CAGR 2011-2021 Growth Rate	8.21%	0.18%	2.48%	7.66%	11.26%

Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.
Note: figures are rounded to the nearest tenth.

SECTION 3: GLOBAL MARKET

ANNUAL GROWTH RATES IN REGIONAL MARKETS EXHIBIT SIMILAR CYCLICAL PATTERNS

Annual growth rates in each of the major regional markets exhibit generally similar cyclical patterns. With few exceptions, the markets expand or contract in unison with the Silicon Cycle, although the magnitude of fluctuation differs between regional markets. As noted below, the Asia Pacific market has outperformed other regional markets almost every year since 1990 with the shift of electronics manufacturing to the region. In contrast, sales to the Americas have lagged other markets from 2001 to 2004 before returning to steady growth in 2005 and 2006.



Source: World Semiconductor Trade Statistics (WSTS) and SIA Estimates.

SEMICONDUCTOR INDUSTRY ASSOCIATION

Section 4
U.S. INDUSTRY BUSINESS PROFILE

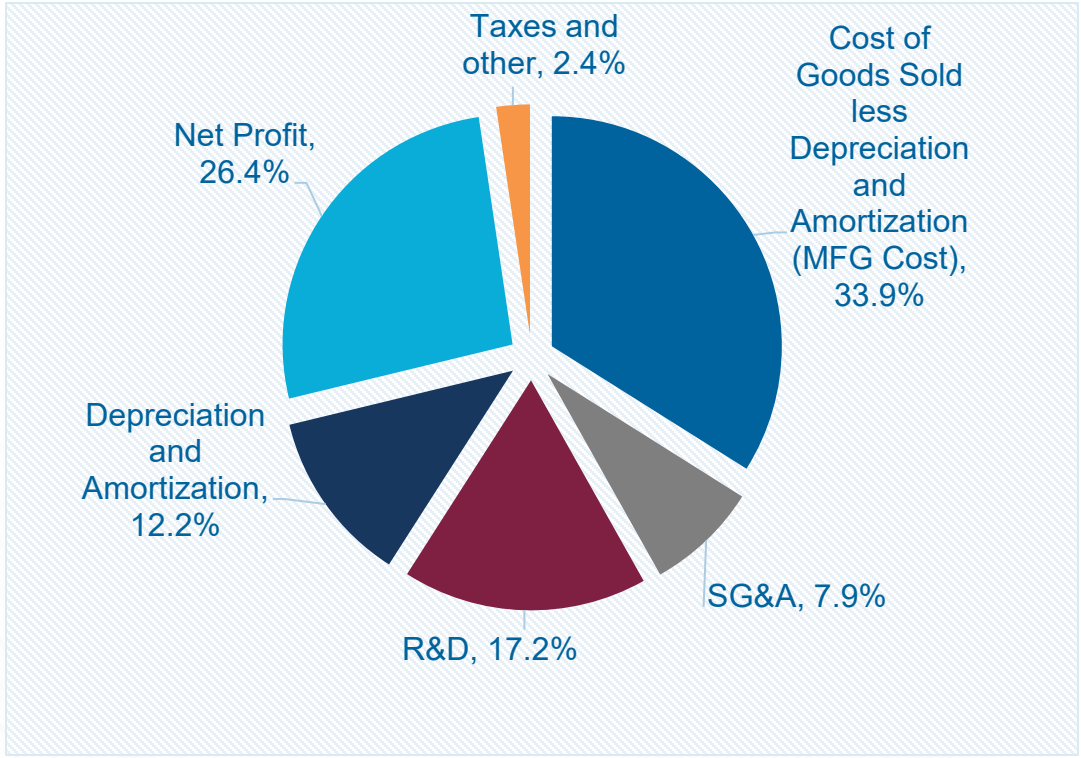
SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

ANNUAL OPERATING EXPENSES REMAIN RELATIVELY STABLE EVEN WHEN THE INDUSTRY EXPERIENCES VOLATILITY

A key to maintaining a viable and financially healthy semiconductor industry is the ability of firms to manage and control production and overhead-related expenditures. Semiconductor firms must curtail expenditures during the downturns in the Silicon Cycle without unduly sacrificing investments in technology and R&D in order to maintain long-term viability in the highly competitive and increasingly demanding technological environment. This section examines historical patterns in spending rates and assesses how the industry has managed this tradeoff historically.

COST STRUCTURE OVERVIEW

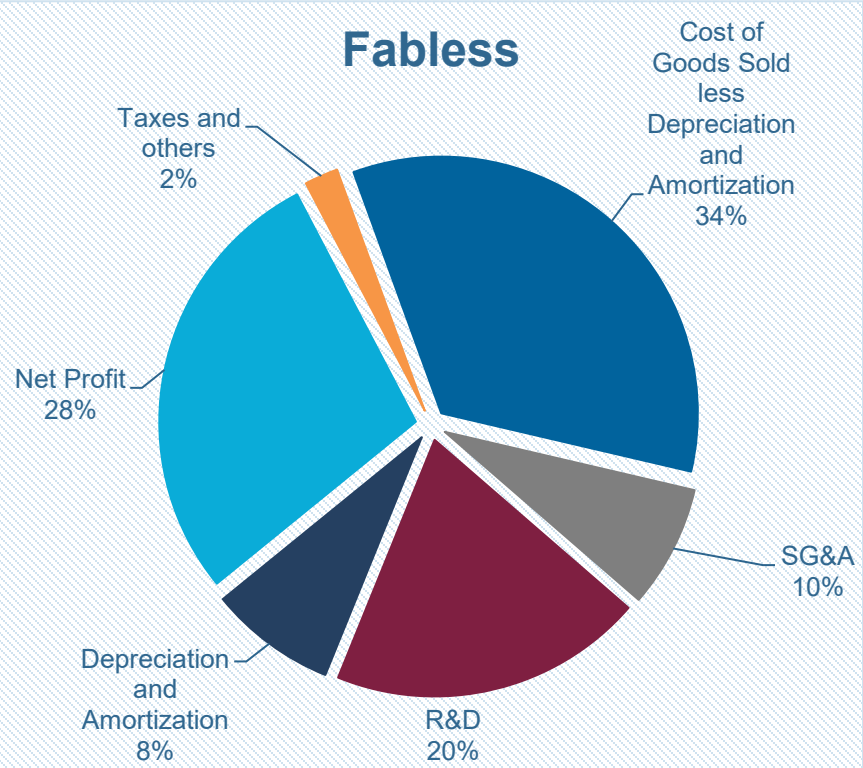
Approximately 34 percent of the expenditures by U.S.-based semiconductor manufacturers are currently allocated to manufacturing costs, less depreciation and amortization. Selling, General, and Administrative (SG&A) costs account for about 8 percent of total outlays. About 30 percent of expenditures relate to expenses incurred to maintain both the short and long-term viability of the industry (i.e., R&D outlays and charges for depreciation of capital equipment).

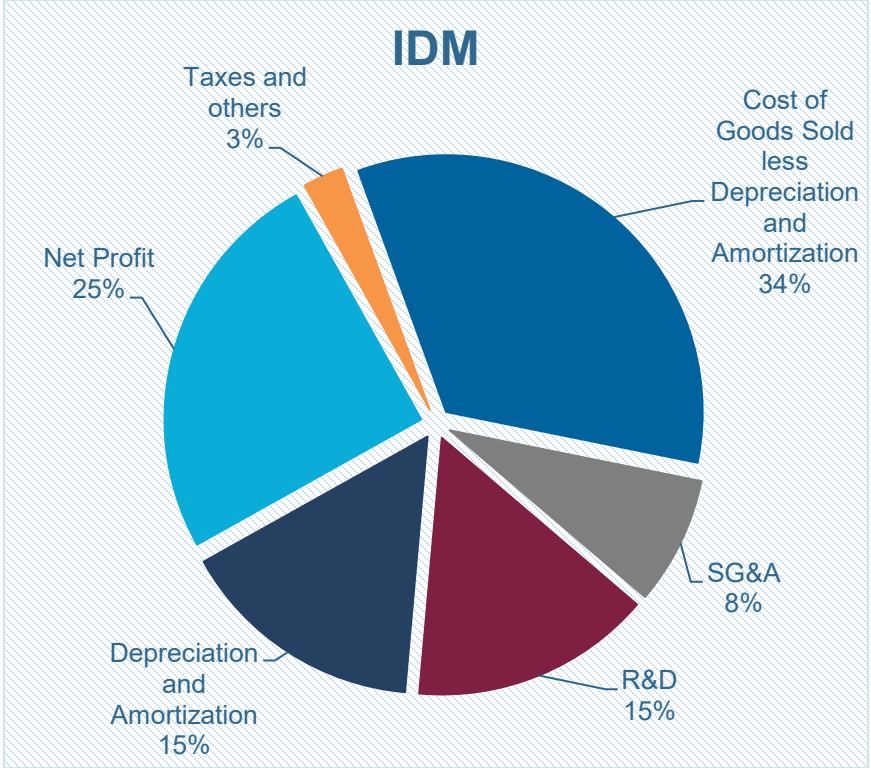


Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.
Note: Figures are rounded to the nearest tenth.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

OPERATING EXPENSES DIFFER FOR FABLESS FIRMS AND IDMS, MAINLY BECAUSE IDMS HAVE HIGHER CAPEX COSTS AND FABLESS FIRMS HAVE HIGHER R&D COSTS





Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.
Note: Figures are rounded to the nearest tenth.

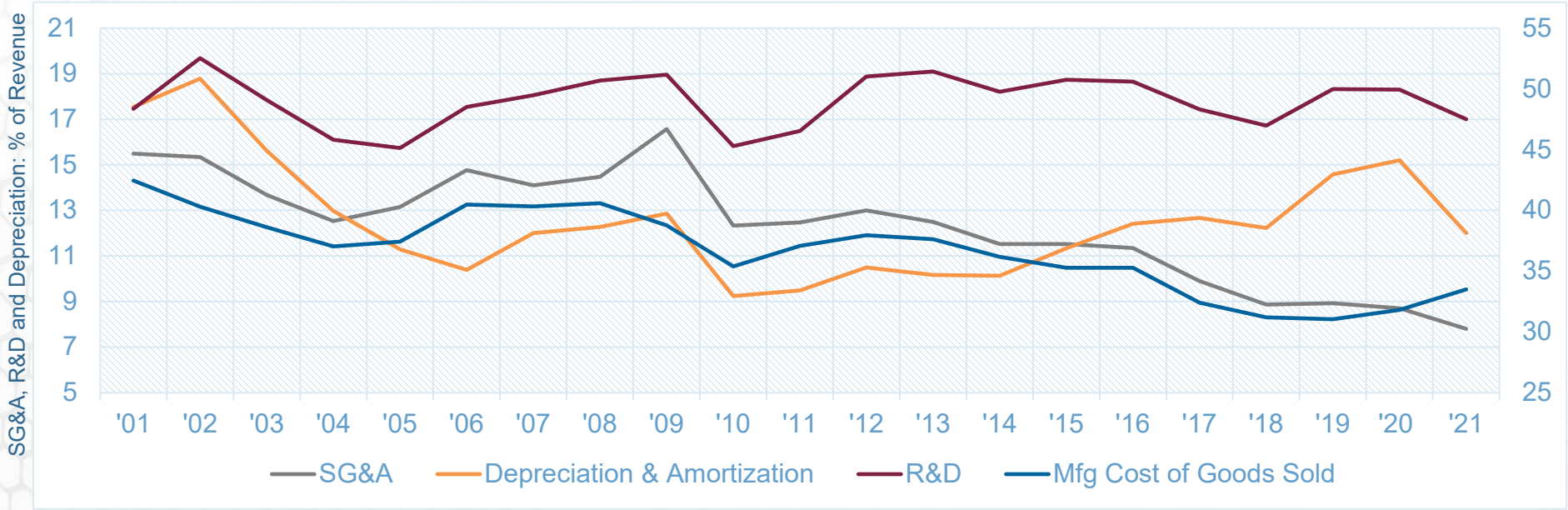
SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

MAJOR COST COMPONENTS HAVE EXHIBITED SIMILAR CYCLICAL PATTERNS AS THE INDUSTRY AS A WHOLE

The Semiconductor Industry Association has compiled data on the following four principal cost components during the 2001 to 2021 period:

- Manufacturing Cost of Goods Sold (all costs directly allocated to production, less depreciation & amortization);
- Selling, General & Administrative Expenses (SG&A);
- Research & Development Expenses; and
- Depreciation & Amortization Expenses.

As shown in the following figure, these major cost components exhibit the same cyclical pattern as the industry as a whole. In the cyclical downturn of 2019, semiconductor companies maintained their spending on R&D and Capex to sustain their long-term viability.

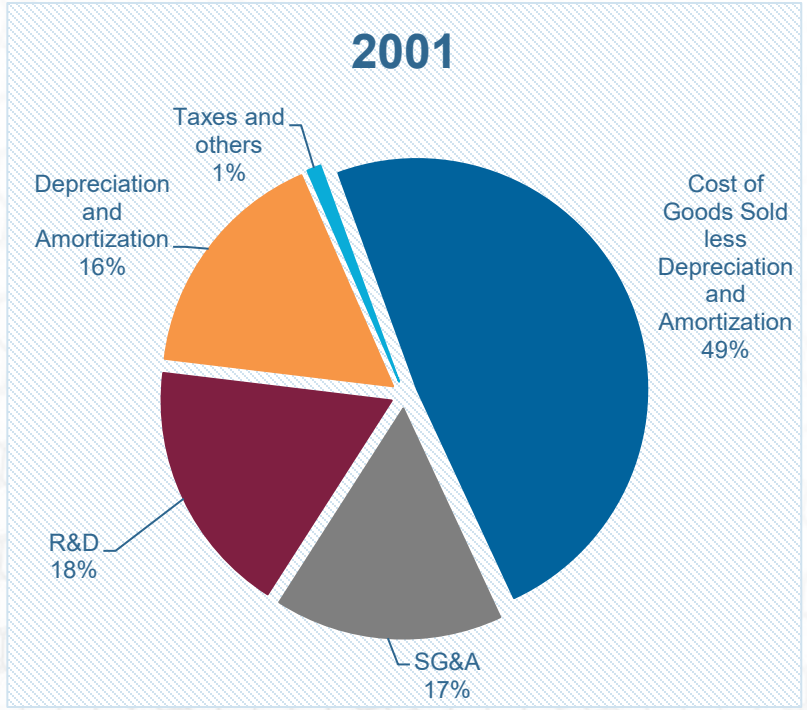


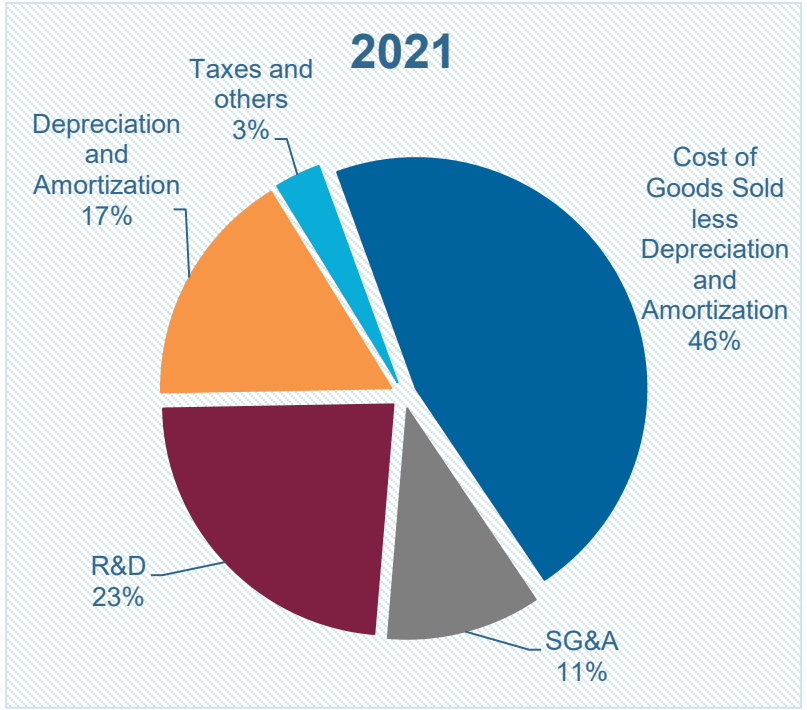
Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

THE COST STRUCTURE OF U.S.-BASED SEMICONDUCTOR PRODUCERS HAS CHANGED SLIGHTLY SINCE 2001

Approximately 63 percent of total expenditures are production-related which is slightly less than the 65 percent in 2001. Production expenditures include manufacturing costs and depreciation & amortization.





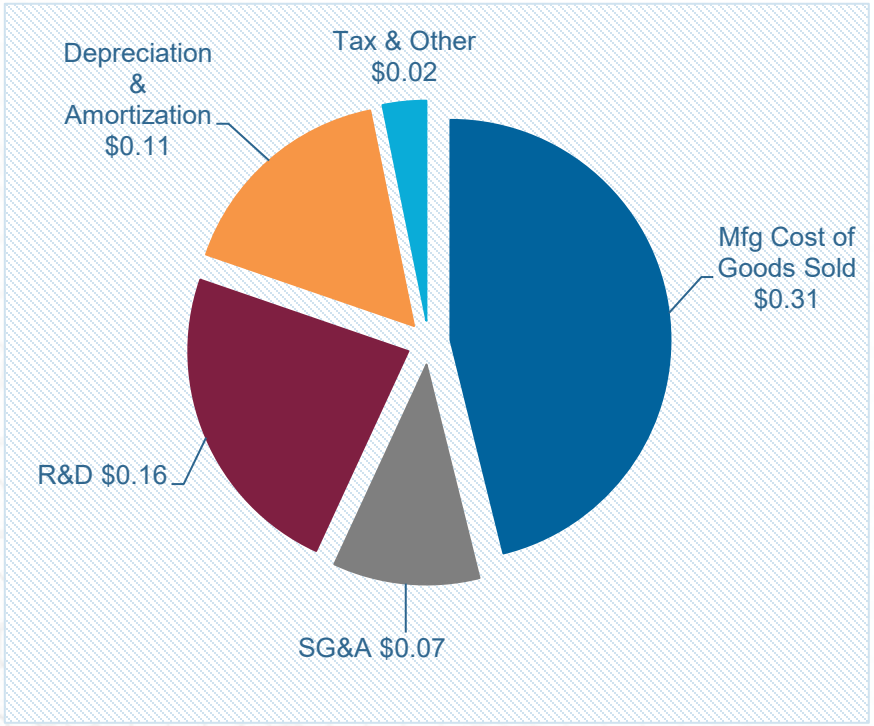
Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.
Note: Figures are rounded to the nearest tenth.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

ANNUAL INDUSTRY COST PER CHIP SOLD IN 2021 TOTALED $0.68

On average, each semiconductor sold by the U.S. semiconductor industry in 2021 cost only $0.68 to produce. These costs per chip were distributed among the five major cost segments as shown below. This distribution is similar to the cost distribution for total cost per semiconductor wafer starts.

Total Expenditures Per Unit of Chip Sold

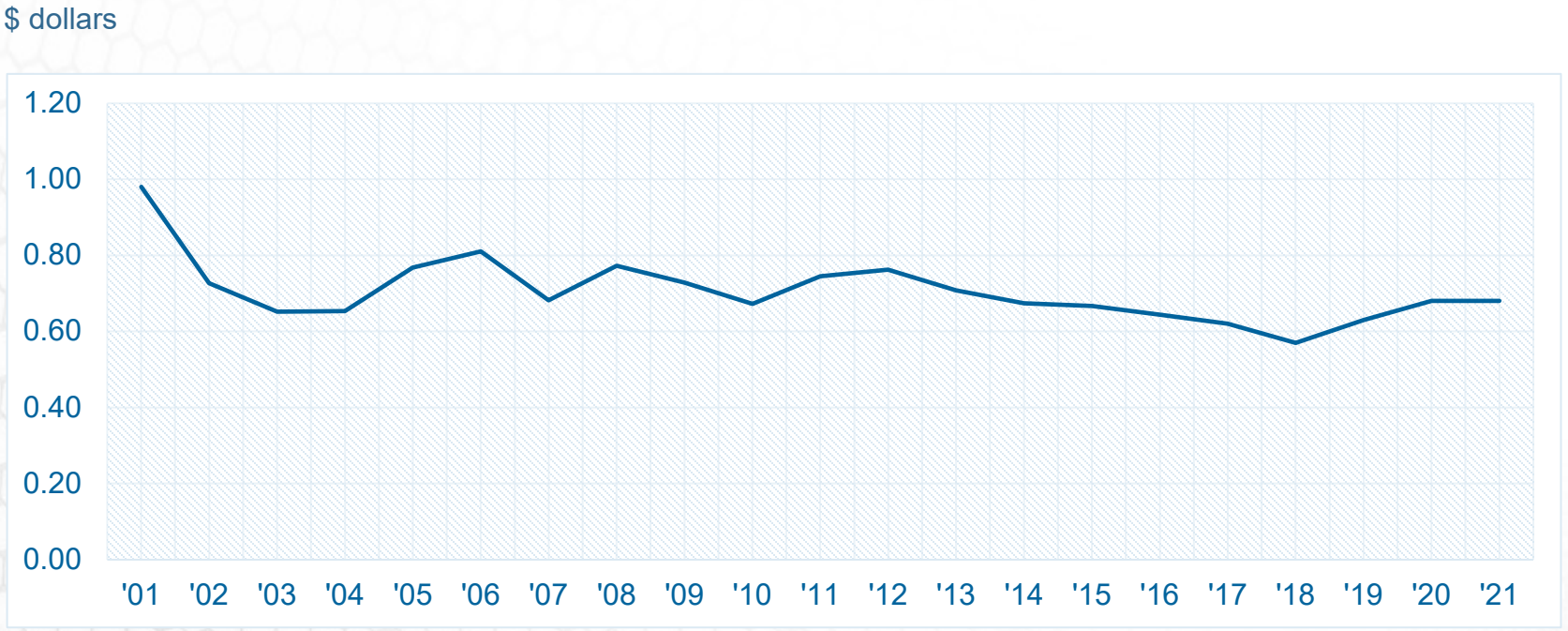


Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.
Note: Figures are rounded to the nearest tenth. Shares may not sum to total due to rounding.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

ANNUAL INDUSTRY COST PER CHIP SOLD HAS MOSTLY DECREASED SINCE 2001

Since 2001, the annual production cost per semiconductor unit has steadily declined as the U.S. semiconductor industry has improved production efficiencies. In 2001, the per unit cost was $0.98, while in 2021 it was $0.68. During this time, there have been fluctuations in the annual costs per semiconductor, which reflects volatility in the market during this period. It should also be noted that the cost per transistor, the basic building block of all semiconductors, has decreased at a much steeper rate over this time than the cost per chip. As the cost per transistor has decreased and the number of transistors per chip has increased, this has meant consumers have benefited from more computing power from semiconductors at a decreased price.

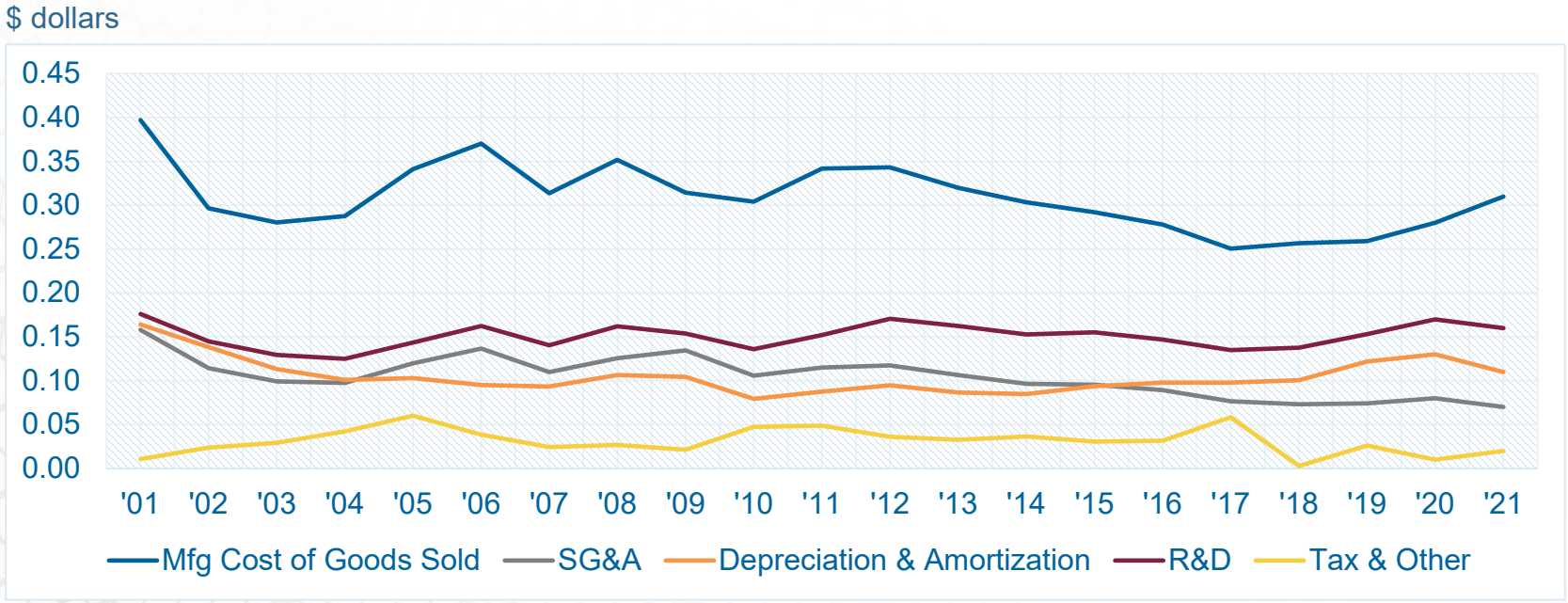


Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.
Note: Figures are rounded to the nearest tenth.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

ANNUAL INDUSTRY COST PER CHIP SOLD BY SHARE SINCE 2001 ROUGHLY REFLECTS TOTAL COST TRENDS

Since 2001, manufacturing cost of goods sold has consistently accounted for the highest share of cost in overall per unit semiconductor costs. In 2021, it accounted for 46 percent of total costs per unit, or $0.31.

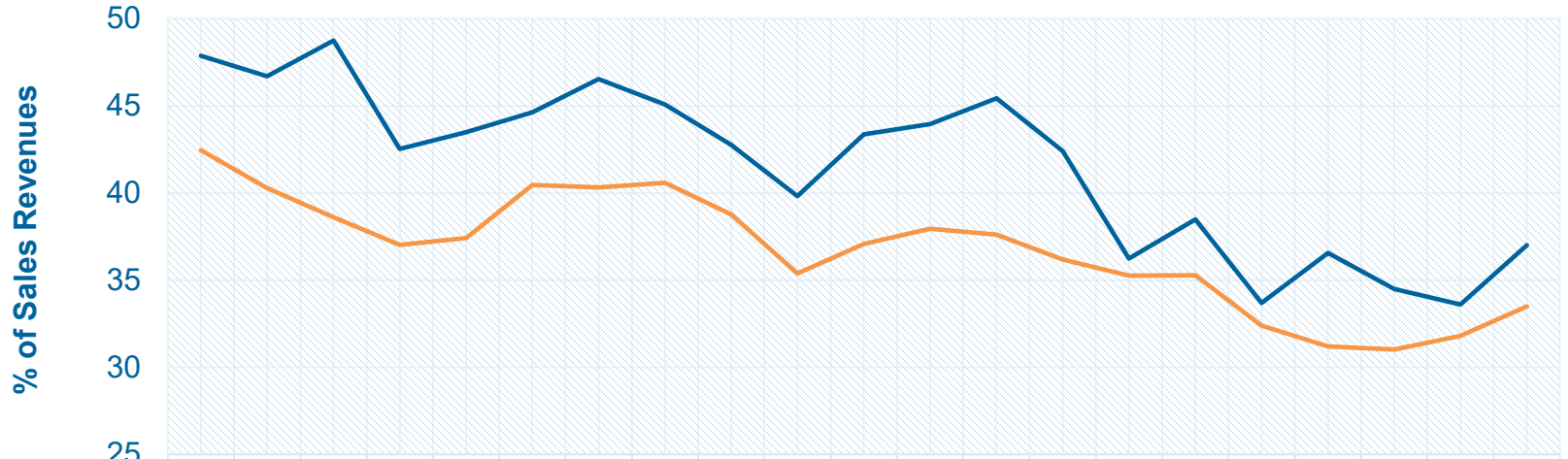


Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.
Note: Figures are rounded to the nearest 10th.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

MANUFACTURING COST OF GOODS SOLD (LESS DEPRECIATION AND AMORTIZATION) AS A PERCENT OF SALES REVENUES HAS FOLLOWED PREDICTABLE CYCLICAL PATTERNS

Manufacturing cost of goods sold as a percent of sales revenues follow predictable cyclical patterns. During periods of slow growth or recession, these expenditures have historically risen faster than sales revenues. In contrast, manufacturing cost of goods sold as a percent of sales revenue has consistently fallen sharply during periods of sustained growth. The industry median ratio usually exceeds the mean value, indicating that, in general, larger firms have a somewhat smaller ratio of manufacturing cost of goods sold to revenues. Cost of goods sold remains at very low levels historically – it remains to be seen if this is sustainable.



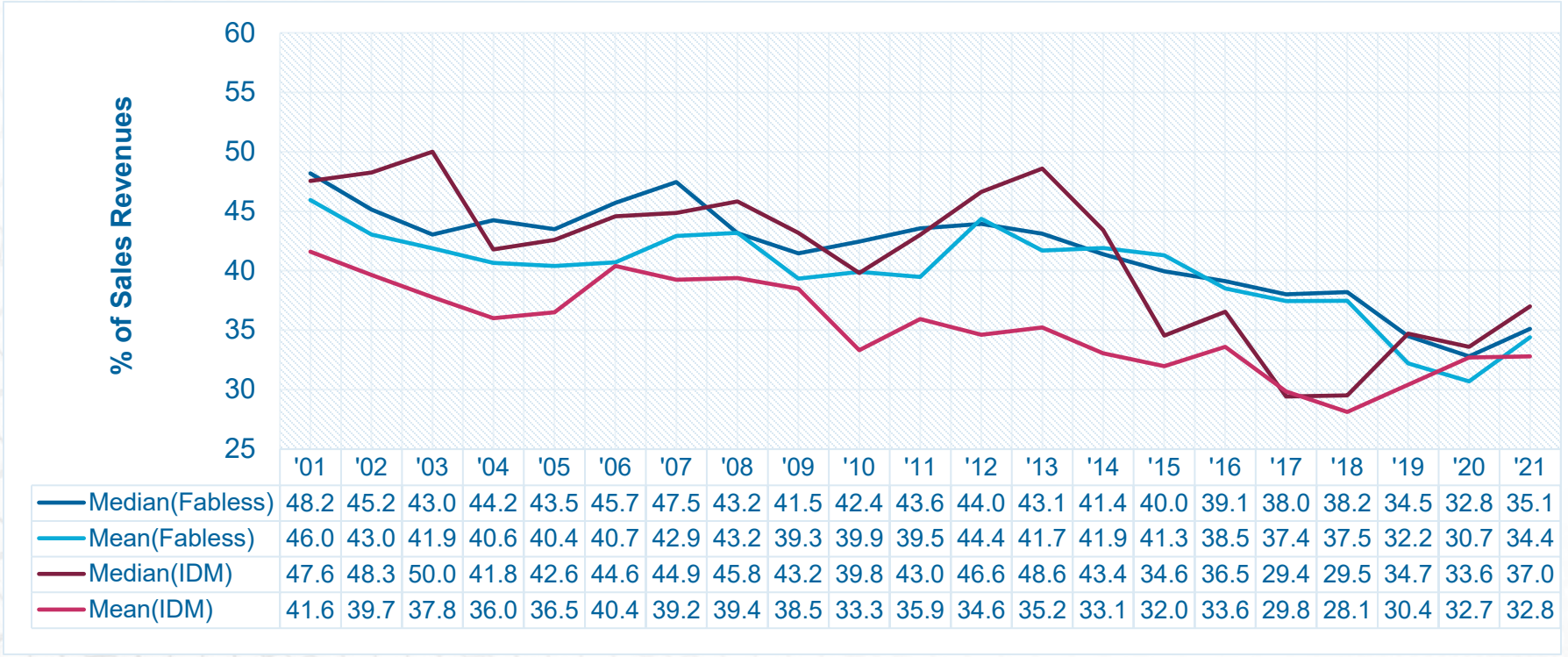
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median	47.9	46.7	48.8	42.5	43.5	44.6	46.5	45.1	42.8	39.8	43.4	44.0	45.4	42.4	36.2	38.5	33.7	36.6	34.5	33.6	37.0
Mean	42.5	40.3	38.6	37.0	37.4	40.5	40.3	40.6	38.8	35.4	37.1	38.0	37.6	36.2	35.3	35.3	32.4	31.2	31.0	31.8	33.5

Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

MANUFACTURING COST OF GOODS SOLD (LESS DEPRECIATION AND AMORTIZATION) AS A PERCENT OF SALES REVENUES DIFFER FOR FABLESS FIRMS VS. IDMS

The table below compares the IDM median and mean with the fabless median and mean for manufacturing cost of goods sold as a percent of sales revenue.



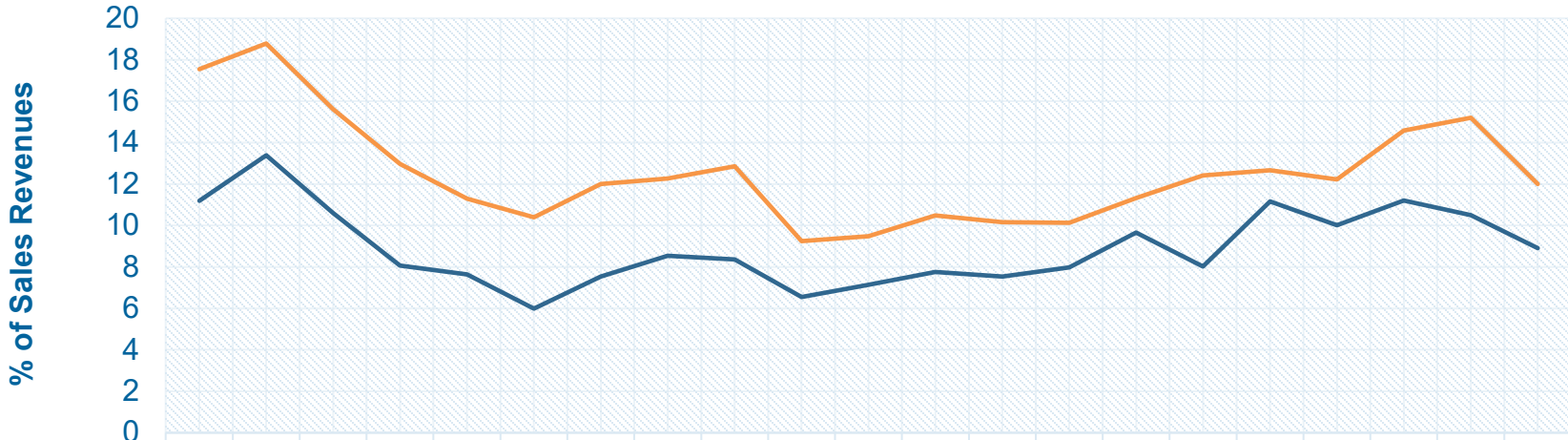
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median(Fabless)	48.2	45.2	43.0	44.2	43.5	45.7	47.5	43.2	41.5	42.4	43.6	44.0	43.1	41.4	40.0	39.1	38.0	38.2	34.5	32.8	35.1
Mean(Fabless)	46.0	43.0	41.9	40.6	40.4	40.7	42.9	43.2	39.3	39.9	39.5	44.4	41.7	41.9	41.3	38.5	37.4	37.5	32.2	30.7	34.4
Median(IDM)	47.6	48.3	50.0	41.8	42.6	44.6	44.9	45.8	43.2	39.8	43.0	46.6	48.6	43.4	34.6	36.5	29.4	29.5	34.7	33.6	37.0
Mean(IDM)	41.6	39.7	37.8	36.0	36.5	40.4	39.2	39.4	38.5	33.3	35.9	34.6	35.2	33.1	32.0	33.6	29.8	28.1	30.4	32.7	32.8

Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

DEPRECIATION AND AMORTIZATION EXPENSES AS A PERCENT OF SALES REVENUES HAVE RANGED FROM 9 TO 19 PERCENT SINCE 2001

Since 2001, average depreciation and amortization expenses as a percent of sales ranged from 9 percent to 19 percent. 2001 and 2002 depreciation expenses were driven to historic levels due to low capacity utilization. The decreases in 2003-2006 were caused by the increased productivity of 300mm fabrication facilities which have on average a 30 percent increase in throughput. Over the past 5 years, the average has ranged from 10 to 15 percent.



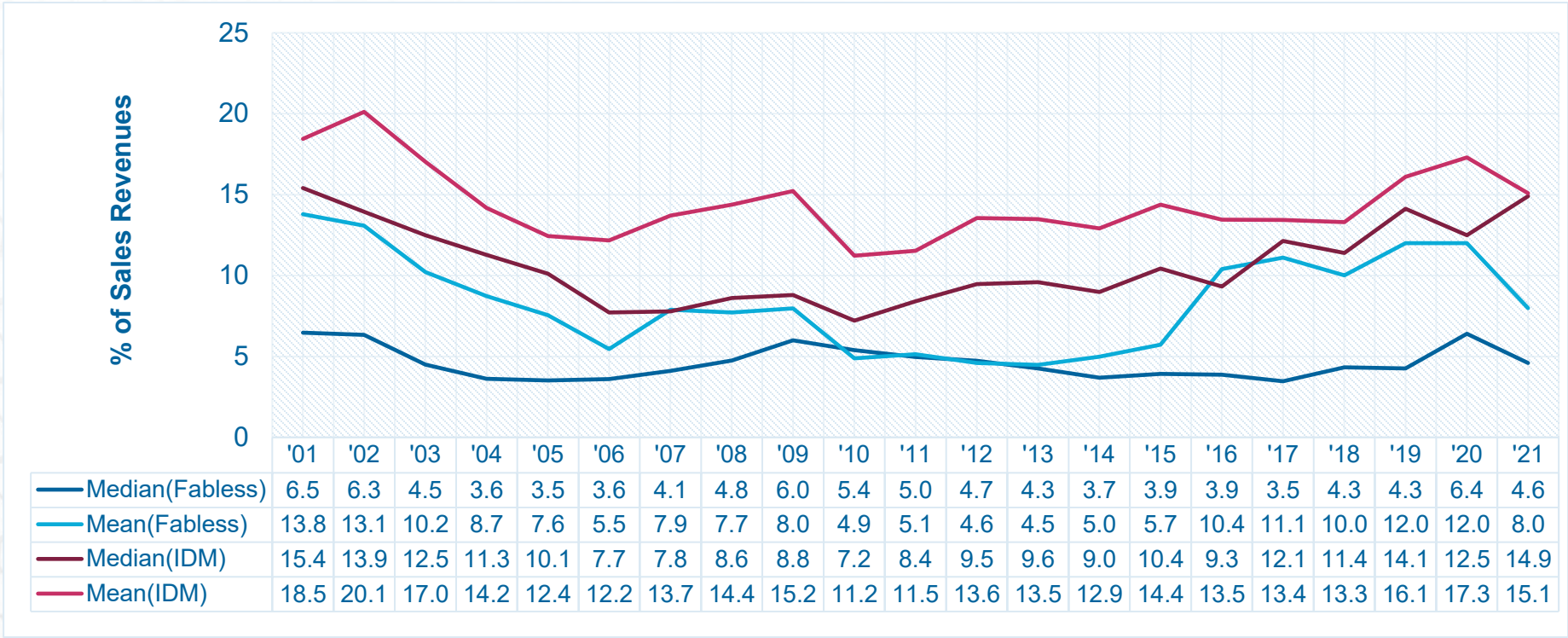
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median	11.2	13.4	10.6	8.1	7.6	6.0	7.5	8.5	8.4	6.5	7.1	7.8	7.5	8.0	9.7	8.0	11.2	10.0	11.2	10.5	8.9
Mean	17.5	18.8	15.6	13.0	11.3	10.4	12.0	12.3	12.9	9.2	9.5	10.5	10.2	10.1	11.3	12.4	12.7	12.2	14.6	15.2	12.0

Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

DEPRECIATION AND AMORTIZATION EXPENSES AS A PERCENT OF SALES REVENUES DIFFER FOR FABLESS FIRMS VS. IDMS

The table below compares the IDM median and mean with the fabless median and mean for depreciation and amortization expense as a percent of sales revenue. For both types of companies, means are higher than medians, which means there are more companies with relatively high depreciation costs than companies with low costs. The median and mean of IDM companies are higher than the median and mean of fabless firms, which indicates that IDMs have higher depreciation and amortization expenses than fabless firms, since they operate fabs while fabless firms do not.



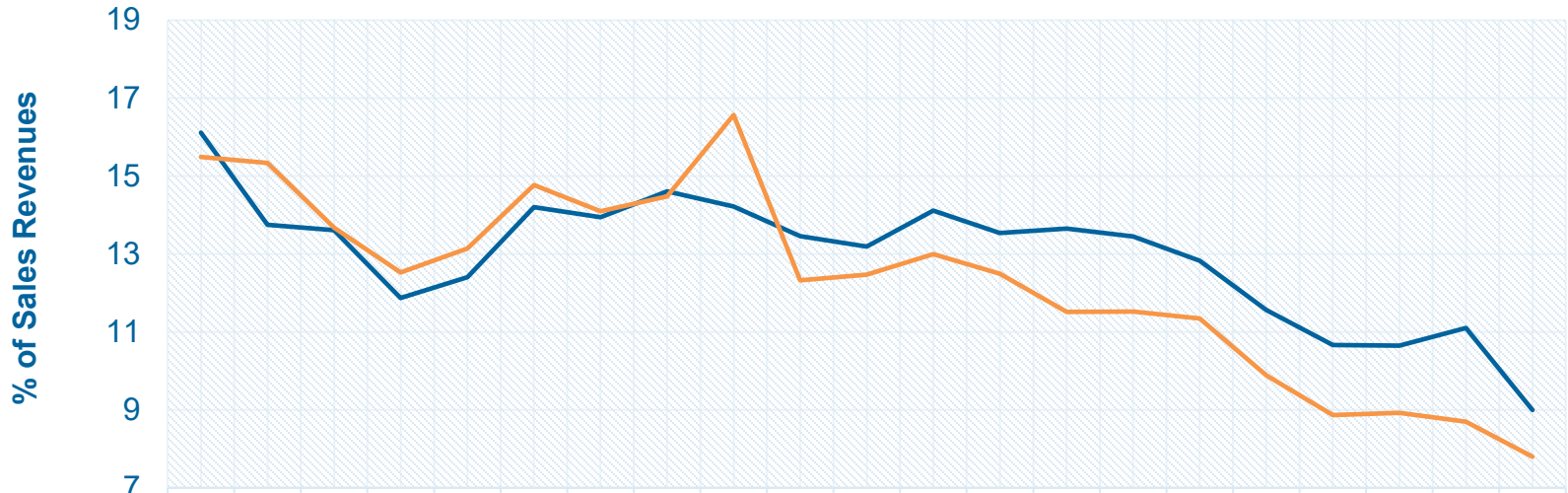
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median(Fabless)	6.5	6.3	4.5	3.6	3.5	3.6	4.1	4.8	6.0	5.4	5.0	4.7	4.3	3.7	3.9	3.9	3.5	4.3	4.3	6.4	4.6
Mean(Fabless)	13.8	13.1	10.2	8.7	7.6	5.5	7.9	7.7	8.0	4.9	5.1	4.6	4.5	5.0	5.7	10.4	11.1	10.0	12.0	12.0	8.0
Median(IDM)	15.4	13.9	12.5	11.3	10.1	7.7	7.8	8.6	8.8	7.2	8.4	9.5	9.6	9.0	10.4	9.3	12.1	11.4	14.1	12.5	14.9
Mean(IDM)	18.5	20.1	17.0	14.2	12.4	12.2	13.7	14.4	15.2	11.2	11.5	13.6	13.5	12.9	14.4	13.5	13.4	13.3	16.1	17.3	15.1

Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

SG&A COSTS AS A PERCENT OF SALES REVENUES HAVE RANGED FROM 8 TO 17 PERCENT SINCE 2001

Since 2001, SG&A costs as a percent of sales generally ranged between 8 to 17 percent, which has decreased significantly compared to the mid-1980s and has shown little cyclical fluctuation except from 2001-2003 which was an anomaly in many ways. The increase was caused by the industry downturn which started in the third quarter of 2000. The 2002 decrease was caused by aggressive expense controls in the industry, and the 2003-2004 decrease was caused by the reluctance of companies to add expense in this area despite the industry recovery. More recent decreases can be partly attributed to the trend toward industry consolidation starting in 2015.



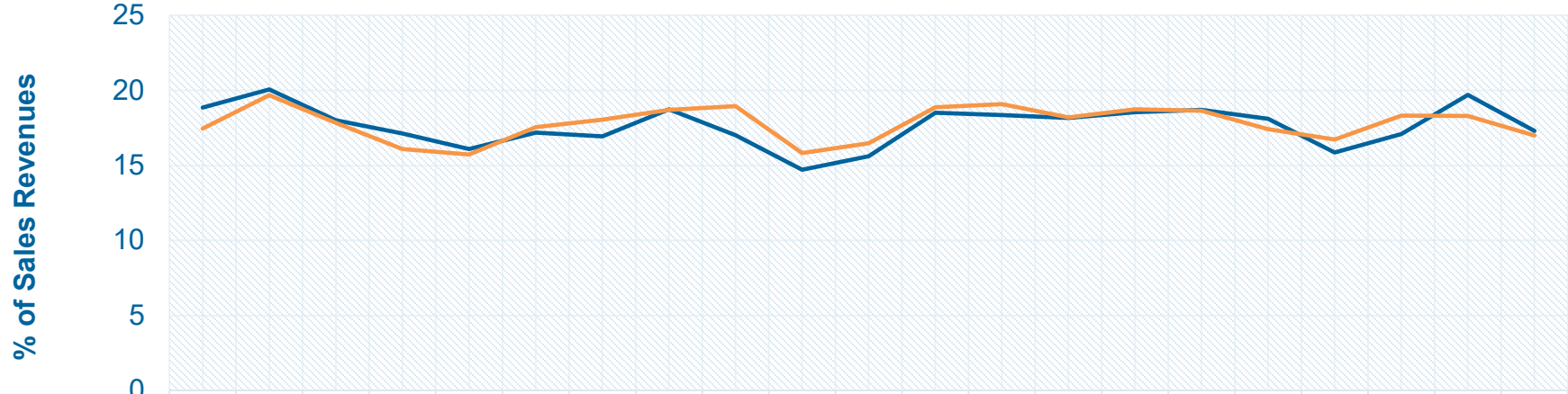
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median	16.1	13.8	13.6	11.9	12.4	14.2	13.9	14.6	14.2	13.5	13.2	14.1	13.5	13.7	13.5	12.8	11.6	10.7	10.6	11.1	9.0
Mean	15.5	15.3	13.7	12.5	13.1	14.8	14.1	14.5	16.6	12.3	12.5	13.0	12.5	11.5	11.5	11.3	9.9	8.9	8.9	8.7	7.8

Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 4: U.S. INDUSTRY BUSINESS PROFILE

ANNUAL R&D EXPENDITURES AS A PERCENT OF SALES REVENUES HAVE GENERALLY EXCEEDED 10 PERCENT OVER THE PAST 20 YEARS, AN UNPRECEDENTED RATE AMONG U.S. INDUSTRIES IN THE UNITED STATES

While R&D expenditures as a percent of sales have exhibited some cyclical fluctuations, total expenditures (measured in dollar terms) have risen at an average annual rate of over 27 percent over the period. R&D expenditures are essential to the competitive position of firms within the semiconductor industry. The rapid pace of technological change requires constant advancements in process technology and device capabilities. The increase in R&D in 2001 and 2002 was caused by companies' commitment to the future of technology despite the industry downturn. The 2003-2004 decrease was not due to a cut in R&D budgets but rather to a stronger than expected recovery in the industry which increased revenues faster than expected and R&D fell as a percentage of sales. After a decline during 2010-2011, the rate returned to 19-20 percent in 2012.



	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median	18.9	20.1	18.0	17.1	16.1	17.2	16.9	18.8	17.0	14.7	15.6	18.5	18.4	18.2	18.6	18.7	18.1	15.9	17.1	19.7	17.3
Mean	17.5	19.7	17.8	16.1	15.7	17.5	18.1	18.7	19.0	15.8	16.5	18.9	19.1	18.2	18.7	18.7	17.4	16.7	18.3	18.3	17.0

Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SEMICONDUCTOR INDUSTRY ASSOCIATION

Section 5
Capital and R&D Investment
A Driving Force in Maintaining a Competitive Semiconductor Industry

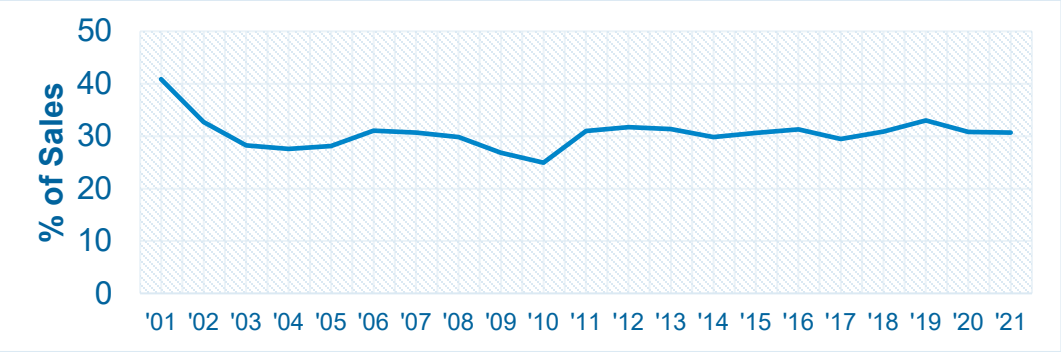
SECTION 5: CAPITAL AND R&D INVESTMENT

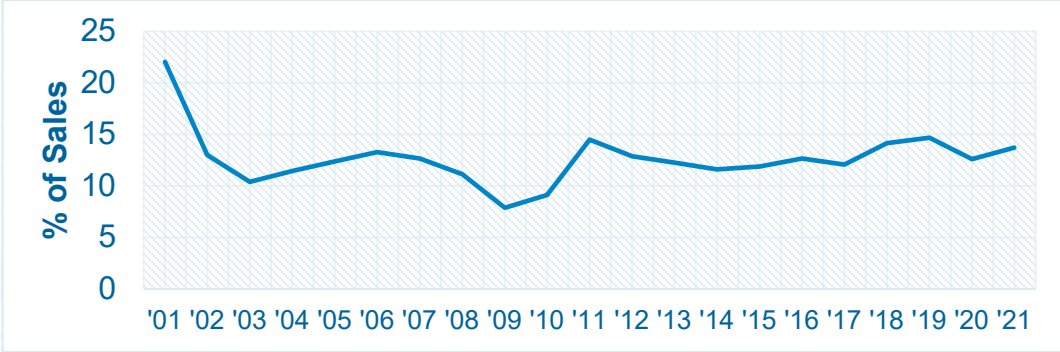
CAPITAL AND R&D INVESTMENT ARE CRITICAL TO MAINTAINING A COMPETITIVE SEMICONDUCTOR INDUSTRY

To remain competitive in the semiconductor industry, firms must continually invest a significant share of revenues in both R&D and new plants and equipment. The pace of technological changes in the industry requires that companies develop more complex process technology and introduce production machinery capable of manufacturing components with smaller feature sizes. The ability to produce state-of-the-art semiconductor components can only be maintained through a continual commitment to keeping pace with industry-wide investment rates of roughly 30 percent of sales. The need to stay on the leading edge of technology has resulted in some extreme fluctuations in years such as 2001, when sales declined precipitously, but expenditures on R&D and capital equipment did not decline at the same rate.

CAPITAL EXPENDITURE RATES

The U.S.-based semiconductor industry had annually spent between 8 and 20 percent of sales revenues to purchase new property, plant, and equipment (again, the spike in 2001 was an anomaly as sales fell sharply). The number has decreased over time as more companies outsource to foundries for wafer fabrication. Typically, three-fourths of capital expenditure outlay are targeted for new machinery and equipment.





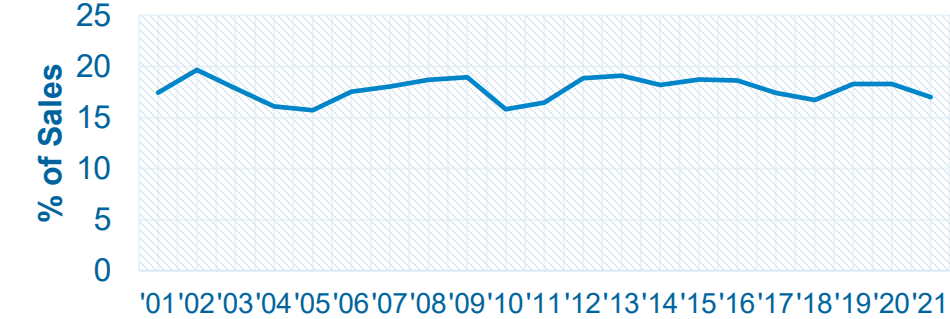
Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

THE U.S. SEMICONDUCTOR INDUSTRY R&D SPENDING RATE IS AMONG THE HIGHEST OF ANY U.S. INDUSTRY

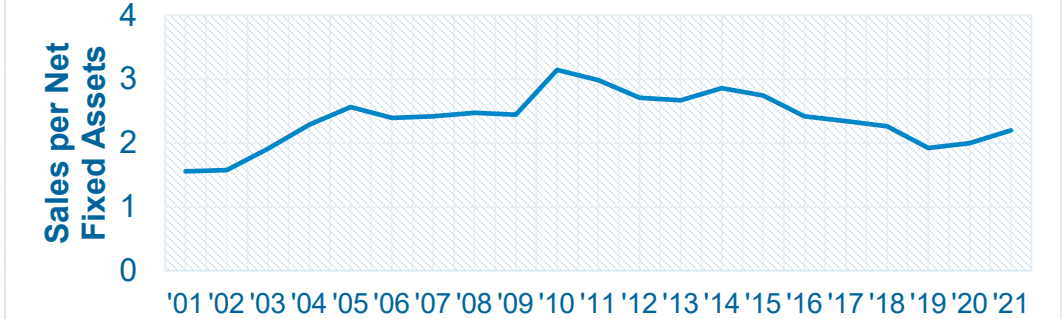
RESEARCH AND DEVELOPMENT SPENDING

The U.S.-based semiconductor industry's expenditures for R&D have exceeded 15 percent of revenues every year since 2001. This rate of spending is virtually unsurpassed by other "high tech" sectors of the U.S. economy.



ASSET TURNOVER RATES

Asset turnover rates have slowed markedly since 1995. In the early 1990s, each dollar of net fixed assets generated more than $2.00 in sales revenue. By 1999, the asset turnover rate fell to below $2.00. When viewed over the 1995-2000 period, turnover rates appear to have stabilized. 2001 and 2002 both saw a major decline because of the industry downturn, but in 2005, the industry experienced a return. In 2010, this rate exceeded $3.00, a level not seen in 10 years.

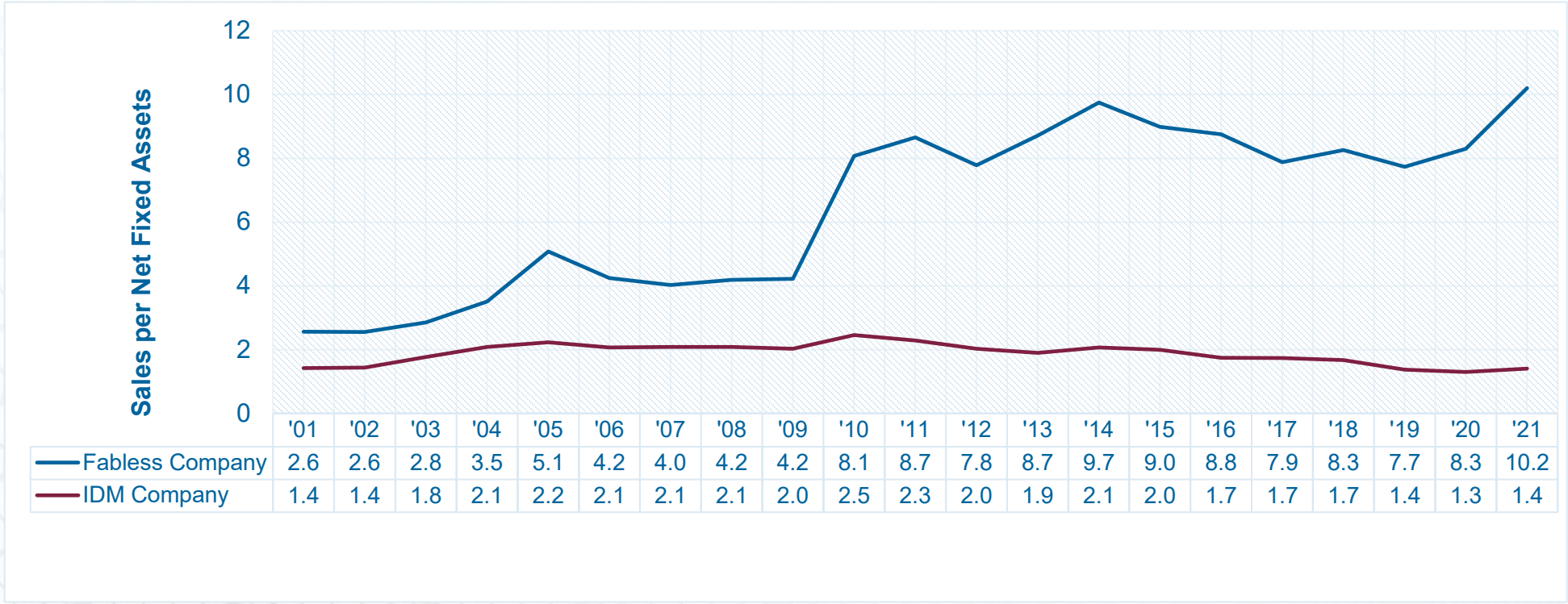


Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

ASSET TURNOVER RATES DIFFER FOR FABLESS FIRMS VS. IDMS

The asset turnover rates of IDMs have stabilized over the 2001-2021 period, since companies cut down on capital investments during downturn years to reduce costs while increasing investments during upturns. The asset turnover rates of fabless companies are more directly impacted by revenue and the merger and acquisition activities in recent years.



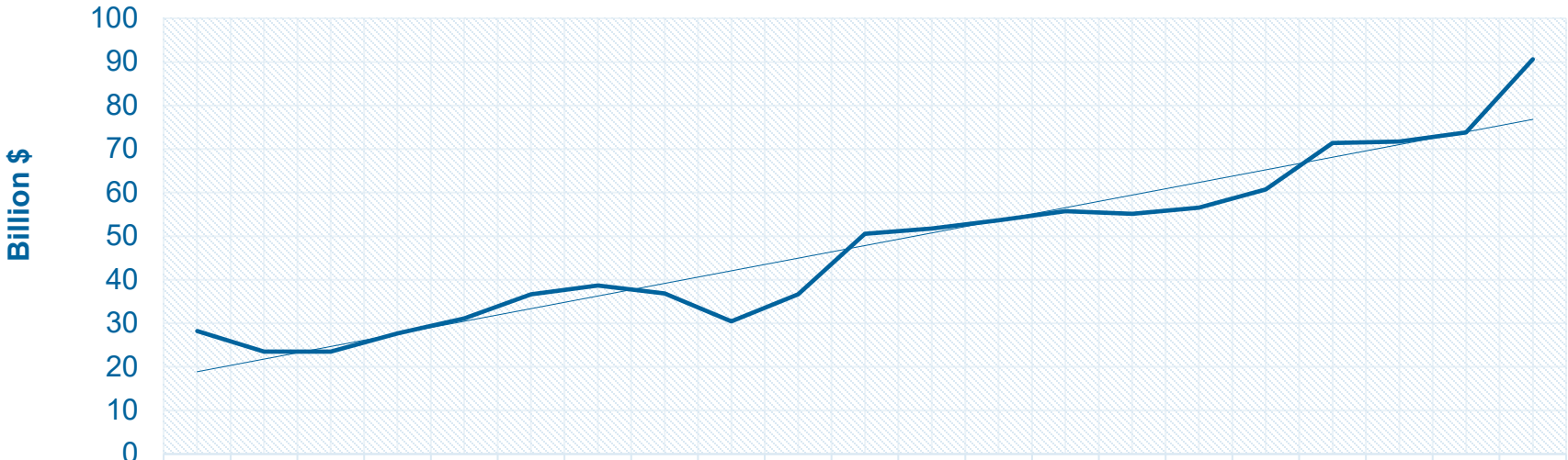
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Fabless Company	2.6	2.6	2.8	3.5	5.1	4.2	4.0	4.2	4.2	8.1	8.7	7.8	8.7	9.7	9.0	8.8	7.9	8.3	7.7	8.3	10.2
IDM Company	1.4	1.4	1.8	2.1	2.2	2.1	2.1	2.1	2.0	2.5	2.3	2.0	1.9	2.1	2.0	1.7	1.7	1.7	1.4	1.3	1.4

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

TOTAL ANNUAL LEVELS OF INVESTMENT IN CAPITAL AND R&D ARE HIGH FOR THE INDUSTRY

Total R&D and capital expenditures by U.S. semiconductor firms including fabless companies was $90.6 billion in 2021, a record high due to efforts to expand capacities and develop products driven by the increasing demand for semiconductors. During the 2001 to 2021 period, the compound annual growth rate was 5.72 percent. Investment levels in dollar terms have not been subject to fluctuations associated with the Silicon Cycle.



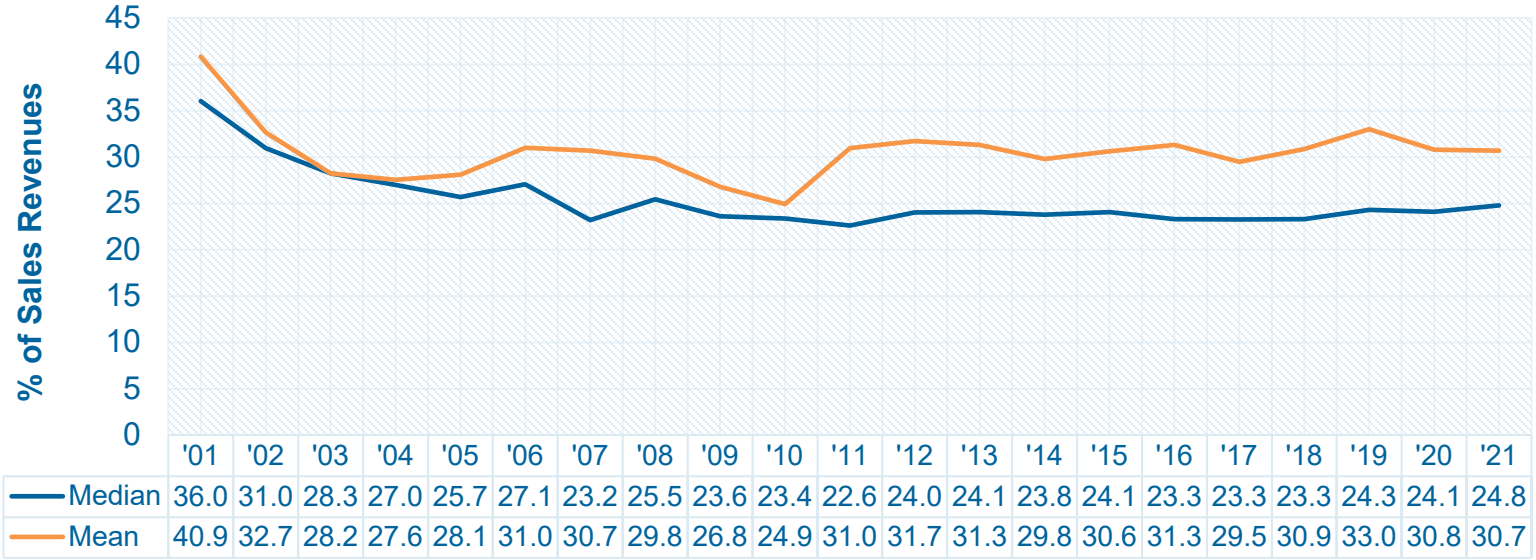
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	'21
Billion $	28.2	23.5	23.5	27.7	31.1	36.7	38.7	36.9	30.5	36.6	50.5	51.8	53.7	55.7	55.1	56.5	60.8	71.4	71.7	73.8	90.6

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U,S, SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

THE TOTAL RATE OF INVESTMENT IN CAPITAL AND R&D TENDS TO REMAIN HIGH DURING MARKET UPTURNS AND DOWNTURNS

Over the past ten years, the median U.S. semiconductor industry investment in gross capital expenditures and R&D outlays has ranged between 20-30 percent of sales revenues. Market cycles drive swings in investment levels relative to sales – however, investments in the future continue to be strong in dollar terms.



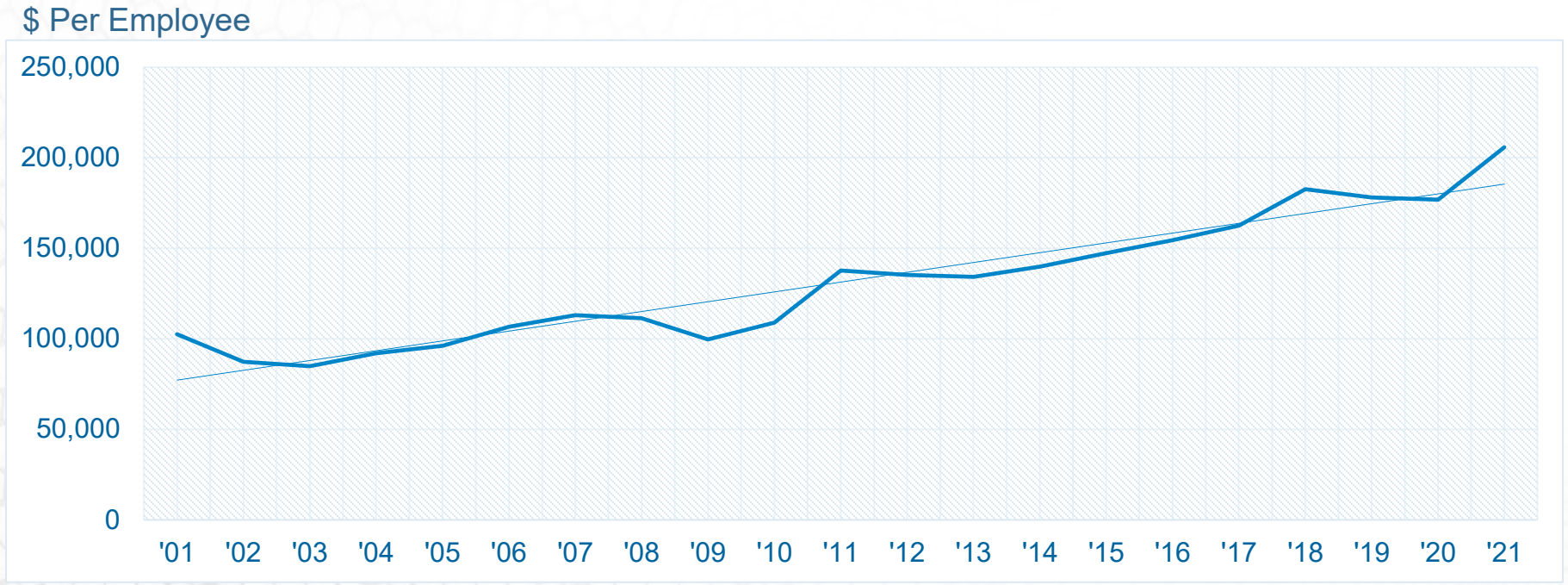
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median	36.0	31.0	28.3	27.0	25.7	27.1	23.2	25.5	23.6	23.4	22.6	24.0	24.1	23.8	24.1	23.3	23.3	23.3	24.3	24.1	24.8
Mean	40.9	32.7	28.2	27.6	28.1	31.0	30.7	29.8	26.8	24.9	31.0	31.7	31.3	29.8	30.6	31.3	29.5	30.9	33.0	30.8	30.7

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

INVESTMENT IN CAPITAL EXPENDITURES AND R&D PER EMPLOYEE IS VERY HIGH – IT HAS INCREASED AT A RATE OF ABOUT 5 PERCENT PER YEAR OVER THE PAST 20 YEARS

From 2001 to 2021, total investment per employee (measured by combined R&D and new gross plant and equipment) has increased at a compound annual rate of about 5.03 percent per year. These expenditures exceeded $100K in 2001 but declined to roughly $85K in 2003 after the 2001 downturn. Investment per employee increased to over $100K in 2006. The 2008-2009 recession resulted in a decline of investment per employee in 2009, but investment per employee returned in 2010, reached an unprecedented level in 2018, dropped slightly in 2019 and 2020, and climbed up to a record high in 2021.

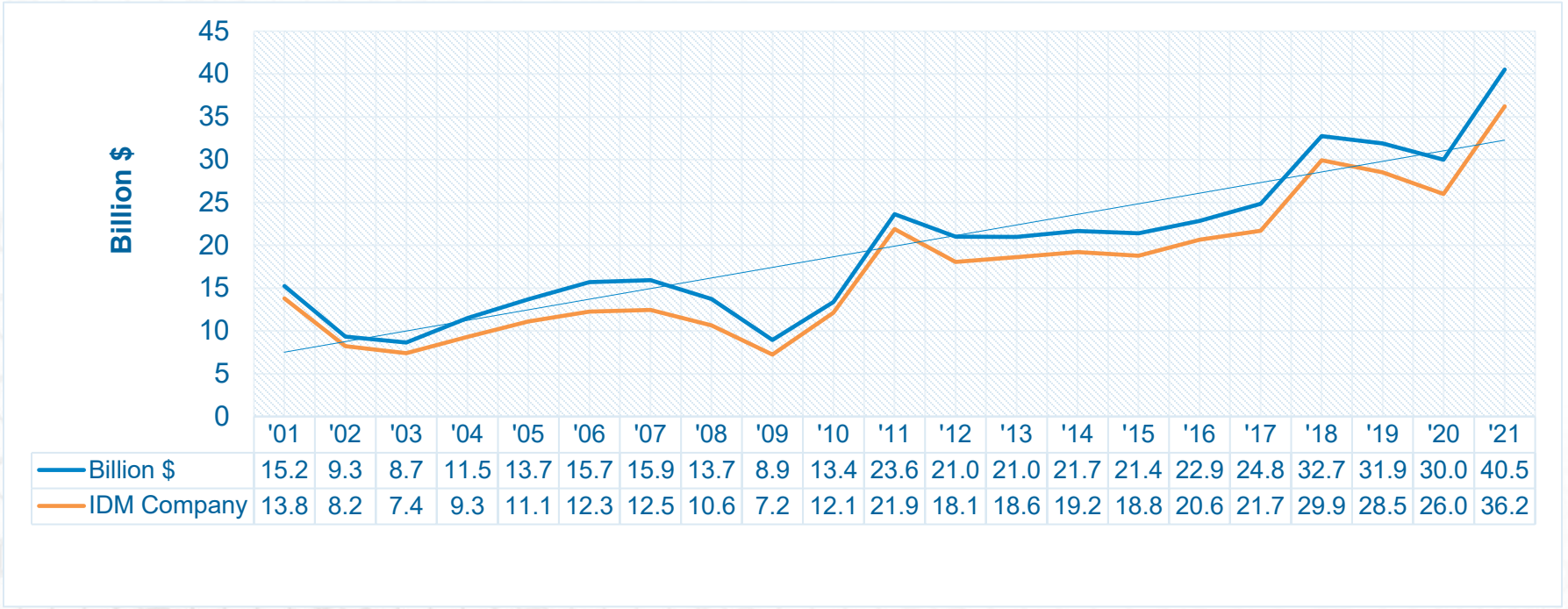


Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

U.S. SEMICONDUCTOR INDUSTRY CAPITAL EXPENDITURES REACHED RECORD HIGH IN 2021

U.S. semiconductor industry gross capital expenditures grew at a compound annual growth rate of approximately 5.0 percent during the 2001 to 2021 period. Capital expenditures declined over the 2001-2003 period due both to the completion of major new facilities during the 1999 - 2001 period and outsourcing to foundries. 2004 saw a rebound and in 2005 the industry was in a balanced position in terms of capital expenditures as a percentage of sales. In 2021, capital expenditures reached a record high.



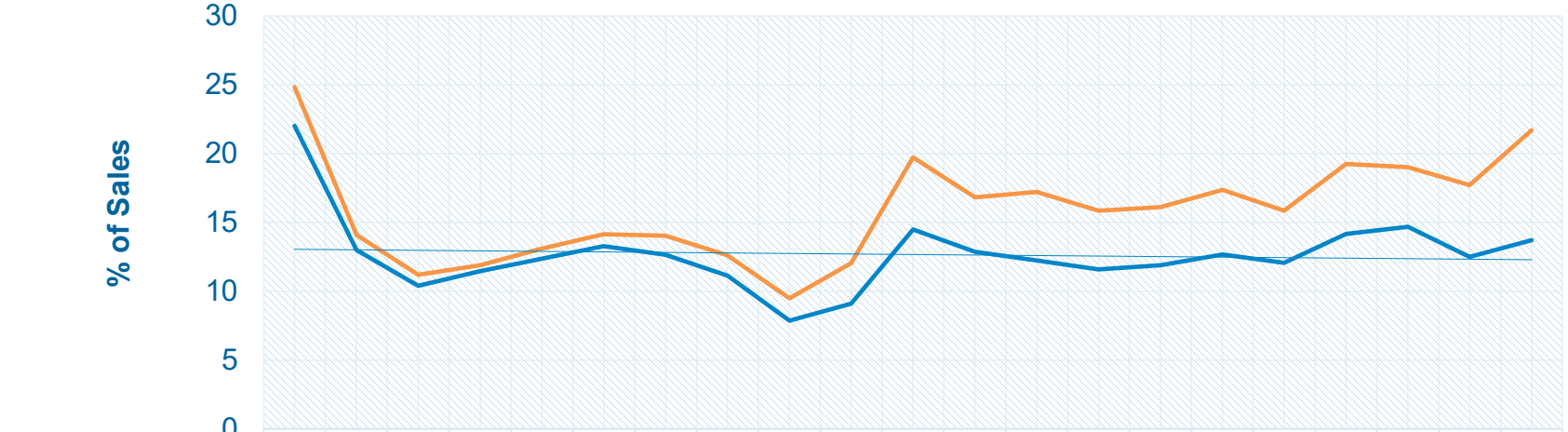
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Billion $	15.2	9.3	8.7	11.5	13.7	15.7	15.9	13.7	8.9	13.4	23.6	21.0	21.0	21.7	21.4	22.9	24.8	32.7	31.9	30.0	40.5
IDM Company	13.8	8.2	7.4	9.3	11.1	12.3	12.5	10.6	7.2	12.1	21.9	18.1	18.6	19.2	18.8	20.6	21.7	29.9	28.5	26.0	36.2

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

CAPITAL EXPENDITURES AS A PERCENT OF SALES REVENUES HAVE HISTORICALLY BEEN VERY HIGH

The U.S. semiconductor industry historically devoted between 10 and 20 percent of sales revenues to gross purchases of property, plant, and equipment, but this number is strongly influenced by cyclical industry trends. 2002 was the beginning of a downward trend in spending for U.S. integrated device manufacturers, as many companies began outsourcing more wafer fabrication rather than build new multi-billion dollar facilities. Capital expenditures picked up to 14.5 percent in 2011 but slightly decreased annually until 2018-2019 when the rate returned to the 14 percent level. 2021 saw capex as a percent of sales increase to 13.7 percent.



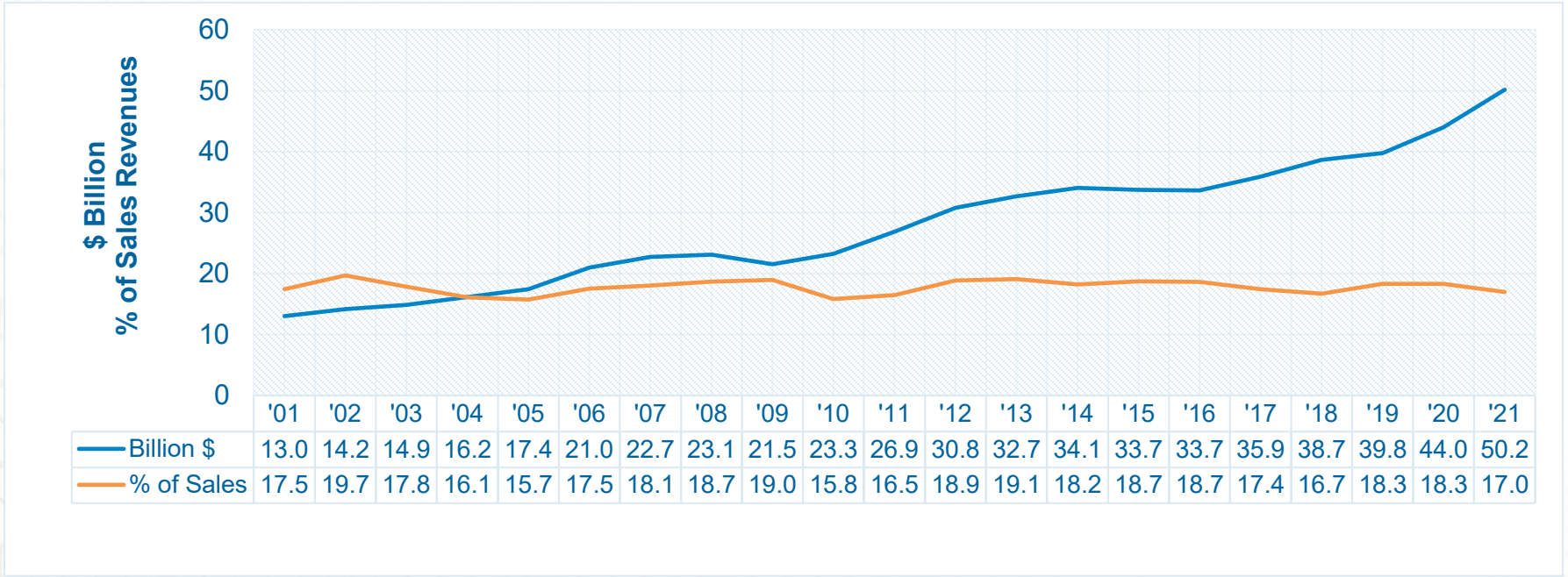
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Gross	22.0	13.0	10.4	11.5	12.4	13.3	12.6	11.1	7.9	9.1	14.5	12.9	12.2	11.6	11.9	12.7	12.1	14.2	14.7	12.5	13.7
IDM Company	24.8	14.1	11.2	11.9	13.1	14.1	14.0	12.6	9.5	12.0	19.7	16.8	17.2	15.9	16.1	17.4	15.9	19.3	19.0	17.7	21.7

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

SEMICONDUCTOR INDUSTRY R&D EXPENDITURES TRENDS ARE HIGHLY COUNTERCYCLICAL

R&D expenditures by U.S. semiconductor firms follow predictable cyclical patterns. As shown below, the rate of R&D spending is highly countercyclical -- rising during the trough of the cycle and decreasing as the cycle peaks.



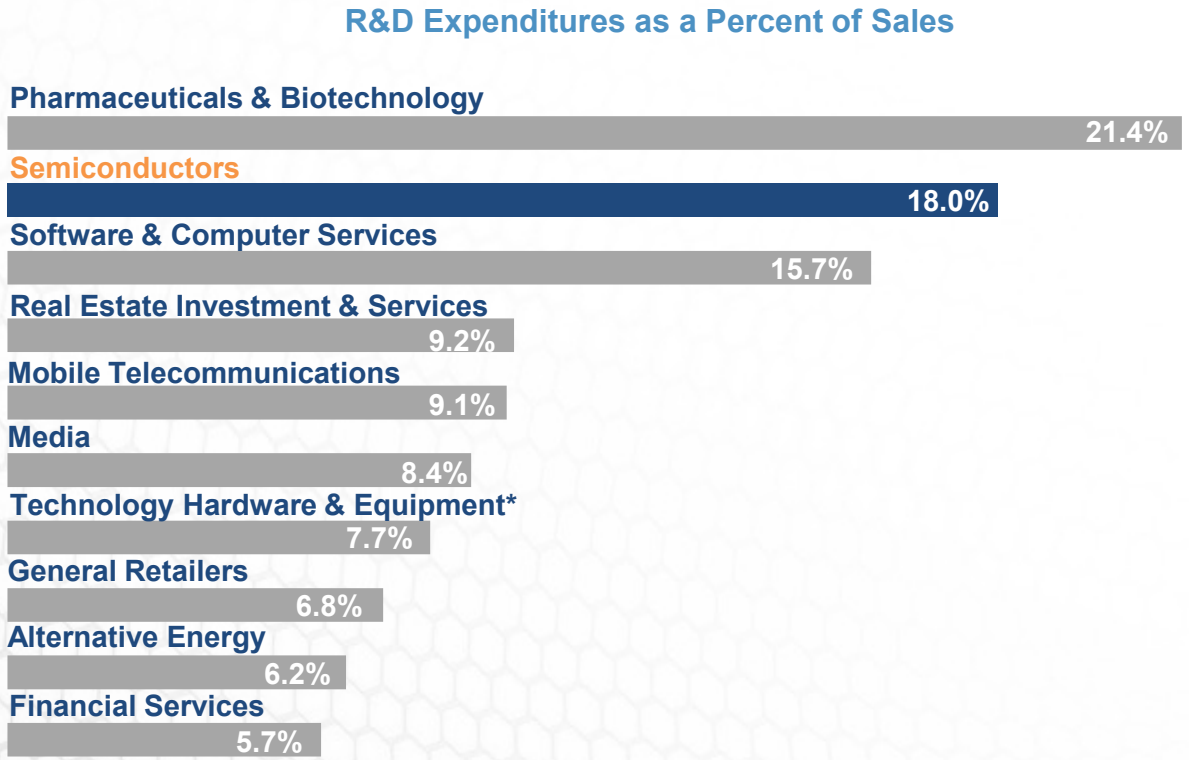
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Billion $	13.0	14.2	14.9	16.2	17.4	21.0	22.7	23.1	21.5	23.3	26.9	30.8	32.7	34.1	33.7	33.7	35.9	38.7	39.8	44.0	50.2
% of Sales	17.5	19.7	17.8	16.1	15.7	17.5	18.1	18.7	19.0	15.8	16.5	18.9	19.1	18.2	18.7	18.7	17.4	16.7	18.3	18.3	17.0

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

THE U.S. SEMICONDUCTOR INDUSTRY IS A LEADER IN R&D SPENDING AS A PERCENT OF SALES AMONG MAJOR U.S. INDUSTRIES

The rate of U.S. semiconductor industry R&D spending is among the highest in key major high technology industrial sectors. Based on the 2021 EU Industrial R&D Investment Scoreboard, the U.S. semiconductor industry was second only to the U.S. pharmaceuticals & biotechnology industry in terms of the rate of R&D spending as a percent of sales.



Note: *Excluding semiconductors.

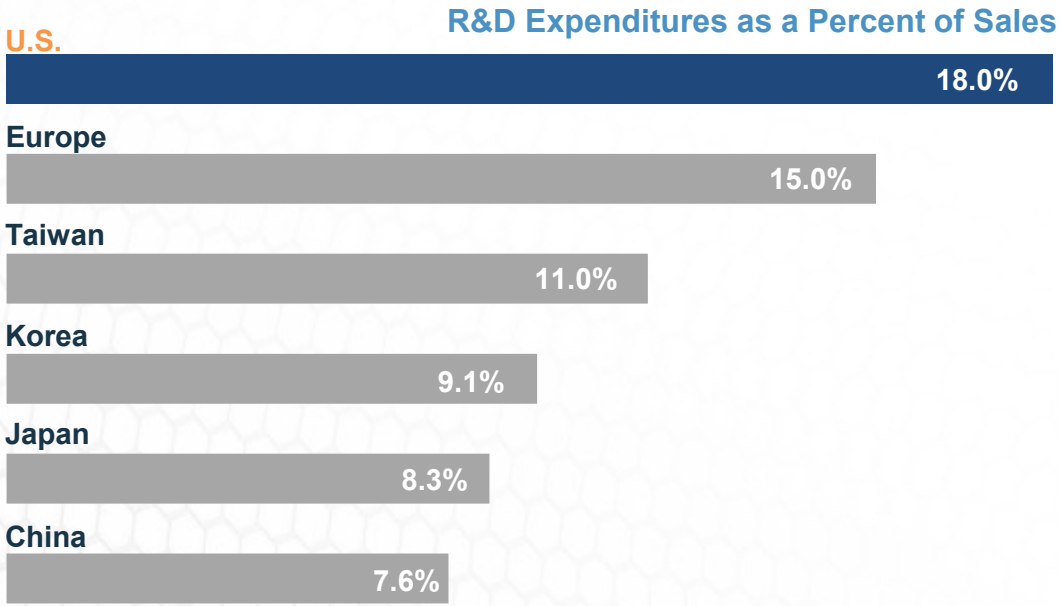
Note: Slight differences in semiconductor industry share from page 18 table due to differences in methodology and source data.

Source: The 2021 EU Industrial R&D Investment Scoreboard.

SECTION 5: CAPITAL AND R&D INVESTMENT

THE U.S. SEMICONDUCTOR INDUSTRY SPENDS MORE ON R&D AS A PERCENT OF SALES THAN ANY OTHER COUNTRY'S SEMICONDUCTOR INDUSTRY

U.S. semiconductor industry's R&D spending as a percent of sales is unsurpassed by any other country's semiconductor industry.

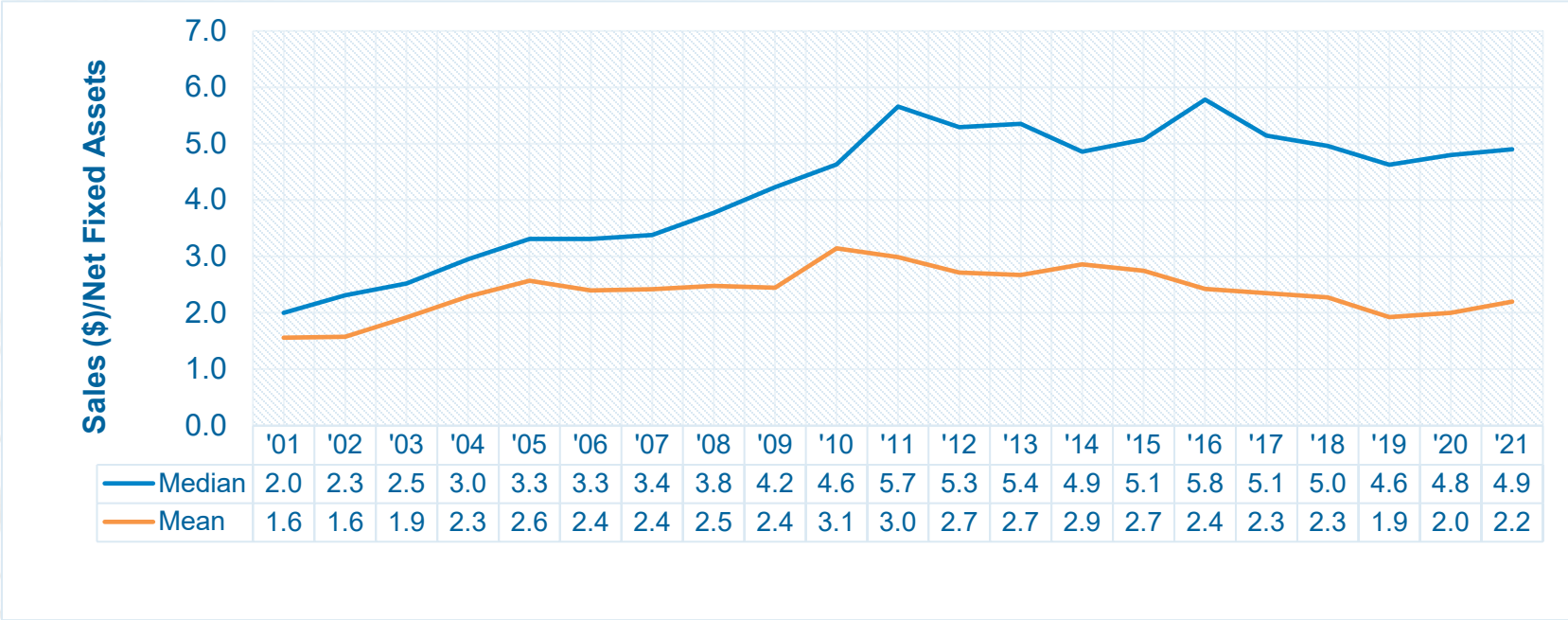


Note: Slight differences in semiconductor industry share from page 18 table due to differences in methodology and source data.
Source: The 2021 EU Industrial R&D Investment Scoreboard.

SECTION 5: CAPITAL AND R&D INVESTMENT

NET FIXED ASSETS IN THE INDUSTRY HAVE RISEN FASTER THAN REVENUES

From 2001 to 2004, every dollar of net fixed assets generated annual sales revenue of between $1.60 to $2.30. Since 2005, every dollar of net fixed assets has generated annual sales revenue between $2.30 to $3.10 but declined to $2.2 in 2021. Future trends in this key ratio are uncertain. The cost of new fabrication facilities is rising rapidly, and some observers question whether revenues generated by new facilities will be adequate to maintain current turnover rates. The rate is also impacted by the percentage of manufacturing outsourced to foundries.



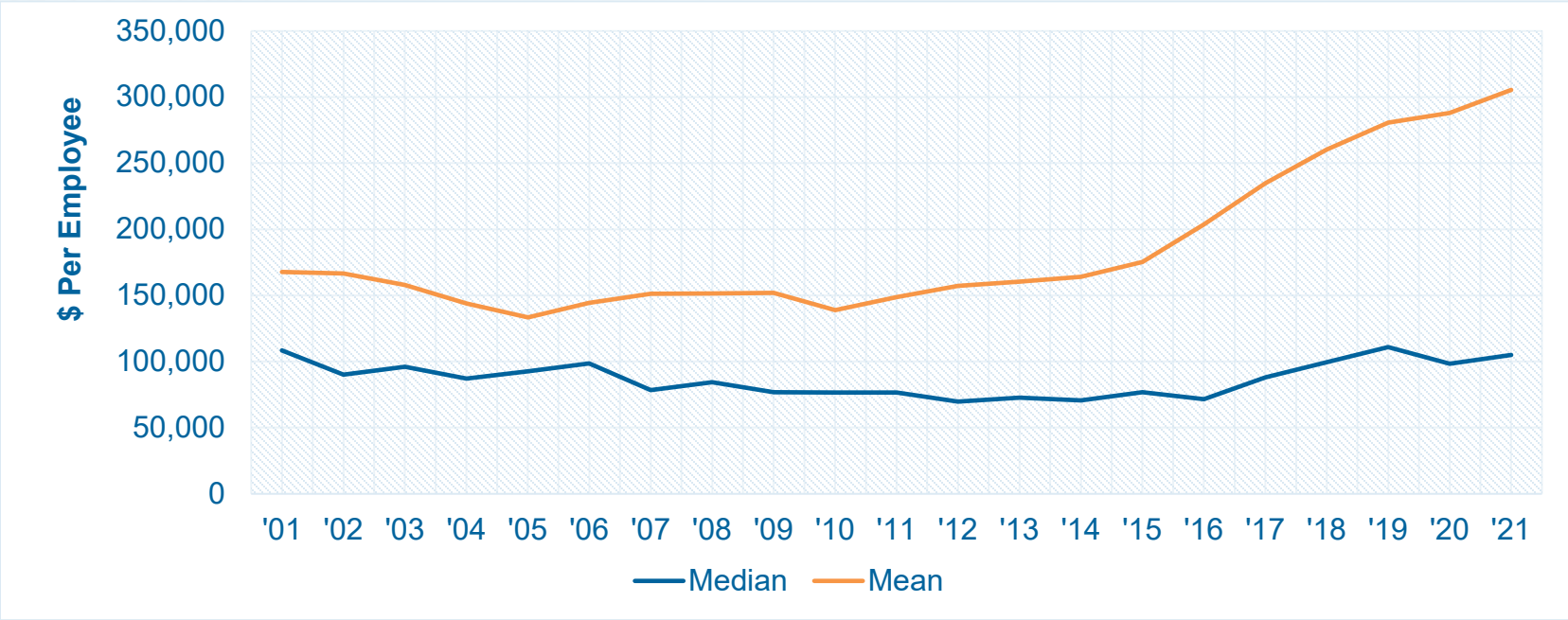
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Median	2.0	2.3	2.5	3.0	3.3	3.3	3.4	3.8	4.2	4.6	5.7	5.3	5.4	4.9	5.1	5.8	5.1	5.0	4.6	4.8	4.9
Mean	1.6	1.6	1.9	2.3	2.6	2.4	2.4	2.5	2.4	3.1	3.0	2.7	2.7	2.9	2.7	2.4	2.3	2.3	1.9	2.0	2.2

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 5: CAPITAL AND R&D INVESTMENT

EACH SEMICONDUCTOR INDUSTRY EMPLOYEE IS SUPPORTED BY OVER $305,000 IN NET FIXED ASSETS

An indicator of the increasingly capital-intensive nature of the semiconductor industry is the value of net fixed assets used to support each employee. Prior to 1980, the ratio for net fixed assets per employee was below $10,000 per employee. In 2007, over $150,000 of net fixed assets were in place per employee while in 2013, after the 2009 recession, the ratio increased to over $160,000. In 2021, the ratio reached over $305,000.



Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

Section 6
Jobs

SECTION 6: JOBS

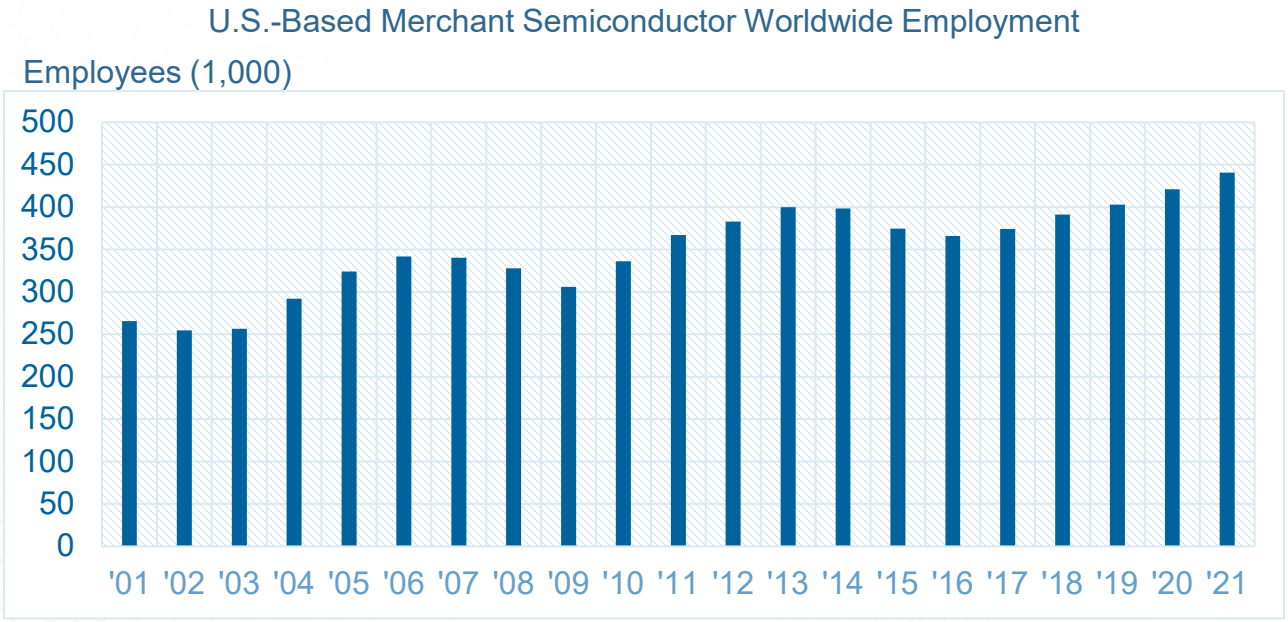
EMPLOYMENT BY U.S.-BASED SEMICONDUCTOR FIRMS HAS GROWN OVER THE LONG TERM

Perhaps more than most sectors of the world economy, the semiconductor industry is well suited to segmented manufacturing operations throughout multiple regions of the world. Typically, the majority of R&D, wafer fabrication, and related corporate overhead functions are located at a firm's national geographic base of origin. Historically, it has always been common for firms to locate more labor-intensive and less value-additive assembly, test, and packaging (ATP) operations in developing nations.

It should be noted that it is becoming increasingly common for firms to establish large wafer fabrication facilities and "design" centers in major regional markets. These facilities may serve their own regions or "trans-ship" wafers or finished devices to other regional markets.

WORLDWIDE EMPLOYMENT LEVELS

In 2021, the U.S.-based semiconductor industry employed over 440,700 workers worldwide.

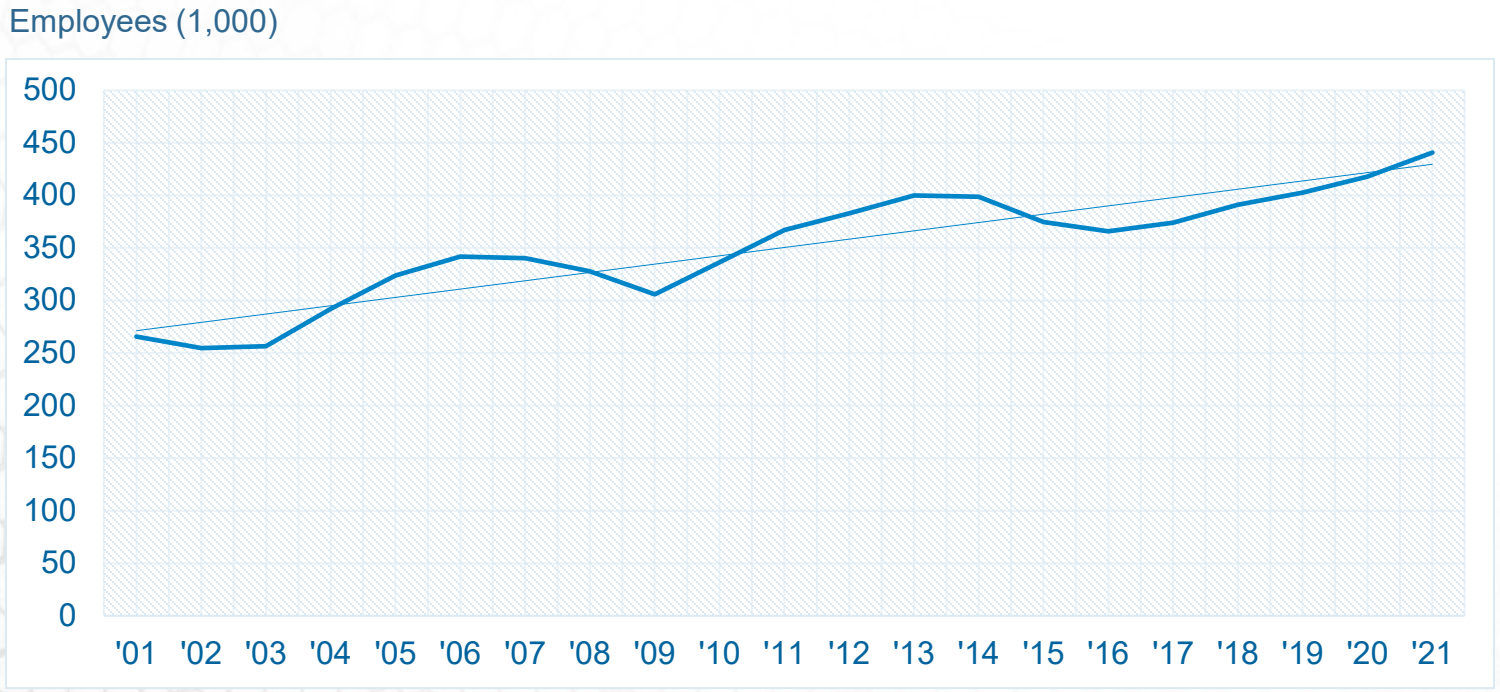


Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 6: JOBS

U.S.-BASED SEMICONDUCTOR INDUSTRY ANNUAL EMPLOYMENT LEVELS HAVE BEEN CYCLICAL

A clear cyclical pattern is evident in employment levels. During periods of rapid sales growth, labor requirements increase, which trigger a rise in industry employment levels. For example, in response to the rebound from the 2009 recession, U.S. firms increased employment substantially. Total employment in 2013 was at all-time high levels. From 2014, employment declined mainly because of industry consolidation, and in 2018 employment increased, due primarily to increased sales growth. In 2021, both sales and the employment reached an unprecedented level.



Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

SECTION 6: JOBS

THE U.S. SEMICONDUCTOR INDUSTRY ACCOUNTS FOR OVER A QUARTER OF A MILLION DIRECT JOBS IN THE UNITED STATES

The U.S. semiconductor industry accounts for over a quarter of a million direct jobs in the United States. This equates to approximately 63 percent of the total global U.S. semiconductor industry workforce being based in the United States.

277,000

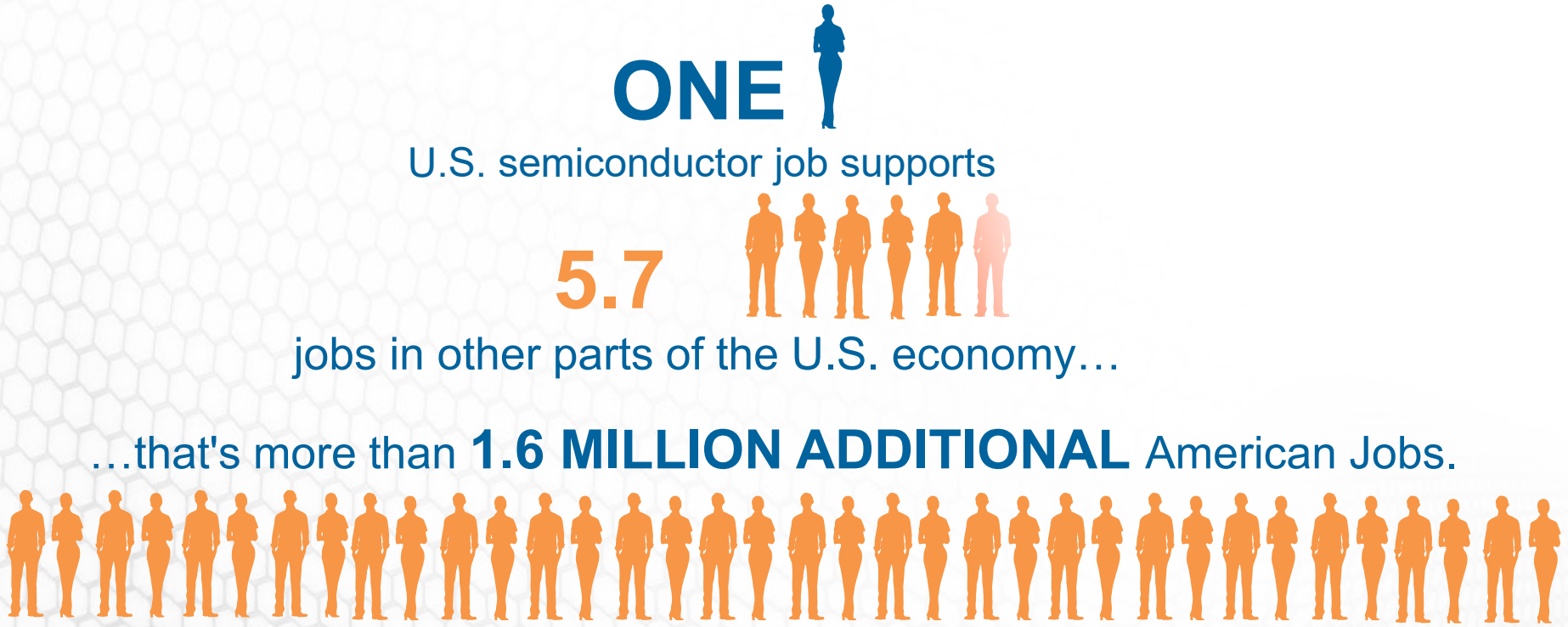
direct jobs in the U.S. semiconductor industry

Source: U.S. Bureau of Labor Statistics, Oxford Economics, and SIA Estimates.

SECTION 6: JOBS

THE U.S. SEMICONDUCTOR INDUSTRY ACCOUNTS FOR OVER 1.6 MILLION ADDITIONAL INDIRECT AND INDUCED JOBS IN THE UNITED STATES

For every semiconductor industry job in the United States, 5.7 additional indirect and induced jobs are created throughout the economy. This ratio is called the industry employment multiplier. These additional jobs are created through upstream industries that provide resources and materials to the semiconductor industry, as well as jobs created through spending by semiconductor employees in downstream sectors. This multiplier rate results in more than 1.6 million additional American jobs created by the industry.

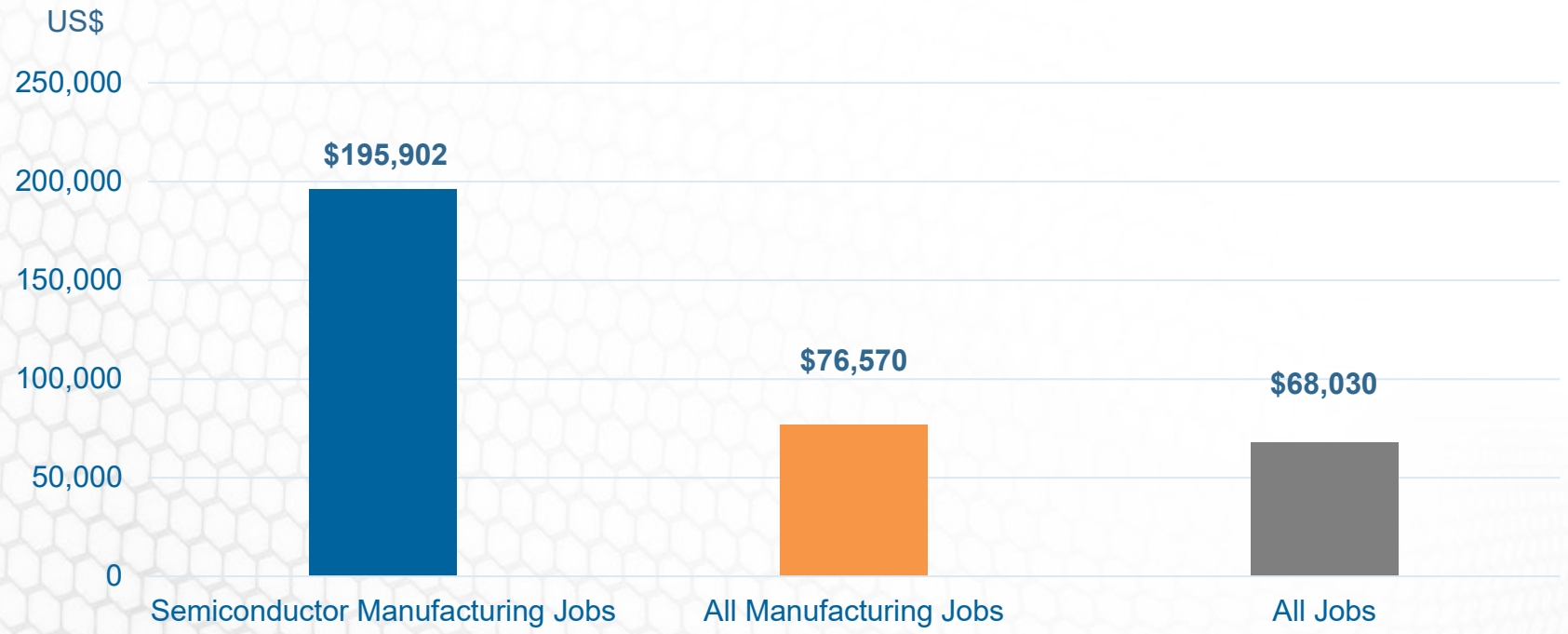


Source: U.S. Bureau of Labor Statistics, Oxford Economics, and SIA Estimates.

SECTION 6: JOBS

THE AVERAGE ANNUAL PAY RATE FOR EMPLOYEES IN THE U.S. SEMICONDUCTOR INDUSTY IS HIGHER THAN AVERAGE PAY RATES FOR ALL JOBS AND ALL MANUFACTURING JOBS IN THE UNITED STATES

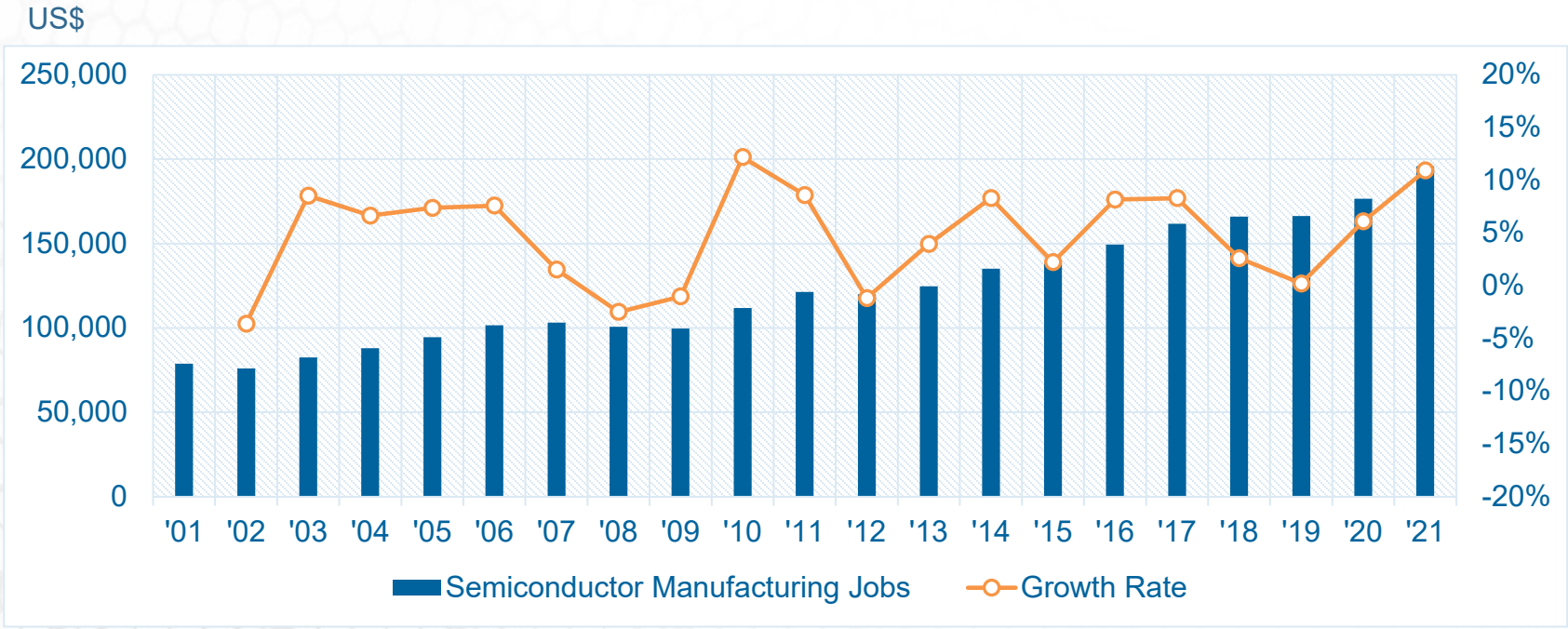
In 2021, the average annual pay rate in the U.S. semiconductor industry was $195,902. This pay rate was well over twice the average annual rate for all jobs in the United States, as well as for all manufacturing jobs in the United States. Workers in the semiconductor industry tend to be highly educated with a high percentage have advanced degrees in math, science, and engineering. This translates into relatively high wages for industry employees.



Source: U.S. Bureau of Labor Statistics and SIA Estimates.

U.S. SEMICONDUCTOR INDUSTRY AVERAGE ANNUAL PAY RATES HAVE STEADILY INCREASED

Since 2001, the annual average pay rate for employees in the U.S. semiconductor industry has steadily increased. The pay rate has grown from an average of $78,817 in 2001 to $195,902 in 2021, which equates to a compound annual growth rate of 4.66 percent.

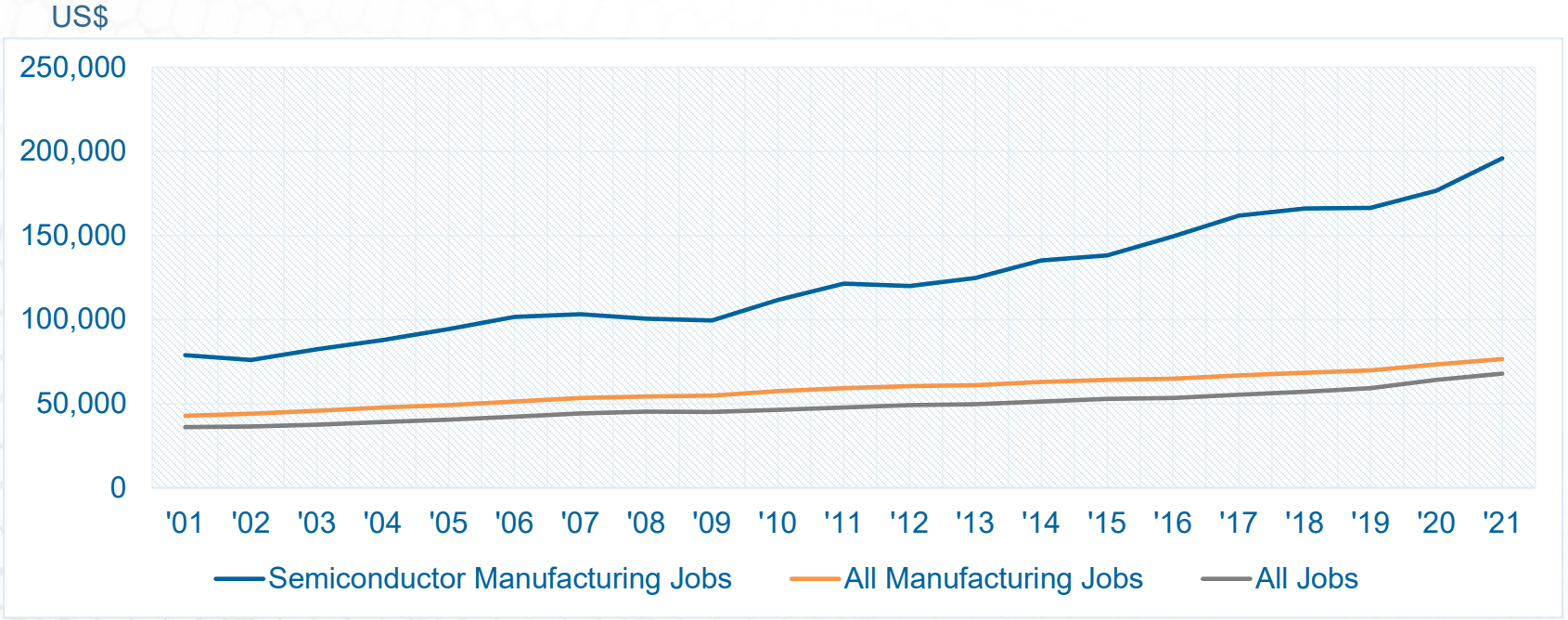


Source: U.S. Bureau of Labor Statistics and SIA Estimates.

SECTION 6: JOBS

U.S. SEMICONDUCTOR INDUSTRY AVERAGE ANNUAL PAY RATES HAVE BEEN CONSISTENTLY HIGHER THAN RATES FOR ALL U.S. JOBS AND ALL U.S. MANUFACTURING JOBS

U.S. semiconductor average annual pay rates since 2001 have been consistently higher than those rates for all U.S. jobs and all U.S. manufacturing jobs. While pay rates for all three categories has increased since 2001, the gap between semiconductor average annual pay rates and those for all jobs and all manufacturing jobs has widened.



Source: U.S. Bureau of Labor Statistics and SIA Estimates.

Section 7
Productivity & Profitability

SECTION 7: Productivity & Profitability

U.S. SEMICONDUCTOR FIRMS HAVE EXPERIENCED RAPID IMPROVEMENTS IN PRODUCTIVITY OVER THE PAST 20 YEARS

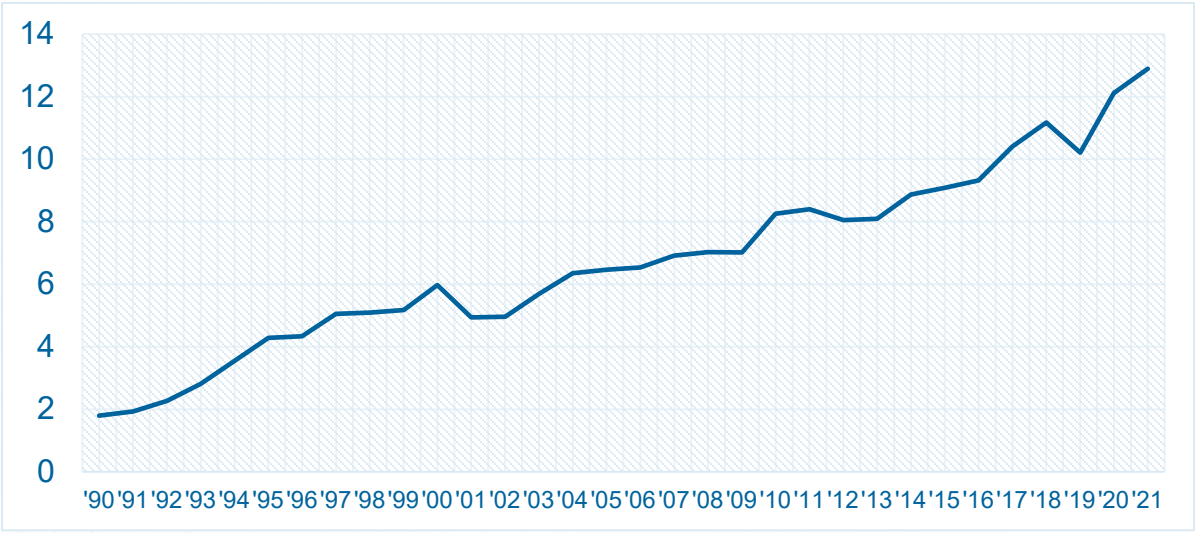
The future viability of the U.S. semiconductor industry ultimately rests on its ability to generate sufficient profits to fund capital and R&D outlays and attract new sources of investment. This chapter analyzes long-term measures of productivity and highlights the financial performance of the industry. Finally, several factors which greatly impact annual profits and losses are discussed.

MEASURES OF INDUSTRY PRODUCTIVITY

U.S.-based semiconductor firms have reported rapid improvements in productivity over the past 20 years. Sales revenues per employee have doubled over the last 20 years. These productivity gains have been made possible by maintaining high capital investment levels and R&D spending rates.

Source: U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC and SIA Estimates.

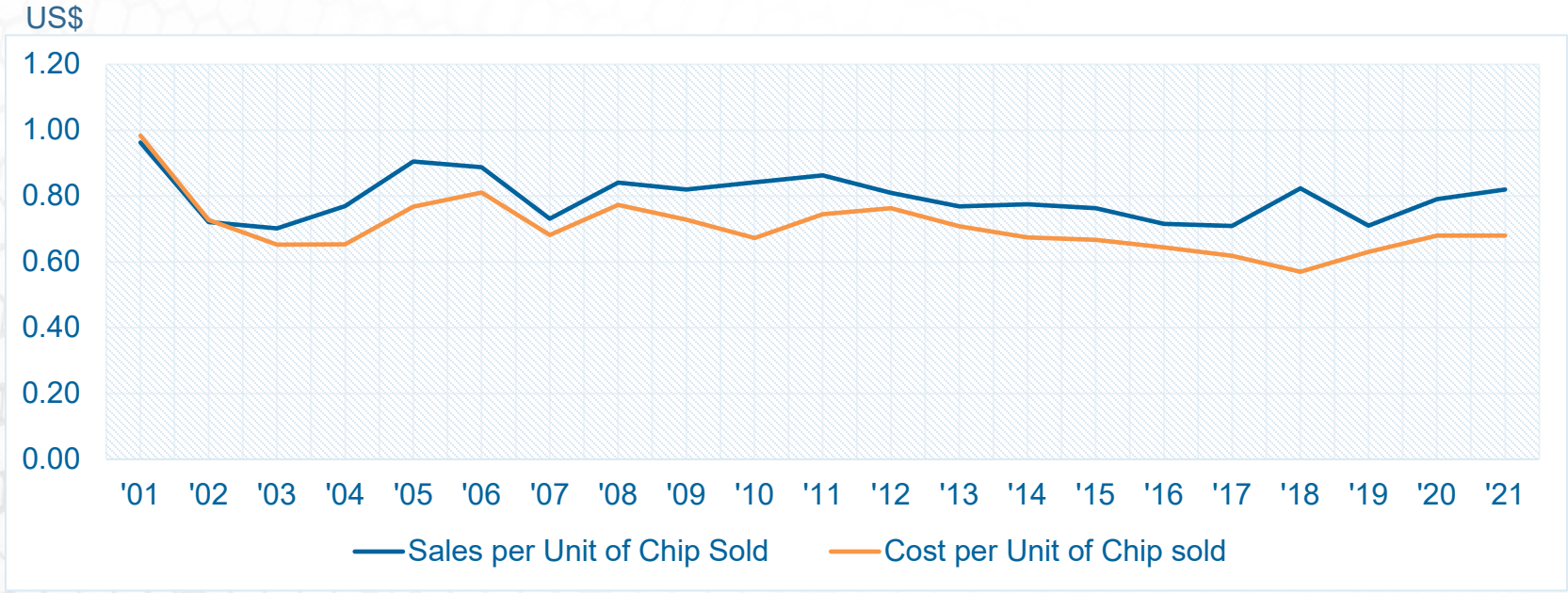
Trends in Industry Productivity
Index (1986=1)



SECTION 7: Productivity & Profitability

SINCE 2001, ANNUAL INDUSTRY COSTS PER SEMICONDUCTOR HAVE CONSISTENTLY RUN BELOW ANNUAL SALES PER SEMICONDUCTOR

Since 2001, the U.S. semiconductor industry has consistently been able to produce semiconductors for less than it has sold them on a per unit basis. In 2021, the U.S. semiconductor industry spent $0.68 to produce each semiconductor produced, while it sold each semiconductor it produced for $0.82, a difference of $0.14. This per unit profit margin is noteworthy, because in most industries, sales per unit (or average selling price) tends to increase due to inflation. By contrast, the semiconductor industry operates under a constant state of deflation. This means in order to maintain profitability, firms must keep production costs down or decrease them, which the industry has historically been successful in doing.



Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.
Note: Figures are rounded to the nearest tenth.

SECTION 7: Productivity & Profitability

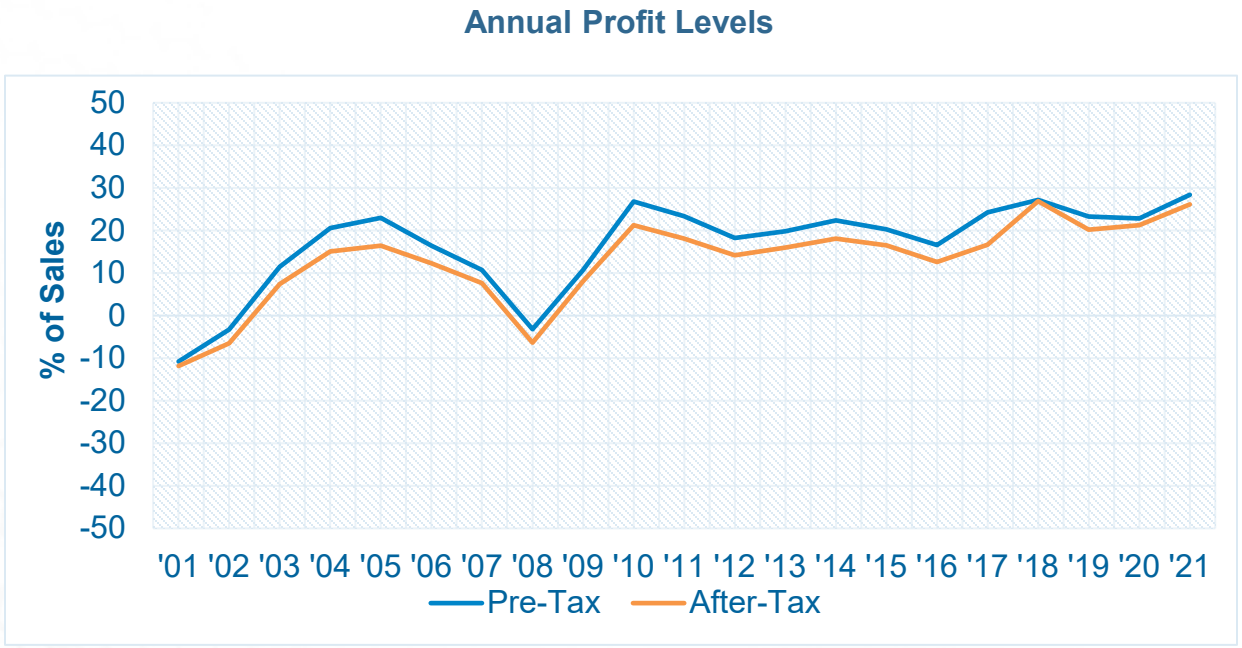
SEMICONDUCTOR INDUSTRY FINANCIAL PERFORMANCE IS HIGHLY CYCLICAL

TRENDS IN INDUSTRY PROFITABILITY

Financial performance is highly cyclical. Both pre-tax and after-tax profits as a percent of sales revenues have historically been strong during the growth periods of the Silicon Cycle. In each of the past three expansionary periods as well as the recent growth, pre-tax income has averaged approximately 20 percent of sales since 2001. In 2001 the industry recorded its first loss since 1985 due to a decline in sales in excess of 30 percent. 2004-2006 saw a return to historical profitability ratios. Profitability also dipped during the global economy recession but soon recovered.

DETERMINANTS OF PROFIT AND LOSS

The semiconductor industry has become increasingly capital-intensive with a growing R&D burden. Its overhead expenses cannot be easily shed during downturns in the Silicon Cycle.

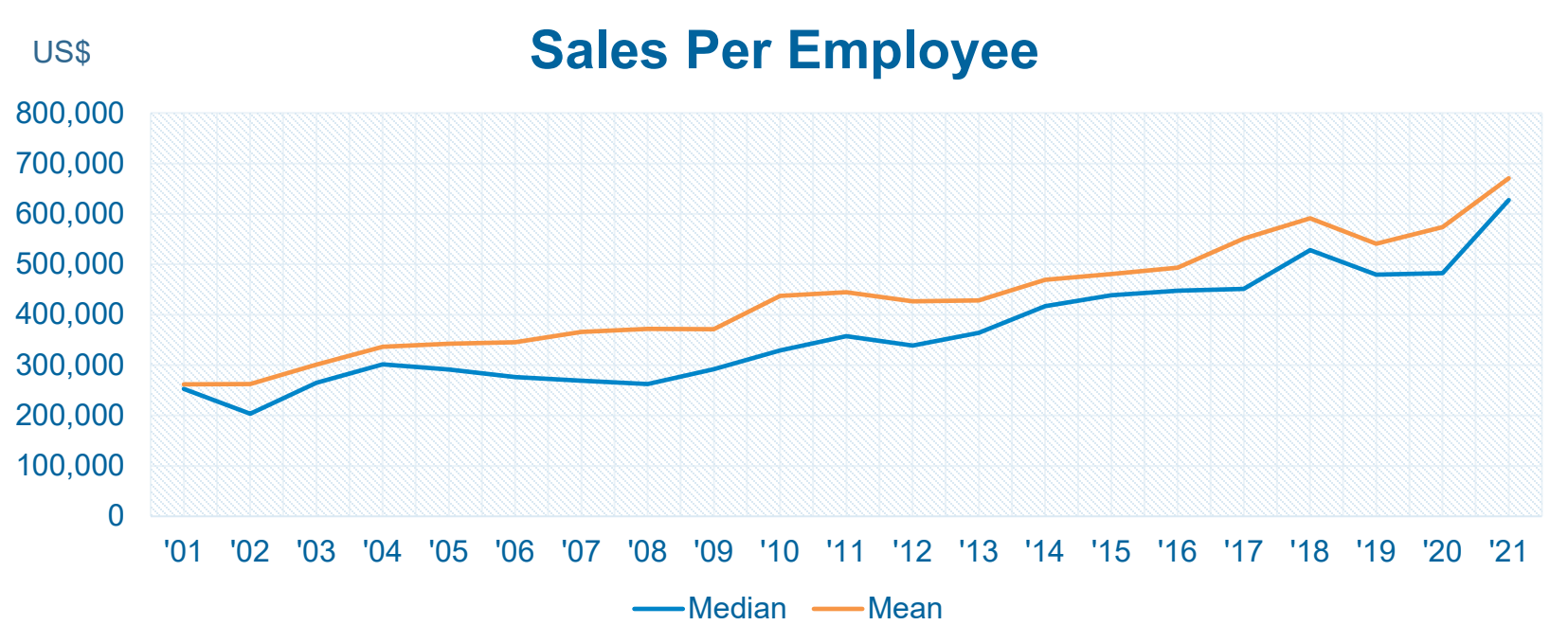


Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 7: Productivity & Profitability

SEMICONDUCTOR INDUSTRY LABOR PRODUCTIVITY HAS DOUBLED SINCE 2001

In 2021, the U.S. semiconductor industry recorded an average sales revenue per employee ratio of over $670,000.

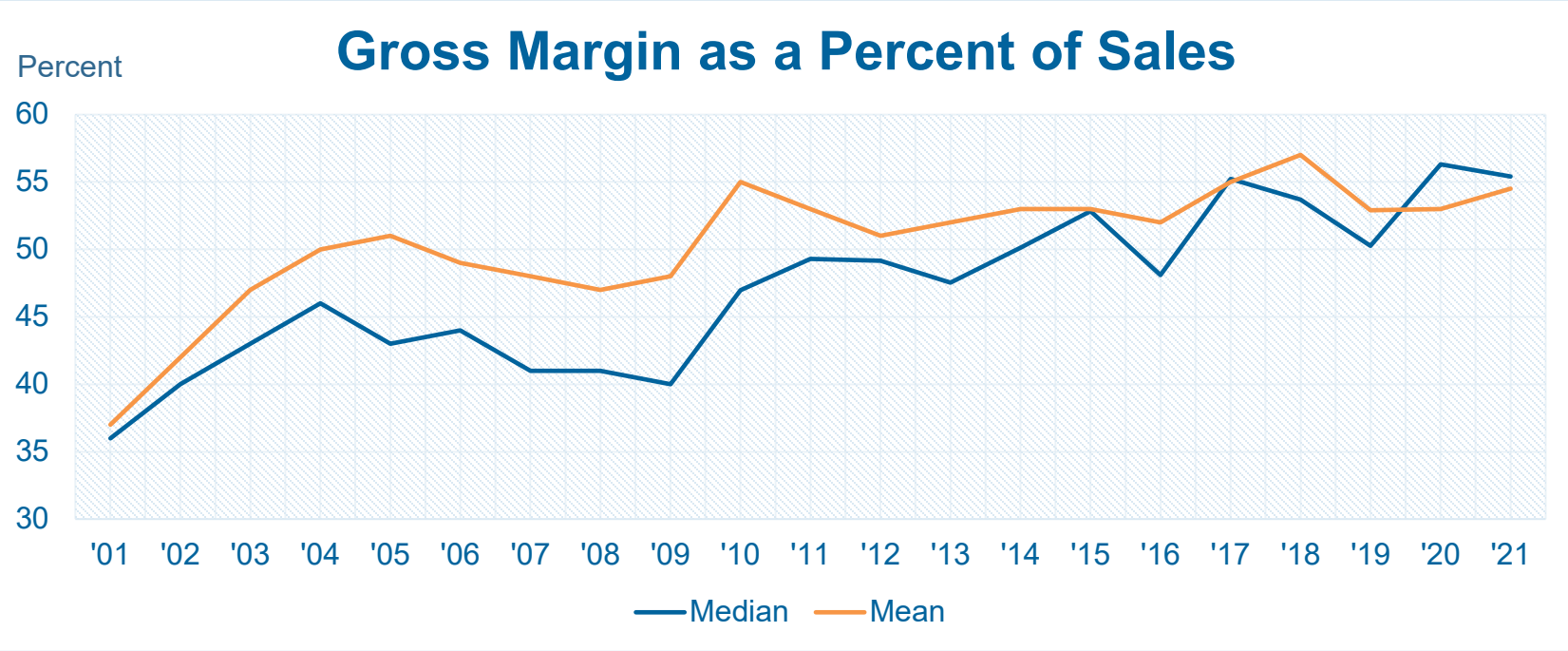


Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 7: Productivity & Profitability

THE U.S. SEMICONDUCTOR INDUSTRY MAINTAINS A HIGH GROSS MARGIN INDICATING THE HIGH VALUE ADDED CREATED BY U.S. SEMICONDUCTOR COMPANIES

Despite being subject to the Silicon Cycle, the U.S. semiconductor industry has been able to main an average gross margin between 37 and 57 percent from 2001 to 2021.

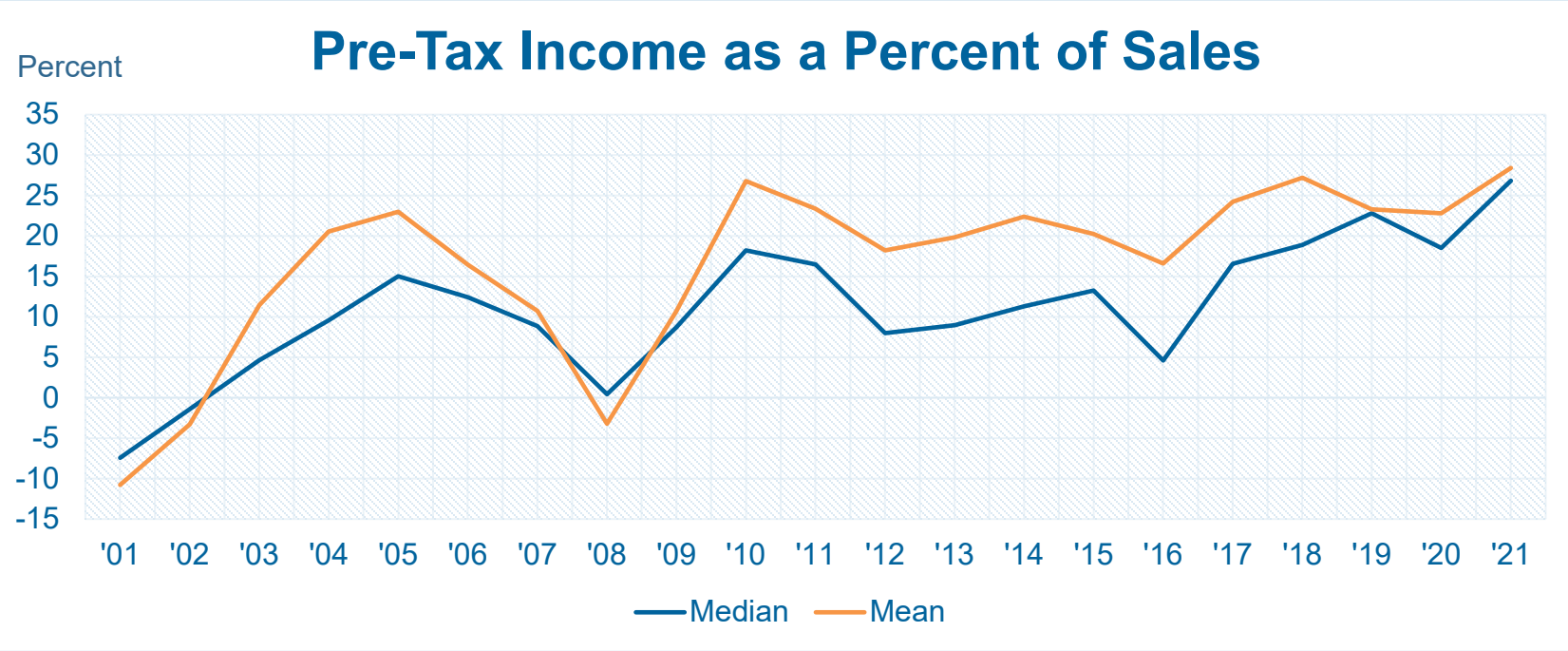


Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 7: Productivity & Profitability

AS MEASURED BY PRE-TAX INCOME AS A PERCENT OF SALES REVENUES, THE SEMICONDUCTOR INDUSTRY HAS BEEN PROFITABLE IN 18 OF THE LAST 21 YEARS

Measured on a pre-tax basis, the U.S. semiconductor industry has reported profits in 18 of the last 21 years. From 1997-2000, pre-tax profits averaged in excess of 20 percent, but the industry reported losses in 2001. The divergence of the mean from the median indicates that many firms did not show similar profits. 2001 saw the end of this trend, as all companies were affected by the downturn. 2002 showed a return to profitability for some companies and 2003 for most. 2005 saw a return to 1990s levels. Before the 2008-2009 recession, the aggregate financial performance of the industry (reflected in the mean ratio) had been strong. In 2010 it returned to 1990s levels again and has remained there ever since.

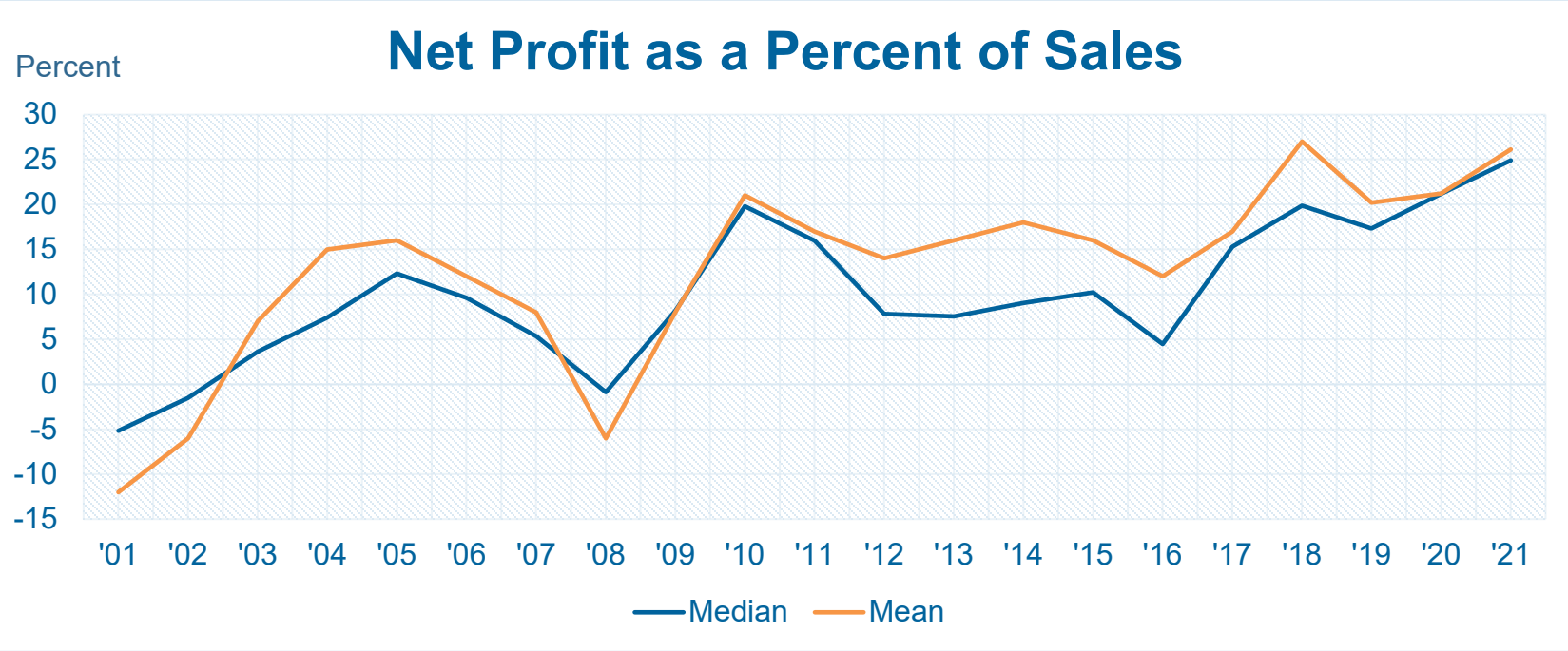


Source: World Semiconductor Trade Statistics (WSTS), SIA Estimates, and U.S. Semiconductor Companies' Annual 10K Filing to the U.S. SEC.

SECTION 7: Productivity & Profitability

NET PROFIT IN THE U.S. SEMICONDUCTOR INDUSTRY HAS IMPROVED CONSISTENTLY DUE TO M&A AND ROLLOUT OF MORE ADVANCED PRODUCTS

Although net profit as a percent of sales is subject to significant cyclical variation, the U.S. semiconductor industry has consistently improved its profitability by developing and producing more advanced products, industry consolidation, adopting a fab-lite model, and shifting to 300mm wafer production for economies of scale.



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