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US Semiconductors and Semicap Equipment

2022 Year Ahead: Bumpy but Worthwhile

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2022 Year-Ahead: Top 3 Takeaways

1. Bullish on Semis, high quality cyclical growth sector

- ✓ Project 13% YoY sales growth, 2x historical trend
- ✓ Combination of solid demand visibility, pricing power, disciplined capacity, multiple growth themes (Cloud computing, 5G, EV, IoT, AR/VR and Metaverse, Gaming, Advanced Driver Assist Systems)
- ✓ There is widespread investor skepticism (relative semis weighting at YE21 at 2-yr low)
- ✓ Assume interest rate fears/expectations will be baked in by Q1, allowing return to fundamentals (historically SOX has outperformed SPX in periods of rising rates)

2. Main lesson from 2021: despite frequent rotations, stocks followed eps revisions

- ✓ Stocks with best eps revisions in 2021 were up 69% on average vs SOX up 40% and below-median revision stocks up only 25% on average
- ✓ Right strategy was to stay diversified along **secular growth (Computing)**, **cyclical growth (Cars)** and **long-duration growth Capex** (semicap equipment)

3. Top picks aligned focused on stocks with best eps revision potential

- ✓ **NVDA top sector pick**, also like MRVL, AVGO, AMD, MU in cloud computing
- ✓ ON top SMidcap pick and in autos, also like NXPI, ADI in autos
- ✓ KLAC top pick in Semicap equipment, also like AMAT, TER, LRCX
- ✓ MU top pick in memory
- ✓ GFS top pick in foundry



Tale of 3 cities (sector rotations) in 2021

	Period1 ~Q1'21	Period2 Q2 + Q3'21	Period3 Q4'21
S&P 500 Index	8.6%	5.5%	10.8%
SOX Index	18.2%	-3.8%	24.1%
AAPL	-5.1%	10.5%	27.6%
IGV (Software)	-0.2%	11.1%	1.2%
XLI (Industrials)	12.9%	-1.4%	7.3%
US 10 Yr Index	86.2%	-13.0%	2.1%
Compute/Growth			
NVDA	7.1%	41.1%	49.1%
AMD	-11.2%	23.2%	43.4%
MRVL	7.4%	12.8%	51.9%
AVGO	11.6%	-2.6%	39.8%
Average	3.7%	18.6%	46.0%
Autos/Industrial			
NXPI	35.0%	-12.0%	20.6%
ON	34.5%	2.0%	51.3%
TXN	20.0%	-3.3%	-1.0%
ADI	10.7%	0.5%	7.0%
MCHP	18.6%	-10.5%	18.8%
Average	23.8%	-4.7%	19.3%
Semiconductors/Memory			
AMAT	65.8%	-12.5%	25.7%
LRCX	39.9%	-16.7%	30.7%
KLAC	37.1%	-7.3%	30.7%
MU	24.7%	-24.7%	31.9%
TER	10.7%	-19.2%	52.4%
Average	35.6%	-16.1%	34.3%
Smartphones			
QCOM	-7.9%	-9.7%	44.4%
SWKS	25.4%	-16.7%	-2.8%
QRVO	19.3%	-17.3%	-4.6%
CRUS	6.6%	-10.3%	17.0%
Average	10.8%	-13.5%	13.5%
EDA			
SNPS	0.3%	11.2%	27.4%
CDNS	6.9%	1.5%	25.9%
Average	6.0%	-0.3%	22.2%

Rotation 1: roughly Q1 (Start of year to April-5) Interest rates surged, Compute/Growth stocks lagged, cyclicals (auto industrial/semicaps) outperformed

Rotation 2: roughly Q2+Q3 (April-5 to Oct-4'21) Interest rates declined, Compute/Growth stocks outperformed, cyclicals lagged

Rotation 3: roughly Q4 (Oct-4'21 to year-end) Interest rates flatlined, Compute/Growth stocks outperformed, semicaps outperformed, auto/industrials lagged

Smartphone and EDA stocks underperformed SOX in most periods



Policy: EPS revisions drove stock performance

<u>Ticker</u>	<u>Avg. CY21/22 EPS Rev</u>	<u>CY21 Stock Perf.</u>
AMBA	147%	119%
ON	91%	109%
KLAC	60%	65%
NVMI	56%	108%
NVDA	52%	124%
MU	49%	30%
AMAT	44%	81%
AMD	42%	56%
MTSI	37%	43%
SWKS	37%	2%
LRCX	35%	48%
NXPI	29%	43%
MCHP	25%	27%
TXN	24%	16%
CRUS	23%	12%
QRVO	22%	-7%
TER	21%	36%
MRVL	19%	84%
ADI	16%	20%
AVGO	12%	53%
CDNS	12%	38%
SNPS	9%	43%
INTC	-3%	6%
IIVI	-4%	-10%
WOLF	-84%	7%
Median	25%	43%

*Top half of stocks with above
median 2021/22 EPS revisions
returned 69% on an average vs
25% return of bottom half (vs
SOX up over 40%)*



Above-trend industry growth of 13% YoY for 2022E

Revenue (\$mn)	2017	2018	2019	2020	2021E	2022E	2023E	2024E	CAGR '21-24E	CAGR '16-21E
Total Semis	\$412,221	\$468,778	\$412,307	\$440,389	\$546,905	\$619,472	\$668,911	\$706,147	8.9%	10.0%
YoY%	21.6%	13.7%	-12.0%	6.8%	24.2%	13.3%	8.0%	5.6%		
Memory	\$123,974	\$157,967	\$106,440	\$117,482	\$155,401	\$188,258	\$212,062	\$227,685	13.6%	15.1%
YoY%	61.5%	27.4%	-32.6%	10.4%	32.3%	21.1%	12.6%	7.4%		
Semis ex-Memory	\$288,247	\$310,812	\$305,867	\$322,907	\$391,504	\$431,214	\$456,849	\$478,462	6.9%	8.4%
YoY%	9.9%	7.8%	-1.6%	5.6%	21.2%	10.1%	5.9%	4.7%		
Autos	\$35,852	\$39,390	\$37,682	\$34,261	\$45,430	\$52,216	\$58,636	\$64,641	12.5%	6.8%
YoY%	9.7%	9.9%	-4.3%	-9.1%	32.6%	14.9%	12.3%	10.2%		
PCMPU	\$29,948	\$32,425	\$33,166	\$38,095	\$40,823	\$41,851	\$40,748	\$41,156	0.3%	7.3%
YoY%	4.3%	8.3%	2.3%	14.9%	7.2%	2.5%	-2.6%	1.0%		
Data Center/Other Compute	\$59,859	\$68,178	\$63,578	\$69,455	\$83,569	\$97,075	\$105,591	\$112,464	10.4%	9.1%
YoY%	10.9%	13.9%	-6.7%	9.2%	20.3%	16.2%	8.8%	6.5%		
Consumer	\$32,099	\$34,149	\$32,914	\$35,068	\$42,783	\$44,494	\$45,384	\$44,022	1.0%	8.1%
YoY%	10.9%	6.4%	-3.6%	6.5%	22.0%	4.0%	2.0%	-3.0%		
Smartphone	\$59,467	\$60,253	\$62,455	\$70,600	\$87,251	\$96,150	\$103,143	\$109,086	7.7%	9.0%
YoY%	4.7%	1.3%	3.7%	13.0%	23.6%	10.2%	7.3%	5.8%		
Wired Communications	\$18,207	\$18,593	\$18,007	\$18,192	\$21,284	\$22,561	\$23,012	\$23,358	3.1%	3.5%
YoY%	1.5%	2.1%	-3.1%	1.0%	17.0%	6.0%	2.0%	1.5%		
Wireless Infrastructure	\$11,689	\$11,930	\$14,149	\$14,481	\$16,509	\$18,325	\$19,241	\$20,203	7.0%	13.2%
YoY%	31.7%	2.1%	18.6%	2.3%	14.0%	11.0%	5.0%	5.0%		

Cloud: robust spending on data infrastructure

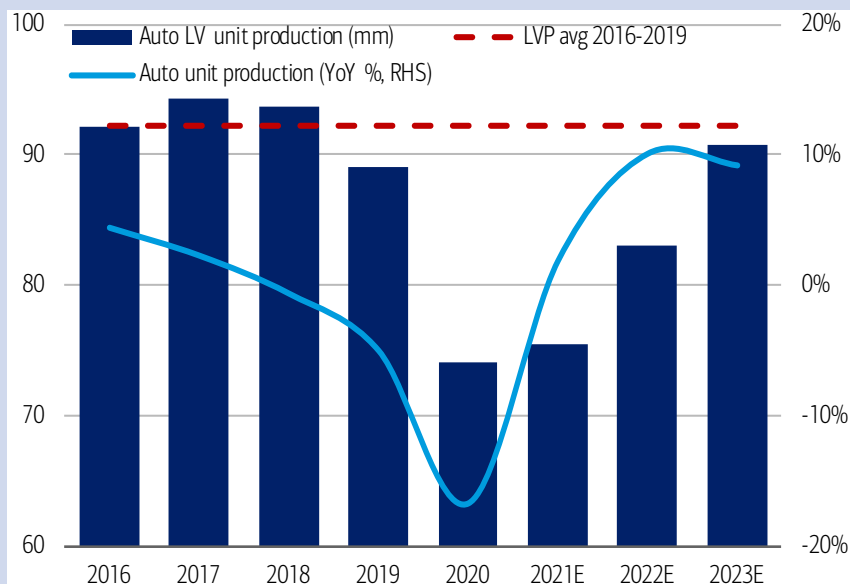


	C1Q20	C2Q20	C3Q20	C4Q20	C1Q21	C2Q21	C3Q21	C4Q21E	C1Q22E	C2Q22E	C3Q22E	C4Q22E	2020	2021E	2022E	2023E
CapEx (\$mn)																
Google	6,005	5,391	5,406	5,479	5,942	5,496	6,819	7,438	6,712	6,684	7,313	7,643	22,281	25,695	28,352	31,337
Microsoft	3,767	4,744	4,907	4,174	5,089	6,452	5,810	5,859	6,107	6,538	6,480	6,751	17,592	23,210	25,876	29,888
Amazon	6,795	7,459	11,063	14,824	12,082	14,288	15,748	12,824	11,303	12,894	13,729	13,023	40,141	54,942	50,949	56,073
Facebook	3,558	3,255	3,689	4,613	4,272	4,612	4,313	5,628	6,731	7,179	7,371	8,210	15,115	18,825	29,492	31,779
Alibaba	932	1,901	1,994	748	922	1,691	1,968	2,498	1,856	3,250	3,843	2,562	5,575	7,079	11,512	11,645
Tencent	868	1,340	1,229	1,474	1,198	1,074	1,096	3,189	1,589	1,838	1,931	2,661	4,912	6,557	8,019	9,358
Baidu	78	120	218	334	228	387	413	511	388	333	402	498	750	1,539	1,620	1,500
Super 7	22,004	24,211	28,506	31,646	29,733	34,000	36,167	37,947	34,687	38,716	41,070	41,347	106,366	137,846	155,819	171,580
Super 7 Ex-Ambazon	15,209	16,752	17,443	16,822	17,651	19,712	20,419	25,122	23,384	25,822	27,341	28,324	66,225	82,904	104,871	115,507
IBM	597	545	680	599	386	534	638	726	655	706	656	776	2,421	2,283	2,792	2,966
Oracle	396	433	436	570	414	717	1,062	1,001	1,058	880	883	898	1,835	3,194	3,718	3,723
Total	22,400	24,644	28,942	32,216	30,147	34,717	37,229	38,948	35,745	39,596	41,953	42,244	108,201	141,040	159,538	175,303
YoY %																
Google	29.5%	-12.0%	-19.7%	-9.5%	-1.0%	1.9%	26.1%	35.8%	13.0%	21.6%	7.2%	2.8%	-5.4%	15.3%	10.3%	10.5%
Microsoft	46.9%	17.1%	45.0%	17.7%	35.1%	36.0%	18.4%	40.4%	20.0%	1.3%	11.5%	15.2%	29.9%	31.9%	11.5%	15.5%
Amazon	106.5%	109.4%	135.5%	179.1%	77.8%	91.6%	42.3%	-13.5%	-6.5%	-9.8%	-12.8%	1.5%	138.1%	36.9%	-7.3%	10.1%
Facebook	-7.3%	-10.4%	4.4%	12.5%	20.1%	41.7%	16.9%	22.0%	57.6%	55.7%	70.9%	45.9%	0.1%	24.5%	56.7%	7.8%
Alibaba	10.0%	57.1%	20.3%	-8.3%	-1.1%	-11.0%	-1.3%	233.9%	101.3%	92.2%	95.3%	2.6%	23.1%	27.0%	62.6%	1.2%
Tencent	29.8%	114.4%	30.0%	42.9%	37.9%	-19.8%	-10.9%	116.4%	32.7%	71.1%	76.2%	-16.6%	50.2%	33.5%	22.3%	16.7%
Baidu	-82.3%	-39.5%	26.1%	165.1%	192.0%	220.8%	89.5%	53.0%	70.1%	-13.9%	-2.7%	-2.7%	-20.0%	105.0%	5.3%	-7.4%
Super 7	35.1%	24.8%	35.0%	50.8%	35.1%	40.4%	26.9%	19.9%	16.7%	13.9%	13.6%	9.0%	36.7%	29.6%	13.0%	10.1%
Super 7 Ex-Ambazon	17.0%	5.7%	6.2%	7.3%	16.1%	17.7%	17.1%	49.3%	32.5%	31.0%	33.9%	12.7%	8.7%	25.2%	26.5%	10.1%
Oracle	-75.6%	4.8%	13.0%	63.3%	4.5%	65.6%	143.6%	75.6%	155.6%	22.7%	-16.9%	-10.3%	-33.8%	74.1%	16.4%	0.1%
Total	25.1%	24.3%	34.6%	51.0%	34.6%	40.9%	28.6%	20.9%	18.6%	14.1%	12.7%	8.5%	34.3%	30.3%	13.1%	9.9%
Capital intensity (%)																
Google	14.6%	17.1%	11.7%	9.6%	10.7%	8.9%	10.5%	12.5%	12.2%	11.4%	11.8%	11.0%	12.7%	10.6%	11.6%	11.0%
Microsoft	10.8%	12.5%	13.2%	9.7%	12.2%	14.0%	12.8%	11.5%	12.7%	12.5%	12.5%	11.7%	11.5%	12.6%	12.3%	12.5%
Amazon	9.0%	8.4%	11.5%	11.8%	11.1%	12.6%	14.2%	9.3%	9.3%	9.9%	10.2%	7.8%	10.4%	11.7%	9.2%	8.7%
Facebook	20.1%	17.4%	17.2%	16.4%	16.3%	15.9%	14.9%	16.8%	22.2%	21.7%	21.1%	19.8%	17.6%	16.0%	21.1%	19.1%
Alibaba	5.7%	8.8%	8.9%	2.2%	3.2%	5.3%	5.0%	7.5%	4.9%	8.8%	8.4%	6.4%	5.9%	5.3%	7.2%	6.5%
Tencent	5.6%	8.3%	6.8%	8.2%	6.3%	5.3%	5.0%	13.6%	6.7%	7.4%	7.4%	9.7%	7.2%	7.8%	7.8%	7.9%
Baidu	2.4%	3.3%	5.3%	7.1%	4.8%	7.9%	8.2%	10.7%	7.2%	5.9%	6.8%	9.3%	4.8%	7.9%	7.3%	6.0%
Super 7	10.8%	11.1%	11.6%	10.2%	10.5%	11.1%	11.4%	11.1%	10.8%	11.3%	11.4%	10.2%	10.9%	11.0%	10.9%	10.3%
Super 7 Ex-Ambazon	11.8%	12.9%	11.7%	9.1%	10.0%	10.2%	9.9%	12.2%	11.7%	12.2%	12.1%	11.8%	11.2%	10.6%	11.9%	11.4%
Oracle	4.0%	4.1%	4.7%	5.8%	4.1%	6.4%	10.9%	9.8%	10.0%	7.5%	8.6%	8.4%	4.7%	7.7%	8.6%	8.2%

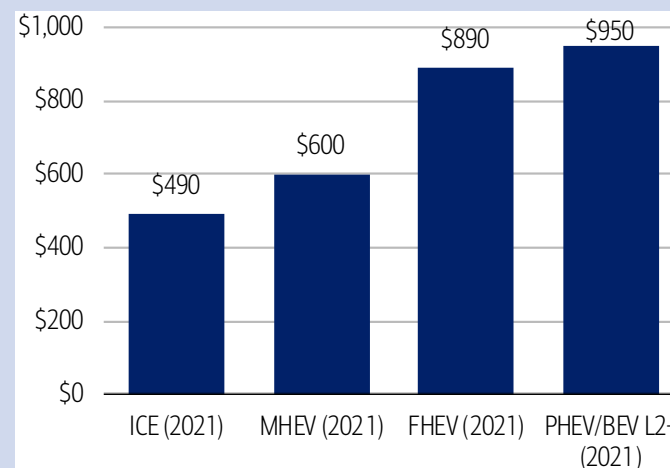
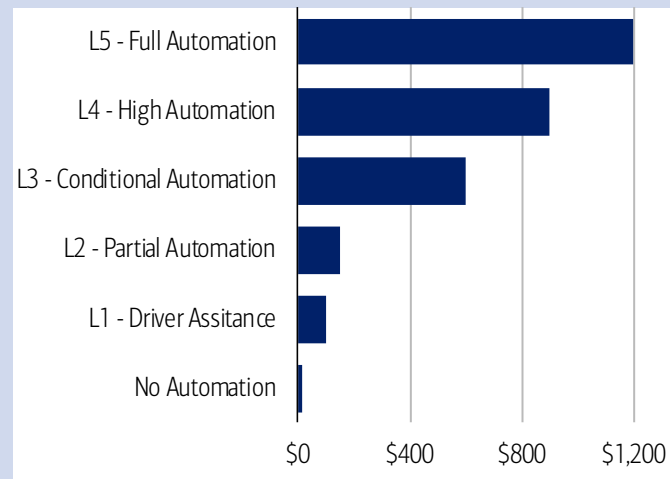
Cars: semis benefit from unit and content growth



Automotive units to grow 10% in 2022, still below more normal 92mn unit level



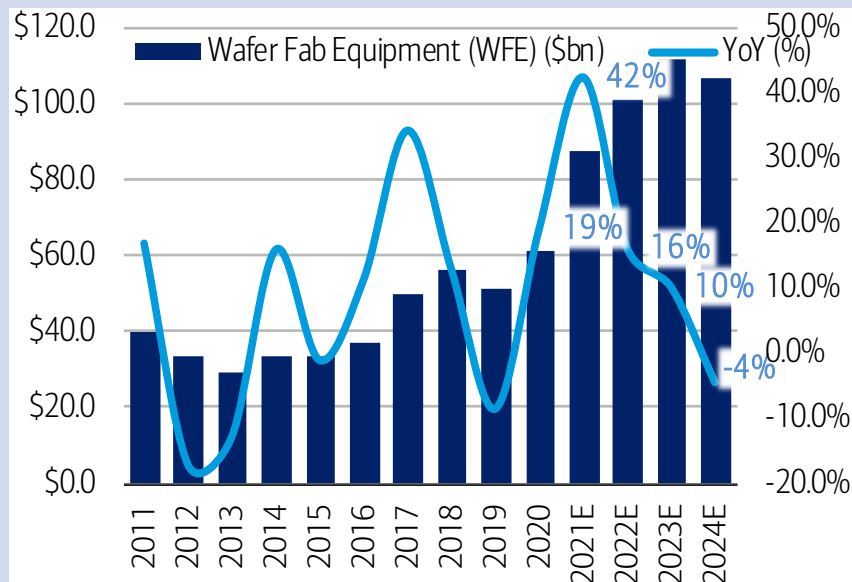
Semis additionally benefit from content boosts from autonomous and electric features



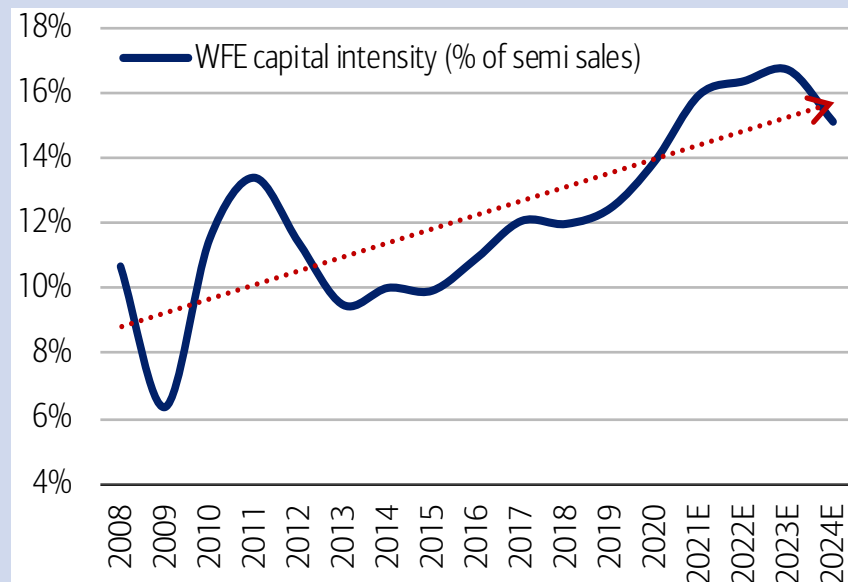


Capex: 16% YoY WFE growth in '22 despite tough compares

We expect WFE to grow double digits for 4 consecutive years followed by a minor digestion in 2024E



WFE capital intensity (WFE as a % of semi sales) is growing over time on higher cost/complexity of manufacturing

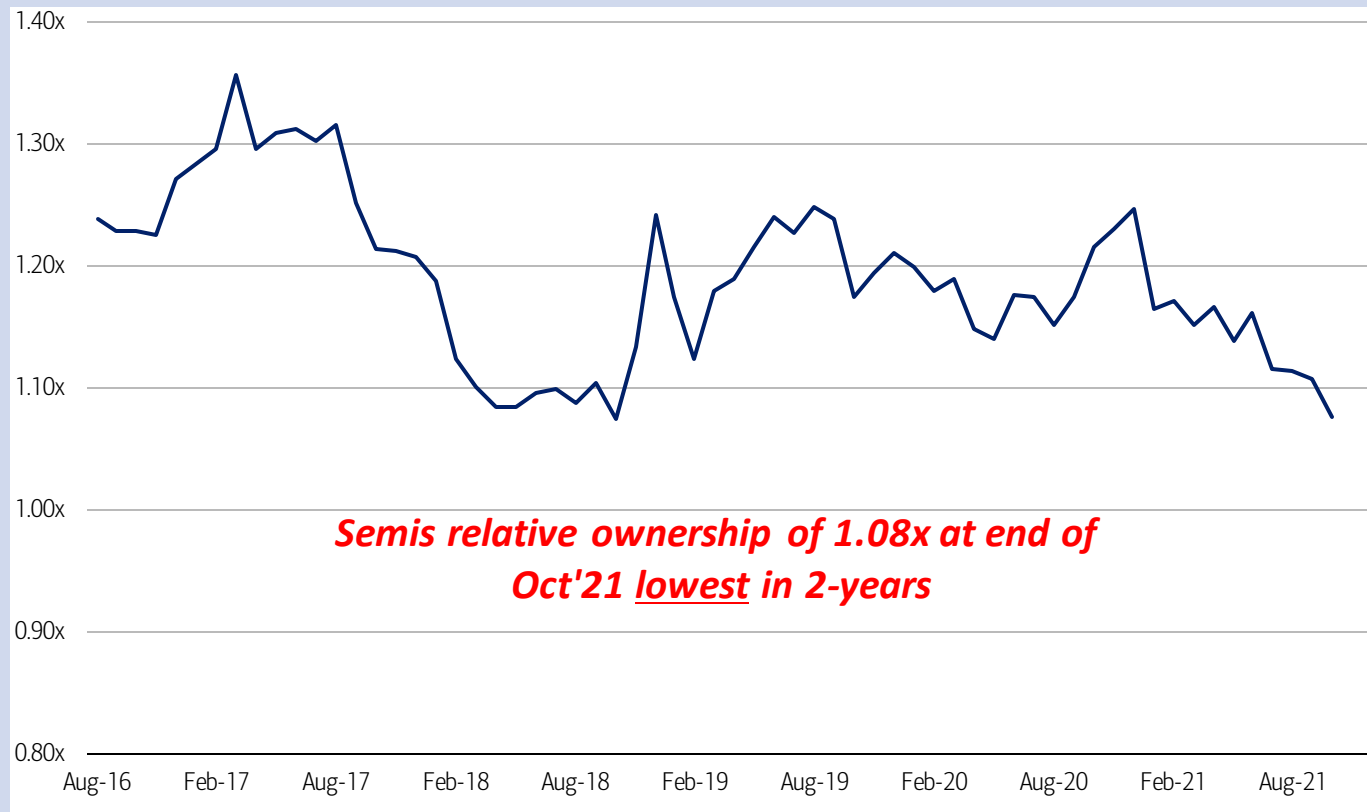


- 2022 WFE growth just to catch-up on supply issues from last year
- 2023E WFE could grow again from reshoring benefits
- Logic complexity (3nm/GAA) all driving higher capital intensity
- Foundry customer prepayments ensure strong demand resilience

Semis positioning among large-cap active US fund managers



Semis weighting vs. S&P 500 at 1.08x is well below peak of 1.36x in 2016





Top themes and picks in Cloud, Cars, Capex

Cloud

- **NVDA:** Best EPS revision potential, CY22 sales could be 25-30% YoY vs BofAe 21% and cons 19%
- **MU:** DDR5 ramp in new CPUs with 30-40% more content and higher ASP
- **MRVL:** largest data center exposure, with broad growth in optics, DPUs, storage, custom silicon
- **AMD:** server CPU share gains vs. INTC with next gen 5nm Genoa CPU ramping in 2H 2022
- **AVGO:** enterprise recovery, cloud switching upgrade cycle, ASIC compute offload opportunity

Cars

- **ON:** growing design funnel with exposure to hyper-growth EVs (power ICs and SiC inverters)
- **NXPI:** largest auto semi vendor with 25% of autos tied to high growth BMS and ADAS
- **ADI:** #1 vendor of BMS for pure battery electric vehicles, MXIM synergies
- **MU:** #1 auto memory vendor with content growing from \$10s to \$1,000 in L3+ vehicles

Capex

- **KLAC:** process control leader benefitting most from higher foundry/logic spending
- **TER:** 3nm/GAA ramp, DDR5 transition, Apple internal modems, industrial automation growth
- **GFS:** Only at scale US-based foundry, benefitting from US/Europe re-shoring efforts
- Also like other semicap vendors **AMAT, LRCX, NVMI**



Key semi battlegrounds

- **Cycle risks:** Legitimate strong demand or double ordering/inventory builds
- **NVDA** valuation premium, how long can it sustain?
- **INTC** vs. **AMD**, are all share gains priced in for AMD?
- **MRVL** does it deserve a cloud stock premium, are CY22 growth targets achievable?
- Can auto sales grow above units (again) in 2022? Is upside for auto chipmakers cyclical or secular, especially for **ON** and **NXPI**?
- Foundry/logic vs. memory spending (**KLAC** vs. **LRCX/AMAT**)
- Apple insourcing risks, Qualcomm RF share gains vs. **QRVO/SWKS**
- DRAM/memory pricing visibility
- Growth vs. value



Summary of ratings and PO for key stocks

Buy	
<u>Ticker (Name)</u>	<u>PO (change)</u>
ADI (Analog Devices)	\$220
AMAT (Applied Materials)	\$190 (from \$175)
AMD (Advanced Micro)	\$175
AVGO (Broadcom)	\$750
GFS (GlobalFoundries)	\$90
KLAC (KLA Corporation)	\$500 (from \$450)
LRCX (Lam Research)	\$785 (from \$675)
MCHP (Microchip)	\$100
MRVL (Marvell)	\$115
MTSI (M/A-com)	\$90 (from \$83)
MU (Micron)	\$118 (from \$100)
NVDA (Nvidia)	\$375
NVMI (Nova Instruments)	\$160 (from \$150)
NXPI (NXP Semiconductor)	\$270 (from \$255)
ON (onsemi)	\$82 (from \$75)
TER (Teradyne)	\$205 (from \$175)
TXN (Texas Instruments)	\$225

Neutral	
<u>Ticker (Name)</u>	<u>PO (change)</u>
IIVI (II-VI)	\$80 (from \$71)
QRVO (Qorvo)	\$180 (from \$190)
SWKS (Skyworks)	\$180 (from \$190)

Underperform	
<u>Ticker (Name)</u>	<u>PO (change)</u>
CDNS (Cadence)	\$180 (from \$160)
WOLF (Wolfspeed)	\$118 (from \$125)
SNPS (Synopsys)	\$355 (from \$330)
INTC (Intel)	\$55 (from \$50)
CRUS (Cirrus Logic)	\$92
AMBA (Ambarella)	\$140 (from \$119)

Summary valuation sheet



				Sales YoY		EPS YoY		PE		FCF Margin				
	Rating	Mkt Cap	Price	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E			
<u>Compute/Networking</u>														
Nvidia	BUY	\$681.2	\$272.5	21%	19%	19%	21%	52.8x	43.7x	41%	46%			
Intel	UNDERP	\$217.3	\$53.4	2%	2%	-25%	-4%	13.5x	14.1x	7%	9%			
Broadcom Limited	BUY	\$255.6	\$619.2	10%	7%	16%	11%	18.1x	16.3x	52%	53%			
AMD	BUY	\$159.4	\$132.0	17%	14%	26%	21%	39.9x	33.0x	21%	23%			
Marvell	BUY	\$70.1	\$83.1	33%	18%	41%	24%	37.8x	30.4x	21%	23%			
II-VI	NEUTRAL	\$7.6	\$71.8	10%	9%	12%	15%	18.3x	15.9x	6%	9%			
Macom	BUY	\$5.0	\$72.5	11%	9%	16%	13%	27.1x	24.0x	24%	25%			
Ambarella	UNDERP	\$5.8	\$157.6	16%	10%	24%	19%	80.4x	67.3x	24%	27%			
<u>Smartphone</u>														
Qualcomm	BUY*	\$202.1	\$180.4	14%	7%	16%	8%	17.0x	NA	28%	28%			
Skyworks	NEUTRAL	\$25.5	\$154.2	15%	7%	17%	9%	12.8x	11.7x	24%	24%			
Qorvo	NEUTRAL	\$17.1	\$154.7	11%	5%	12%	7%	11.8x	11.0x	28%	30%			
Cirrus Logic	UNDERP	\$5.0	\$88.2	11%	8%	9%	10%	15.6x	14.2x	18%	18%			
<u>Industrial/Auto/IoT</u>														
Texas Instruments	BUY	\$165.7	\$179.4	6%	5%	9%	7%	20.9x	19.5x	38%	41%			
Analog Devices	BUY	\$88.7	\$168.8	28%	7%	15%	12%	21.6x	19.3x	39%	39%			
NXP Semiconductors	BUY	\$58.9	\$221.3	12%	10%	12%	15%	18.8x	16.4x	22%	24%			
Infineon Tech	BUY*	\$51.4	\$39.2	14%	8%	27%	7%	24.6x	22.8x	8%	9%			
Microchip	BUY	\$45.5	\$81.9	12%	5%	17%	10%	16.9x	15.4x	35%	37%			
STMicroelectronics	BUY*	\$39.3	\$43.1	10%	6%	22%	7%	16.2x	15.1x	9%	12%			
ON Semi	BUY	\$27.8	\$64.6	6%	5%	11%	13%	20.7x	18.3x	19%	19%			
Wolfspeed	UNDERP	\$12.7	\$109.0	41%	53%	NA	NA		99.1x	NA	NA			
SEMIS EX-MEM ONLY				12.1%	8.8%		16.8%	11.5%		21.6x	20.0x		24%	24%
<u>Memory</u>														
Micron	BUY	\$105.8	\$94.5	17%	7%	31%	11%	9.7x	8.7x	17%	18%			
<u>Semicap Equipment</u>														
ASML	BUY*	\$307.3	\$756.1	17%	6%	24%	14%	44.4x	39.0x	25%	29%			
Applied Materials	BUY	\$134.0	\$150.8	15%	6%	19%	9%	17.2x	15.7x	24%	26%			
Lam Research	BUY	\$94.2	\$669.3	11%	4%	13%	11%	18.2x	16.5x	29%	31%			
KLA-Tencor	BUY	\$63.2	\$416.9	16%	6%	17%	7%	19.5x	18.2x	28%	33%			
Teradyne	BUY	\$25.8	\$158.3	9%	13%	13%	19%	23.7x	19.9x	27%	33%			
Nova Instruments	BUY	\$3.8	\$132.0	15%	7%	16%	8%	29.9x	27.7x	28%	29%			
Tokyo Electron	BUY*	\$10,206.1	\$64,920.0	12%	-1%	21%	1%	20.9x	20.7x	17%	21%			
Advantest	BUY*	\$2,137.1	\$10,710.0	15%	7%	15%	1%	18.5x	18.3x	19%	20%			
GlobalFoundries	BUY	\$31.9	\$60.0	17%	11%	NA	42%	34.2x	24.0x		9%			
SEMICAP EQP ONLY				15%	6%		17%	9%		20.2x	19.1x		26%	29%



Backup Charts



Policy: reaction to rising interest rates

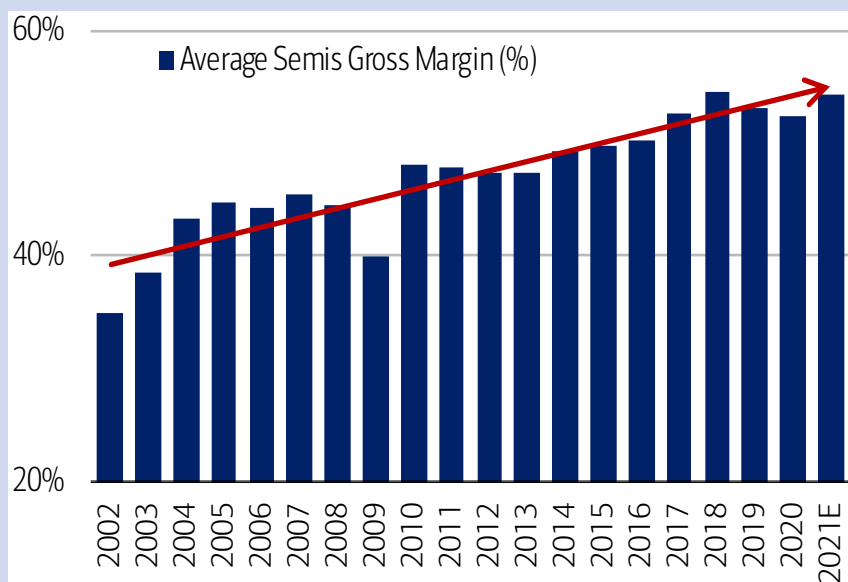
Start	End	SOX Total Return (%)	SPX Total Return (%)	NASDAQ Total Return (%)
12/29/1995	8/30/1996	(15.5%)	5.9%	8.5%
9/30/1998	1/31/2000	265.7%	37.1%	132.6%
5/30/2003	6/30/2006	15.5%	31.8%	36.1%
12/31/2008	4/30/2010	77.2%	31.4%	56.1%
7/31/2012	12/31/2013	39.4%	34.0%	42.1%
7/29/2016	1/31/2018	77.6%	29.9%	43.6%
8/4/2020	3/8/2021	25.0%	16.0%	15.0%
Median		39.4%	31.4%	42.1%
Delta vs. SOX		0bps	(805bps)	265bps
Delta vs. SOX (ex-late 90s)		0bps	(158bps)	687bps

Performance of SOX Index historically resilient in rising rate environment

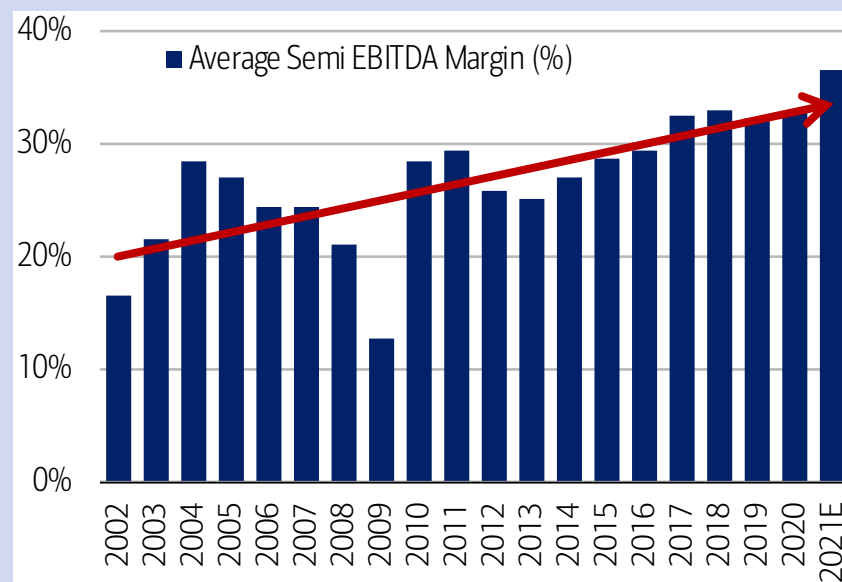
Profits: semiconductor industry more profitable than ever



Average semiconductor industry gross margins have grown from 30-40% in the early 2000s, to 40-50%+ today



Average semiconductor industry op. margins have improved dramatically and are much more consistent in the 30-40% range



Investors survey summary



Topic	Dec 2021 Survey Results	Sep 2021 Survey Results	May 2021 Survey Results	Nov 2020 Survey Results
SOX Outperformance vs. SPX	517bps (blended average)	320bps (blended average)	115bps (blended average)	350bps (blended average)
End Market Preference (weighted average score out of 100%)	1: Computing (85%)	1: Cyclical (77%)	1: Semicap (87%)	1: Memory (66%)
	2: Semicap (69%)	2: Computing (76%)	2: Computing (68%)	2: Computing (65%)
	3: Cyclical (63%)	3: Semicap (64%)	3: Cyclical (60%)	3: Cyclical (60%)
	4: Memory (59%)	4: Smartphone (45%)	4: Memory (55%)	4: Smartphone (57%)
	5: Foundry (49%)	5: Memory (38%)	5: Smartphone (29%)	5: Semicap (53%)
	6: Smartphone (44%)			
	7: EDA (31%)			
Top 3 Most Mentioned Longs	1: Micron 2: Marvell 3: Nvidia	1: Analog Devices 2: AMD 3: Nvidia	1: Applied Materials 2: Micron 3: ASML	1: Micron 2: AMD 3: Nvidia
Top 3 Most Mentioned Shorts	1: Intel 2: Texas Instruments 3: Nvidia	1: Micron 2: Intel 3: AMD/Lam Research (tied)	1: Intel 2: Qualcomm 3: Skyworks/Qorvo (tied)	1: Intel 2: Texas Instruments 3: AMD



Price Objective Basis and Risk

Advanced Micro Devices, Inc (AMD)

Our \$175 price objective (PO) is based on 44x our 2023E non-GAAP EPS, which is in the middle of AMD's historical 22x-64x range and within compute peer range of 11x-53x.

Downside risks: 1) Sharp correction in share price following strong rally to-date, 2) Strong competition from larger names, 3) Lumpy nature of consumer and enterprise spending that could create delays in acceptance and success of new products, 4) Reliance on multiple outsourced manufacturing partners, 5) Maturity of current game console cycle.

Ambarella (AMBA)

Our price objective of \$140 is based on 12x CY23E EV/S, in line with high growth auto tech peers trading 10x-15x. We assign AMBA a multiple that is at the mid to low end of the range based on the company's long-term growth potential offset by near-term headwinds/uncertainty.

Downside risks to our PO: Macro/COVID headwinds, US-China trade tensions which could negatively impact security camera market sales, semiconductor cyclicality, further deterioration in legacy consumer businesses, failure to successfully penetrate target auto/security markets with new computer vision chip roadmap.

Upside risks to our PO: Faster penetration of CV chip technology in focus automotive/security markets, semiconductor industry consolidation.

Analog Devices Inc. (ADI)

Our \$220 PO is based on 26x CY2023E EV/FCF, within the diversified peer range of 17x-48x, and justified based on ADI's best in class profitability and differentiated/secular comms exposure.

Downside risks to our price objective are: 1) Economic downturn can reduce demand for automotive, industrial products. 2) Inability to realize the planned cost synergies with Linear Tech. 3) Higher than historical debt leverage could limit valuation multiples and increase risks in a cyclical downturn. 4) Customer concentration, with Apple contributing 10% of sales on an average and much higher during seasonally stronger quarters. 5) Competition from larger vendors such as TXN which have lower-cost production facilities.

Applied Materials, Inc. (AMAT)

Our PO of \$190 is based on 20x our CY23E EPS estimate, at the high end of its historical range of 8x-23x, though in line with the 1x-2x historical discount to more profitable semicap peers.

Upside risks to our PO are: stronger-than-expected electronics demand that would tighten up semiconductor capacity, driving increased semiconductor equipment sales and/or increasing market share.

Downside risks to our PO are: slower-than-expected capital spending cycle, delay in memory capacity adds, market share loss in etch or clean segments, merger & integrations risk, and macro headwinds.

Broadcom Inc (AVGO)

Our \$750 price objective for Broadcom is based on 20x CY23E EV/FCF, within AVGO's long-term 10x-30x range.

Downside risks to our price objective are: 1) Semiconductor cycle risks including sensitivity to US/China trade relations, 2) High exposure to Apple with potential design out risks, 3) Competitive risks in networking, smartphone, storage, enterprise software markets, 4) Frequent acquirer of assets which increases financial and integration risks, and 5) Recent strategy towards moving into non-core software businesses creates mis-execution risks.



Price Objective Basis and Risk

Cadence (CDNS)

Our \$180 PO is based on 41x FY23E EV/FCF within peer range and justified given predictability of EPS/FCF/EBITDA streams and growing strategic importance of EDA in increasingly fragmented global electronics supplychain. We like CDNS leverage to all of the top secular drivers (Artificial intelligence, 5G, autonomous cars) in semis/electronics/technology, especially with much more predictable/recurring revenues. Still, limited operating leverage and highly recurring revenues that could cap growth potential as well as price appreciation.

Downside risks are: (1) Share loss in existing markets to primary competitors, (2) a broader economic downturn dampens semis R&D spending and corresponding spend on EDA tools and services, (3) escalation of US-China trade war limits CDNS' ability to sell to key customers, (4) semiconductor industry consolidation accelerates which could diminish customer spending power, (5) venture into adjacent system analysis market fails to meaningfully accelerate revenue growth and incremental investments suppress margin expansion.

Upside risks are: (1) Share gains in existing markets vs primary competitors, (2) increased government investment in semiconductor R&D and development as nations develop internal ecosystems, (3) material M&A that enables consistent margin expansion or further accelerates sales CAGR

Cirrus Logic (CRUS)

Our price objective of \$92 is based on 15x CY23E pf-PE, in the middle of CRUS normalized five year range (9x-25x) and reflects CRUS' content growth opportunities in Apple/Android.

Upside risks to our PO: faster unit/content growth in flagship smartphone models from top customers Apple and Samsung, faster penetration of Android smartphone market, quicker market transition to digital headsets, and potential M&A tailwinds increasing valuations across the semiconductor sector.

Downside risks to our PO: Macro headwinds, slower smartphone unit growth, increased sales/margin pressures from content loss and/or ASP degradation at Apple/Samsung, failure to diversify and grow into targeted customer/market adjacencies.

GlobalFoundries (GFS)

Our PO of \$90 is based on 13x our CY23E EV/EBITDA, which is in the middle of Asian pure-play foundry peers at 10x and more US-based integrated design/manufacturing peers at 14x though more towards mostly US-based comps given recent positive Qualcomm and Ford partnership news flow.

Downside risks to our PO are: (1) semi industry cyclicality where foundries are more impacted in down-cycle given high fixed cost structure, (2) execution on strategic repositioning which is critical to gross margin expansion and EPS growth, (3) large ownership concentration with Mubadala, which is wholly owned by the government of Abu Dhabi adds geopolitical and investor concentration risk.

II-VI (IIVI)

We assign a \$80 PO based on 18x CY23E P/E (in line with 6x-22x range), given strong multi-year secular drivers (5G, data center) and opportunity for share gains in key end markets (3D sensing) offset by margin headwinds

Downside risks to our PO are: 1) inability to realized planned cost synergies with Finisar acquisition, 2) Lumpy telecom/hyperscaler capex trends, 3) frequent M&A activity increasing leverage limiting valuation multiples, 4) sustained COVID-19 headwinds impacting 5G/cloud capex, 5) heightened trade tensions impacting opportunities in growing Asia markets

Intel (INTC)

Our \$55 price objective is based on 14x our 2022 EPS estimate, at the low end of compute peers (10x-48x), which we view as appropriate given manufacturing uncertainties and risks of new foundry strategy.

Upside risks to our price objective are: 1) Clarity or breakthrough on yields for 7nm process technology, 2) new products allowing Intel to limit share loss, 3) improving product mix which can drive upside to gross margins, 4) manufacturing slip up at key foundry competitors. Downside risks to our price objective are: 1) Weaker-than-expected trends in a mature PC market, which is largest revenue generator for Intel, 2) further delays in 7nm process technology and roadmap, 3) accelerated share loss to AMD, 4) more competition in profitable data center market.

Price Objective Basis and Risk



KLA Corporation (KLAC)

We assign a \$500 PO based on 22x CY23E PE, within KLAC's historical range of 10x-26x as we move more late-cycle. We continue to believe KLAC has a unique position as a key enabler of semiconductor manufacturing technology, a less cyclical topline, industry leading profit margins, and best-in-class shareholder returns.

Downside risks to our PO are the cyclical nature of the semiconductor capital spending and its impact on earnings, competitive price and market share issues, particularly against Applied Materials, ability to get new products and technologies into the market in a timely manner.

Lam Research Corp. (LRCX)

We assign a \$785 PO based on 19x cash adjusted CY23E PE, within LRCX's historical range of 8x-24x and justified in our view based on LRCX's long-term 20% EPS growth rate and given we are in a multi-year wafer fabrication equipment growth cycle where LRCX is well positioned to benefit.

Upside risks to our PO are: stronger-than-expected electronics demand that would tighten up semiconductor capacity, driving increased semiconductor equipment sales and/or increasing market share.

Downside risks are slower than expected capital spending cycle, delay in memory capacity adds, market share loss in etch or clean segments, merger & integrations risk, and macro headwinds.

M/A-Com (MTSI)

Our \$90 PO is based on a 30x CY23E P/E, towards the median of high margin compute peers and justified, in our view, based on MTSI's long term EPS growth potential.

Downside risks to our price objective are: (1) Semiconductor cyclicality driven by weak macroeconomic conditions, demand or inventory corrections, (2) Large private ownership with limited public float could add volatility to the stock price, (3) Demand fluctuations in optical, aerospace and defense markets, and (4) High degree of leverage could limit Mcom's flexibility and ability to engage in buybacks/dividends.

Upside risks are: (1) Faster recovery in core telecoms business, (2) potential for M&A in a consolidating industry.

Marvell Technology Group Ltd. (MRVL)

Our \$115 PO is based on a 42x FY24E/CY23E pf-EPS, which is in line with growth peers and well-supported by the 30%+ longer-term compounded annual EPS growth potential, driven by potential success in 5G and cloud over the next few years.

Downside risks: 1) Integration risks in recent deals, 2) Financial risks related to going to net debt from net cash position, and in achieving expected cost synergies in a timely manner, and 3) Cyclical industry risks including potential slowdown in legacy hard disk drive and storage assets, 4) Competitive risks against larger well resourced rivals such as AVGO, INTC and NVDA.

Microchip (MCHP)

We assign a \$100 PO based on 23x our 2023E EV/FCF, which is in between comps trading 21x-40x range and justified, in our view, based on MCHP's mix of growth, execution, profitability, and leverage.

Upside risks to our PO: better than expected synergies from the MSCC acquisition, continued strong share gains in the 8/32bit MCU category, and M&A tailwind increasing valuation across the board. Downside risks to our PO: macro headwinds related to trade/COVID-19 and increased competition capping any market share gains. GM growth hitting a ceiling



Price Objective Basis and Risk

Micron Technology, Inc (MU)

Our \$118 PO is based on 2.4x our CY22E P/B, which is within MU's long-term 0.8x-3x. It also implies 12x CY22 PE, which is inline with MU's long-term average multiple.

Downside risks to our PO: (1) larger than expected memory ASP decline, (2) greater competition from China newcomers, (3) share loss to other large competitors like Samsung or SK Hynix, (4) softening of demand across major end markets such as data center, smartphones, or PCs.

Navitas Semiconductor (NVTS)

We rate NVTS Neutral and assign a \$20 PO on 8x CY24E EV/S, in line with power and special material semis peers, justified given NVTS' strong growth upside and expansion in attractive EV/solar/data center markets

Downside risks to our PO include: (1) delayed ramp across EV/solar/data center markets which offer attractive growth potential and margin upside, (2) inability to pass higher costs onto large OEM customers, (3) heightened competition from larger, established semis vendors in the auto/industrial supply chain, (4) Macroeconomic conditions reducing consumer demand for smartphones/laptops, (5) Supply chain risks impacting production

Upside risks to our PO include: (1) accelerated product ramps across non-mobile/consumer markets, (2) increased demand across auto OEMs, particularly as EV penetration rises, (3) newly formed partnerships with leading OEMs increasing overall market TAM

Nova (NVMI)

We assign a \$160 PO which is based on 32x our CY23E non-GAAP EPS including stock comp and adjusted for net cash. This is within semicap peer range of 16x-45x and is justified, in our view, given Nova's superior gross margin profile and ability to outgrow the market over the next three years.

Downside risks: 1) inability to take share in new X-Ray metrology market, 2) strong competition from larger players like KLA Corp, 3) historically cyclical nature of semiconductor capital spending.

NVIDIA Corporation (NVDA)

Our \$375 PO is based on 60x CY23E PE ex cash, towards the higher end of NVDA's historical 20x-67x forward PE range, reflecting Nvidia's superior long-term growth profile in large, underpenetrated markets.

Risks to our price objective are: 1) exposure to PC market, 2) Competition with INTC & PLD companies in HPC/accelerated computing markets and MCU vendors in Autos. 3) Lumpy and unpredictable sales in new enterprise, data center, and autos markets, 4) Potential for decelerating capital returns, 5) potential for autos slowdown until ADAS becomes more meaningful, and 6) elevated opex growth.

NXP Semiconductors NV (NXPI)

Our PO of \$270 is based on 22x 2023E EV/FCF, our preferred metric for diversified semi stocks, inline with median diversified auto/industrial compares which trade in a range of 18x-47x CY22 EV/FCF

Downside risks: 1) Semiconductor cycle risks, 2) Lumpy nature of projects in key identification segment, 3) Some exposure to and growth driven by Apple, which could add volatility, 4)

Execution risk surrounding management's capability to reengage following two-year hiatus, 5) Macroeconomic supply/demand disruption.

Price Objective Basis and Risk



onsemi (ON)

We assign a \$82 PO based on 26x 2023E EV/FCF, at the low end of peer range of 21x-45x due to ON's lower margin profile.

Downside risks to our PO are: 1) Macro/cyclical risks, given high exposure to automotive and industrial markets, make ON susceptible to any potential global trade tensions/tariffs, 2) Prolonged COVID-19 headwinds limiting pace of automotive/industrial recovery, impacting utilization levels, 3) Difficulty in ramping 300mm fabrication facility limiting gross margin improvement, 4) sustained elevated capex levels relative to peers.

Qorvo Inc. (QRVO)

Our \$180 price objective is based on 13x our CY23E Non-GAAP EPS (excluding stock comp), in line with historical trading levels (13x-15x average) and smartphone peers.

Downside risks to our PO are: 1) Potential share losses in handset power amplifiers (PAs) where product cycles are short (6-12 months) resulting in changes in power amplifier selection by key customers, 2) Customer concentration at Apple and Samsung, 3) Gross margin headwinds associated with lower factory utilization due to weaker design win momentum, 4) Weaker smartphone growth trajectory, and 5) Semiconductor cyclicalities driven by strong macroeconomic conditions and/or supply chain expansion, 6) COVID-19 headwinds further impacting supply chain or creating demand destruction.

Upside risks to our PO are: 1) higher RF content growth in new smartphones more than offsets quarterly unit volatility in Q4, 2) M&A that diversifies the business away from mobile and adds more long life cycle business, and 3) substantial share gain against peers in smartphone driven by higher R&D spend.

Rockley Photonics (RKLY)

Our \$6 PO based on 2x CY23E EV/S, at the lower-end of smartphone and optical peers trading 2x-6x, justified given execution risks.

Downside risks to our outlook include (1) execution risk, as RKLY's opportunities are not expected to materially ramp until CY23E, with potential for customers delay a adoption of RKLY solutions, (2) limited pricing leverage with competition likely increasing and RKLY's primary opportunity controlled by a limited number of large consumer OEMs, (3) customer concentration, with nearly all revenues through FY22E associated with one large OEM, (4) significant consumer exposure could weigh on multiple expansion opportunities

Upside risks to our outlook include (1) faster than expected ramp of wearable and medtech products, accelerating revenue timeline, (2) expansion of customer engagements allowing RKLY to reach different segments of the consumer market, (3) operational efficiency driving better than expected operating margins

Skyworks Solutions, Inc. (SWKS)

Our \$180 PO is based on 14x CY 2023E PE (ex. stock comp expense, cash adjusted), in the middle of the historical 8x-22x range and in line with smartphone peers.

Downside risks to our price objective: (1) High exposure to mature smartphone market and to daily sentiment shifts around large customers Apple, Huawei and Samsung, (2) exposure to Chinese smartphone customers who could be impacted by global trade/tariff tensions, (3) Competitive risks from AVGO, QRVO and QCOM, (4) High capex requirements for filter manufacturing, (5) Semiconductor cycle risk especially in the broad markets business, and (6) Financial/integration risks with any potential M&A.

Upside risks to our price objective: (1) Share gains, (2) Earlier than expected boost from 5G adoption, and (3) semis consolidation.

Synopsys (SNPS)

Our \$355 PO based on 32x 2023E EV/FCF, in line with EDA, IP, and broader software peers (30x-58x) given in-line EPS/EBITDA/FCF growth potential.

Upside risks are: (1) Share gains in existing markets vs primary competitors, (2) increased government investment in semiconductor R&D and development as nations develop internal ecosystems, (3) material M&A that enables consistent margin expansion or further accelerates sales CAGR, (4) faster than expected cost improvements driving higher operating margin.

Downside risks are: (1) a broader economic downturn dampens semis R&D spending and corresponding spend on EDA tools and services, (2) Semiconductor industry consolidation accelerates, which could diminish customer spending power, (3) Ongoing investments in Software Integrity market limit operating leverage.



Price Objective Basis and Risk

Teradyne (TER)

Our \$205 price objective is based on 25x PE applied to our FY23E Non-GAAP EPS. Our choice of PE is in line with Teradyne's long-term trading range (12x-26x) given TER's newer/unique exposure to 5G/automation, cyclical recovery in auto/industrial markets, and share gains in core semi test.

Downside risks to our price objective are (1) cyclical and/or share losses in the core semiconductor test market, and (2) increasing competition in the robotics segment.

Texas Instruments Inc. (TXN)

We assign a \$225 PO based on 26x 2023E EV/FCF, within diversified peers trading range of 17x-48x and justified, in our view, based on TXN's best-in-class profitability and cash flow returns.

Risks to our price objective: 1) Macro/cyclical risks given high exposure to automotive, industrial, and telco capex markets, also makes TXN susceptible to any potential global trade tensions/tariffs, 2) Increasing capex intensity and higher depreciation burden could be a headwind to gross margins, 3) Increased R&D spending pressure to maintain an edge versus the competition, 4) Inventory cycles and potential double ordering by customers that can often create mismatches between real supply and demand, 5) Exposure to several mature markets such as PC and other consumer.

Valens Semiconductor (VLN)

We rate VLN a Buy with a \$12 PO based on 9.5x CY23E EV/S, at the mid point of premium-value auto semi specialists and more mature and profitable analog semi peers that trade at 6x-15x. Our valuation is justified given VLN in line multi year growth profile in comparison to its peers. Risks to our outlook are: 1) Execution risks as VLN opportunities are not expected to materially ramp up until CY24. (2) Customer concentration risk with the majority of revenues coming from a single customer. (3) Limited history and track record as a public entity (4) Lockup expiration risks particularly towards the end of March 2022.

WolfSpeed Inc (WOLF)

We assign a \$118 PO on 10x CY23E EV/S, in line with high-growth auto tech peers, justified given the leverage to high growth prospects in automotive and communication markets, partially offset by limited near GM expansion opportunities.

Upside risks to our PO are: (1) Faster than anticipated EV adoption with higher SiC penetration, (2) Accelerated ramp of Mohawk Valley driving stronger than expected cost improvements, (3) Slowdown in competitor investment in SiC technology, (4) Market share gains in autos or telecom

Downside risks to our PO are: (1) lumpy 5G telecom capex and rollout of next generation base stations, (2) long-term impacts of COVID-19 reducing automotive demand, (3) higher than expected investment to sustain SiC factory production

Analyst Certification



We, Vivek Arya, Blake Friedman and Jamie Zakalik, hereby certify that the views each of us has expressed in this research report accurately reflect each of our respective personal views about the subject securities and issuers. We also certify that no part of our respective compensation was, is, or will be, directly or indirectly, related to the specific recommendations or view expressed in this research report.

Special Disclosures



BoFA Securities is currently acting as financial advisor to Globalfoundries Inc in connection with its proposed sale of a 300mm fab located in East Fishkill, NY to ON Semiconductor Corp, which was announced on April 22, 2019.

BoFA Securities is currently acting as a financial advisor to Coherent Inc in connection with its proposed sale of the company to II-VI Inc, which was announced on March 25, 2021.

BoFA Securities is currently acting as financial advisor to Xilinx in connection with its proposed acquisition by Advanced Micro Devices, which was announced on October 27, 2020.

Important Disclosures



Equity Investment Rating Distribution: Electronics Group (as of 31 Dec 2021)

Coverage Universe	Count	Percent	Inv. Banking Relationships Error! Reference source not found.	Count	Percent
Buy	32	55.17%	Buy	13	40.63%
Hold	12	20.69%	Hold	3	25.00%
Sell	14	24.14%	Sell	5	35.71%

Equity Investment Rating Distribution: Technology Group (as of 31 Dec 2021)

Coverage Universe	Count	Percent	Inv. Banking Relationships Error! Reference source not found.	Count	Percent
Buy	242	64.53%	Buy	153	63.22%
Hold	77	20.53%	Hold	47	61.04%
Sell	56	14.93%	Sell	31	55.36%

Important Disclosures



Equity Investment Rating Distribution: Global Group (as of 31 Dec 2021)

Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	1982	58.85%	Buy	1249	63.02%
Hold	696	20.67%	Hold	429	61.64%
Sell	690	20.49%	Sell	346	50.14%

^{R1} Issuers that were investment banking clients of BofA Securities or one of its affiliates within the past 12 months. For purposes of this Investment Rating Distribution, the coverage universe includes only stocks. A stock rated Neutral is included as a Hold, and a stock rated Underperform is included as a Sell.

Important Disclosures



FUNDAMENTAL EQUITY OPINION KEY: Opinions include a Volatility Risk Rating, an Investment Rating and an Income Rating. *VOLATILITY RISK RATINGS*, indicators of potential price fluctuation, are: A - Low, B - Medium and C - High. *INVESTMENT RATINGS* reflect the analyst's assessment of both a stock's absolute total return potential as well as its attractiveness for investment relative to other stocks within its *Coverage Cluster* (defined below). There are three investment ratings: 1 - Buy stocks are expected to have a total return of at least 10% and are the most attractive stocks in the coverage cluster; 2 - Neutral stocks are expected to remain flat or increase in value and are less attractive than Buy rated stocks and 3 - Underperform stocks are the least attractive stocks in a coverage cluster. Analysts assign investment ratings considering, among other things, the 0-12 month total return expectation for a stock and the firm's guidelines for ratings dispersions (shown in the table below). The current price objective for a stock should be referenced to better understand the total return expectation at any given time. The price objective reflects the analyst's view of the potential price appreciation (depreciation).

Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster ^{R1}
Buy	≥ 10%	≤ 70%
Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

^{R1} Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

INCOME RATINGS, indicators of potential cash dividends, are: 7 - same/higher (dividend considered to be secure), 8 - same/lower (dividend not considered to be secure) and 9 - pays no cash dividend. *Coverage Cluster* is comprised of stocks covered by a single analyst or two or more analysts sharing a common industry, sector, region or other classification(s). A stock's coverage cluster is included in the most recent BofA Global Research report referencing the stock.

Important Disclosures



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