

Technology | Semiconductors

2022 Semis Playbook

- Semiconductors Bottoming
- Moore's Bend – Transistor/CPU Inflection
- SemiCap Eq Launch
- The 4th Tectonic Shift in Computing

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Valuation Table

Company	Rating	Jefferies Analyst	Market Cap (bn)	Price Target	8/23/22 Price	P/E 2022	P/E 2023	EV/FCF 2022	EV/FCF 2023	EV/S 2022	EV/S 2023	P/TanBk	Gross Margin [1]	Operating Margin [1]
Logic / Neural Networking:														
AMD	Buy	Lipacis	\$ 150	\$ 135	\$ 92	21x	19x	30x	18x	6x	5x	35x	44%	17%
INTC	Hold	Lipacis	\$ 139	\$ 37	\$ 34	15x	13x	n.m.	n.m.	2x	2x	2x	50%	17%
NVDA	Buy	Lipacis	\$ 430	\$ 370	\$ 172	31x	27x	42x	28x	14x	12x	22x	65%	40%
LSSC	Buy	Lipacis	\$ 8	\$ 72	\$ 60	36x	30x	40x	35x	13x	11x	87x	61%	25%
AMBA	Buy	Kelley	\$ 3	\$ 122	\$ 82	67x	44x	54x	36x	8x	7x	14x	62%	-8%
Analog / MCU:														
Large Cap														
ADI	Buy	Lipacis	\$ 85	\$ 215	\$ 164	17x	17x	18x	17x	7x	7x	n.a	50%	24%
Infineon	Underperform	Menon	EUR 33	EUR 18	EUR 25	14x	13x	27x	22x	3x	2x	14x	43%	19%
MCHP	Buy	Lipacis	\$ 38	\$ 100	\$ 69	12x	12x	16x	16x	6x	5x	n.a	54%	30%
NXPI	Buy	Lipacis	\$ 46	\$ 211	\$ 174	12x	13x	21x	16x	4x	4x	n.a	52%	27%
STM	Underperform	Menon	\$ 32	\$ 24	\$ 36	9x	9x	32x	18x	2x	2x	3x	45%	23%
TXN	Buy	Lipacis	\$ 158	\$ 191	\$ 173	18x	19x	23x	27x	8x	8x	16x	69%	53%
ON	Buy	Lipacis	\$ 31	\$ 77	\$ 71	14x	14x	21x	18x	4x	4x	10x	45%	29%
SMID Cap														
ALGM	Buy	Lipacis	\$ 5	\$ 33	\$ 25	25x	21x	34x	23x	5x	5x	7x	54%	18%
ams OSRAM	Hold	Menon	CHF 2	CHF 8	CHF 7	6x	5x	n.m.	n.m.	1x	1x	n.a	34%	10%
LFUS	Buy	Kelley	\$ 6	\$ 305	\$ 240	14x	16x	32x	22x	2x	2x	8x	38%	21%
Melexis	Underperform	Menon	EUR 3	EUR 55	EUR 77	21x	19x	22x	20x	4x	4x	7x	44%	26%
MTSI	Buy	Lipacis	\$ 4	\$ 67	\$ 59	20x	19x	22x	20x	6x	6x	18x	55%	19%
NVTS	Buy	Lipacis	\$ 1	\$ 10	\$ 5	n.m.	n.m.	n.m.	n.m.	12x	5x	3x	44%	-112%
PI	Buy	Lipacis	\$ 2	\$ 90	\$ 93	170x	109x	n.m.	n.m.	10x	8x	n.a.	53%	-18%
Comms:														
AVGO	Buy	Lipacis	\$ 214	\$ 720	\$ 530	14x	13x	14x	14x	7x	7x	n.a	59%	38%
MRVL	Buy	Lipacis	\$ 44	\$ 105	\$ 52	22x	18x	21x	16x	8x	7x	n.a	47%	-3%
QCOM	Hold	McNealy	\$ 158	\$ 160	\$ 141	11x	11x	14x	10x	4x	3x	47x	58%	33%
Memory:														
RMBS [2]	Hold	Lipacis	\$ 3	\$ 28	\$ 28	20x	16x	17x	16x	5x	5x	6x	71%	15%
SGH	Buy	Lipacis	\$ 1	\$ 32	\$ 19	6x	6x	7x	n.m.	1x	1x	4x	25%	10%

Source: FactSet, Jefferies Research. [1] Please note that Gross Margin and Operating Margin are in GAAP terms. [2] Given footnote 1 and ASC 606, please note that RMBS's gross margin and operating margin presented in the table are not reflective of its cash flow from fixed-fee licensing agreements.

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Company	Rating	Jefferies Analyst	Market Cap (bn)	Price Target	8/23/22 Price	P/E 2022	P/E 2023	EV/FCF 2022	EV/FCF 2023	EV/S 2022	EV/S 2023	P/TanBk	Gross Margin [1]	Operating Margin [1]
Foundry:														
GFS	Buy	Lipacis	\$ 32	\$ 82	\$ 60	22x	23x	n.m.	30x	4x	4x	4x	23%	11%
Hua Hong - 1347	Buy	Lee	HKD 31	HKD 32	HKD 24	12x	12x	1060x	1060x	2x	2x	1x	29%	16%
SMIC - 981	Buy	Lee	HKD 93	HKD 25	HKD 16	9x	10x	n.m.	n.m.	1x	1x	1x	57%	21%
TSEM	Hold	Lipacis	\$ 5	\$ 48	\$ 46	20x	18x	976x	65x	3x	3x	3x	24%	14%
IP:														
AIP	Buy	Lipacis	\$ 0.2	\$ 19	\$ 7	n.m.	n.m.	n.m.	66x	3x	3x	6x	92%	-27%
Alphawave	Buy	Menon	GBP 1	GBP 3	GBP 1	0x	0x	11x	10x	4x	3x	2x	94%	47%
Wafers:														
Siltronic	Buy	Hesse	EUR 2	EUR 115	EUR 72	6x	7x	n.m.	n.m.	1x	1x	1x	33%	24%
Soitec	Hold	Rumph	EUR 5	EUR 206	EUR 149	26x	20x	144x	72x	5x	4x	6x	35%	15%
Semi Cap Equipment:														
<i>Front-End</i>														
ACMR	Buy	Lee	\$ 1	\$ 34	\$ 16	23x	18x	5x	n.m.	1x	1x	1x	45%	13%
Adv Micro - 688012	Buy	Lee	CNY 84	CNY 219	CNY 136	93x	79x	264x	119x	17x	12x	6x	42%	16%
Aixtron	Buy	Menon	EUR 3	EUR 35	EUR 23	29x	24x	29x	21x	4x	4x	5x	42%	23%
AMAT	Buy	Lipacis	\$ 89	\$ 158	\$ 102	13x	13x	18x	13x	3x	3x	11x	47%	31%
ASM International	Buy	Menon	EUR 14	EUR 390	EUR 287	23x	21x	34x	25x	6x	6x	7x	48%	27%
ASML Holding	Buy	Menon	EUR 214	EUR 700	EUR 526	37x	27x	44x	30x	10x	8x	96x	51%	32%
Canon - 7751	Hold	Nakanomyo	JPY 4,569	JPY 3,300	JPY 3,426	14x	14x	22x	16x	1x	1x	2x	46%	8%
KLAC	Buy	Shrotre	\$ 51	\$ 423	\$ 362	15x	16x	19x	15x	6x	5x	n.a.	61%	40%
Lasertech - 6920	Buy	Nakanomyo	JPY 1,939	JPY 25,000	JPY 20,570	51x	32x	360x	70x	15x	10x	28x	53%	36%
LRCX	Buy	Lipacis	\$ 64	\$ 670	\$ 464	13x	13x	21x	12x	3x	3x	13x	46%	31%
NAURA - 002371	Hold	Lee	CNY 158	CNY 219	CNY 300	94x	70x	1351x	160x	11x	8x	14x	35%	7%
Nikon - 7731	Buy	Nakanomyo	JPY 602	JPY 2,000	JPY 1,592	15x	14x	34x	10x	1x	1x	1x	44%	8%
TEL - 8035	Buy	Nakanomyo	JPY 7,125	JPY 70,000	JPY 45,320	14x	14x	20x	14x	3x	3x	6x	45%	28%
<i>Back-End</i>														
Advantest - 6857	Buy	Nakanomyo	JPY 1,652	JPY 15,000	JPY 8,280	15x	14x	19x	15x	3x	3x	7x	57%	29%
Disco - 6146	Buy	Nakanomyo	JPY 1,291	JPY 40,000	JPY 35,750	20x	19x	19x	17x	4x	5x	4x	61%	37%

Source: FactSet, Jefferies Research.

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Valuation Table

Company	Consensus Sales (m)		Cash (m)	Debt (m)	Net Debt /EBITDA	Net Debt /Shr	JEF EPS		Cons. EPS		ROIC
	2022	2023					2022	2023	2022	2023	
Logic / Neural Networking:											
AMD	\$ 26,274	\$ 30,079	\$ 5,992	\$ 3,199	\$ (0.56)	\$ (1.72)	\$ 4.43	\$ 5.24	\$ 4.38	\$ 4.86	9%
INTC	\$ 66,319	\$ 69,109	\$ 27,044	\$ 35,430	\$ 0.33	\$ 2.04	\$ 2.30	\$ 2.82	\$ 2.27	\$ 2.58	18%
NVDA	\$ 29,353	\$ 34,099	\$ 20,338	\$ 11,699	\$ (0.71)	\$ (3.46)	\$ 5.30	\$ 6.01	\$ 5.46	\$ 6.47	34%
LSCC	\$ 647	\$ 735	\$ 118	\$ 171	\$ 0.18	\$ 0.39	\$ 1.67	\$ 1.97	\$ 1.67	\$ 1.98	17%
AMBA	\$ 347	\$ 424	\$ 201	\$ 11	\$ (16.81)	\$ (4.98)	\$ 1.58	\$ 2.39	\$ 1.22	\$ 1.84	-5%
Analog / MCU:											
<i>Large Cap</i>											
ADI	\$ 12,284	\$ 12,345	\$ 1,525	\$ 6,253	\$ 0.96	\$ 9.19	\$ 10.06	\$ 9.73	\$ 9.90	\$ 9.72	9%
Infineon	EUR 14,578	EUR 15,098	EUR 3,569	EUR 7,627	EUR 1.00	EUR 3.11	EUR 1.71	EUR 1.65	EUR 1.76	EUR 1.92	10%
MCHP	\$ 7,960	\$ 8,333	\$ 379	\$ 7,597	\$ 2.06	\$ 13.06	\$ 5.63	\$ 5.40	\$ 5.62	\$ 5.71	16%
NXPI	\$ 13,305	\$ 13,762	\$ 3,545	\$ 11,160	\$ 1.67	\$ 29.00	\$ 13.64	\$ 12.72	\$ 14.15	\$ 13.84	14%
STM	\$ 15,953	\$ 16,762	\$ 3,443	\$ 2,519	\$ (0.23)	\$ (1.01)	\$ 3.89	\$ 3.10	\$ 3.78	\$ 3.85	17%
TXN	\$ 20,206	\$ 19,977	\$ 8,387	\$ 7,244	\$ (0.10)	\$ (1.25)	\$ 9.41	\$ 8.66	\$ 9.43	\$ 8.94	42%
ON	\$ 8,251	\$ 8,453	\$ 1,810	\$ 3,458	\$ 0.50	\$ 3.80	\$ 5.11	\$ 4.98	\$ 5.13	\$ 4.98	17%
<i>SMID Cap</i>											
ALGM	\$ 877	\$ 989	\$ 296	\$ 41	\$ (1.55)	\$ (1.34)	\$ 0.97	\$ 1.32	\$ 0.98	\$ 1.17	28%
ams OSRAM	CHF 4,820	CHF 4,501	CHF 1,275	CHF 3,161	CHF 1.47	CHF 6.88	CHF 1.21	CHF 1.34	CHF 1.16	CHF 1.47	4%
LFUS	\$ 2,514	\$ 2,625	\$ 811	\$ 934	\$ 0.13	\$ 4.96	\$ 16.76	\$ 14.86	\$ 16.67	\$ 15.03	12%
Melexis	EUR 811	EUR 843	EUR 63	EUR 4	EUR (0.25)	EUR (1.45)	EUR 3.69	EUR 3.50	EUR 3.58	EUR 4.06	31%
MTSI	\$ 694	\$ 749	\$ 536	\$ 603	\$ 0.37	\$ 0.96	\$ 2.96	\$ 3.01	\$ 2.93	\$ 3.13	11%
NVTS	\$ 40	\$ 100	\$ 241	\$ 12	\$ 7.37	\$ (1.82)	\$ (0.28)	\$ (0.07)	\$ (0.28)	\$ (0.18)	-55%
PI	\$ 245	\$ 297	\$ 163	\$ 293	\$ 14.29	\$ 5.09	\$ 0.34	\$ 0.72	\$ 0.55	\$ 0.86	3%
Comms:											
AVGO	\$ 33,988	\$ 35,117	\$ 9,005	\$ 39,466	\$ 1.81	\$ 75.43	\$ 37.97	\$ 40.11	\$ 38.71	\$ 40.88	18%
MRVL	\$ 6,187	\$ 7,239	\$ 465	\$ 5,148	\$ 3.63	\$ 5.51	\$ 2.34	\$ 2.97	\$ 2.33	\$ 2.92	4%
QCOM	\$ 45,616	\$ 47,999	\$ 6,848	\$ 15,545	\$ 0.55	\$ 7.74	\$ 11.65	\$ 12.15	\$ 12.80	\$ 13.37	38%
Memory:											
RMBS	\$ 554	\$ 588	\$ 352	\$ 86	\$ (2.93)	\$ (2.40)	\$ 1.64	\$ 1.68	\$ 1.39	\$ 1.69	19%
SGH	\$ 1,806	\$ 1,892	\$ 387	\$ 530	\$ 0.42	\$ 2.86	\$ 3.07	\$ 3.51	\$ 3.15	\$ 3.24	19%

Source: FactSet, Jefferies Research. [1] Please note that Gross Margin and Operating Margin are in GAAP terms.

Valuation Table

Company	Consensus Sales (m)				Cash (m)	Debt (m)	Net Debt /EBITDA	Net Debt /Shr	JEF EPS		Cons. EPS		ROIC
	2022	2023	2022	2023					2022	2023	2022	2023	
Foundry:													
GFS	\$ 8,070	\$ 8,409	\$ 2,999	\$ 2,584	\$ (0.18)	\$ (0.77)	\$ 2.64	\$ 2.41	\$ 2.68	\$ 2.56	6%		
Hua Hong - 1347	HKD 19,272	HKD 18,938	HKD 13,403	HKD 12,534	HKD (0.15)	HKD (0.67)	HKD 2.28	HKD 2.20	HKD 1.91	HKD 1.94	7%		
SMIC - 981	HKD 59,179	HKD 59,083	HKD 118,356	HKD 56,929	HKD (1.56)	HKD (10.30)	HKD 2.04	HKD 1.65	HKD 1.69	HKD 1.60	8%		
TSEM	\$ 1,702	\$ 1,746	\$ 856	\$ 280	\$ (1.14)	\$ (5.27)	\$ 2.37	\$ 2.48	\$ 2.34	\$ 2.58	10%		
IP:													
AIP	\$ 51	\$ 64	\$ 81	\$ 4	\$ 3.80	\$ (2.37)	\$ (0.53)	\$ (0.29)	\$ (0.51)	\$ (0.31)	-84%		
Alphawave	GBP 109.43	GBP 173.90	GBP 369.87	GBP 5.77	GBP (10.99)	GBP (0.53)	GBP 5.46	GBP 8.83	GBP 5.63	GBP 8.98	926%		
Wafers:													
Siltronic	EUR 1,749	EUR 1,846	EUR 869	EUR 297	EUR (0.85)	EUR (19.07)	EUR 11.43	EUR 9.50	EUR 11.30	EUR 10.22	31%		
Soitec	EUR 992	EUR 1,300	EUR 291	EUR 297	EUR (0.01)	EUR 0.15	EUR 5.48	na	EUR 5.73	EUR 7.62	13%		
Sumco - 3436	JPY 432,853	JPY 482,617	JPY 278,624	JPY 141,086	JPY (1.01)	JPY (393)	JPY 181	JPY 214	JPY 181	JPY 214	8%		
Semi Cap Equipment:													
<i>Front-End</i>													
ACMR	\$ 387	\$ 497	\$ 418	\$ 31	\$ (8.58)	\$ (7.14)	\$ 0.61	\$ 0.79	\$ 0.70	\$ 0.92	10%		
Adv Micro - 688012	CNY 4,449	CNY 6,126	CNY 10,656	CNY 267	CNY (20.37)	CNY (16.86)	CNY 1.29	CNY 1.51	CNY 1.47	CNY 1.72	5%		
Aixtron	EUR 494	EUR 562	EUR 375	EUR -	EUR (3.19)	EUR (3.31)	EUR 0.96	EUR 1.48	EUR 0.79	EUR 0.96	12%		
AMAT	\$ 26,246	\$ 26,206	\$ 3,548	\$ 5,456	\$ 0.23	\$ 2.19	\$ 7.87	\$ 8.52	\$ 7.86	\$ 7.83	40%		
ASM International	EUR 2,275	EUR 2,329	EUR 552	EUR 16	EUR (0.99)	EUR (10.88)	EUR 13.40	EUR 16.63	EUR 12.24	EUR 13.73	22%		
ASML Holding	EUR 21,177	EUR 25,313	EUR 4,402	EUR 4,385	EUR (0.00)	EUR (0.04)	EUR 13.15	EUR 19.76	EUR 14.35	EUR 19.59	41%		
Canon - 7751	JPY 4,010,656	JPY 4,103,333	JPY 462,861	JPY 423,631	JPY (0.28)	JPY (29)	JPY 273	JPY 258	JPY 249	JPY 253	8%		
KLAC	\$ 10,045	\$ 10,150	\$ 2,708	\$ 6,774	\$ 0.97	\$ 28.68	\$ 23.38	\$ 24.58	\$ 23.64	\$ 23.36	37%		
Lasertech - 6920	JPY 125,840	JPY 195,530	JPY 23,495	JPY 38	JPY (0.64)	JPY (249)	JPY 396	JPY 689	JPY 405	JPY 649	32%		
LRCX	\$ 18,713	\$ 18,679	\$ 3,658	\$ 5,006	\$ 0.24	\$ 9.84	\$ 36.87	\$ 42.02	\$ 35.80	\$ 35.67	42%		
NAURA - 002371	CNY 13,566	CNY 19,282	CNY 7,255	CNY 1,545	CNY (5.06)	CNY (10.83)	CNY 1.97	CNY 2.92	CNY 3.19	CNY 4.26	7%		
Nikon - 7731	JPY 590,448	JPY 590,246	JPY 367,440	JPY 133,228	JPY (3.35)	JPY (619)	JPY 114	JPY 120	JPY 109	JPY 115	4%		
TEL - 8035	JPY 2,242,040	JPY 2,275,904	JPY 314,601	JPY 11,200	JPY (0.48)	JPY (1,930)	JPY 3,245	JPY 3,477	JPY 3,241	JPY 3,351	28%		
<i>Back-End</i>													
Advantest - 6857	JPY 511,296	JPY 463,157	JPY 107,471	JPY 46,679	JPY (0.41)	JPY (305)	JPY 557	JPY 601	JPY 562	JPY 610	30%		
Disco - 6146	JPY 276,359	JPY 256,991	JPY 113,382	JPY -	JPY (1.13)	JPY (3,141)	JPY 1,870	JPY 1,933	JPY 1,806	JPY 1,892	24%		

Source: FactSet, Jefferies Research.

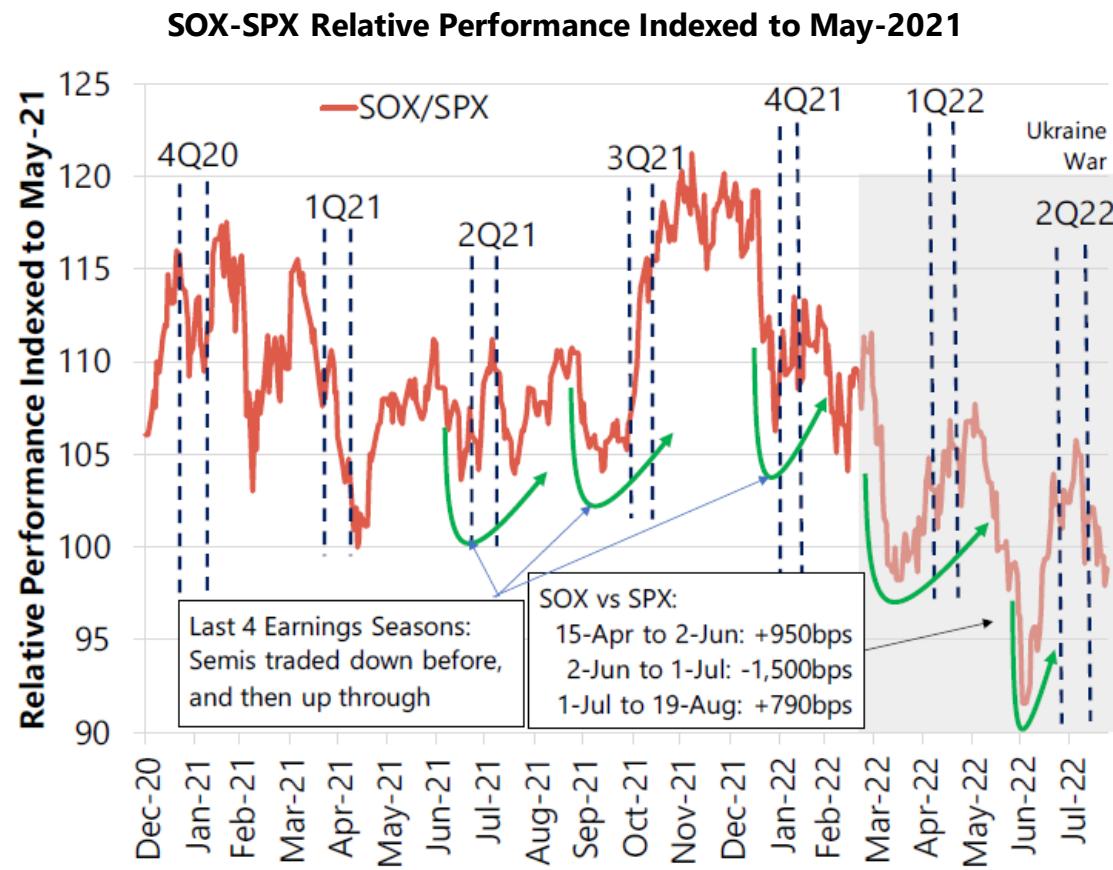
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SOX Bottomed vs SPX on July 1, 14 Months Post MCC, At MCC, 20% P/E Discount to SPX

This chart shows the SOX performance relative to the SPX with parallel vertical dashed lines representing earnings seasons.

Over the past year, the SOX has consistently underperformed in the 2-4 weeks heading into earnings seasons and outperformed during earnings seasons (green arrows).

SOX underperformed SPX by 680bps since Aug-4 but is up 790bps vs SPX since Jul-1 to Aug-23.



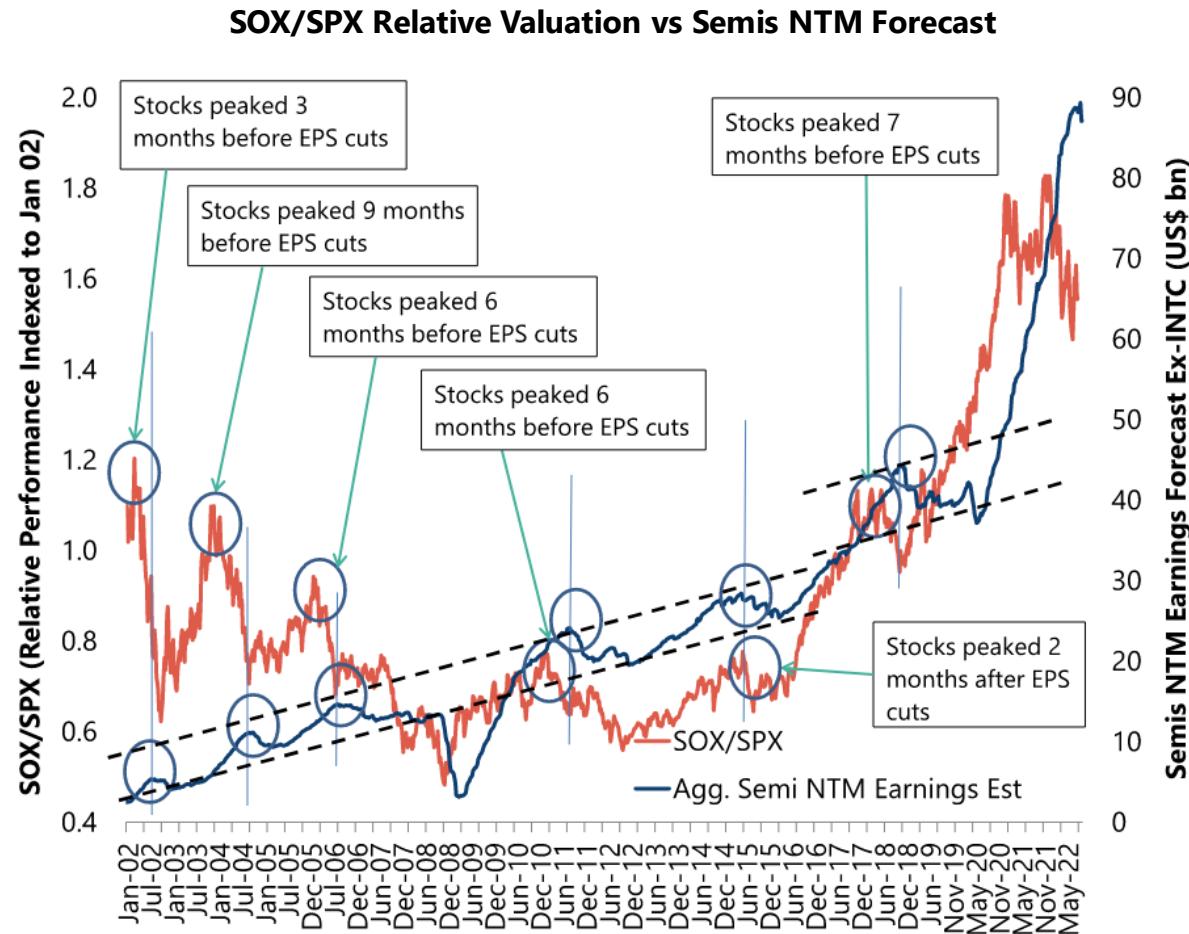
Pattern 1: Semis Peak 6 Months Before Cuts, and Bottom When Cuts Start

Blue Line: Aggregate NTM earnings estimates for a large sample of semiconductor stocks. Peak estimates for each local earnings peak bisected with thin vertical line

Red Line: Relative performance of the SOX vs SPX

Over the past 18 years, the SOX relative performance vs SPX typically peaked 3-to-9 months before aggregate semiconductor earnings cuts (mean and mode ~6 months before)

The exception was the 2015-16 inventory correction, when the SOX peaked relative to the SPX 2 months after cuts started. We attribute this to a material M&A cycle the sector was experiencing



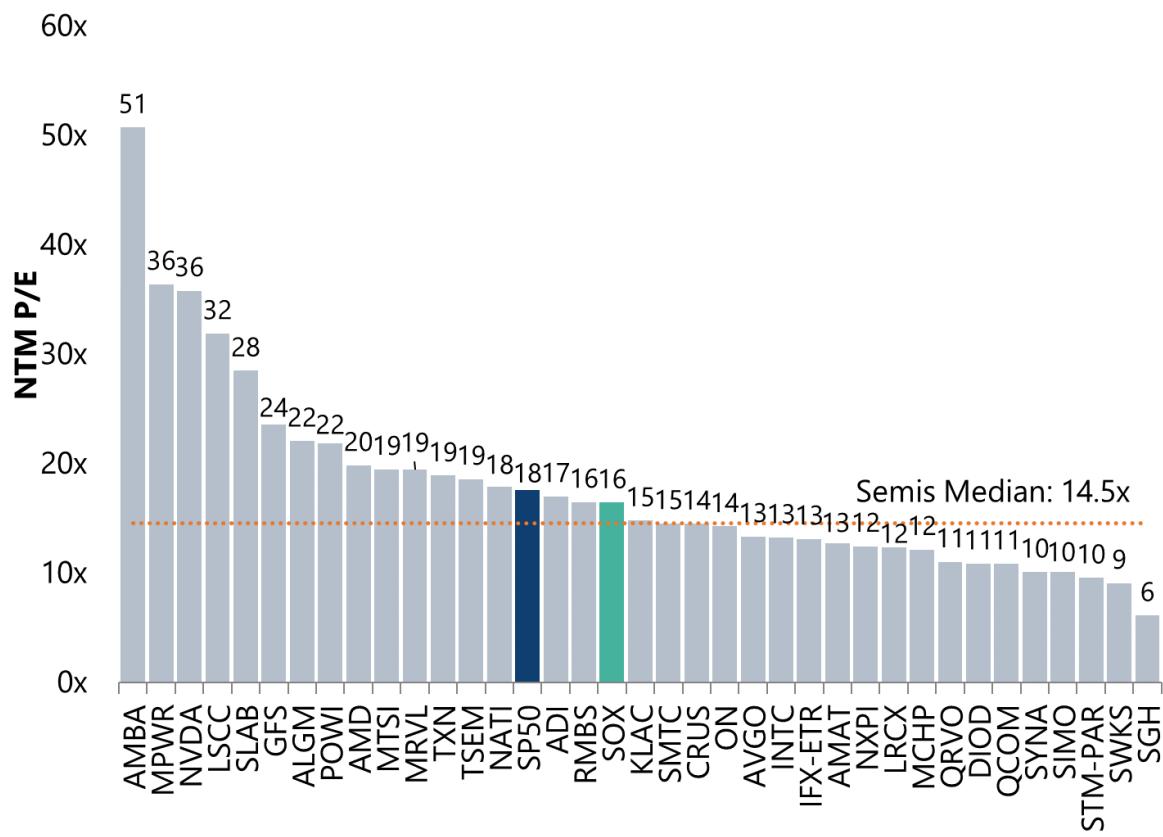
Median Semi P/E at 18% Discount to the SP50

The SOX P/E is currently trading at an 7% discount vs the SP50 PE.

However, the median P/E in this semiconductor sample is 14.5x, 12% lower than the SOX and 18% lower than the SPX, reflecting the skew of the index toward higher P/E, larger cap stocks like NVDA and AMD.

Historically, semis bottomed at a trough P/E of 20-25% discount to the SPX

Semi Coverage Valuations NTM P/E

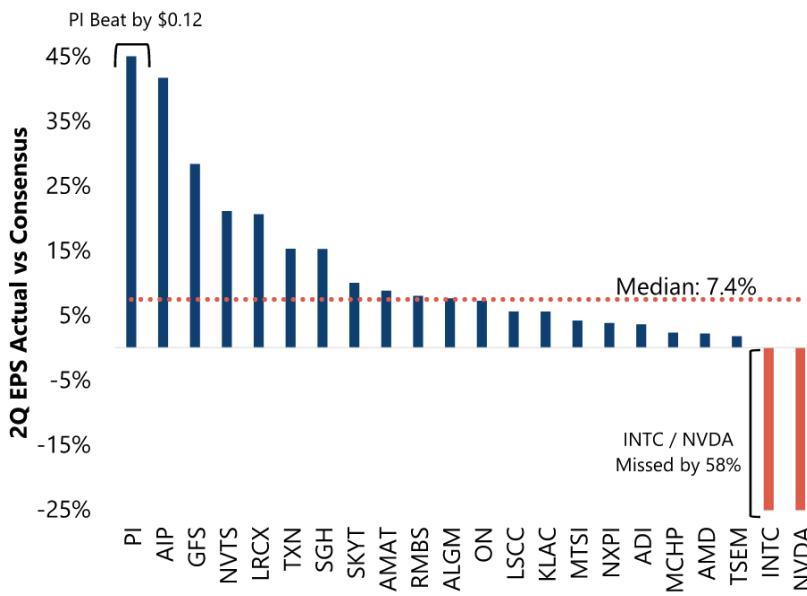


Source: FactSet, Jefferies Research

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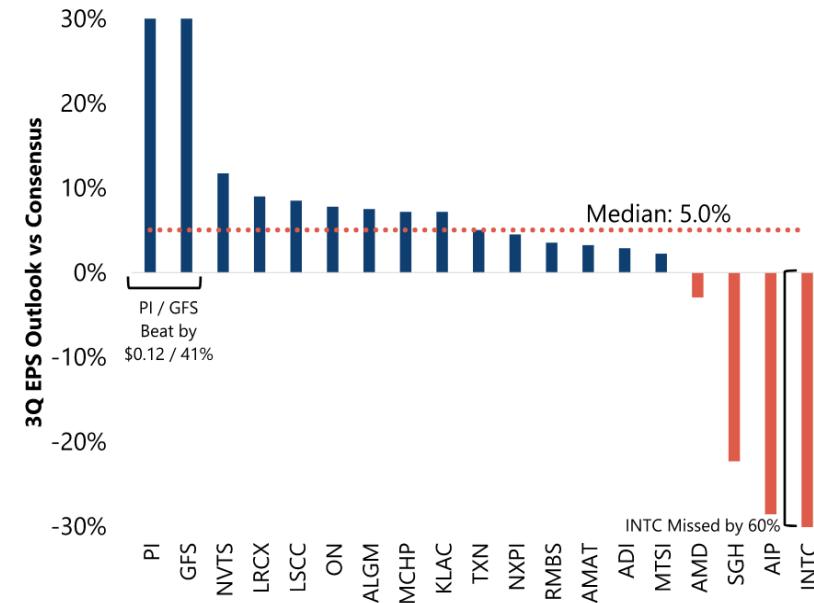
2Q22 Earnings Season Update

Median 2Q22 EPS Beat = 7.4%



At the median, semis beat 2Q22 consensus EPS by 7.4%. NVDA earnings are implied based on the negative pre-announcement.

Median 3Q22 EPS Outlook = 5.0% Above Consensus



At the median, semis provided a 3Q22 EPS outlook, (explicitly or implied) that was 5.0% above consensus.

Source: Jefferies, Factset, company data.

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Gross Margins Still Upsiding

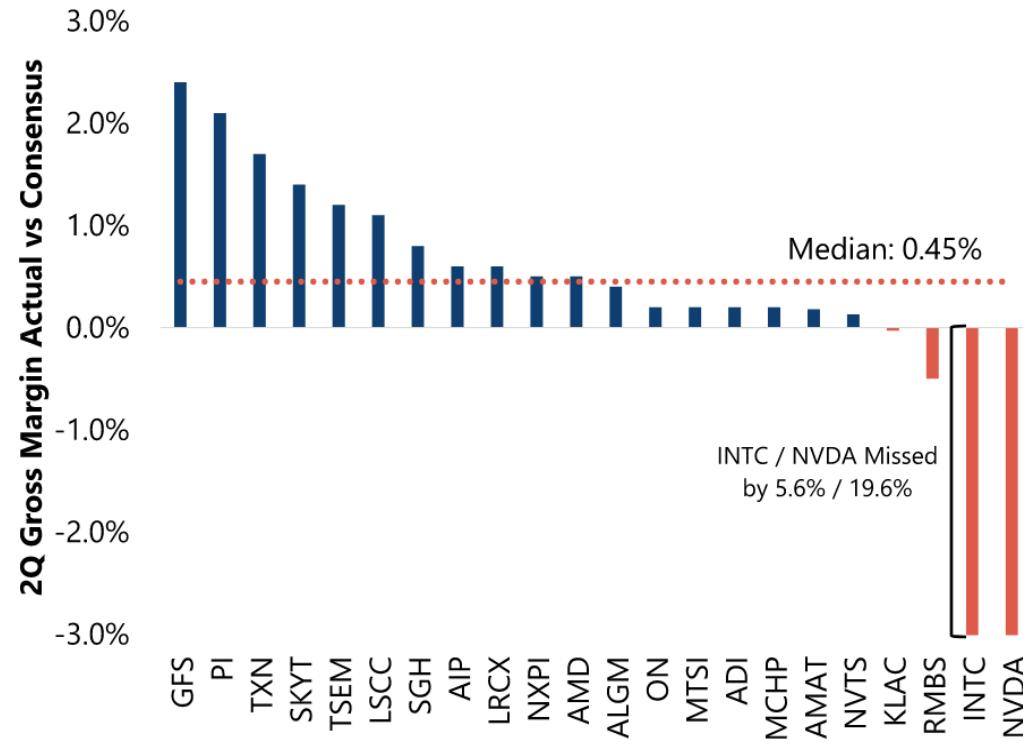
All companies in our coverage universe except NVDA, KLAC, INTC, and NVTS beat gross margin consensus expectations.

At the median, 2Q22 gross margin beat consensus by 45 bps.

The gross margin upside is consistent with our channel checks, which indicate ASP increases for semis.

We continue to think Consensus is underestimating the impact tight supply and ASP increases will have on semiconductor profitability throughout 2022.

Median 2Q22 Gross Margin Beat Consensus by 45 bps

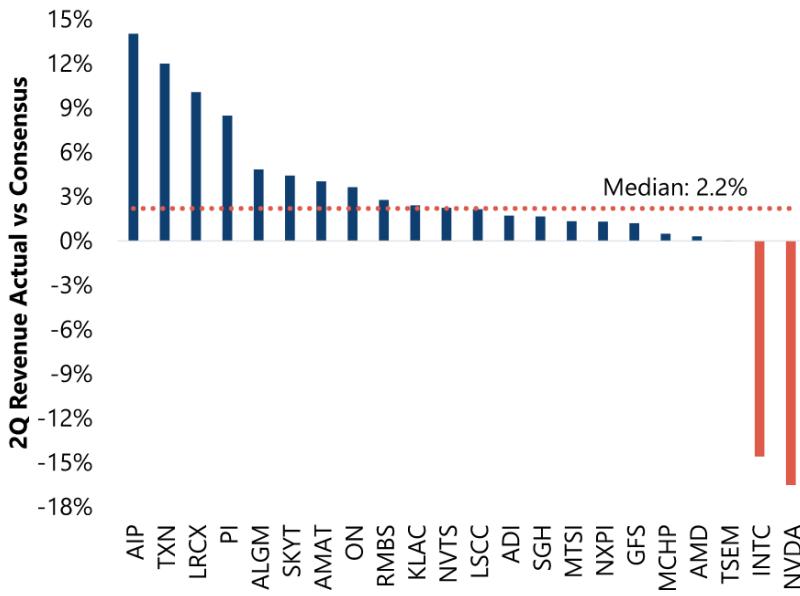


Source: Jefferies, Factset, company data

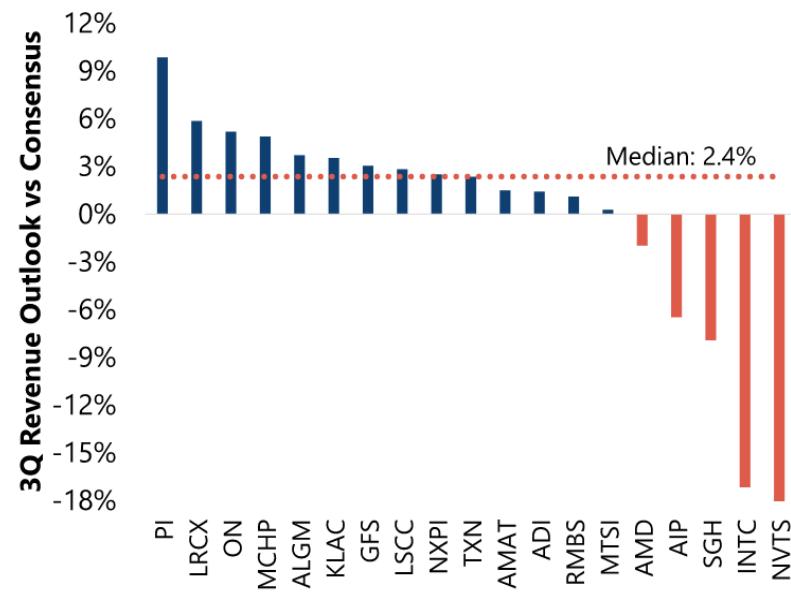
Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

2Q22 Earnings Season Update

Median 2Q22 Revenue Beat = 2.2%



Median 3Q22 Rev Outlook = 2.4% Above Consensus



All companies except INTC, NVDA, AMD, AIP, NVTS and SGH reported 2Q22 revs and 3Q22 rev outlook that was above consensus expectations. NVDA pre-announced negative 2Q22 results ahead of its scheduled earnings call in 2 weeks.

Source: Jefferies, Factset, company data.

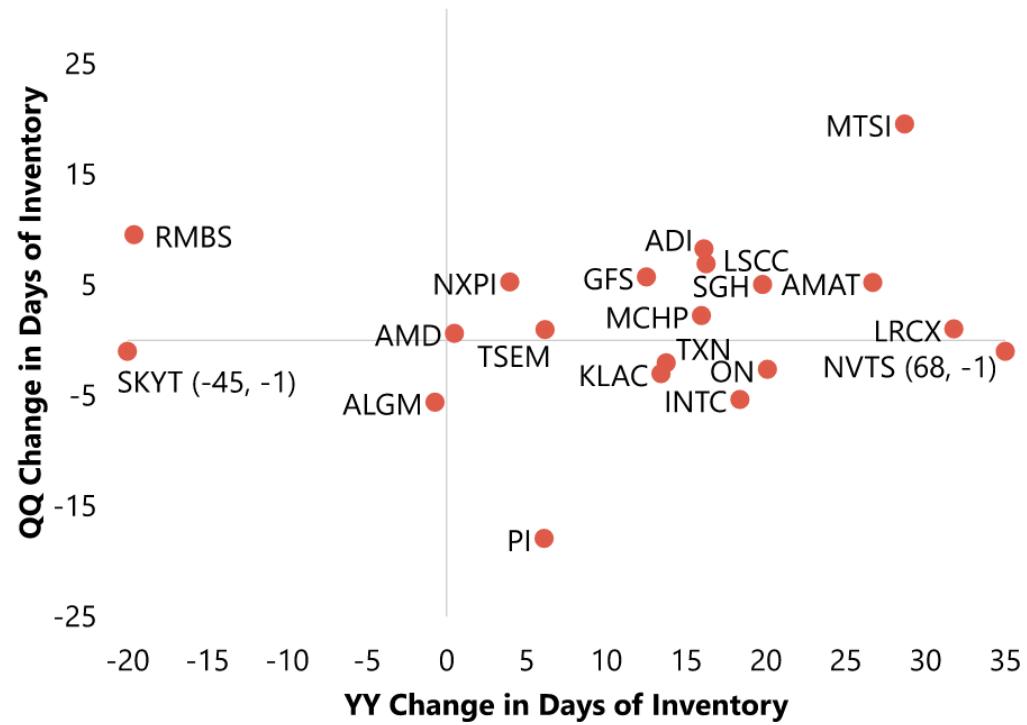
Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

All Semis except 2 Reported DOI Increasing YY

Within our coverage, all semis that reported 2Q22 earnings, except ALGM and SKYT posted YY DOI increases (SGH is memory module/Specialty Computing/LED lighting, RMBS is IP/memory interface company).

Ultimately, we would expect higher DOI to translate to lower lead times, and ultimately lead to an inventory correction

All Semis except 2 Reported DOI Increasing YY and QQ



Source: Jefferies, Factset, company data

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Total Semi DOI Back Above Trendline, Supply Should Loosen in 2H22

In 2Q22 DOI has increased by 1 day.
In 1Q22, DOI increased by 10 days. In 4Q21, DOI increased by 2 days. Semi DOI bottomed in 1Q21 and increased QQ in 2Q21 for the first time in over a year, and decreased QQ in 3Q21.

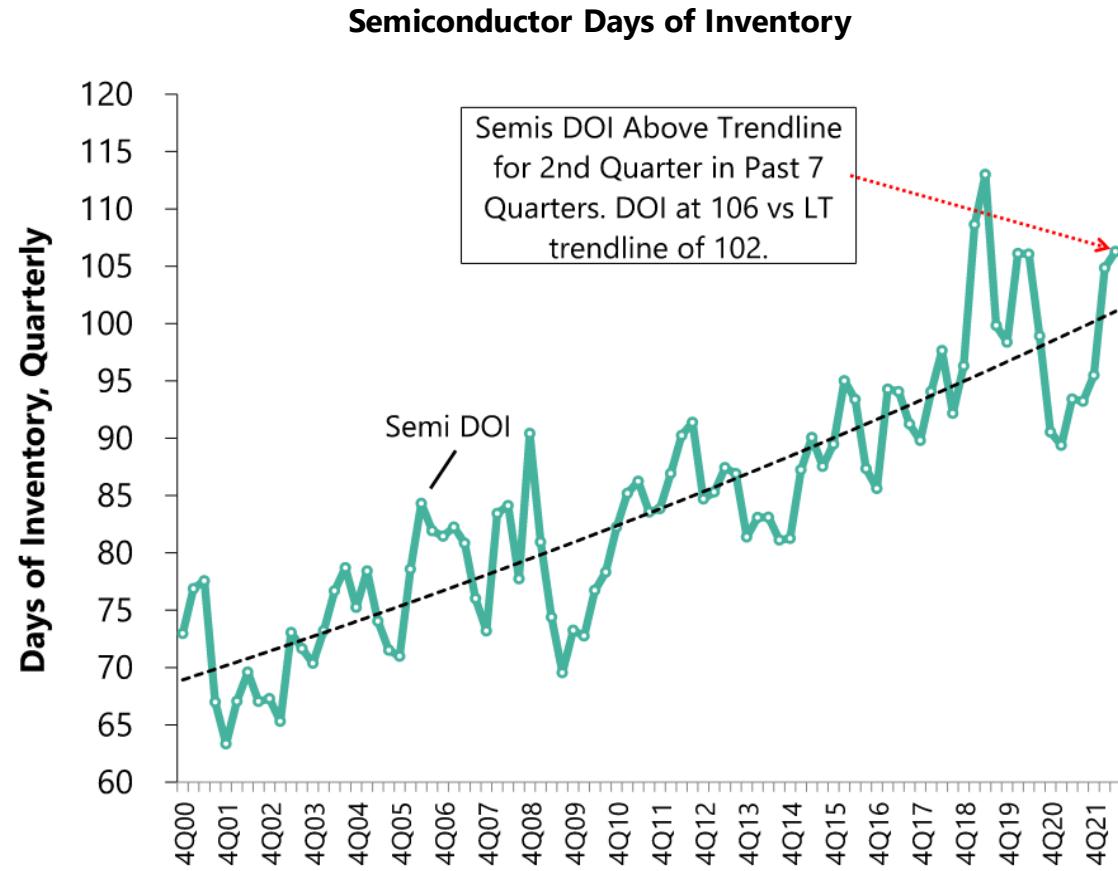
Semi DOI increased to 106 days above the LT trendline level of 102.

Data is still pending reports from NVDA, AVGO, and MRVL.

We believe higher Semi DOI will ultimately lead to a loosening of component availability in 2H22. Semi DOI bottoms have been a leading-to-coincident indicator for SOX peaks...

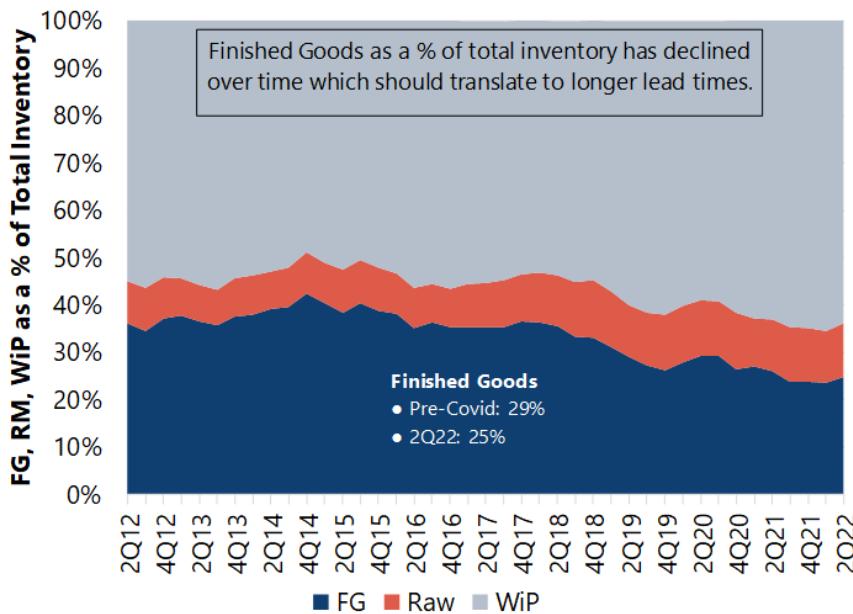
... we think causality is lead times.

However, finished good levels as a percentage of total inventory has declined from 29% to 25% since 2Q20. We think finished goods levels need to increase by at least ~24% for lead times to normalize.

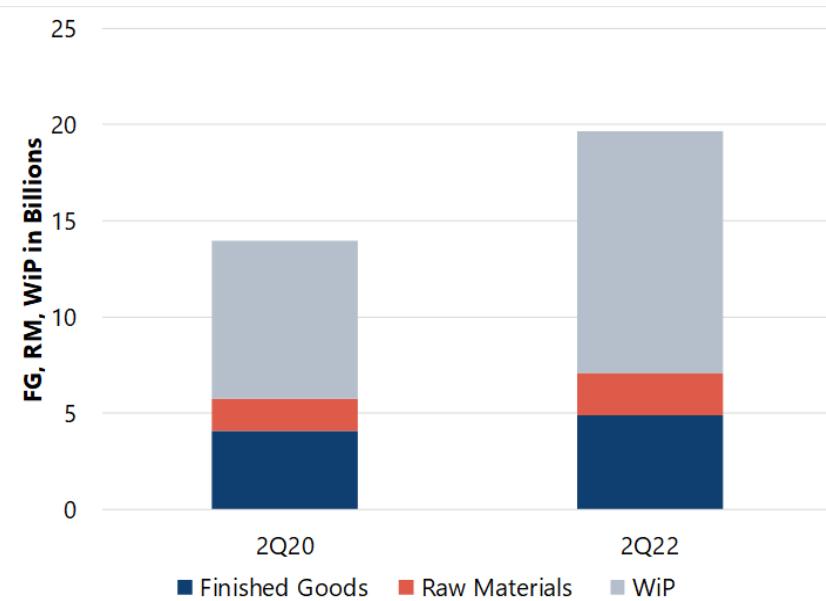


But Semi Inventory Restock is All WIP – FG Needs to Increase by 25%-50%

Finished Goods as a % of Total Inventory has Decreased from 29% to 25% since 2Q20.



Increase in Inventories Driven by Increases in WiP. Finished Goods and Raw Material Levels Stable.



Source: Source: Jefferies, Factset. Jefferies, Factset. Sample Set includes 12 semis companies (MU, AMD, DIOD, LSCC, MTSI, NATI, ON, POWI, QCOM, SLAB, SWKS, TXN) that have reported inventory breakdown.

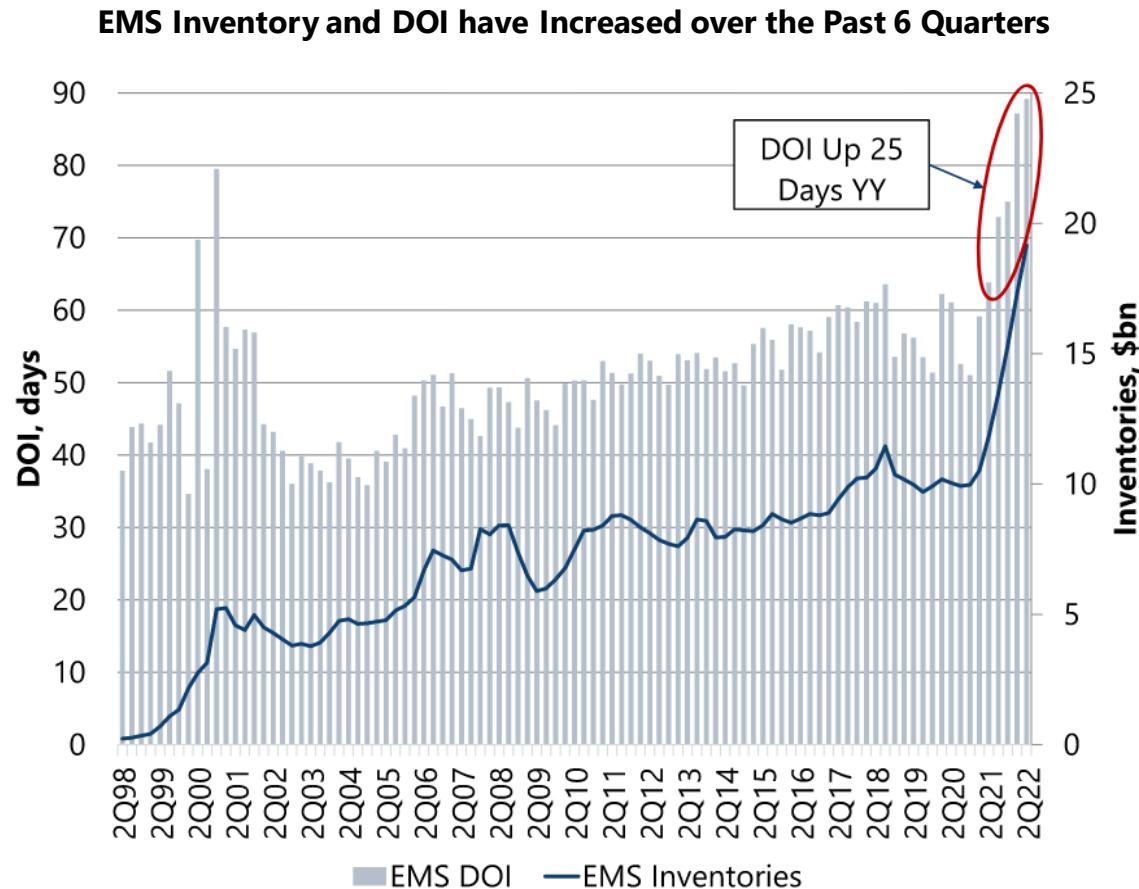
EMS DOI Above Pre-Internet Bubble Level – There Will Be An Inventory Correction

EMS inventory DOIs at 20-year highs lead us to believe semiconductor stocks are entering a cycle peaking process

EMS DOI increased by 25 days YY and 2 days QQ to 89 days in 2Q22. In dollar terms, Inventories increased by \$7.3bn YY and \$1.8bn QQ. We believe that build-up of partially-built manufacturing kits is driving the increase.

EMS sample includes Celestica, Jabil, Flex, Sanmina, Plexus, Benchmark.

It is not clear to what extent the increasing inventories is due to increases in component ASPs

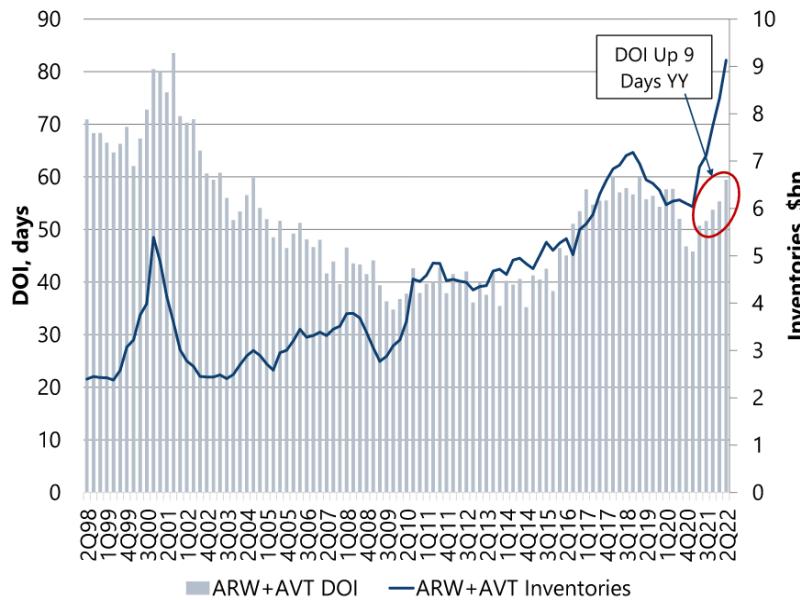


Source: FactSet, Jefferies Research

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Semi Disti DOI Normal

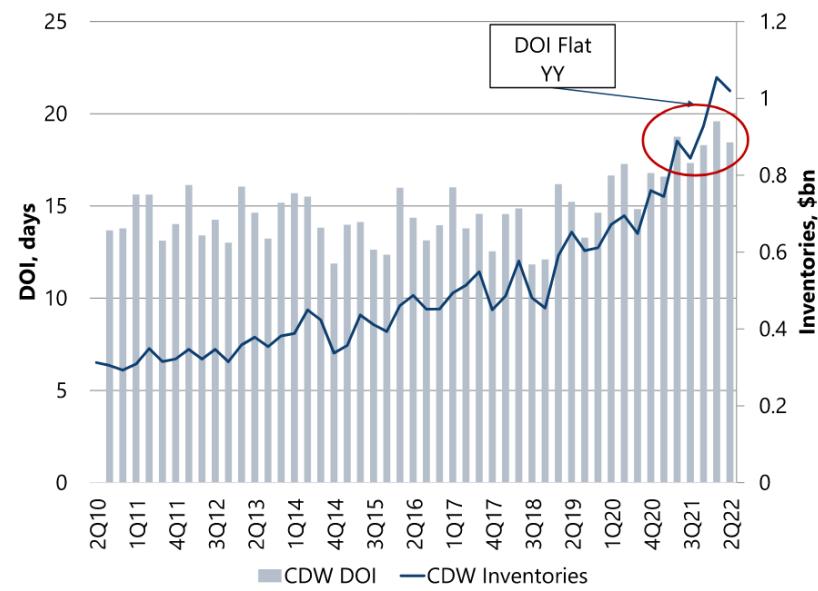
2Q22 Chip Distributor Inventory Days Increased 4 Days QQ



Chip distributor DOI increased 9 days YY and 4 days QQ to 59 days in 2Q22. Balance Sheet inventories increased by \$2.3bn YY and \$0.8bn QQ to \$9.1bn.

Notably DOI is now 2 days above 2019-1H20 average levels

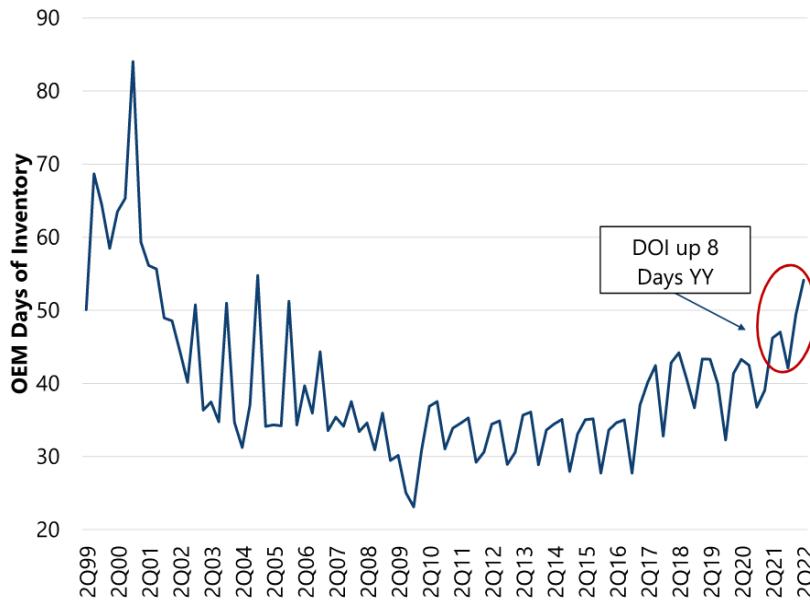
Electronic Equipment Distributor 2Q22 DOI decreased 1 Day QQ



Electronics distributor CDW's DOI was flat YY and down 1 day QQ in 2Q22. Balance sheet Inventories increased by \$130m YY and decreased by \$35m QQ.

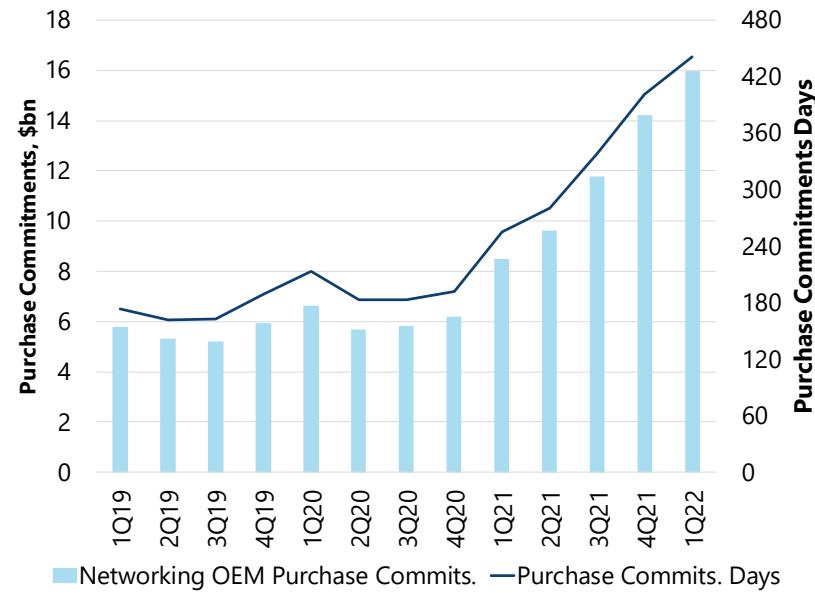
OEM DOI Above Normal – Purchase Commitments Have Doubled

2Q22 OEM DOI 8 Days Higher YY



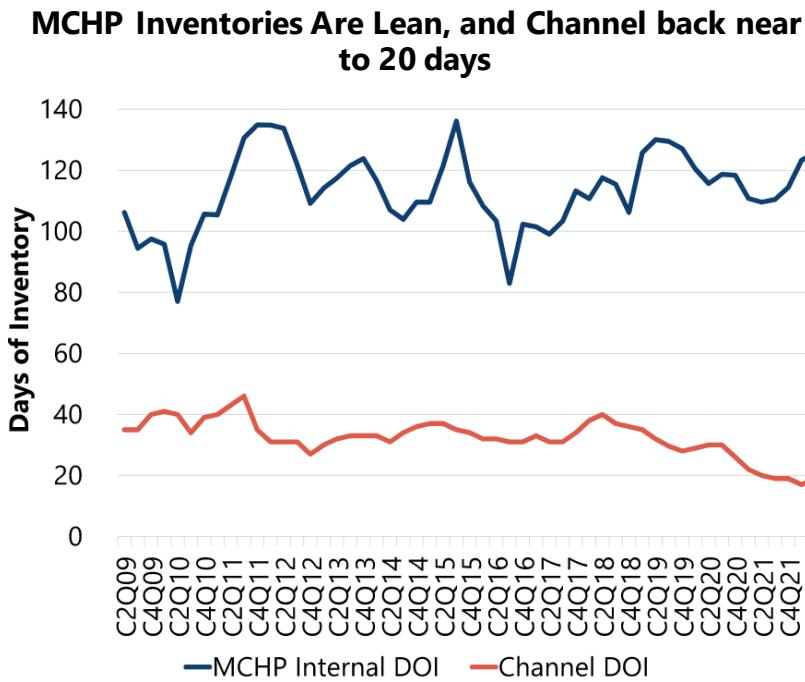
OEM DOI increased by 8 days YoY in 2Q22

Networking OEM Total Purchase Commitments and Days



OEM purchase commitments have grown 88% YY as lead times have stretched. Purchase Commitment Days have increased by 73%, up 186 days YY.

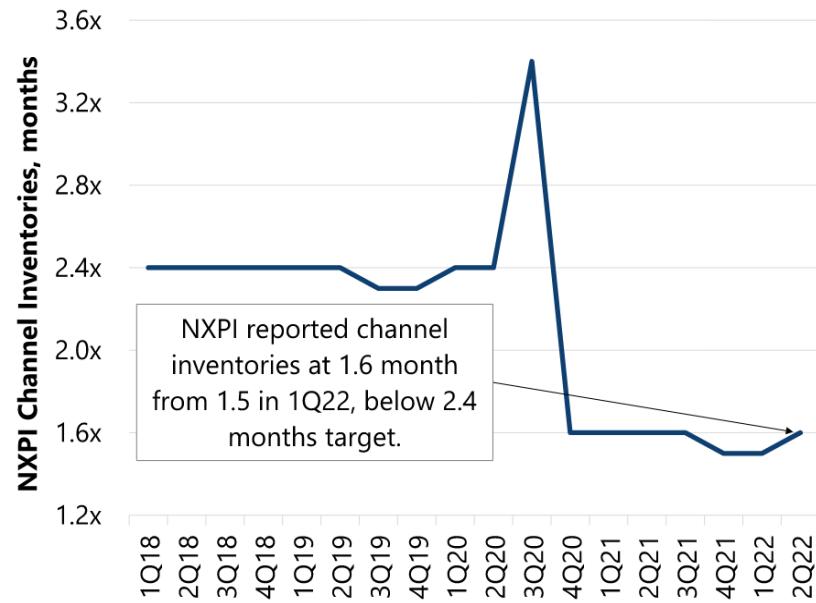
Semiconductor Peak-Cycle Handbook



MCHP's internal inventories DOI increased 2 days QQ.

Channel inventories increased by 2 days been at 19 days, categorized by MCHP as "low when compared to what the channel has historically required to serve customers effectively".

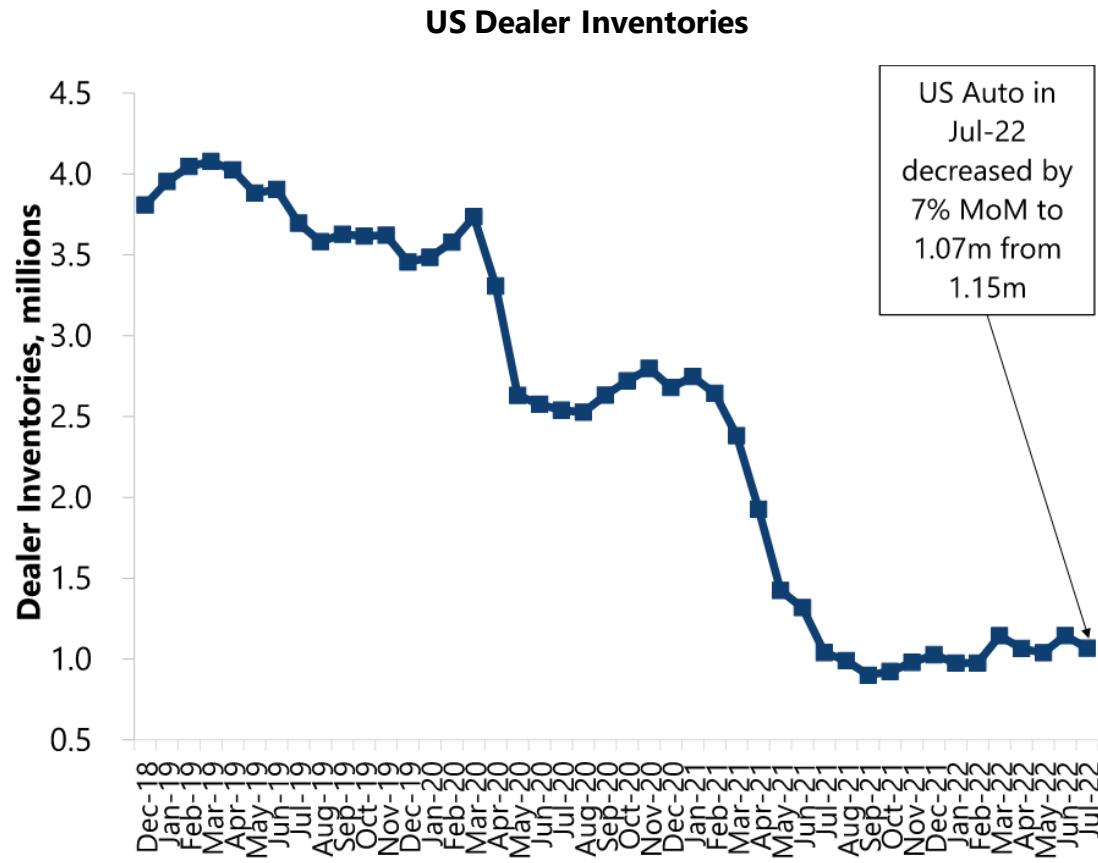
NXPI Channel Inventories Well Below Target Level



NXPI channel inventories at 1.6 months are well below its target of 2.4 months. In the past, NXPI estimated that bringing inventories to the normal level would result in \$400m in revs and does not anticipate reaching 2.4 months level any time this year.

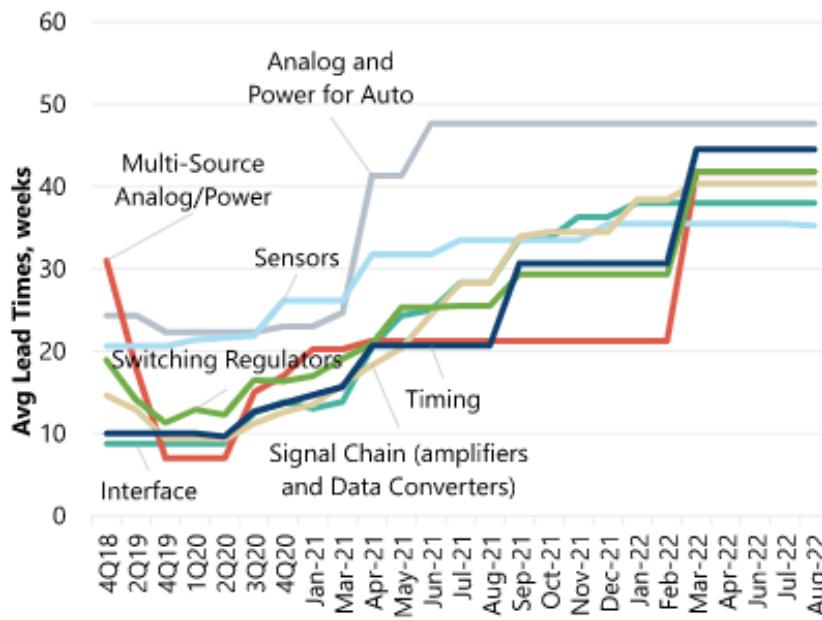
Semiconductor Peak-Cycle Handbook

US Auto Dealer inventories decreased by 7% month-over-month in Jul-22 to 1.07m after hitting multi-year lows in Sep-21 of 0.900m.



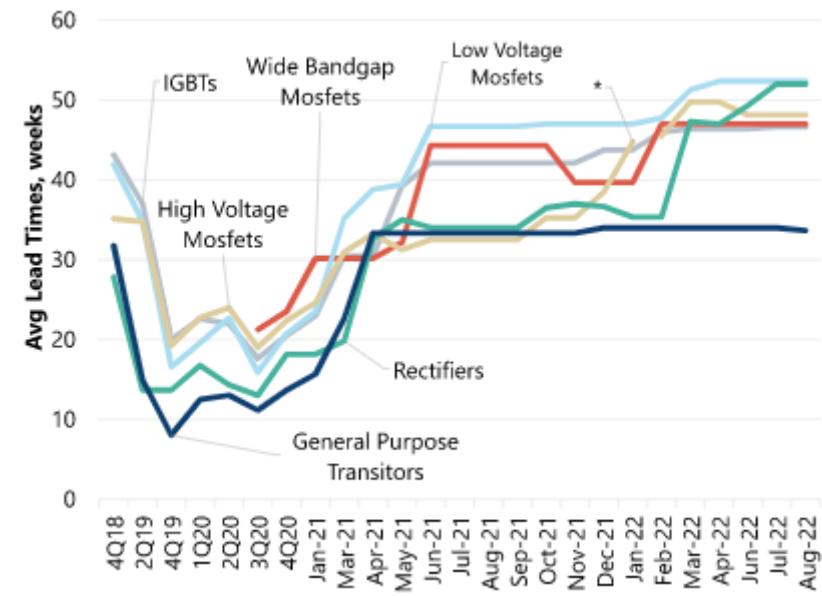
As of August – Semi Lead Times Had Not Improved

Analog Lead Times Stable in August



Analog components' lead times were largely stable from April through August. In August, 1 of the 26 components declined 1 week.

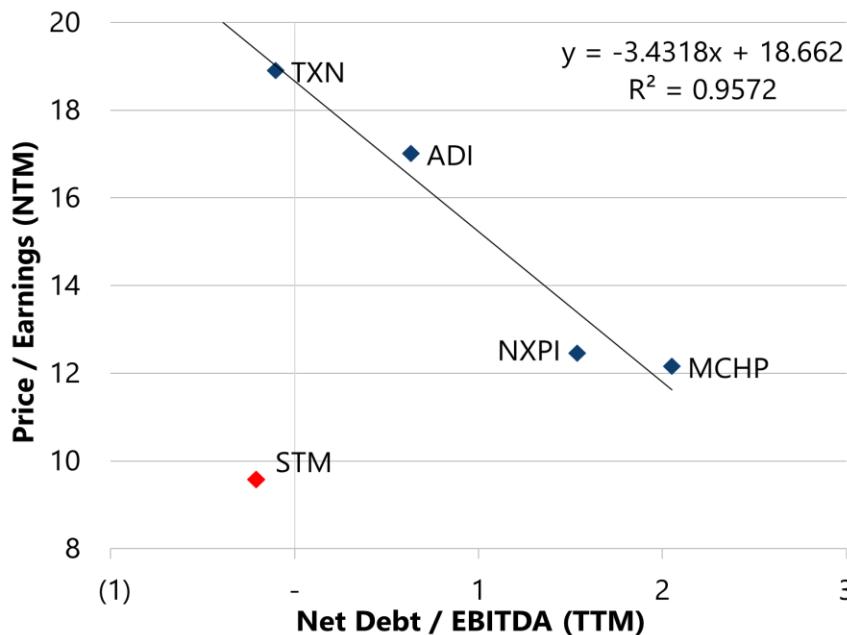
Discrete Components Lead Times Roughly Decreased in August



Discrete component lead times declined for 8 Nexperia components by 1 week going from 16-52 weeks range to 16-50 weeks.

Investors Pay More For Earnings If You Return It To Them

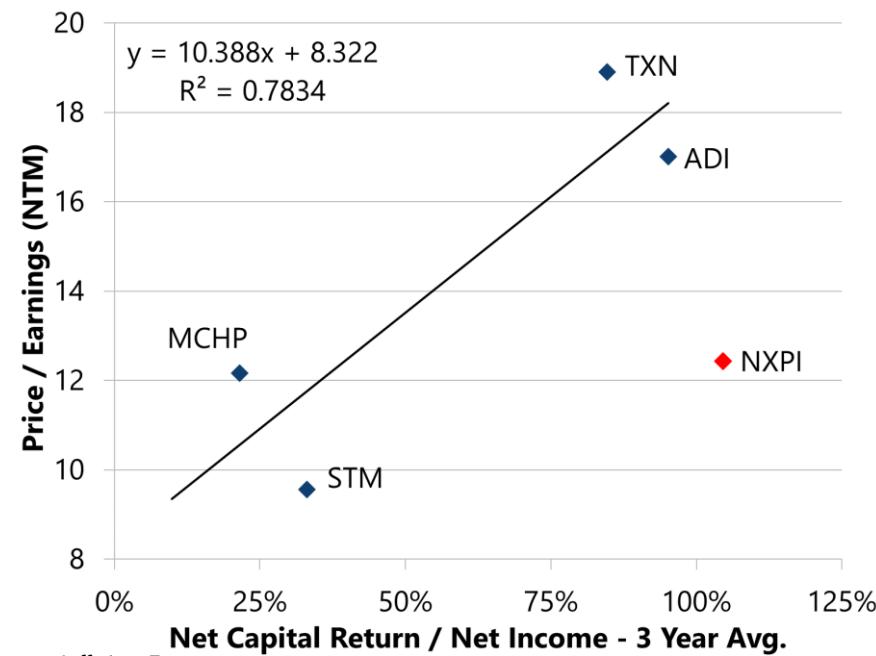
Inverse Correlation Between P/E and Leverage for Analog/MCU Stocks



Source: Jefferies, Factset, company data. Using latest reported Net Leverage and TTM EBITDA. Ex-ON due to mgmt change and restructuring.

Broad-based large-cap semi P/E ratios are inversely correlated with leverage ratios (R-squared 96%)

High Correlation Between P/E and Capital Return for Analog/MCU Stocks

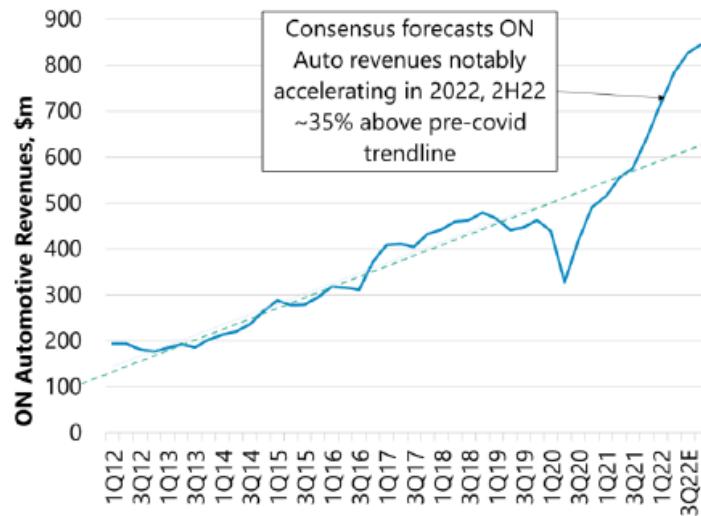


Source: Jefferies, Factset

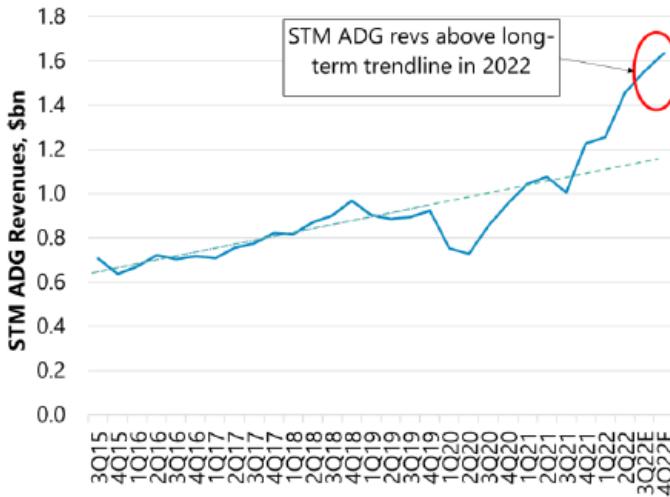
Broad-based analog semi P/E ratios are correlated with the capital return, measured by NCR/Net Income (R-squared 78%)

Semi Auto Revenues are 25%-30% Above Long Term Trendline – Secular or Cyclical?

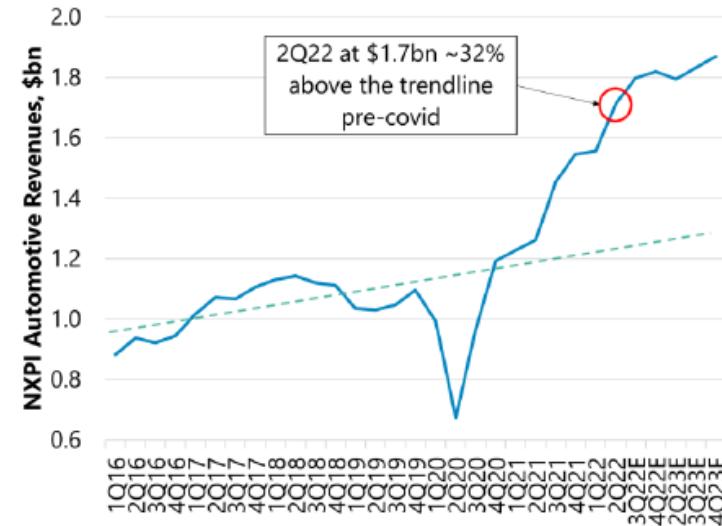
Consensus Forecasting ON Auto Revs Above Trendline



STM ADG Revs Expected Above Trendline in 2022



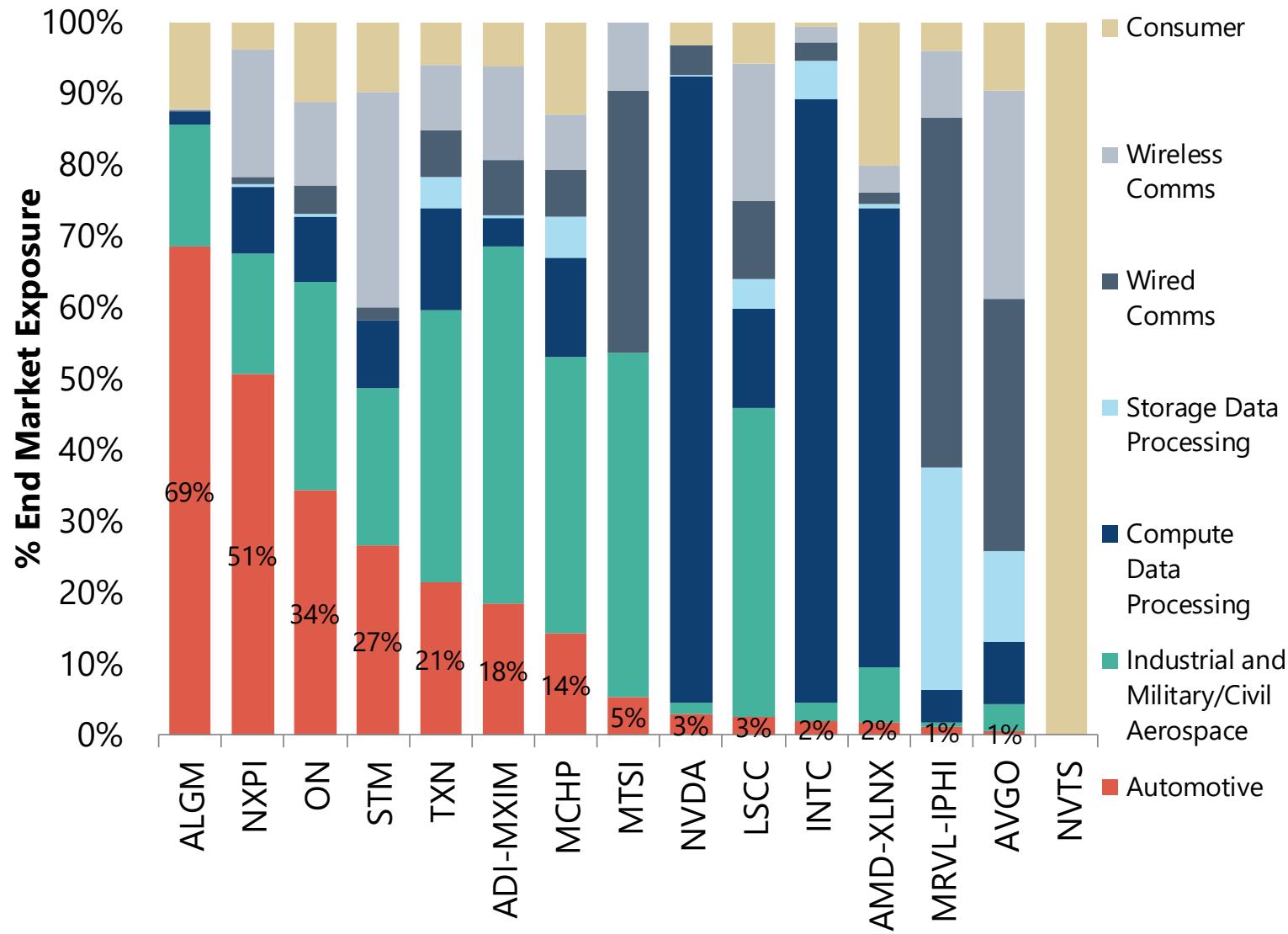
NXPI Revenues Remain Above Trendline Through 2022



Source: Jefferies, Visible Alpha Consensus forecast 1Q22E onwards

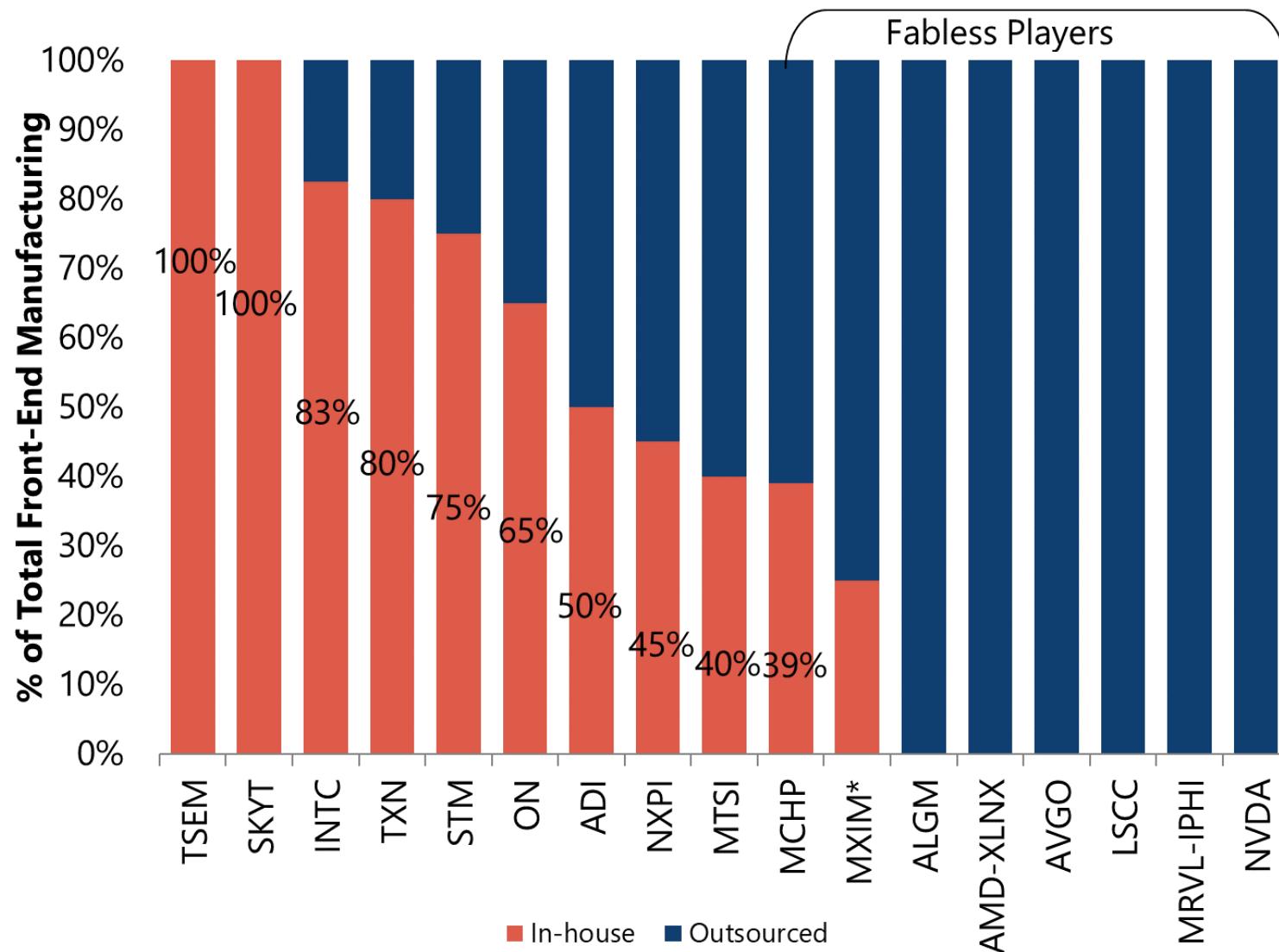
Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

Vertical Market Exposure



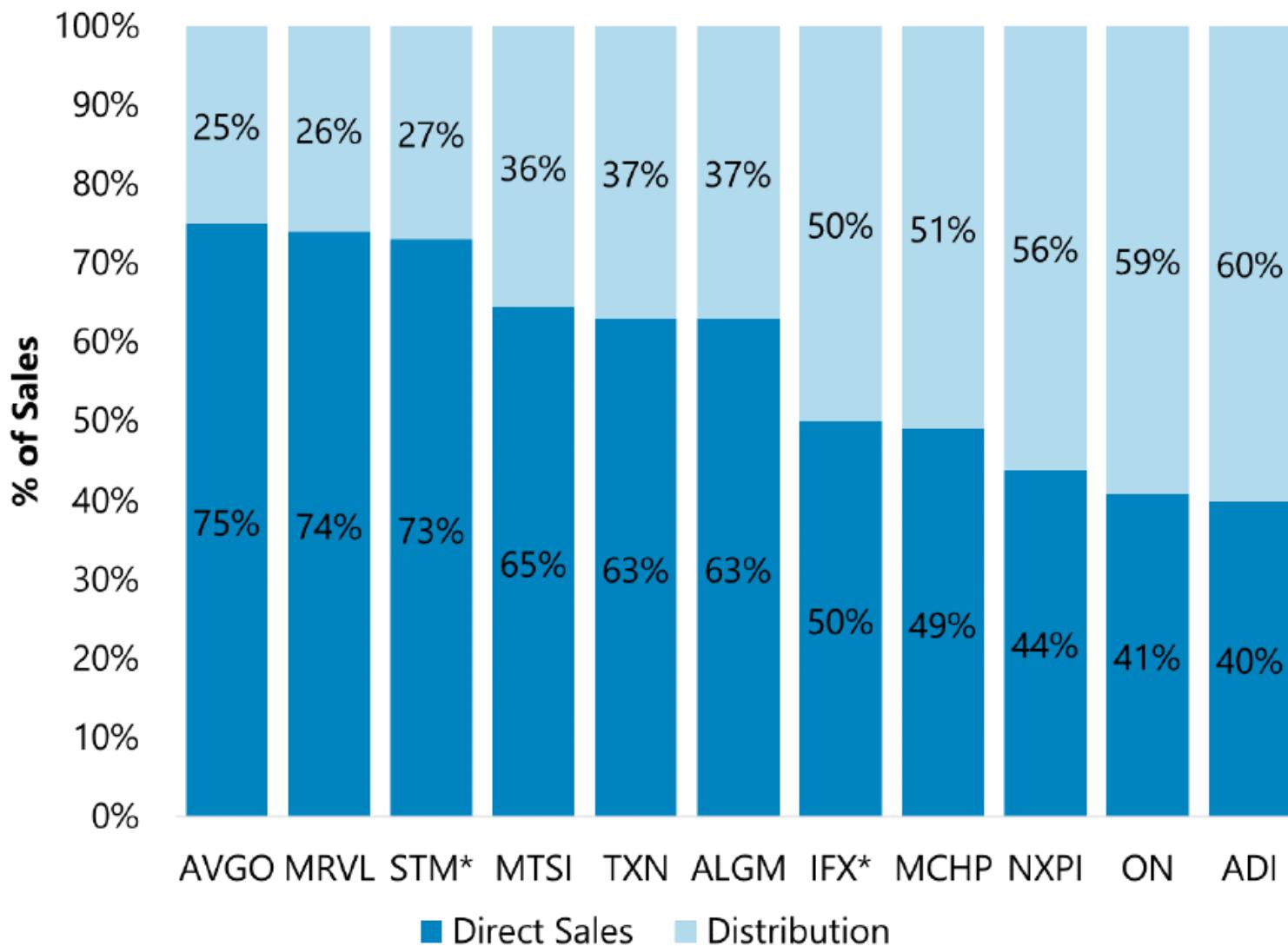
Source: Gartner, Jefferies Research; Data for Calendar 2021 sales

Manufacturing Model



Source: Jefferies estimates, companies data; *MXIM was recently acquired by ADI but presented on a standalone basis as an additional data point

Direct Sales vs Distribution Split

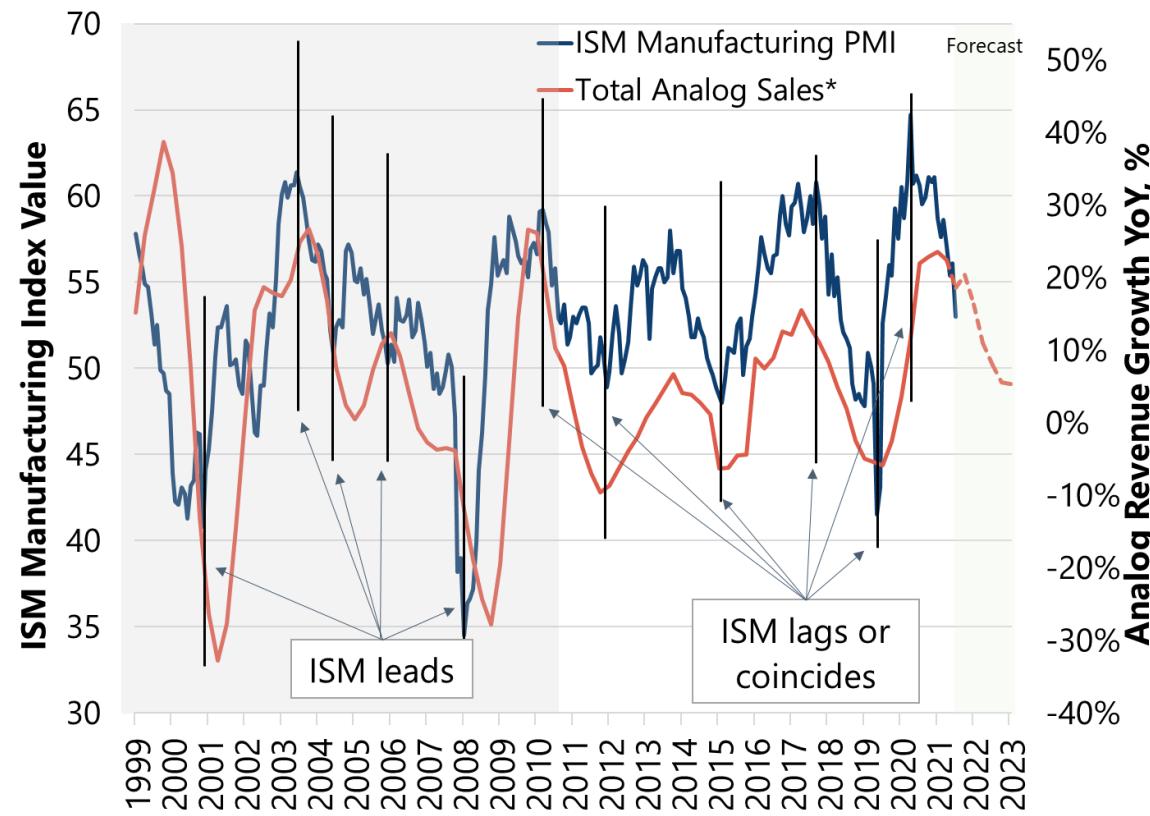


Source: Jefferies, company data, FactSet. Excluding foundries, semicap, other companies not disclosing the direct sales proportion. Includes STM* and IFX*, covered by JEFF team in Europe

Semiconductor Peak-Cycle Handbook

ISM Manufacturing PMI has historically been a leading-to-coincident indicator of analog semiconductor sales. After rebounding sharply in 2020, analog sales followed

ISM Manufacturing PMI vs Total Analog Sales



Source: FactSet, Jefferies Research

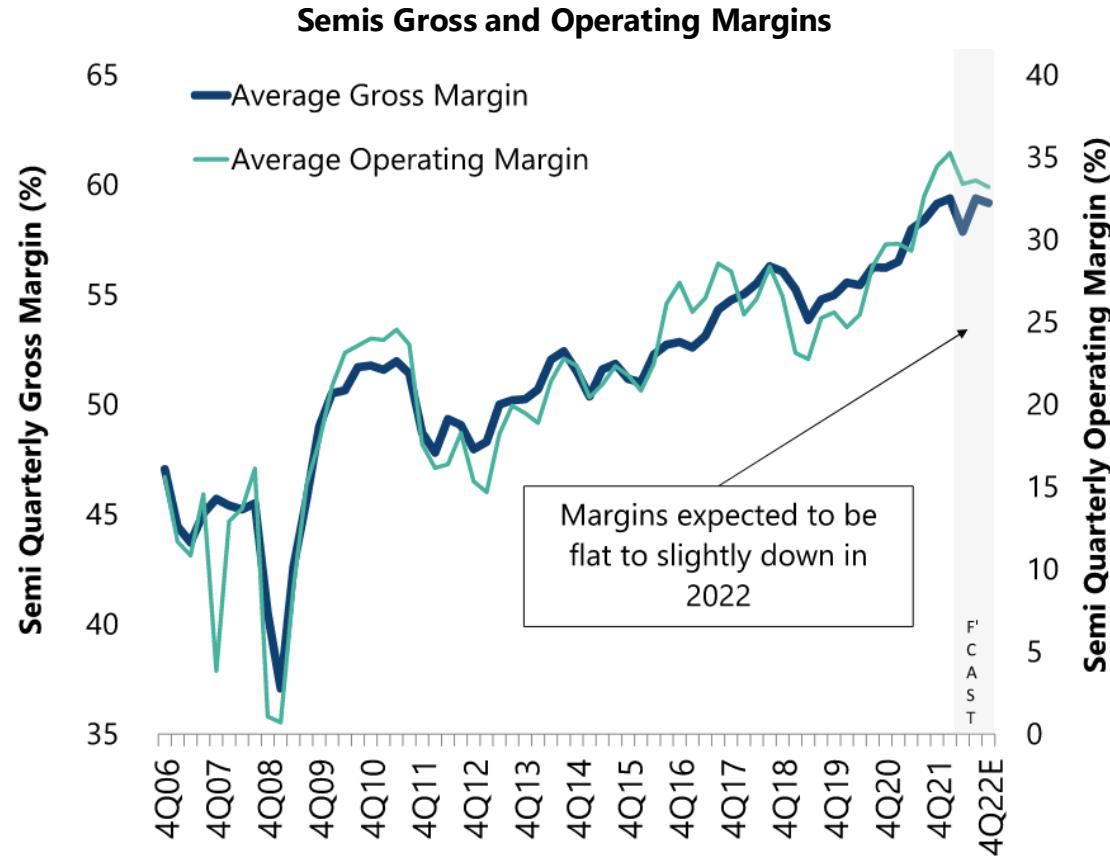
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Semiconductor Peak-Cycle Handbook

Consensus average forecasts for gross margins and operating margins are expected to reach new highs while also continuing to increase through 2022

Semiconductor gross margins continue to have upside surprises thus far due to tight capacity and stretching lead times that result in full utilization, improved fixed cost absorption and higher pricing.

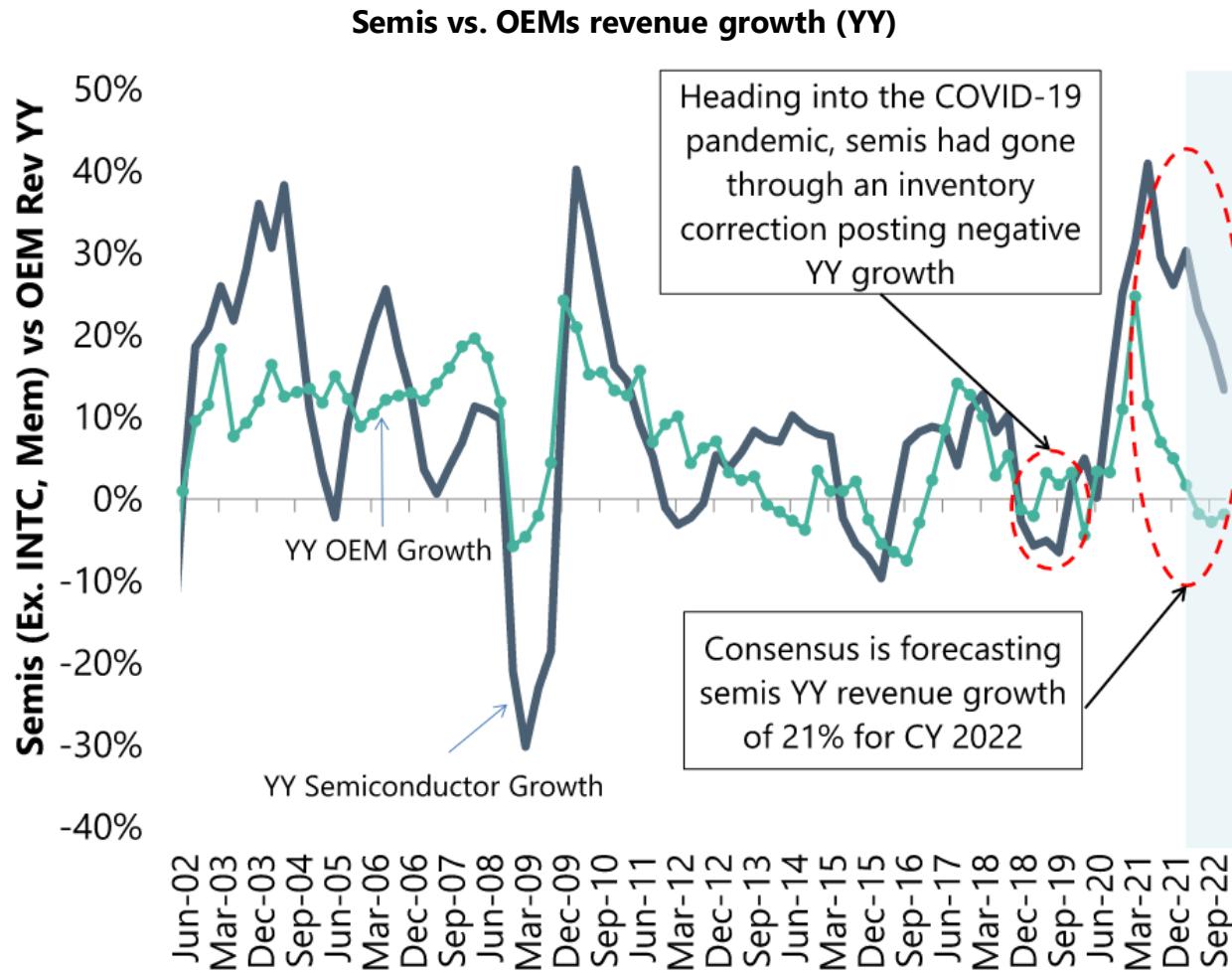
We think semiconductor gross margins have the best potential for upside surprises over the next 2-to-3 quarters as tight capacity and stretching lead times lead to full utilization, improved fixed cost absorption and higher pricing



Semiconductor Peak-Cycle Handbook

Consensus is currently forecasting 21% YY growth for CY 2022, up from 17% before the 1Q22 earnings season.

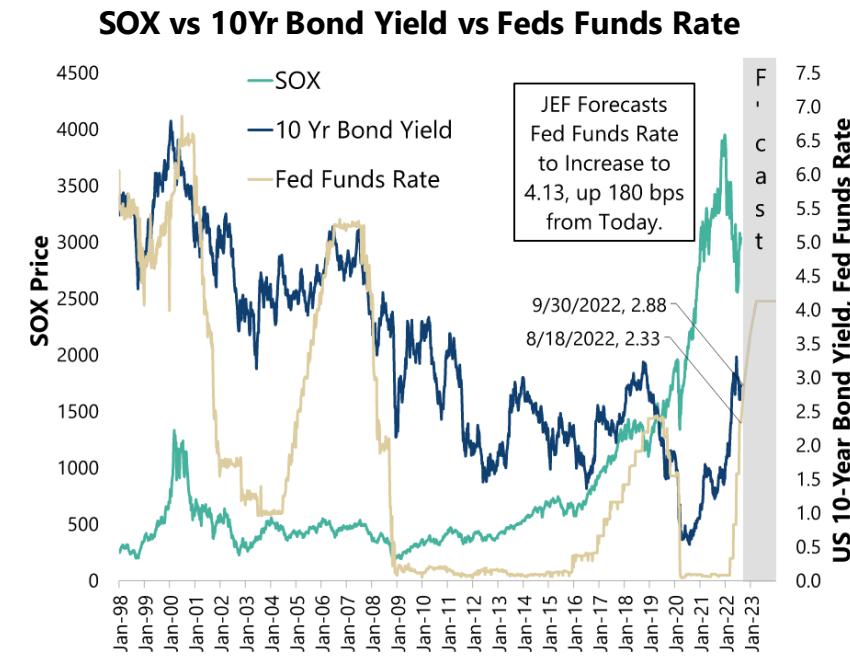
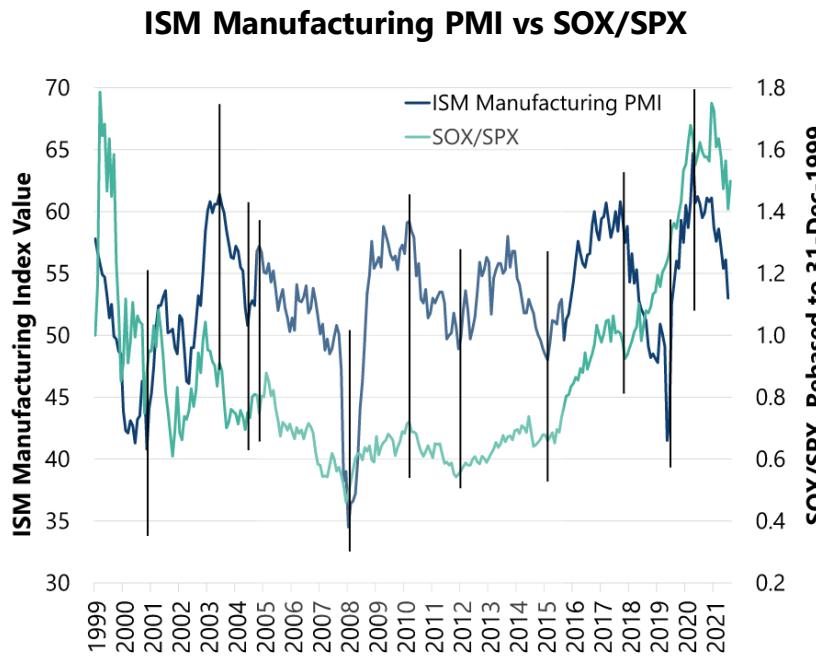
Semis YY revenue growth was significantly revised higher up through 2021 to a robust 31% for CY 2021. This compares to the consensus estimate of 13.4% YY growth for CY 2021 when we last published this chart in January 2021



Source: FactSet, Jefferies Research

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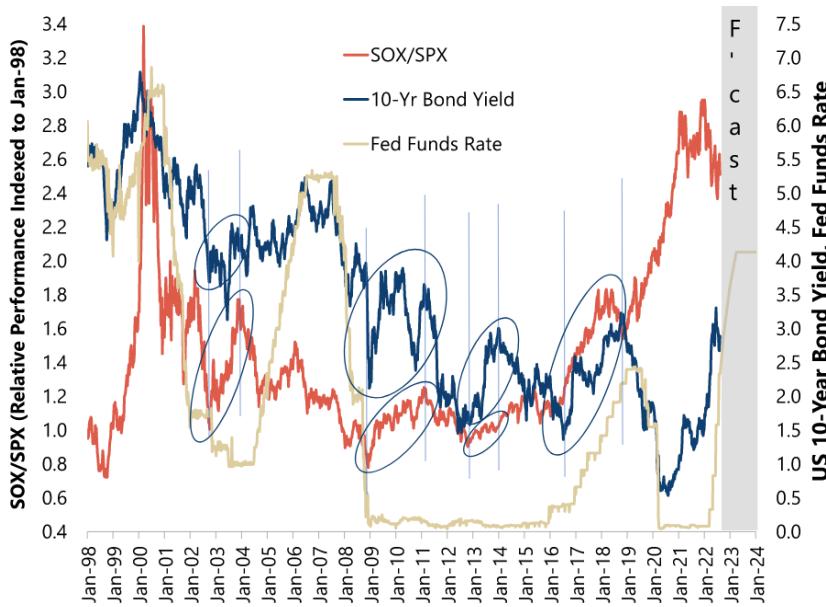
Reference Macro Charts



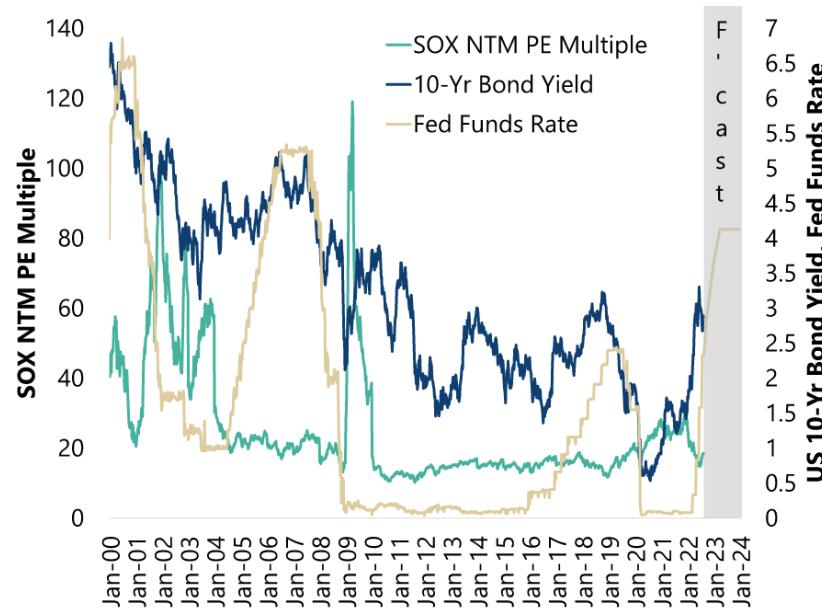
SOX and US 10 Yr Bond Yield Data Ends at 8-18-2022. Fed Funds Rate beyond 8-18-2022 reflects JEF forecast estimates as of Aug-2022.

Reference Macro Charts

10-Yr Bond Yield Increases Have Aligned with Positive SOX/SPX Performance



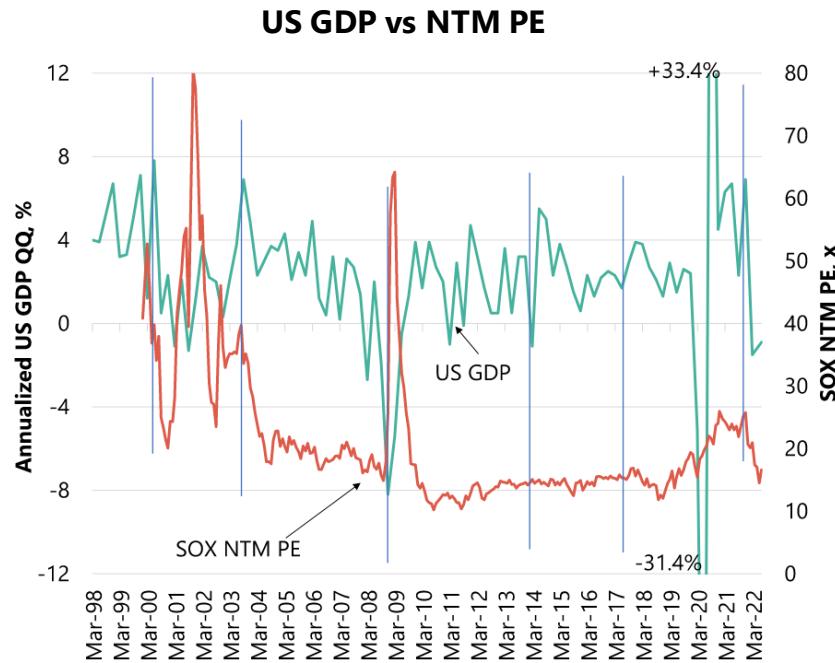
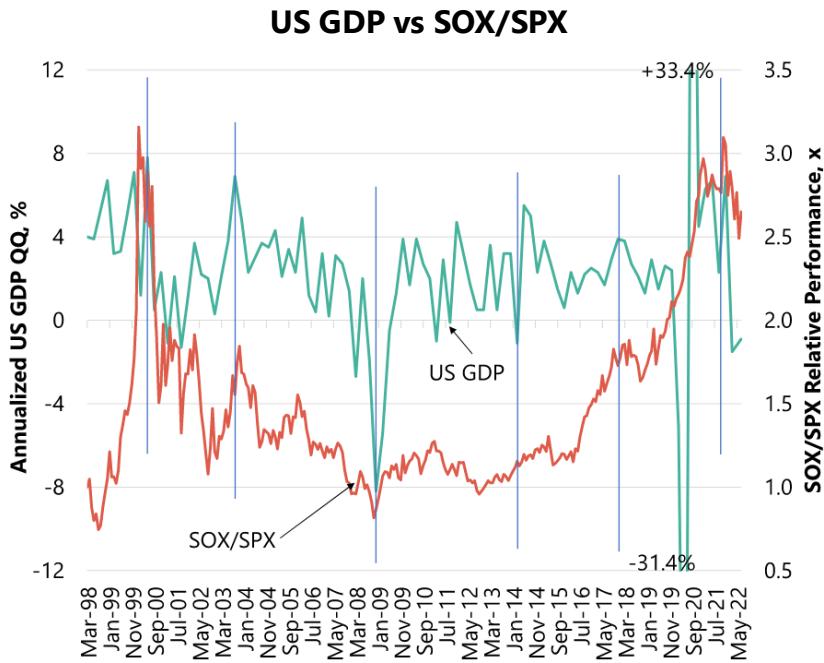
SOX NTM PE Multiple vs 10Yr Bond Yield vs Fed Funds Rate



Source: FactSet, Bloomberg, Jefferies Research

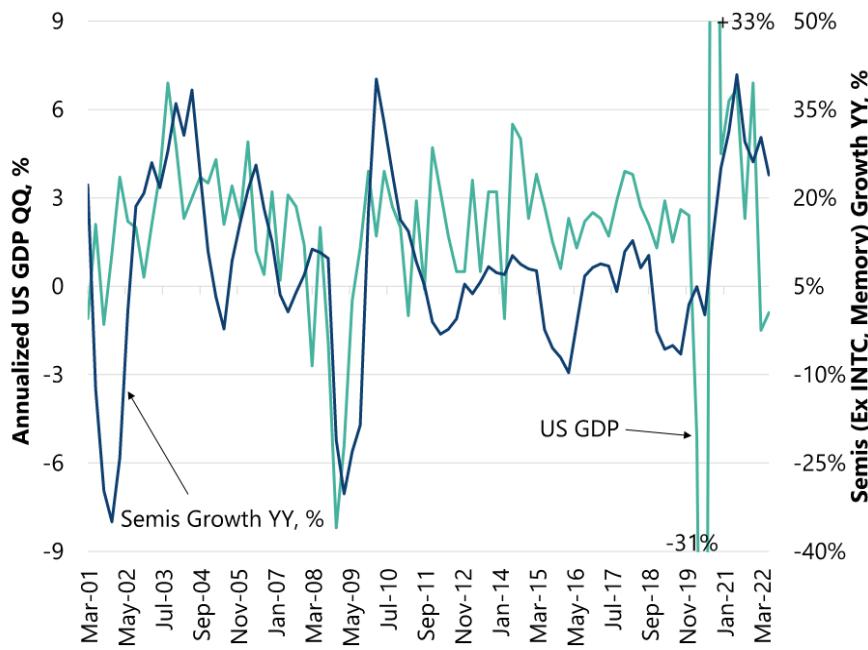
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Reference Macro Charts

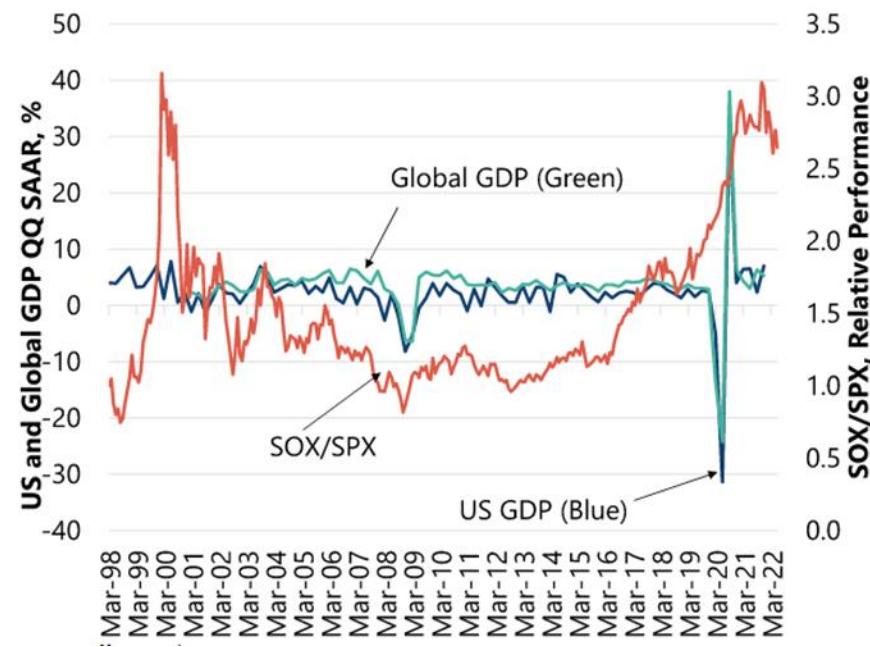


Reference Macro Charts

Annualized US GDP QQ vs Semis YY Growth Rate



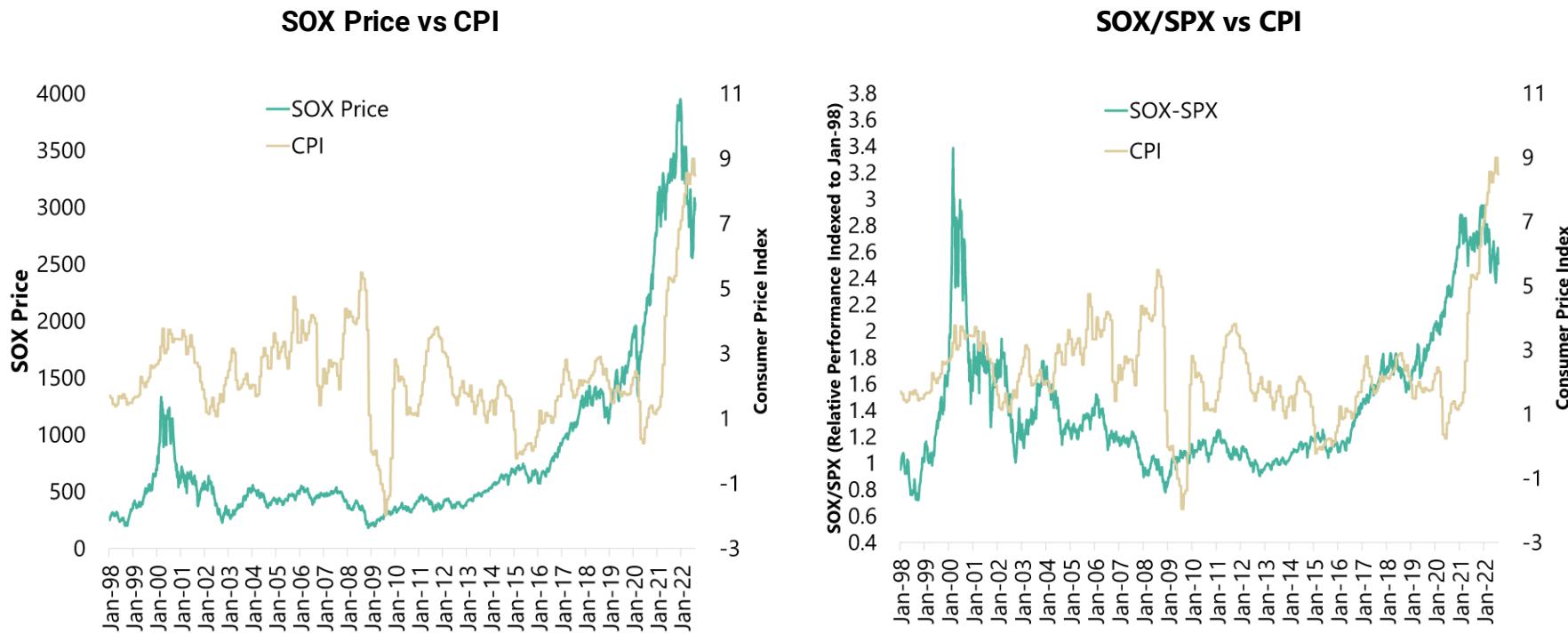
US and Global GDP vs SOX/SPX



Source: FactSet, Bloomberg, Jefferies Research

Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

Reference Macro Charts

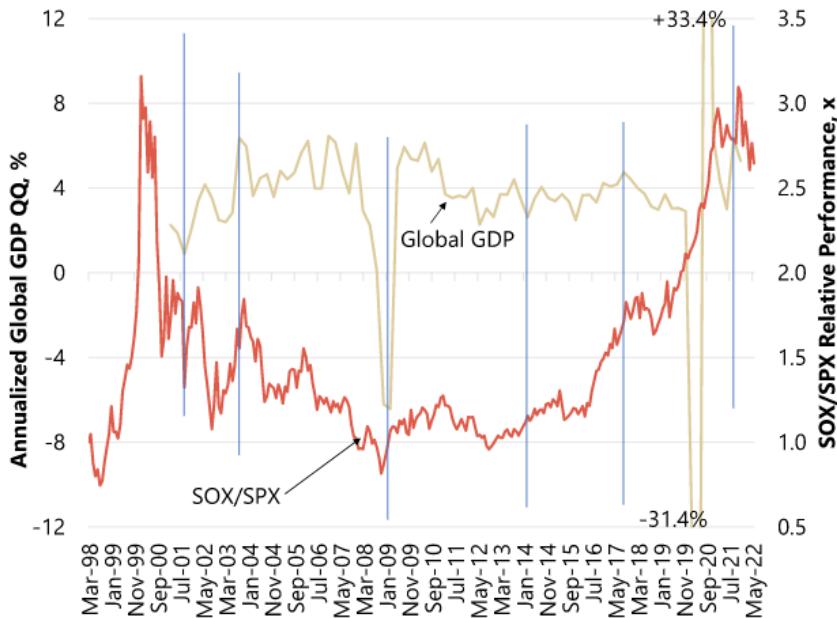


Source: FactSet, Bloomberg, Jefferies Research

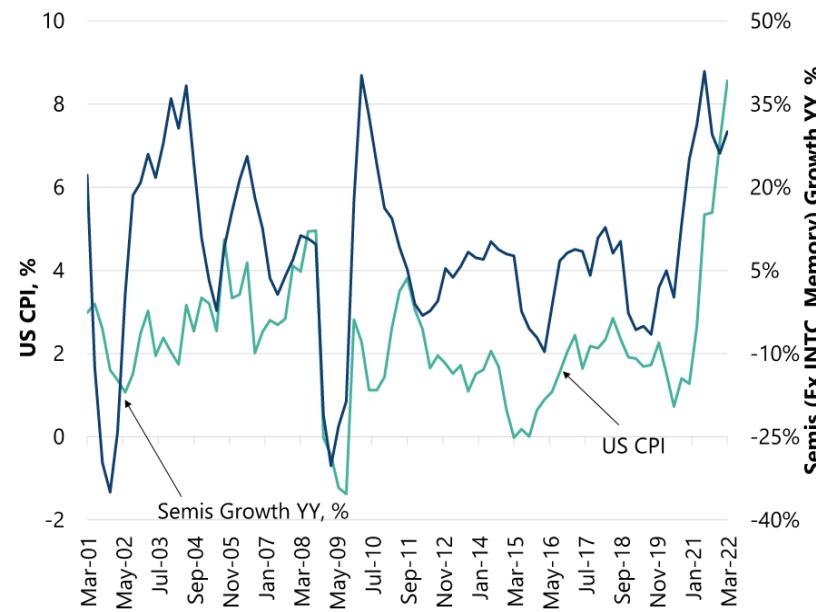
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Reference Macro Charts

SOX/SPX vs Global GDP



CPI vs Semis Growth



Data Center Leasing Volume Charts

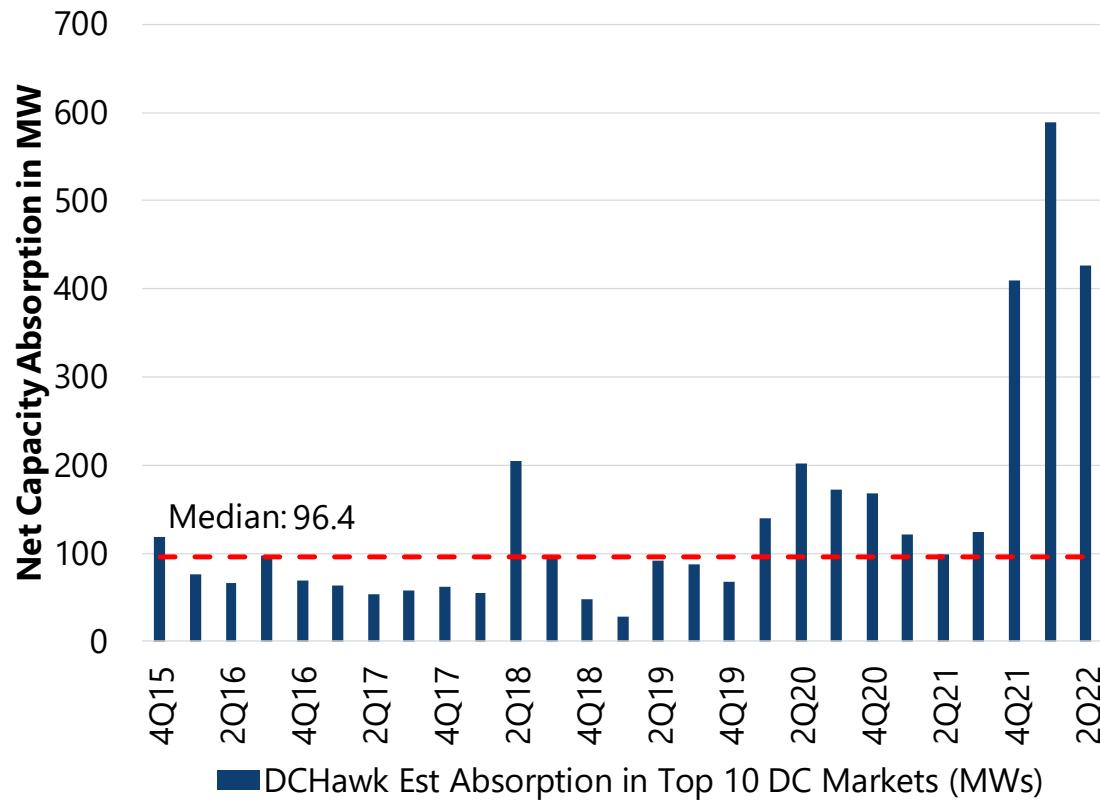
DatacenterHawk reports that the top 10 data center markets had more data center leases signed over the past 3 quarters than the previous 12 quarters combined

We believe that this is driven in part by the low vacancy rates in data centers. Data center vacancy rates declined to 3% which is a historic low

The absorption levels in 2Q22 continue to be much higher than LT median absorption of 96MW and are the 2nd highest quarter in the 7 year sample set

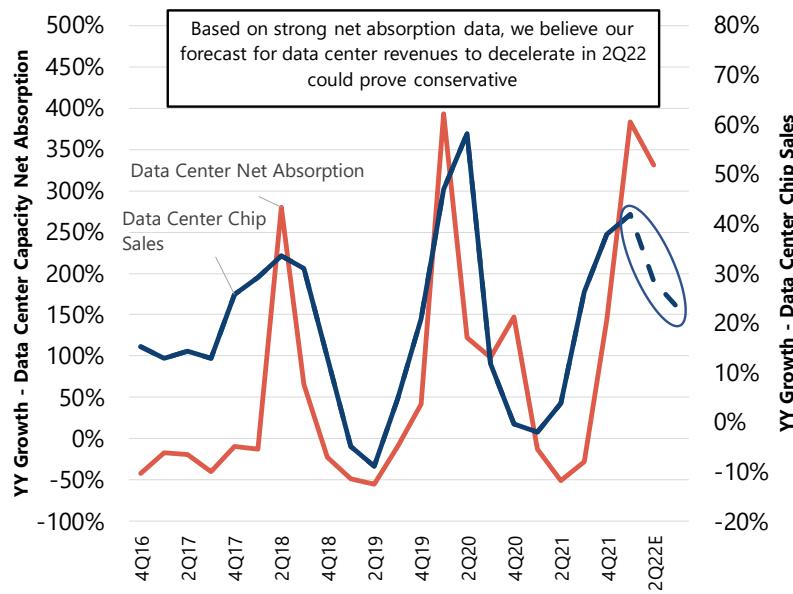
Data center net absorption YY growth remained elevated at 330% in 2Q22, and data center vacancies declined to 3.4% in 2Q, a historic low well below the historic vacancy rate of 10%.

Datacenter Leases Signed Over the Past 3 Qtrs Are Higher than the Past 12 Qtrs Combined

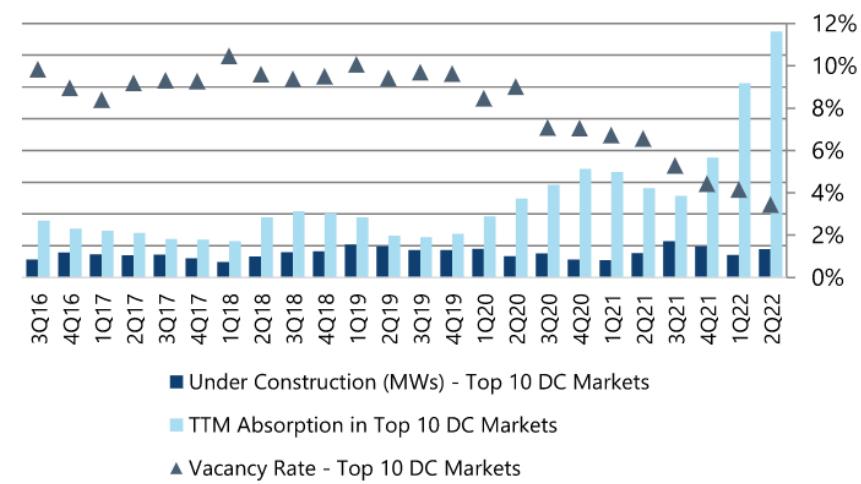


Data Center Leasing Volume Charts

YY Growth for Data Center Net Absorption and Data Center Chip Sales are Correlated



Absorption and Vacancy for Top 10 US DC Markets



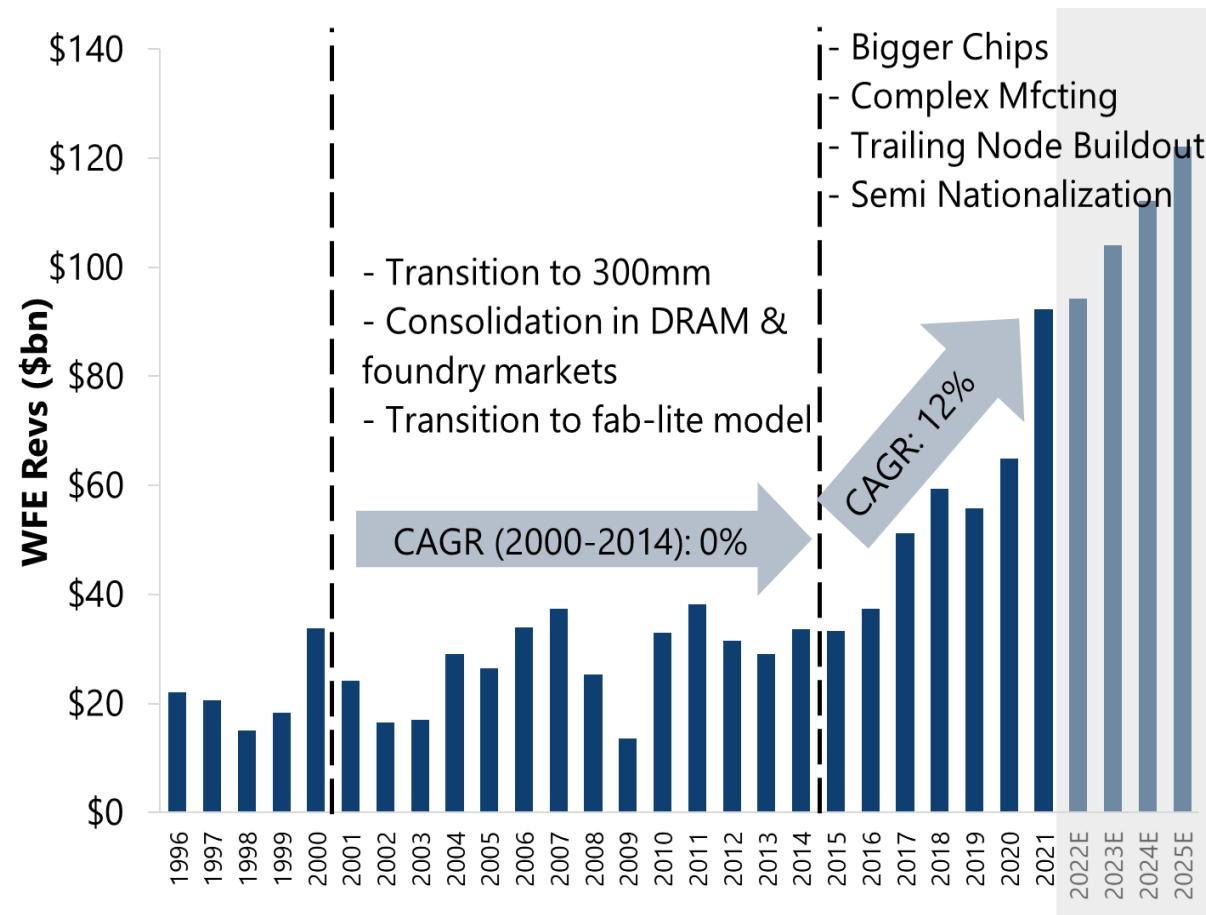
YY growth for net absorption of capacity of the Top 10 DC markets as measured by DatacenterHawk (red bar), has been a strong coincident-to-leading indicator for YY spending growth on data center processors (blue line) sold by INTC, NVDA and AMD/XLNX. We also view networking chip companies AVGO and MRVL as beneficiaries. We believe that our projection for deceleration of data center chip sales into 2H22 could prove conservative based on record leasing volumes and our view that a new generation of AI workloads is driving spending for datacenter infrastructure not just at Cloud companies, but for the first time in years, at Enterprises as well.

SemiCap Initiation: Thesis #1: WFE Has Seen a Secular, Tectonic Shift to Growth

We think the inflection in WFE growth from flat pre-2015 to double digit post 2015 is secular, driven by

- 1.1) Bigger Chips. CPU size was historically a constant: 120mm² for PCs, 300mm² for servers, but physics capped clock speed increases, dictating a Tectonic Shift to a "Parallel Processing Era" with larger chips w/ more processing cores
- 1.2) More Complex Manufacturing. Between 2004 and 2015, the number of manufacturing process steps increased at a rate of 5% per transistor node (90nm->14nm), however, since 2015, it has been increasing at a rate of 27% per node
- 1.3) Trailing Node Buildout. A Tectonic Shift to a Computing Era w/10s of billions of IoT devices shipping annually, layers demand for trailing node MCU and analog ICs on top of leading edge logic and memory ICs, which have historically driven WFE spend
- 1.4) Semiconductor Nationalization Drives Competition and CapEx. We believe recent government efforts to support building regional semiconductor supply chains sustains for the foreseeable future and translates to increased foundry and IDM competition and higher CapEx

SCE Thesis #1: WFE Has Seen a Secular, Tectonic Shift to Growth



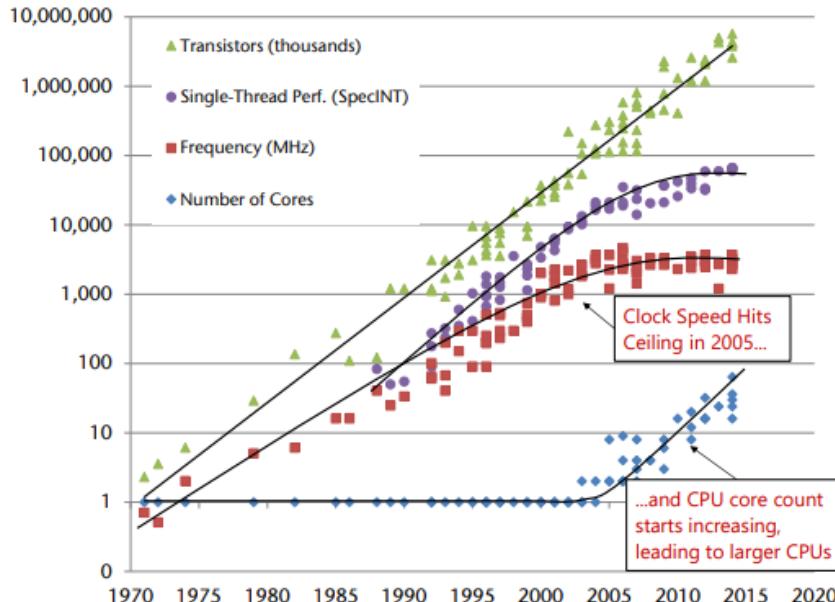
Source: Gartner, Jefferies Research

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SemiCap Initiation: Chips are Getting Bigger for the First Time Ever

CPU Clock Speed Ceiling in 2005 = More Cores, More Sq. mm

40 Years of Microprocessor Trend Data

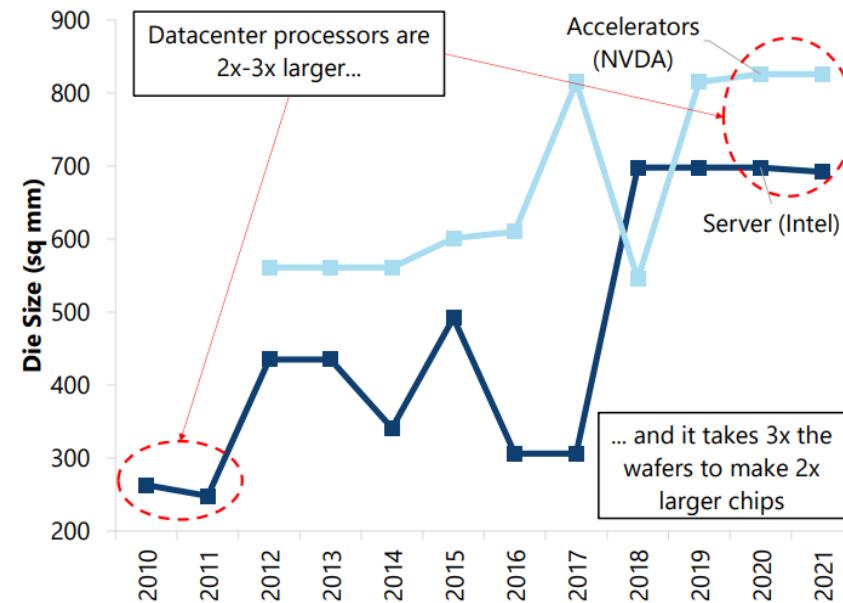


This scatter plot shows that up until 2005, CPUs improved performance by both increasing transistors per chip (green scatter - Moore's Law), and clock speed per chip (red scatter). CPUs would be similar in size (100-120 mm sq) across generations, they would just have more transistors operating at higher clock speeds - translating to higher performance CPUs.

However, starting in 2005, clock speed topped out at 4GHz, and the industry shifted to adding execution cores (aka Arithmetic Logic Units - ALUs) to each CPU (blue scatter). Compounding the clock speed ceiling is that transistor node are being introduced at a slower pace, which has translated to the need for larger processors

Source: Jefferies. Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten. New plot and data collected for 2010-2015 by K. Rupp; Jefferies, Anandtech, techpowerup.com, wccftech.com, Company data

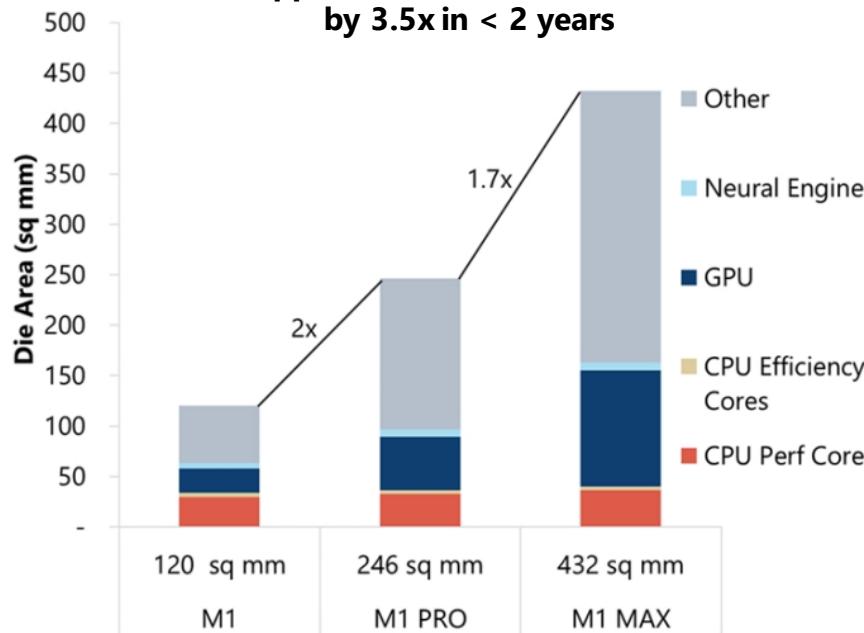
Intel Server CPU 300->700 sq mm; Nvidia GPU 550->800 sq mm



This chart shows that over the past 5 years, NVDA GPUs have increased in size by about 50%, while INTC's Xeon datacenter CPUs, doubled in size. We think the larger die sizes are a consequence of slowing clock-speed improvements (illustrated in previous chart) causing a requirement for more processing cores per chip in lieu of higher clock speeds. Not only are both CPUs and GPUs getting larger, but there is also a market share shift to GPUs from CPUs in the datacenter. The increased die size has a multiplicative effect on demand for wafers. We estimate that a 2x increase in die size translates to 3x increase in the demand for wafers for the same number of CPUs or GPUs.

SemiCap Initiation: Chips are Getting Bigger for the First Time Ever

Tectonic Shift to Parallel Computing Impacting PCs Too: Apple M1 Mac CPU: Die Size Increased by 3.5x in < 2 years

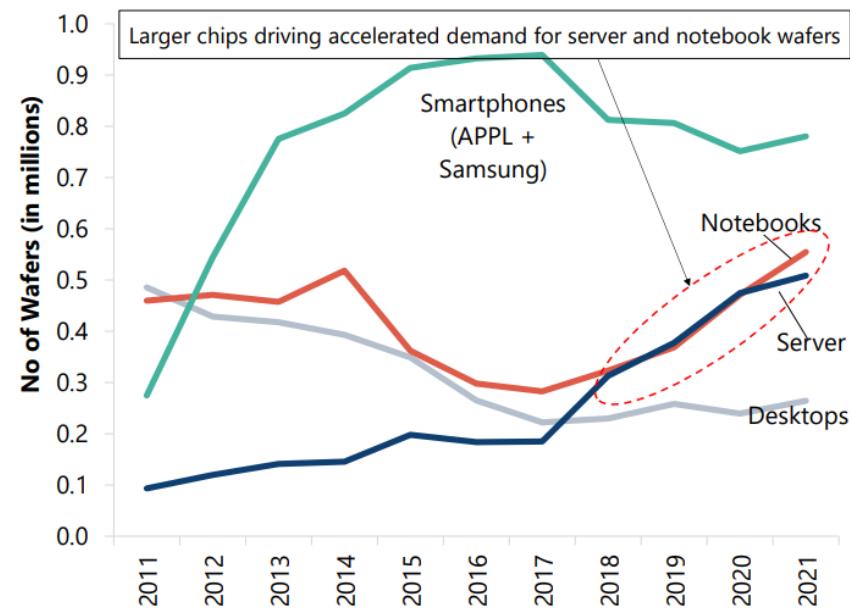


The increasing die size phenomenon we observed in the datacenter over the past 10 years is more recently being reflected in the PC market as well. This

chart shows how the die size of the Apple M1 family of ARM CPUs has increased over time from 120 sq mm to 246 sq mm and 432 sq mm over the past two years.

Historically, INTC x86 PCs CPUs were 100-120 sq mm. Apple's CPU circuitry (bottom orange-layer) has been consistent, but the multi-core, GPU and Neural engines have been growing, and in the most recent revision of the processor, are now 3x the size of the CPU circuitry. M1 PRO and MAX processors launched in 2021 are 2x and 3.5x times larger than the original M1 launched in 2020. This translates to 2.3x and 4.6x more wafers required to make the same number of M1 Max and M1 PROs as the original M1 CPU

We Est Larger Chips Have Driven 26%/16% CAGR in Demand for Server/Notebook Wafers Since 2017



We use data from the previous three charts, coupled with unit shipment data to calculate the increased demand for wafers for different vertical markets. Since 2017, we estimate that the number of wafers required to meet data center processor demand has increased at a 26% CAGR, and the number of wafers to meet notebook demand has increased at a 16% CAGR, both well in excess of the unit demand for those end markets.

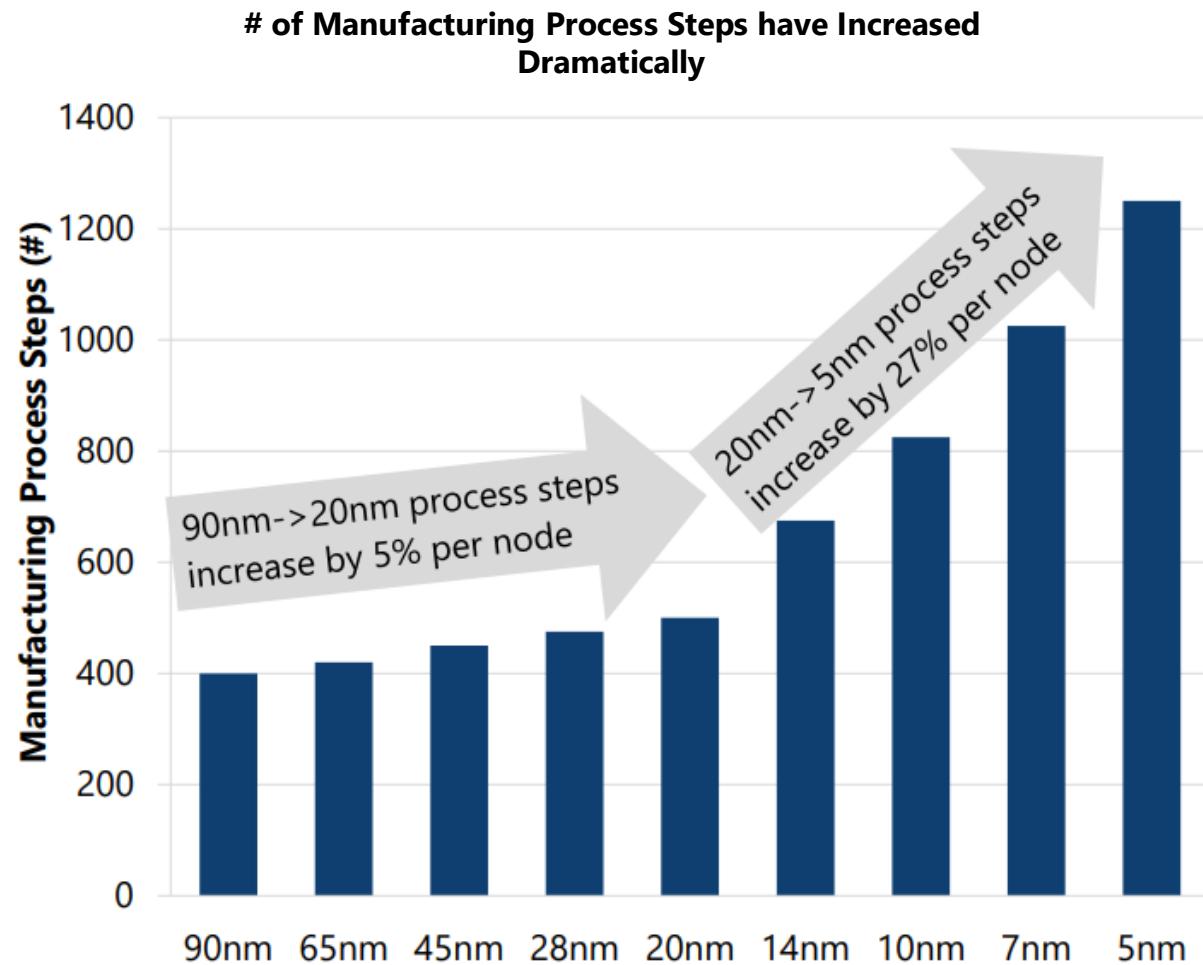
Source: Jefferies. Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten. New plot and data collected for 2010-2015 by K. Rupp; Jefferies, Anandtech, techpowerup.com, wccftech.com, Company data

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SemiCap Initiation: More Complex Manufacturing

Between 2004 and 2015, the number of manufacturing process steps increased at a rate of 5% per transistor node (90nm- > 14nm), however, since 2015, starting with the 14nm transistor, it has been increasing at a rate of 27% per node

We think that the increase in the rate of growth in process steps per transistor node puts upward bias on amount of capital equipment required to manufacture the same number of wafers

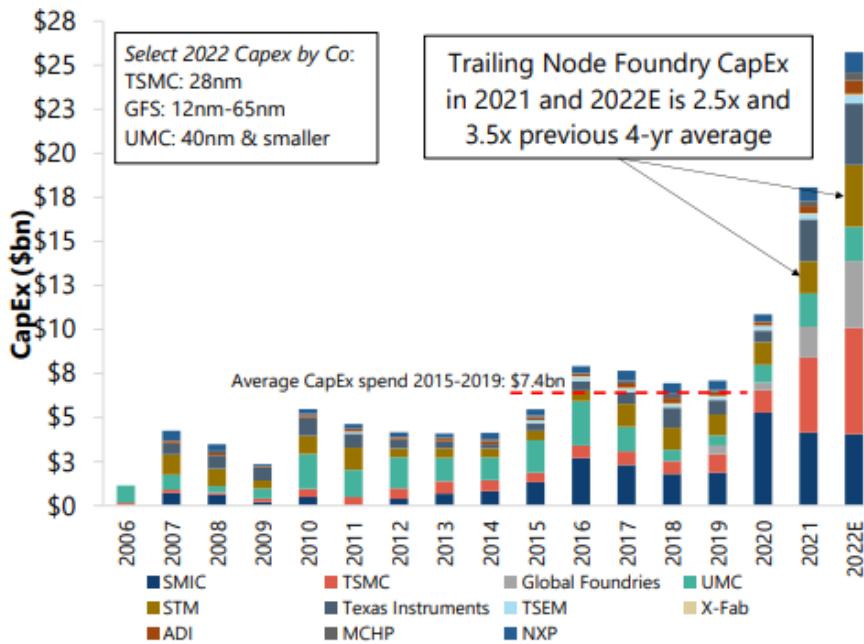


Source: Jefferies, electriiq.com, AMAT presentation

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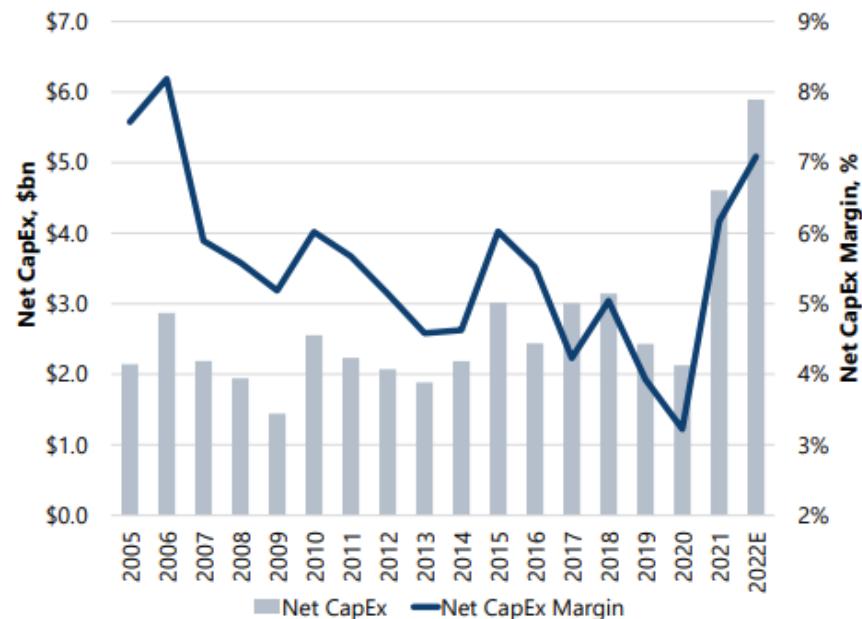
SemiCap Initiation: Trailing Node Buildout

Trailing Node Foundry CapEx is 2x-to-3x 4-yr Average



CapEx for trailing node foundry equipment in 2020 and 2021e is 2x and 3x the previous 4-year average. We expect total CapEx to increase by 49% and 24% YoY in 2021 and 2022. Historically, investments in Semiconductor manufacturing capacity were driven by demand for leading edge logic chips like CPUs in PCs, processors used in datacenters or application processors and modems used in cellphones, or increasingly smaller and cheaper memory. However, this chart indicates that trailing node capacity is being demanded as well

Analog and MCU CapEx Intensity Halved = Long Term Underinvestment in Trailing Nodes?



In absolute dollars, analog and MCU company capex for our sample increased 2x in 2021 compared to the 2005-2020 average.

We note that capex as % of sales increased in 2021 to levels not seen since 2006. We think that many analog and MCU stocks will be entering a CapEx cycle, and exiting a capital return cycle, which could pressure P/E ratios.

One exception to this is MCHP, which we've argued is entering a capital return cycle that we expect will translate to an appreciating P/E ratio relative to its peers

Source: Jefferies, Gartner, Factset. Analog industry players include TXN, NSM, ADI, LLTC, ATML, MCHP, MXIM, AVGO, BRCM, MTSI, IPHI, SWKS, QRVO, TQNT.

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SemiCap Initiation: Semiconductor Nationalization Drives Competition and CapEx

Global Semiconductor Manufacturing Incentives Aggregate to \$84bn/yr

Global Annual Incentives over next 5 years = ~\$84bn						
Manufacturing Capacity*	USA 12%	Europe 9%	S. Korea 21%	Japan 15%	Taiwan 22%	China 15%
Value of Incentives	CHIPS Act: \$52bn Endless Frontier Act: \$100bn FABS Act	\$150bn	\$451bn	\$338m	\$9bn	\$150bn
Incentives	Tax credits for facility /equipment investments and R&D expenses	Invest in local design & production of semiconductors	50% tax credit on R&D investment; 20% on facility investment; Low-rate loans	Partnership with TSMC with focus on tech for 3D Chip Assembly	Subsidies half of all R&D costs incurred by chip companies that build centers in Taiwan	Tax holidays; Reduced tax rates; Tax credits; Free/discounted land; equipment leasing; preferential loans
Period	2021-2026	2021-2031	2021-2031	2021	2020-2027	2014-2020
Annual Incentive	\$12bn	\$15bn	\$45bn	\$0.3bn	\$1.3bn	\$10bn

Since 2021, we estimate various governments have instituted incentives to support their local semiconductor industries equal to \$84bn annually for the next 5 years. We think Semiconductor Capital Equipment companies will be primary beneficiaries.

Source: Jefferies Research, [Semis on Fire: Two Risks to our Mid-Cycle Correction Thesis](#) published on May 16, 2021

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SemiCap Initiation: Thesis #2: Expect SCE P/E Ratios to Expand Beyond Parity to SPX

Between 2009 and 2015, SCE stocks largely traded at parity to the SPX, however, they have been trading at a discount over the past 5 years.

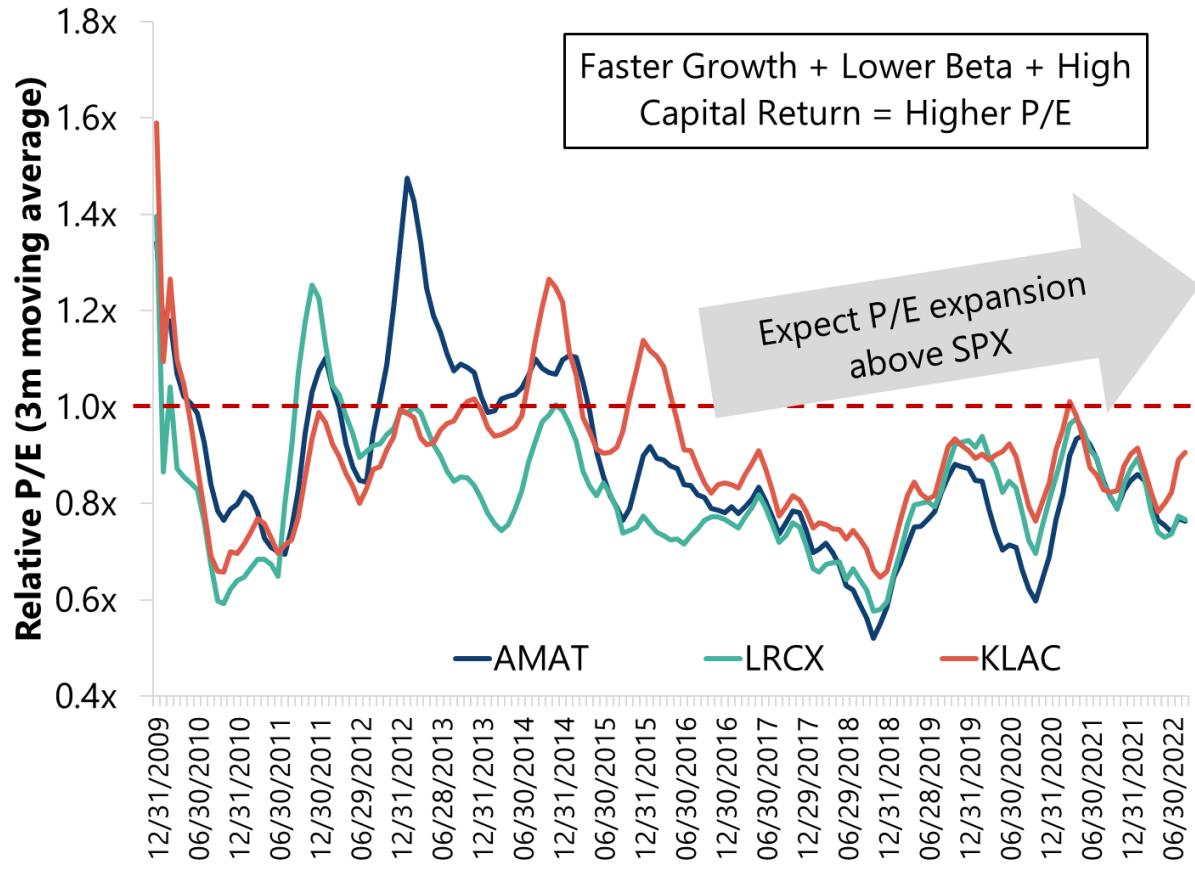
We think P/E ratios of SCE companies will expand to trade above parity to the SPX, due to:

2.0) Faster Growth. As we demonstrate in part one of our thesis above, we expect the P/E multiple for this group to expand as the market appreciates that it has shifted from pure cyclical to a growth cyclical industry

2.1) Lower Beta, Associated w/ Lower Earnings Volatility. We show earnings volatility of SCE stocks has declined over time, as FCF has increased. We expect this to translate to lower beta and higher P/E over time.

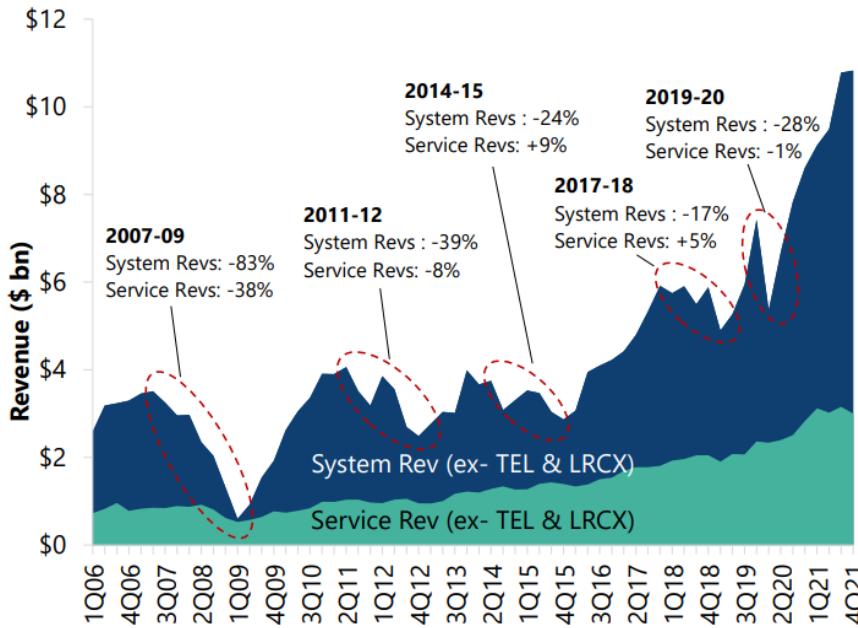
2.2) Higher Profitability Leading to Higher Capital Returns and Levered EPS Growth. We show consolidation has driven higher profitability levels. We expect profitability levels will continue to climb higher, driving levered EPS growth and increased levels of capital return, which we expect will also translate to higher P/E ratios over time

SCE Thesis #2: Expect SCE P/E Ratios to Expand Beyond Parity to SPX



SemiCap Initiation: Lower Earnings Volatility Should Translate to Lower Beta and Higher P/E

Higher Service Revs Contributing to Lower Volatility

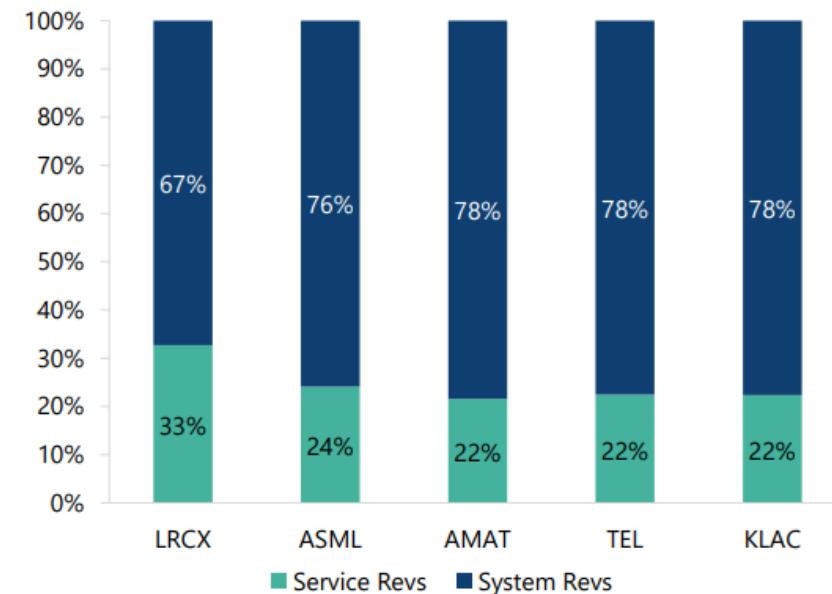


Service revenues are becoming a bigger portion of the total semicap revenues creating predictable, subscription like revenue stream which are less cyclical.

In this chart, we show that in the last 5 cycles, service revenue declines have consistently been lower in magnitude as compared to system revenue declines.

With increasing contribution from service revenues, we expect the semicap industry to exhibit lower revenue and earnings volatility driving P/E expansion

Service Revs Exposure

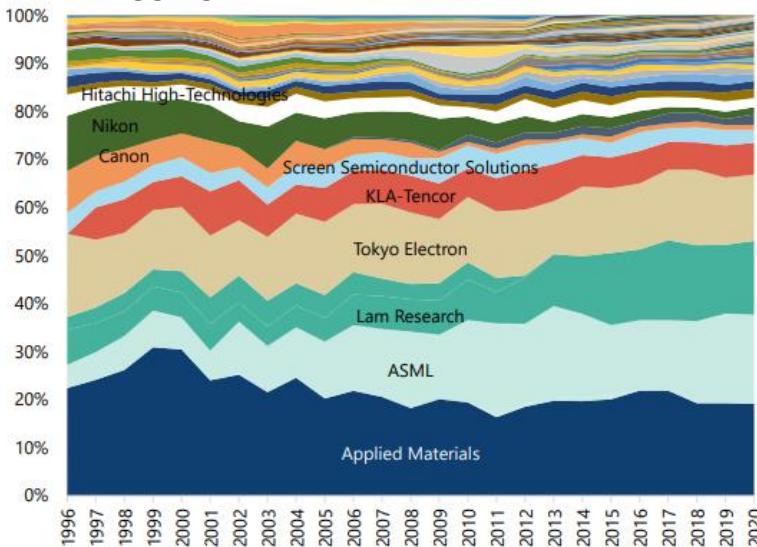


LRCX has the highest exposure to service revenues at 33% of total sales. We expect service revs of AMAT, LRCX and KLAC to grow double-digit driven by: 1) Growing installed base; 2) Increased system complexity; 3) Strength in trailing edge nodes; 4) Higher fab utilization.

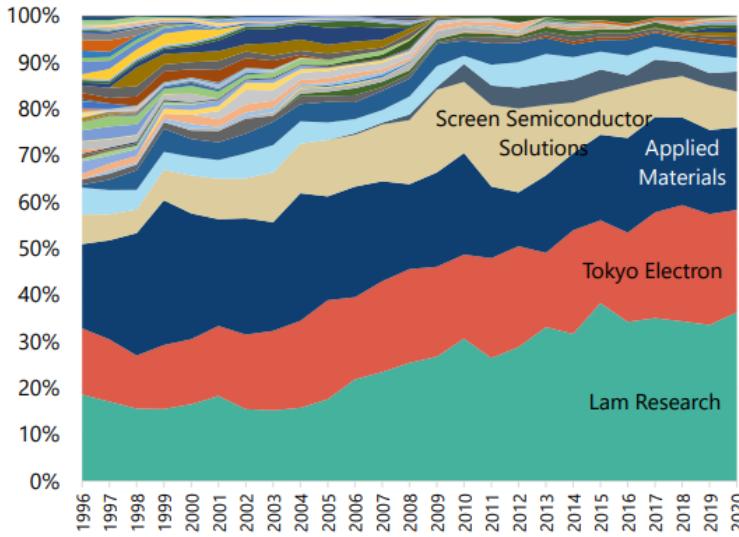
We expect higher service revenues will have the effect of lowering earnings volatility and therefore beta, and therefore, by extension, increasing P/E multiples

SemiCap Initiation: Consolidation Driving...

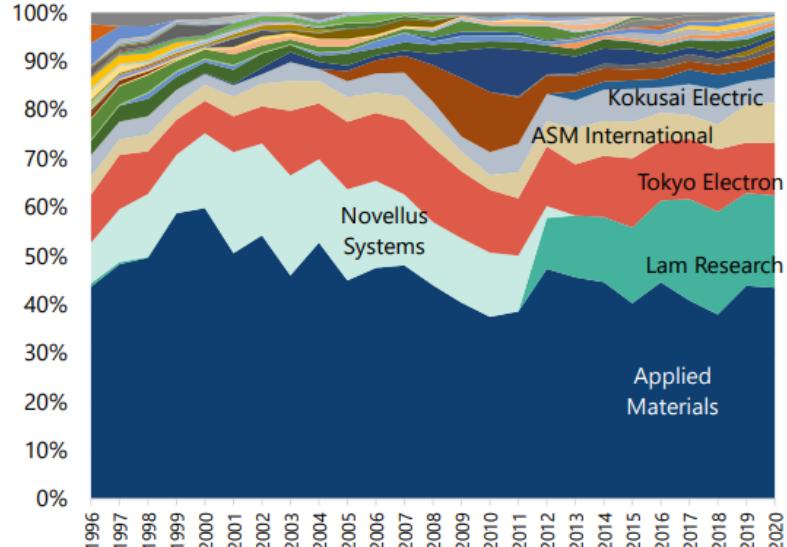
In the Aggregate, WFE Revenue Share Appears Static



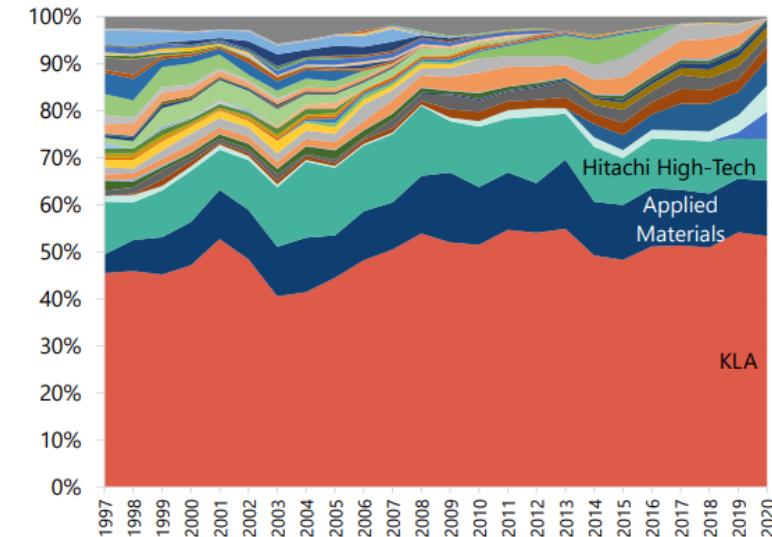
LRCX Is The Etch Leader



AMAT Dominates Deposition Market



KLA Dominates Process Control Markets

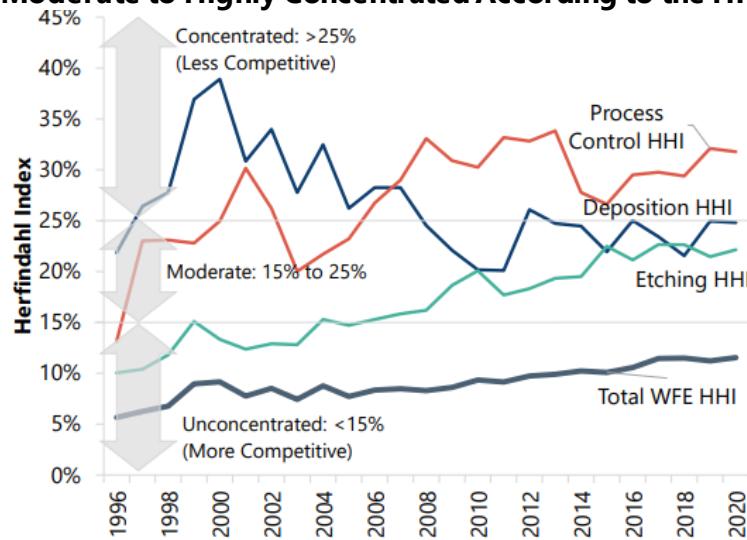


Source: Gartner, Jefferies Research

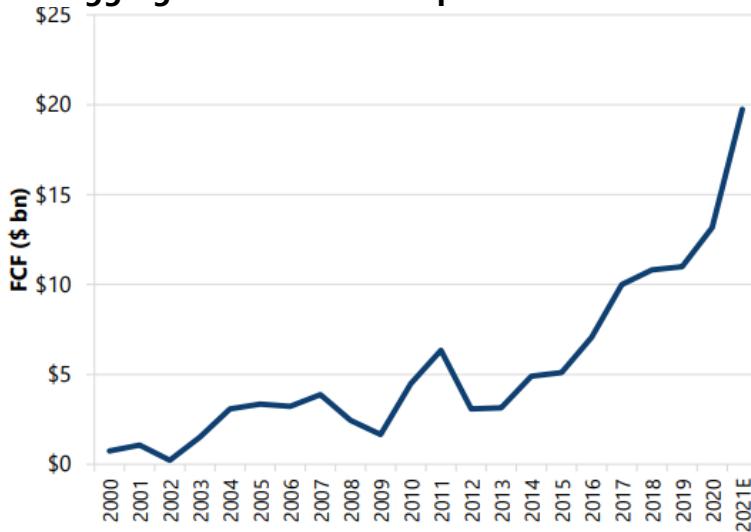
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SemiCap Initiation: ...Higher Profitability, Levered EPS Growth and Higher Capital Return

Process Control, Deposition and Etching Markets are Moderate to Highly Concentrated According to the HHI



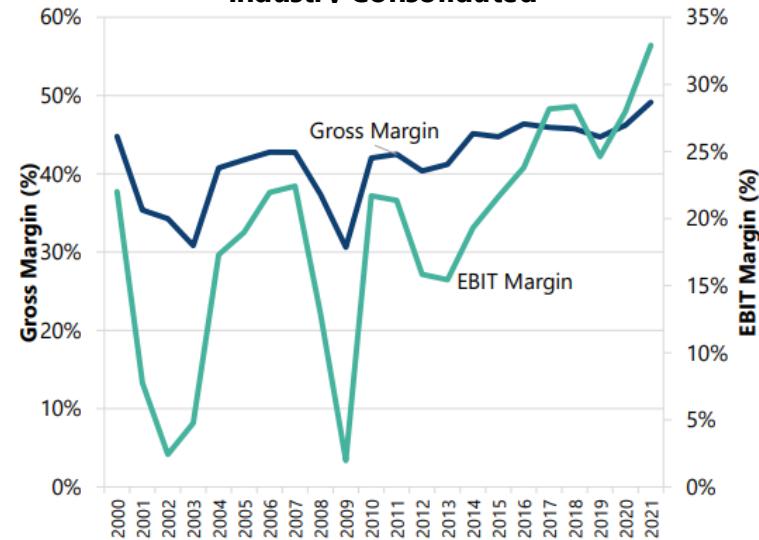
Aggregate FCF of SCE Companies Has Increased



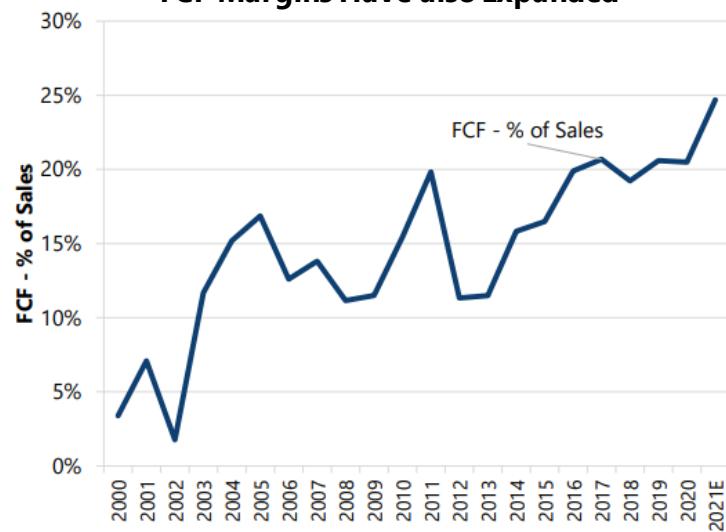
Source: Gartner, Jefferies Research

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WFE Gross and EBIT Margins Have Expanded as the Industry Consolidated

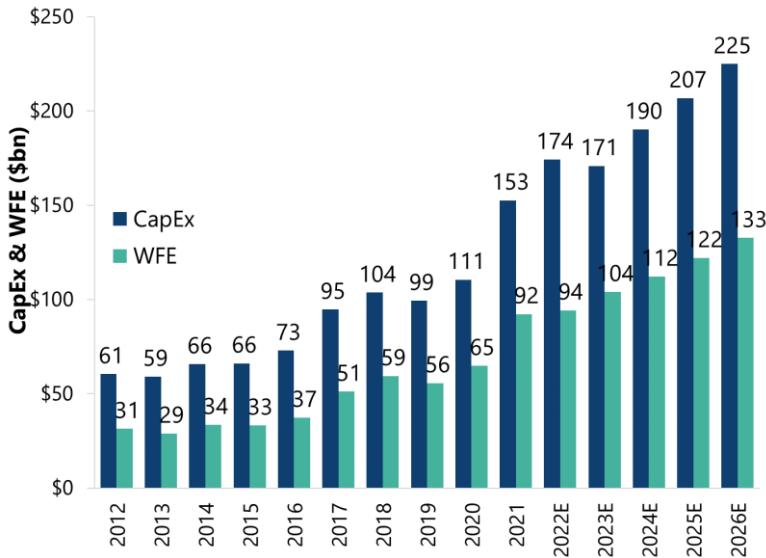


FCF Margins Have also Expanded

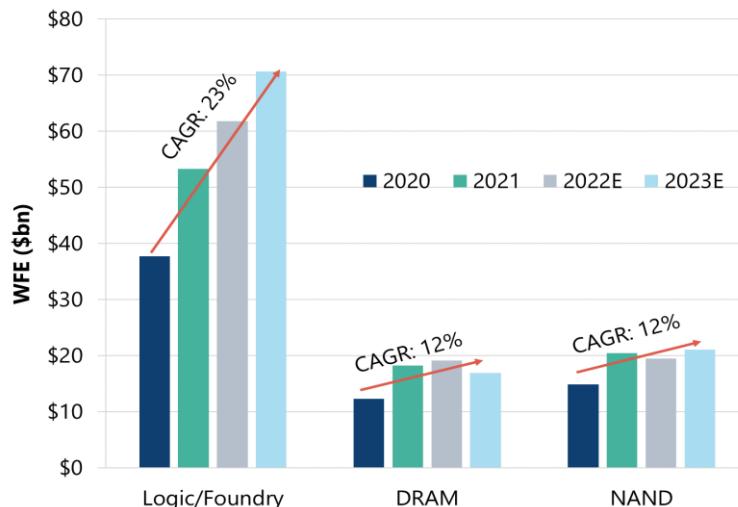


SemiCap Initiation: WFE Forecast

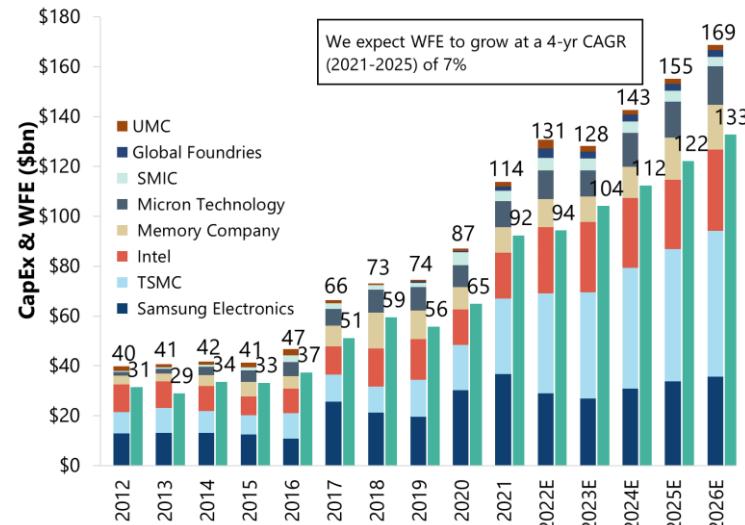
WFE Spend is Typically 60% of Semi CapEx



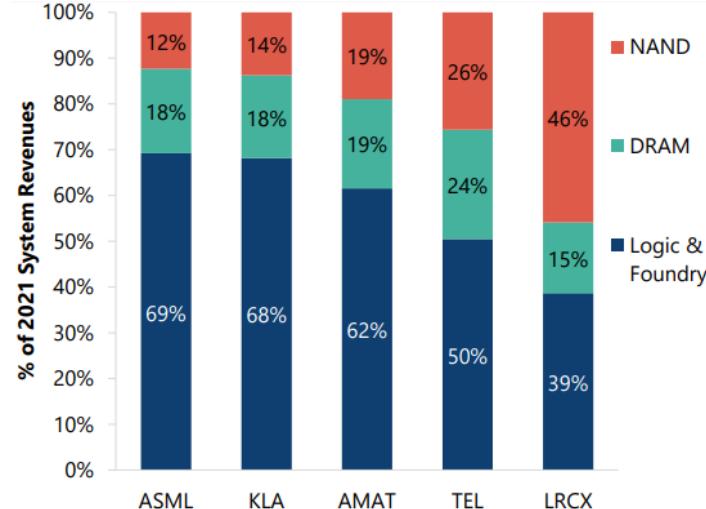
Logic and Foundry Have Driven WFE Spend



CapEx Growth of Top 8 Semi Companies is a Good Proxy for WFE Growth



ASML, KLAC, AMAT - Highest Exposure to Logic & Foundry

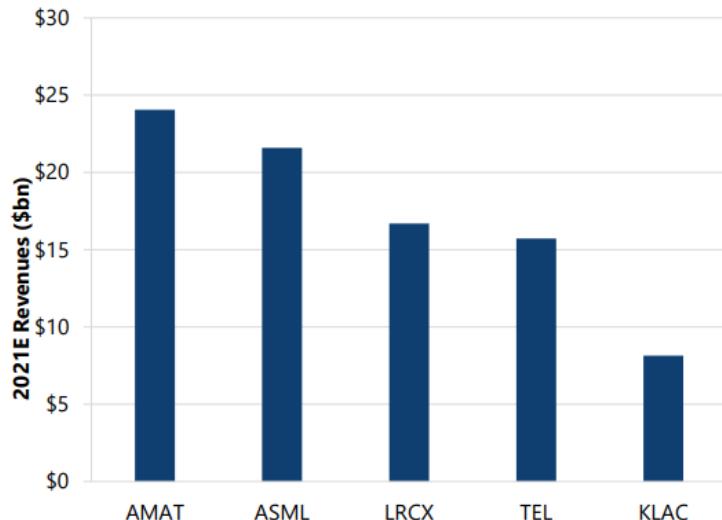


Source: Jefferies, Gartner, company data, FactSet. Includes aggregate Gross Margin and EBIT Margin of AMAT, ASML, LRCX, TEL and KLAC

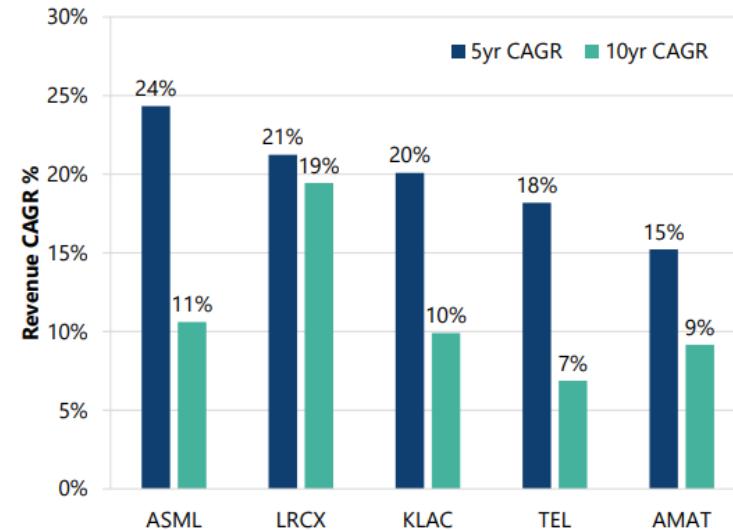
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SemiCap Initiation: Large-Cap SemiCap Equipment Company Comparison Charts

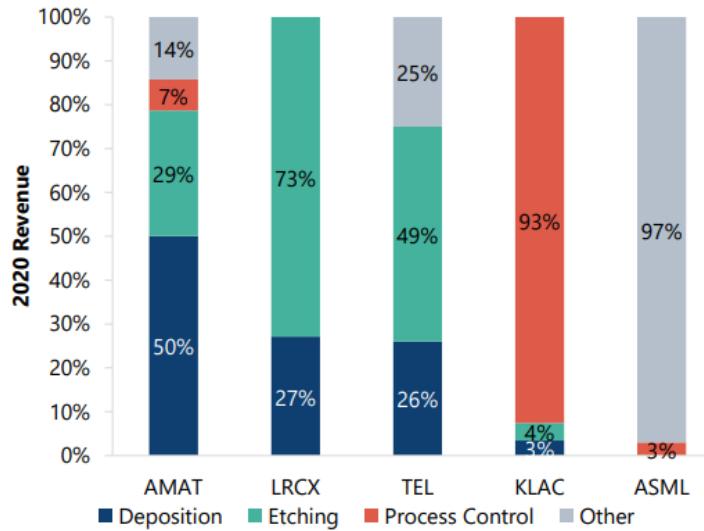
AMAT Is Closing In On \$25bn in Annual Revenues



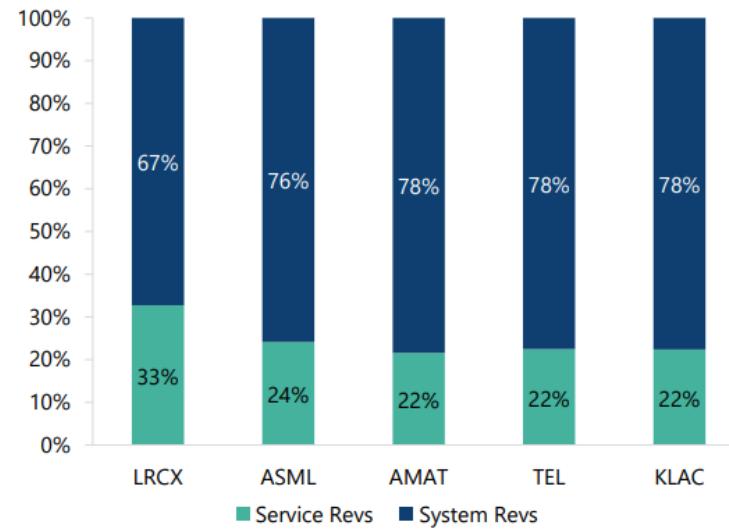
All Large-Cap SCEs Posted Double-Digit 5-yr Rev CAGR



AMAT-Deposition, LRCX – Etch, KLAC - Process Control



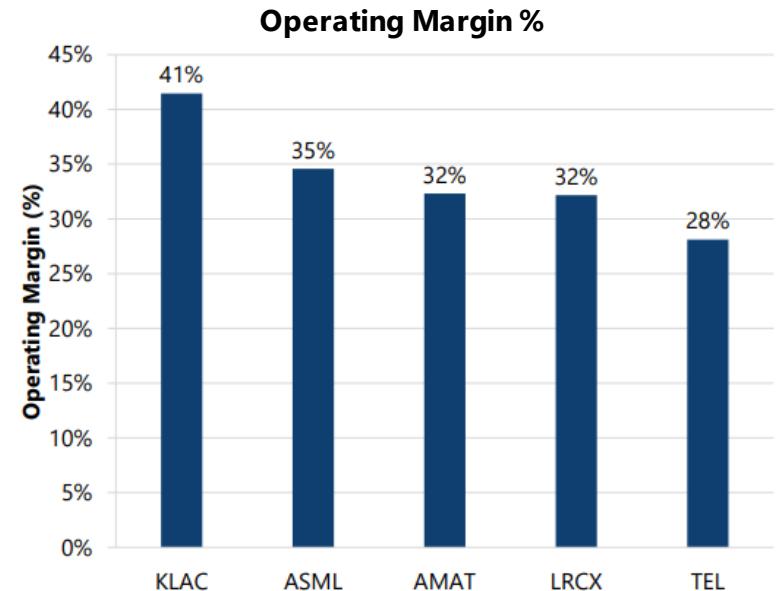
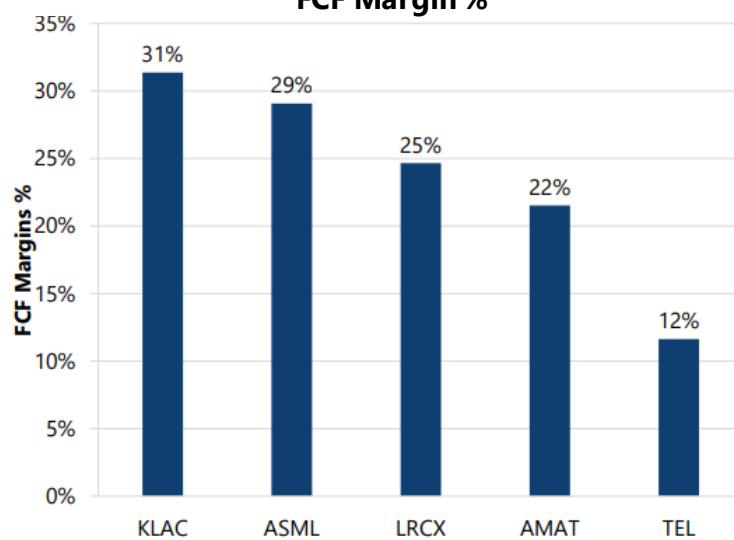
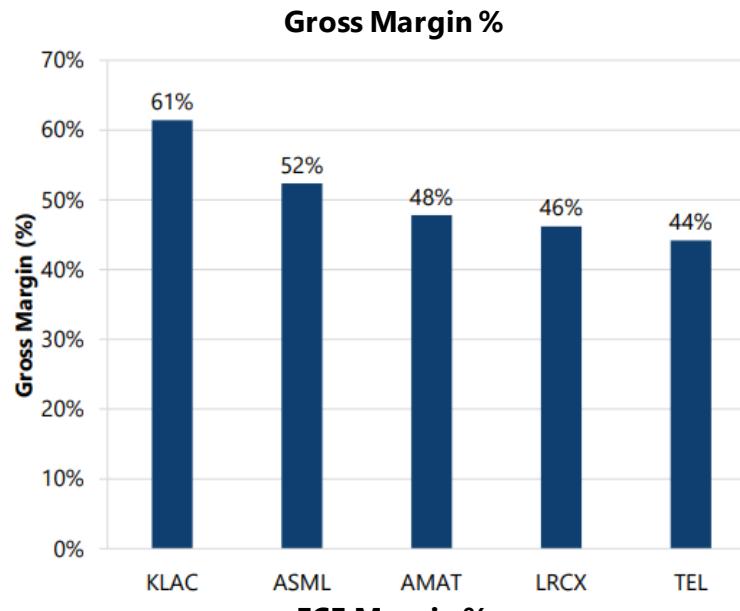
LRCX – Highest Exposure To Predictable Service Revs



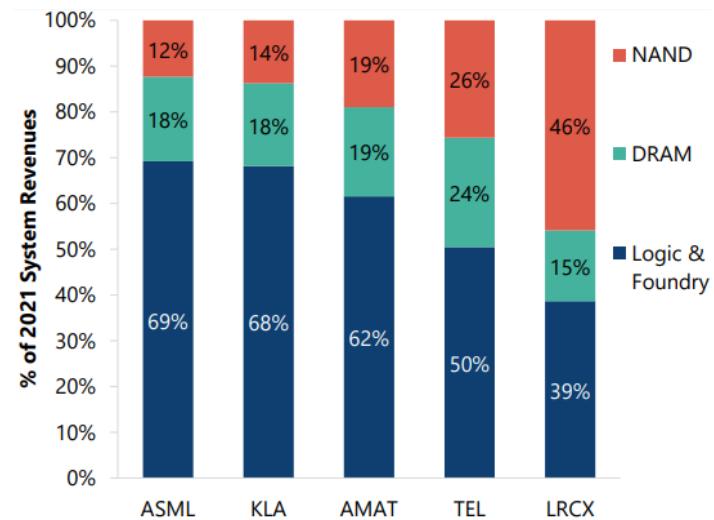
Source: Gartner, Jefferies Research

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SemiCap Initiation: Large-Cap SemiCap Equipment Company Comparison Charts



ASML, KLAC, AMAT- Highest Exposure to Logic & Foundry



Source: Gartner, Jefferies Research

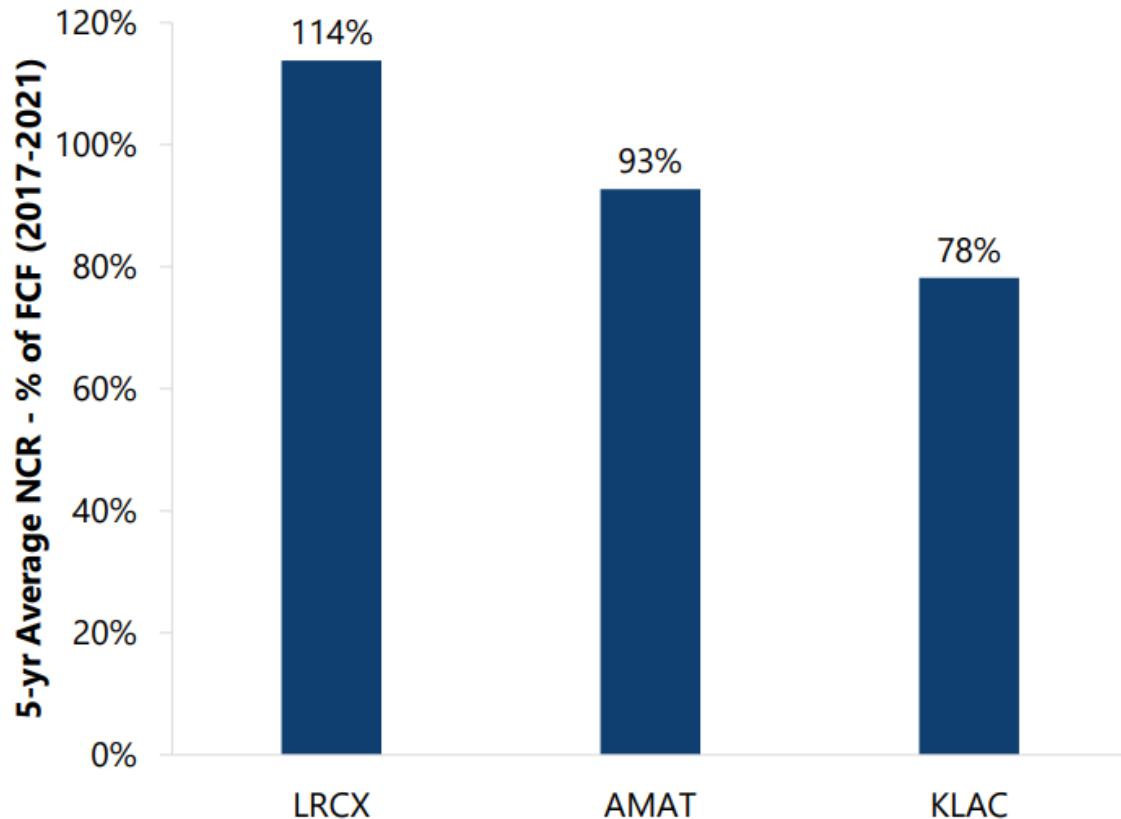
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SemiCap Initiation: Large-Cap SemiCap Equipment Company Comparison Charts

LRCX has done the best job in capital return, returning 14% more FCF to shareholders than it generated over the past 5 years

KLAC has the best opportunity to increase its capital return ratio

5-yr Average NCR - % of FCF (2017-2021)



Source: Jefferies, Company data, FactSet. NCR = Net Capital Return, defined as dividends + stock buybacks - cash from options exercises

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Moore's Bend: Transistor/CPU Inflection = "Bigger Chips" and Secular WFE Growth

When clock speeds (red scatter) hit a ceiling in 2005, INTC and AMD started introducing multi-core CPUs (blue scatter), which required larger-die CPUs. We've argued this inflection of core count signaled a Tectonic Shift to a Parallel Processing Era (link to note here)

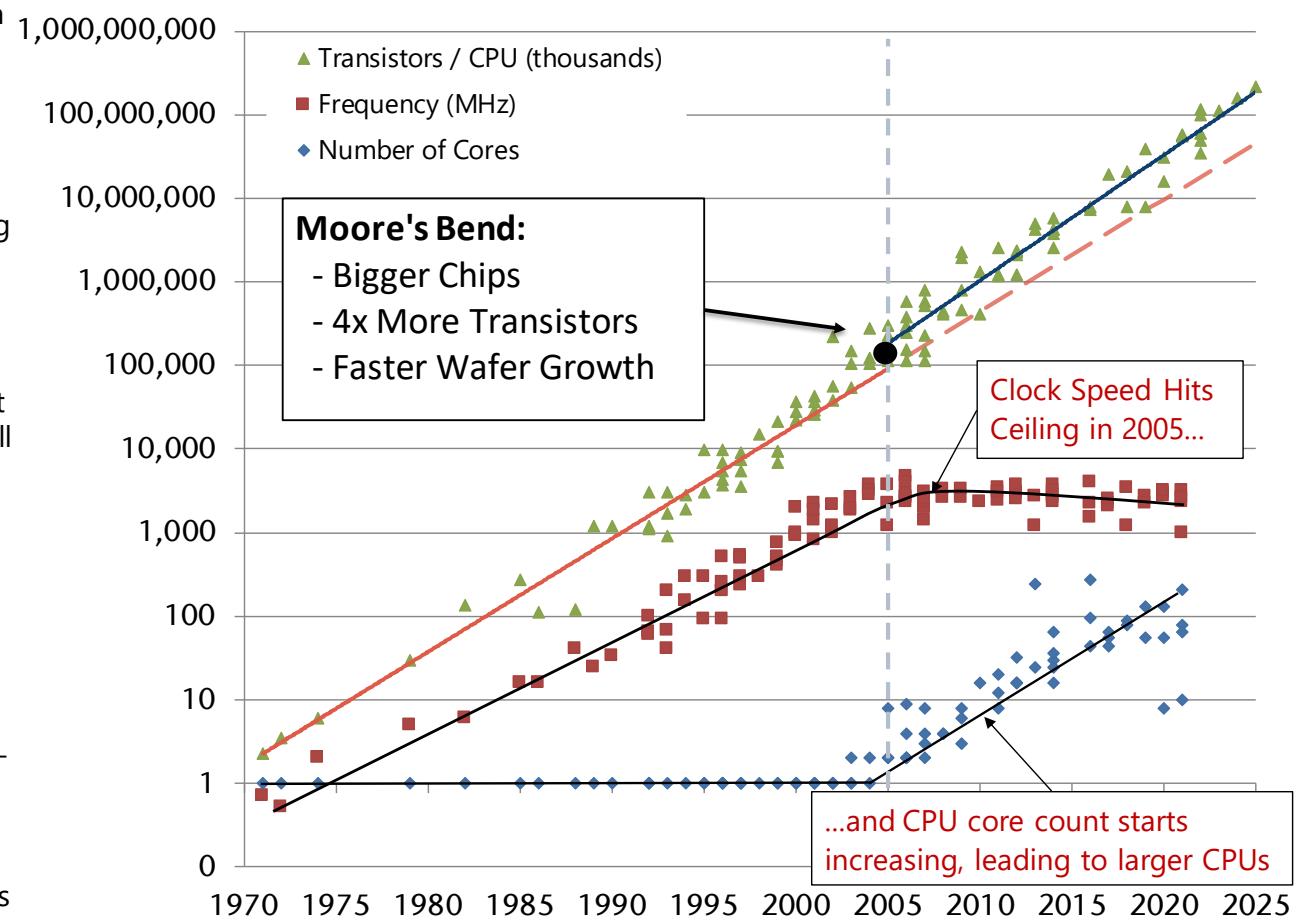
Transistors/CPU (green scatter) also inflected with increased CPU core count in 2015 to a steeper curve that is 4x higher than the original - we call this inflection "Moore's Bend"

The solid red line is a curve fit of transistors per CPU between 1970 and 2000 - "pre-multi-core processors"

The solid blue line is a curve fit of transistors per CPU starting in 2005 - "post multi-core processors"

Since log scale plots obscure the magnitude of inflections, we plot this chart on a normal y-axis scale below

Moore's Bend: Transistors/CPU Inflected with Multi-Core CPUs in 2005



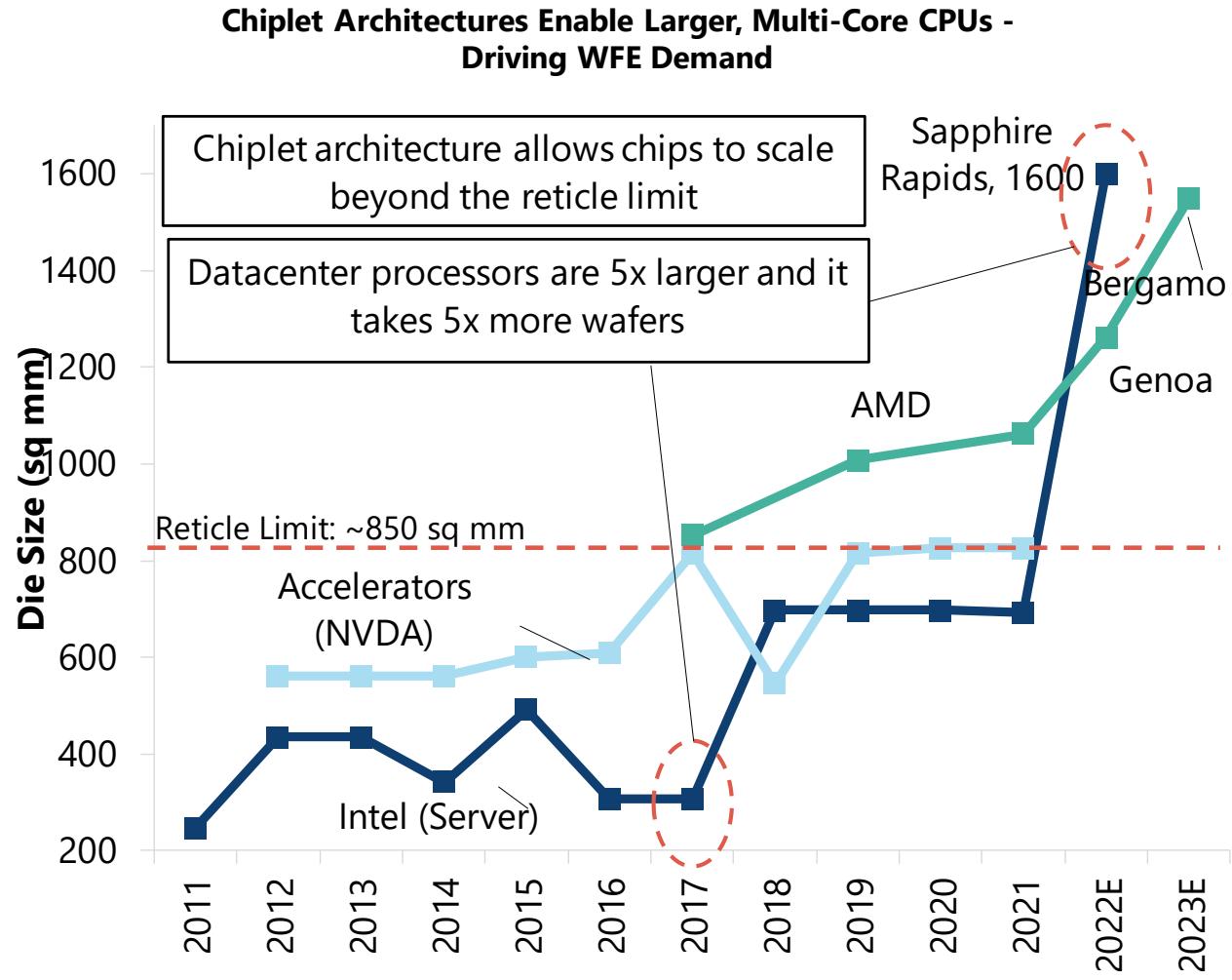
Source: Jefferies. Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten. New plot and data collected for 2010-2021 by K. Rupp.

Moore's Bend: Transistor/CPU Inflection = "Bigger Chips" and Secular WFE Growth

In our Jan-2022 Semi-Cap Equipment initiation note (link here), we argued that starting in 2017, market demand shifted to larger, multi-core CPUs, which consequently transitioned the wafer fab equipment (WFE) industry to secular, growth-cyclical from ex-growth, pure cyclical

In our original note, we showed the progression of die size increases of datacenter processors from INTC and NVDA made from monolithic die. Those processors approached the "reticle limit" (aka photomask) of about 850 sq mm, represented by the red dashed line on the chart to the left

In this updated chart, we show that "chiplet" architectures are extending the growth of processor die size well past the reticle limit of 850 sq mm. The new data gives us increased conviction in our thesis that WFE demand is now on a secular growth trajectory due to the demand of larger, multi-core processors



Source: Jefferies, Anandtech, wccftech.com, techpowerup.com, Company data

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Moore's Bend: Transistor/CPU Inflection = "Bigger Chips" and Secular WFE Growth

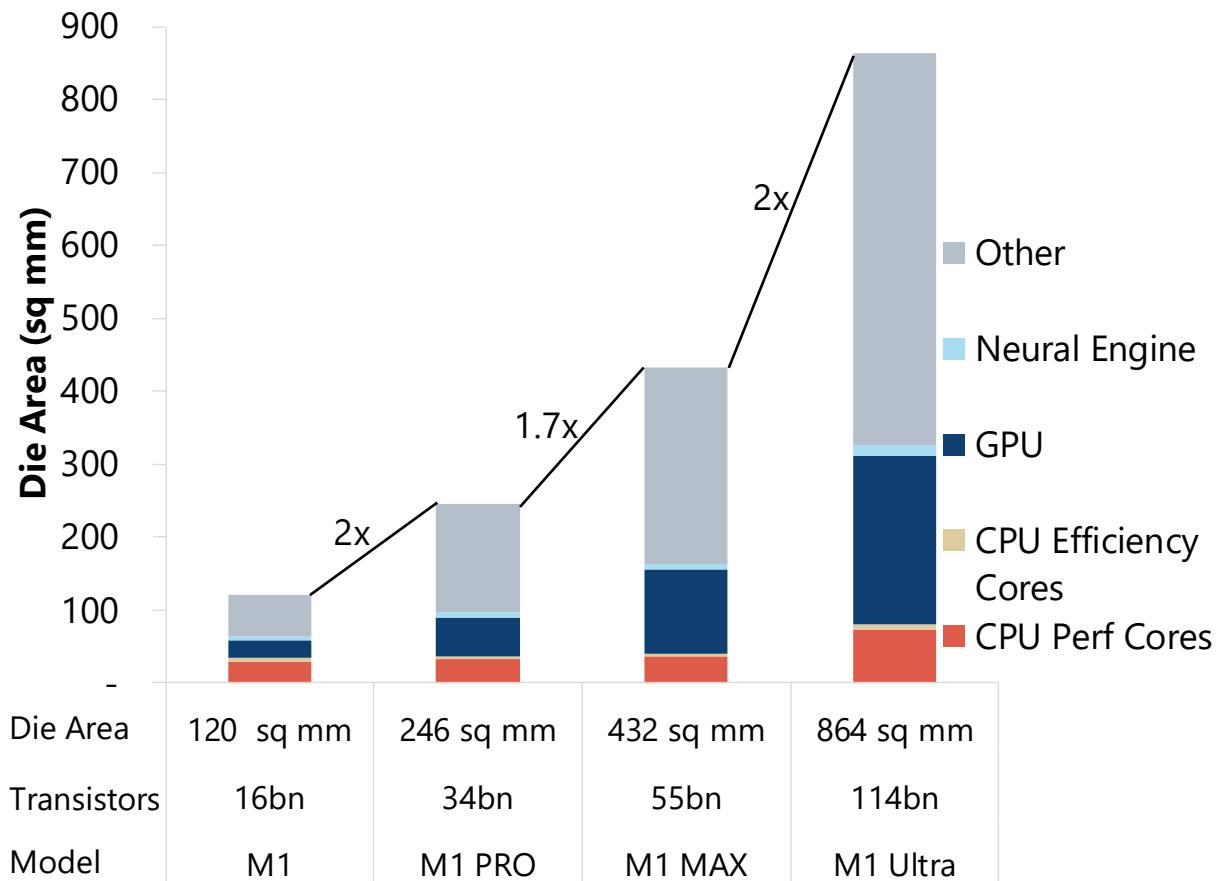
Increasing die size is not just a data center phenomenon, it also can be seen in client PCs - the most obvious example is the evolution of Apple's M1 ARM CPU

Over just the past 3 years, the die size of Apple M1 family of ARM CPUs has increased 2x and 3.5x with M1 PRO and M1 MAX vs. the original M1. The recently launched M1 Ultra is 7x bigger than M1

The transistor count has scaled with the same magnitude increasing 7x with M1 Ultra and 3x M1 MAX vs. the original M1 at 16bn, with no change in process node

The increased die size translates to 2.3x; 4.6x and 9x more wafers required to make the same number of M1 Max; M1 PROs and M1 Ultras vs. the original M1 CPU

Apple M1 ARM CPUs Have Seen 7x Increase in Die Size in just 3 Years



Source: Jefferies, company data

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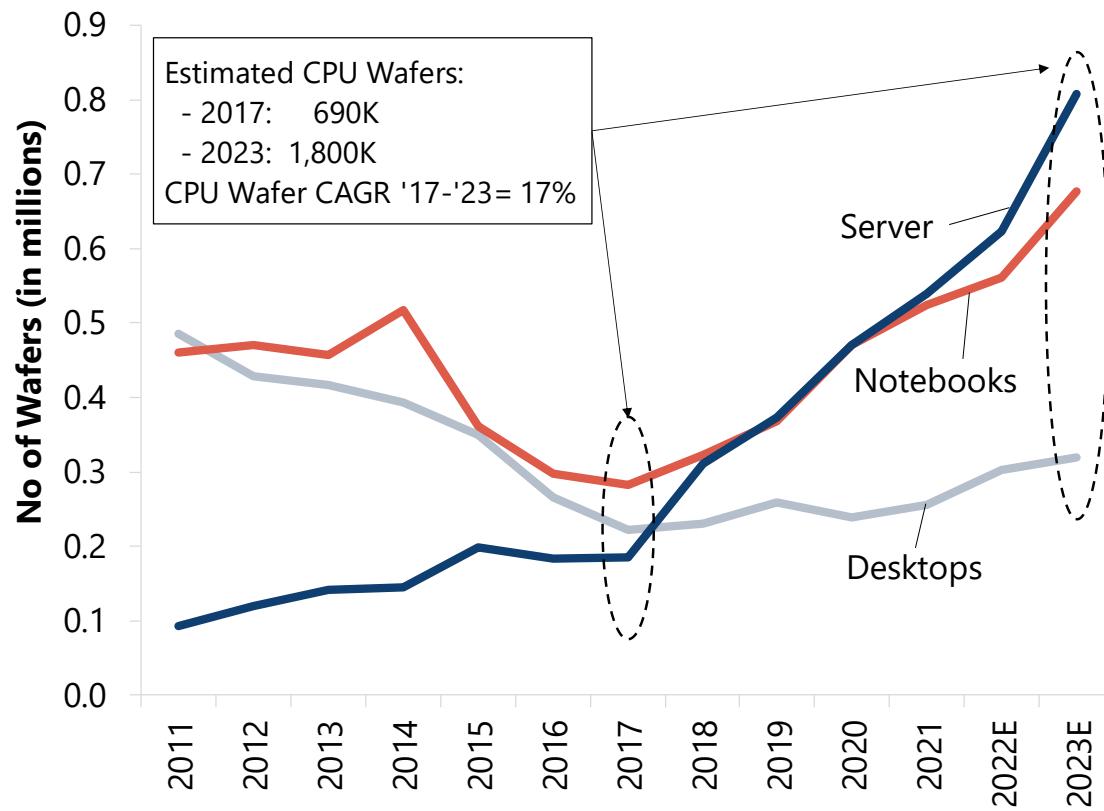
Moore's Bend: Transistor/CPU Inflection = "Bigger Chips" and Secular WFE Growth

We use data from the previous charts, coupled with unit shipment data to calculate the increased demand for wafers for the Server and Client CPU markets

We estimate that increased CPU chip sizes will have driven an increase in the number of wafers necessary to make Client and Server CPUs to 1.8m wafers in 2023 from 690K wafers in 2017, or a 17% CAGR, well in excess of the 2% CPU unit CAGR forecasted for the same time period

We estimate that demand for server CPU wafers alone will have increased at a 28% CAGR between 2017 and 2023, while demand for notebook CPU wafers will have increased at a 16% CAGR

We Estimate Demand for CPU Wafers Increases at a 17% CAGR between 2017-2023, Well in Excess of 2% CPU Unit Growth



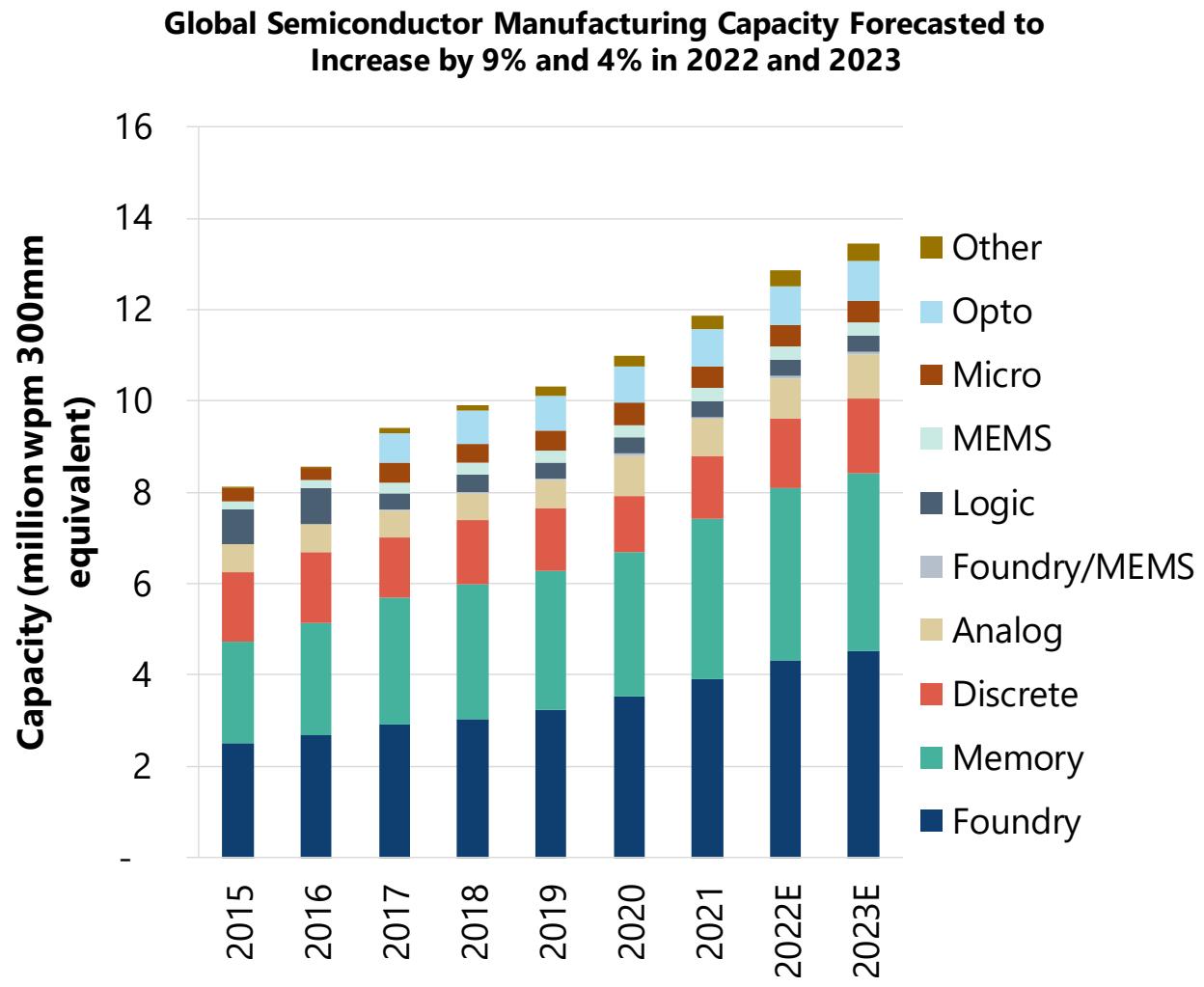
Source: Jefferies, Mercury, Anandtech, techpowerup.com, wccftech.com, Company data

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Moore's Bend: Transistor/CPU Inflection = "Bigger Chips" and Secular WFE Growth

SEMI forecasts global semiconductor wafer capacity to increase by 9% in 2022 and by 4% in 2023

Our sense is consensus expects a much larger increase in capacity



Source: Jefferies, SEMI

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Moore's Bend: Transistor/CPU Inflection = "Bigger Chips" and Secular WFE Growth

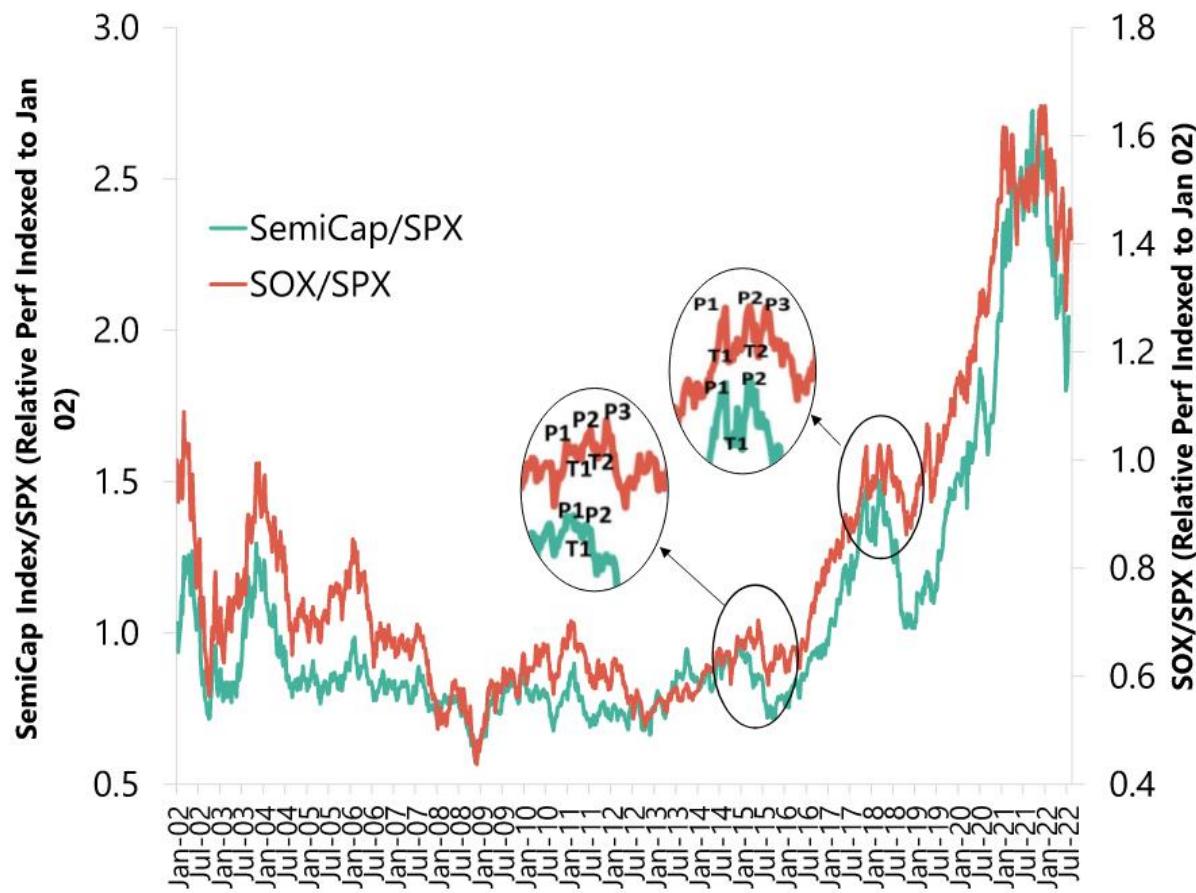
We believe that Semiconductor stocks have entered the peaking process for this cycle. Because of high order backlog and tight capacity, we expect the peaking process to last at least 6 months.

The Peaking Process of the SCE stocks slightly varied from SOX during the 2014-15 and 2017-18 cycles

- Relative to SPX, SCE stocks experienced 2 Peaks and 1 Trough each cycle as compared to 3 Peaks and 2 Troughs pattern of SOX
- SCE stocks peaked before SOX
- Relative to the SPX, the SCE End-of-Cycle bottom was 6% and 20% lower than the Mid-Cycle-Correction Bottom in 2017-18 and 2014-15 cycle respectively

We observe that our SCE Index is below the mid-cycle correction in May, where it bottomed during the 2018 cycle

Relative to the SPX, in 2018, Our SCE Index is Trading Below the Mid-Cycle Correction



Source: Jefferies, FactSet. SemiCap Index is cap-weighted (AMAT, ASML, LRCX, TEL and KLAC)

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Channel Checks

23-Jun-22: Backlog and Inventories Continue Building

We hosted a call with supply-chain expert Richard Kwartek post 2 weeks of checks. Key takes: (1) record backlog, solid 2Q bookings and billings, although resellers noted MoM deceleration of bookings since April, (2) lead times elevated and stable, sense of urgency has subsided and shortage lists shortened, (3) small uptick in pushouts and cancellations as inventory risks become a focus, (4) some OCMs signaled price increases in 3Q.

- 1) 2Q strong bookings and record backlog, but decelerating monthly booking through the quarter.
- 2) Demand robust broadly, except for smartphones and computing.
- 3) Lead times are stable at extended levels however, golden screw lists and the sense of urgency in the supply chain have declined.
- 4) OEMs and EMS inventories were at a historic high in 1Q22, even higher in 2Q22.
- 5) Concerns about inventory risks increase.
- 6) A small uptick in pushouts and cancellations.
- 7) Semis raising prices in July/3Q, aftermarket 100x markup cases exit, but less frequent.
- 8) Some OEMs are able to successfully minimize purchase price variance (PPV), compared to previous Qs.
- 9) Component resellers are seeing early signals of cycle turning: (a) fewer shortages, (b) lower tolerance to pay high ASPs, (c) demand for smaller quantities of components, (d) monthly bookings still solid but decelerating through 2Q.
- 10) After six consecutive record quarters, one reseller hoping for flat 3Q vs 2Q.
- 11) OEMs more willing to part with excess inventory. Common "pain point" products are now becoming more available in the aftermarket, although not cheap.
- 12) Two scenarios from here:
 - if demand remains strong, inventory will be consumed
 - if demand declines, inventory correction likely
- 13) Some expect supply shortages to ease in 2H22, as new fabs come online

Source: Jefferies Research, see note [Supply Chain Checks 24-Mar-22: Backlog and Inventories Continue Building](#) published on Mar 25, 2022

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Expert Call on Ukraine Neon Market Disruption

17-Mar-22: Expert Call on Ukraine Neon Market Disruption

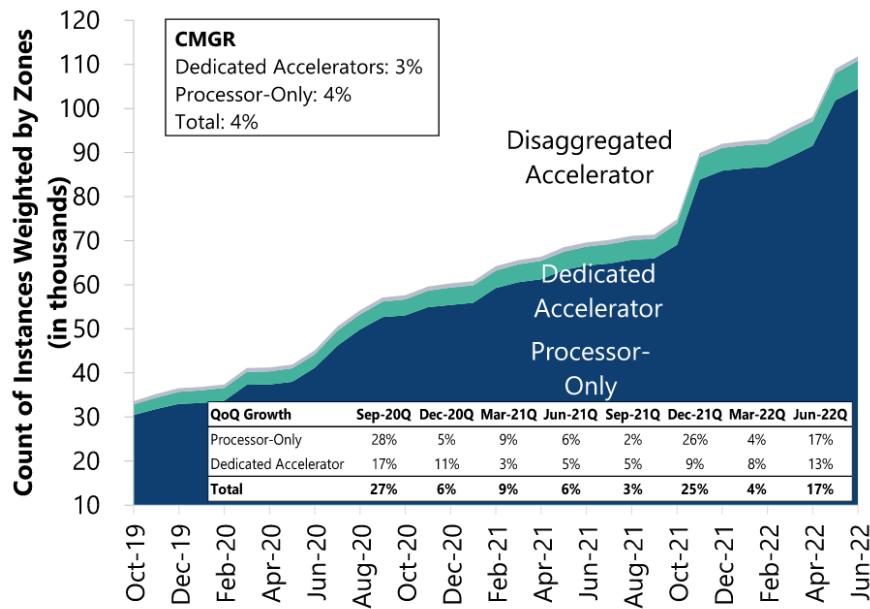
We recently hosted an expert call on neon. The disruption of the Ukraine neon trade will trigger a shift in trade flows and higher prices in the near term to pull volumes from lower-value applications, but inventories should smooth out the near term, with equilibrium restored by mid-to-late 2023.

- **A High-Profile Pricing Cycle:** Neon gas prices are up 5x since December, vs the >6x move when Russia invaded Crimea. Russia and Ukraine likely represent 20-30% of neon supply. Including neon flowing through Ukraine for maritime exports, Ukraine represented 35-40% of purified neon supply.
- **Demand Considerations:** The neon market is relatively small, normally \$45-50m in global sales for the industrial gas companies, and double that at the level of regional distributors. Trend-growth is ~5%, mostly due to its use in semiconductor production (particularly in lithography). We estimate 50-55% of demand is currently for semiconductor production (mostly higher-purity product grades)
- **The Supply Chain Can Smooth Volatility...** Current neon production capacity is likely already running full-out, with minimal flex available. The supply chain usually carries 3-6 months of supply, and double-ordering and hoarding appear to have started in January, which should provide some cushion. Another cushion for supply/demand balances is that we estimate 5-10% of the neon supply could be repurposed relatively quickly from lower-value applications.
- **... with a Return to Equilibrium Next Year:** Even in the extreme case, the industrial gas industry can probably rebalance the supply chain outside the Ukraine and Russia with a fairly modest \$300-400m investment cycle. Bringing new capacity onstream can take 12-18 months to secure the key components and maybe another 3-6 months if supply chains remain disrupted, offset by industrial gas companies likely pulling forward capacity additions outside Ukraine in January.
- **NT considerations:** Semiconductor producers could find neon one more complication by Q3, and be inclined to stretch out inventories until new supply arrangements rebalance the market (e.g. Russian supply could be routed through China to be purified in countries where sanctions are less stringent).

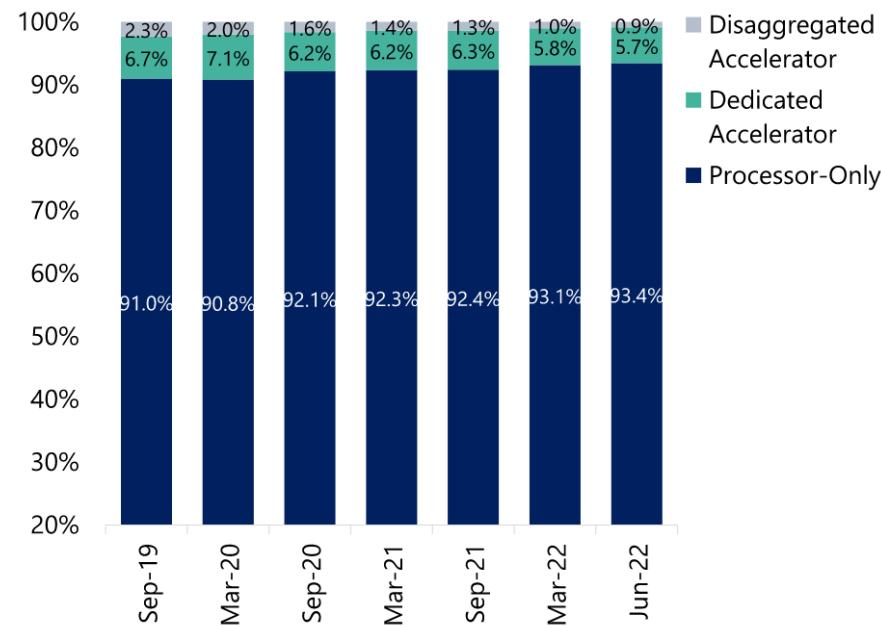
Cloud Instance Analysis

Cloud Instance Analysis – Jun'22: Accelerator vs. Processor Only Instances

Accelerator vs. Processor Only Instances Weighted by Zone Availability



Processor Only vs. Dedicated Accelerator Share

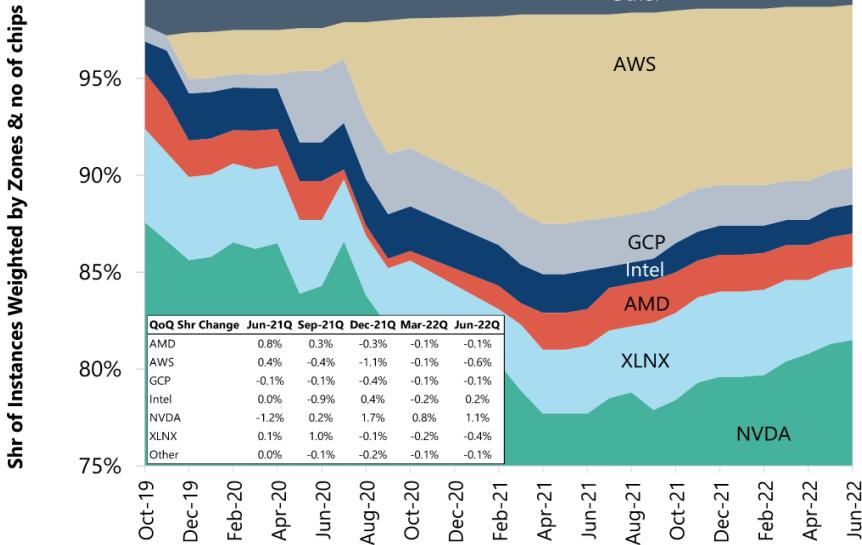


The total number of zone-weighted instances deployed by the 5 CSPs grew 2.6% MoM in Jun-22, driven by 2.6% MoM increase from processors and 3.0% from dedicated accelerator instances. Jun-22Q instance growth was 17% after Mar-22Q instance growth of 4%, which represents an acceleration on QQ instance growth of 6%, 9%, 6%, 3% and 25% in Dec-20Q, Mar-21Q, Jun-21Q, Sep-21Q and Dec-21Q.

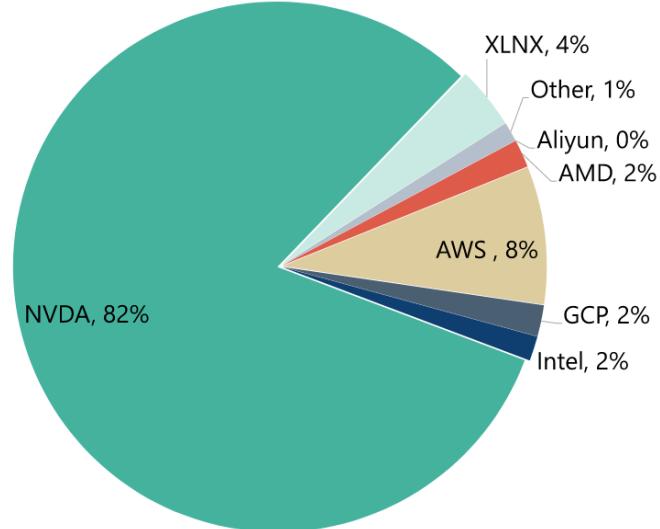
Source: Liftr Insights, Jefferies. More current and detailed data available by Liftr Insights. *Oct-21 is first month in all charts that includes instances from Oracle Cloud.

Cloud Instance Analysis – Jun'22: Accelerator Instances

Dedicated Accelerator Share Over Time



Processor Only vs. Dedicated Accelerator Share

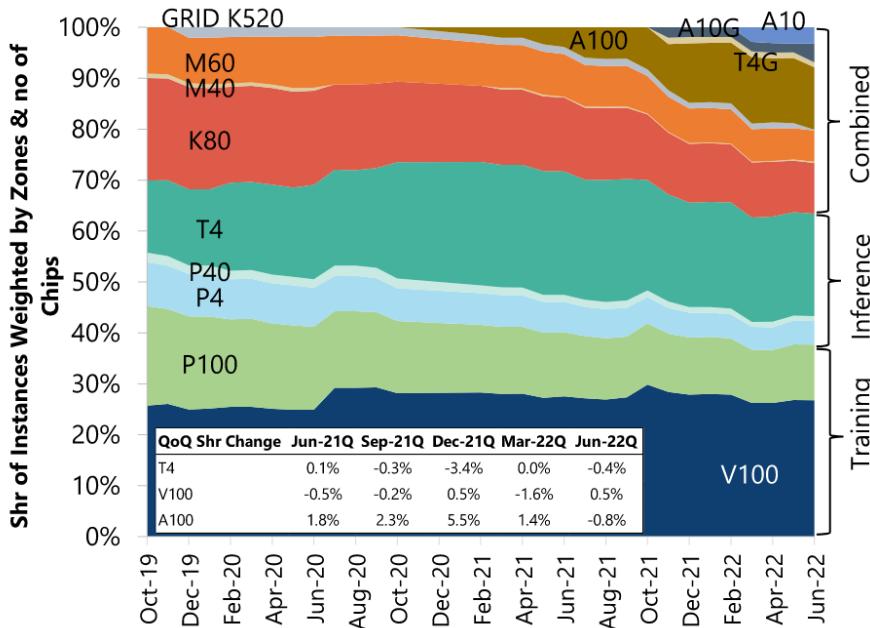


NVDA dominates Dedicated Accelerator instances with approx. 82% share. NVDA share was up 20bps in Jun-22. NVDA made up 98% of incremental overall accelerator deployments. A10G, T4, A100 and V100 made up 71%, 14%, 7% and 6% respectively of total new instances, respectively. Since Sep-20, there was a ~0.7% decrease in NVDA-based instances largely due to AWS's custom inference chip 'Inferentia', which is up 1.5% since Sep-20. More recently, since June-21, NVDA has gained 380bps of share. GPUs now make up 83% of the total accelerator instances available.

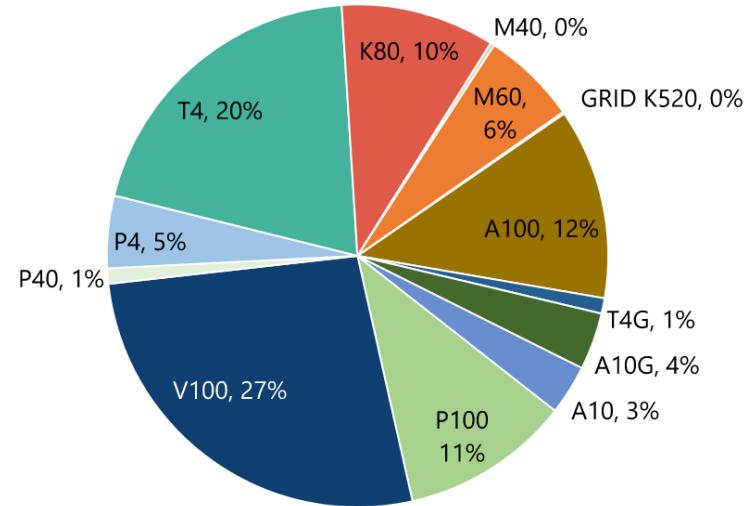
Source: Liftr Insights, Jefferies. More current and detailed data available by Liftr Insights. *Oct-21 is first month in all charts that includes instances from Oracle Cloud.

Cloud Instance Analysis – Jun'22: NVDA Accelerator Instances

NVDA's Accelerator Instances Share by Generations



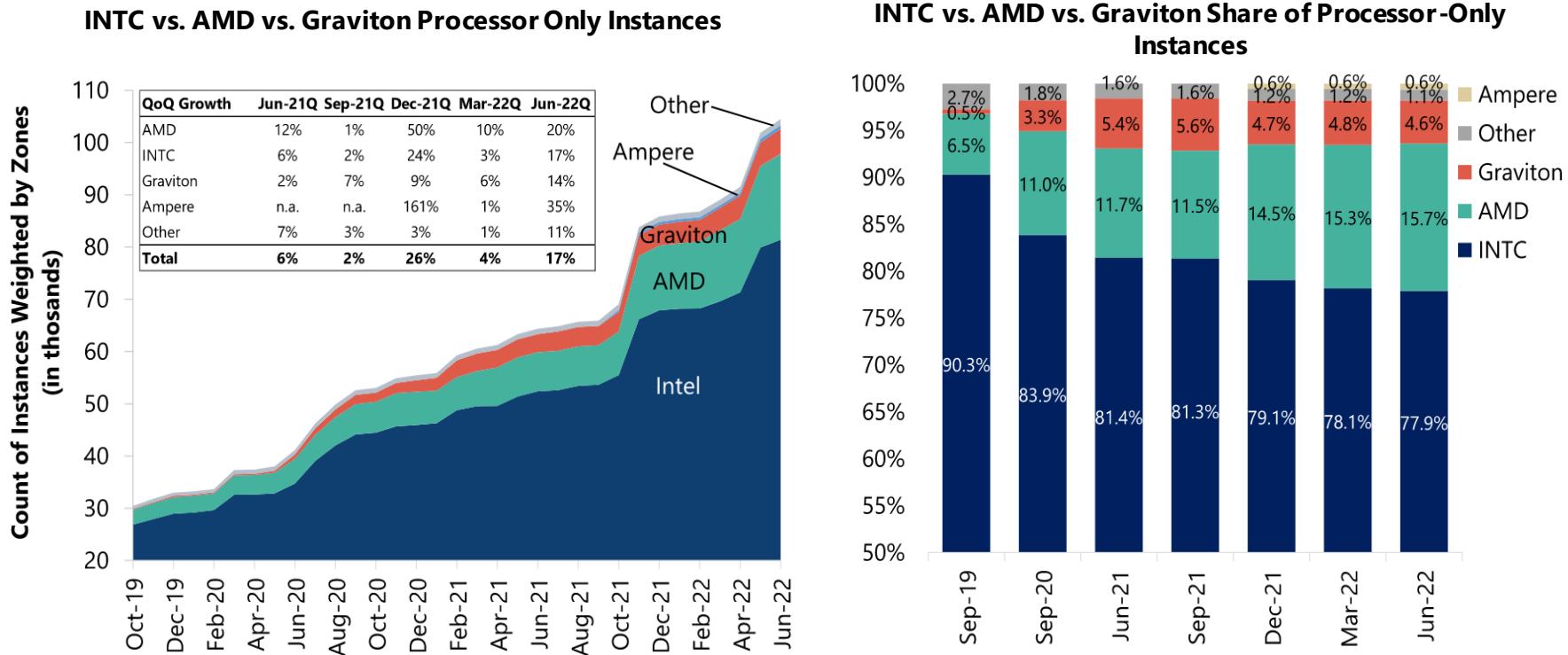
NVDA Accelerator Share by Generation as of Jun-22



A10G, T4, A100 and V100 made up 71%, 14%, 7% and 6% of total new instances deployed in Jun-22, respectively. A100 now comprises 12% of NVDA-based accelerator instances as of Jun-22, up 6.1% since Sep-21.

Source: Liftr Insights, Jefferies. More current and detailed data available by Liftr Insights. *Oct-21 is first month in all charts that includes instances from Oracle Cloud.

Cloud Instance Analysis – Jun'22: Processor-Only Instances

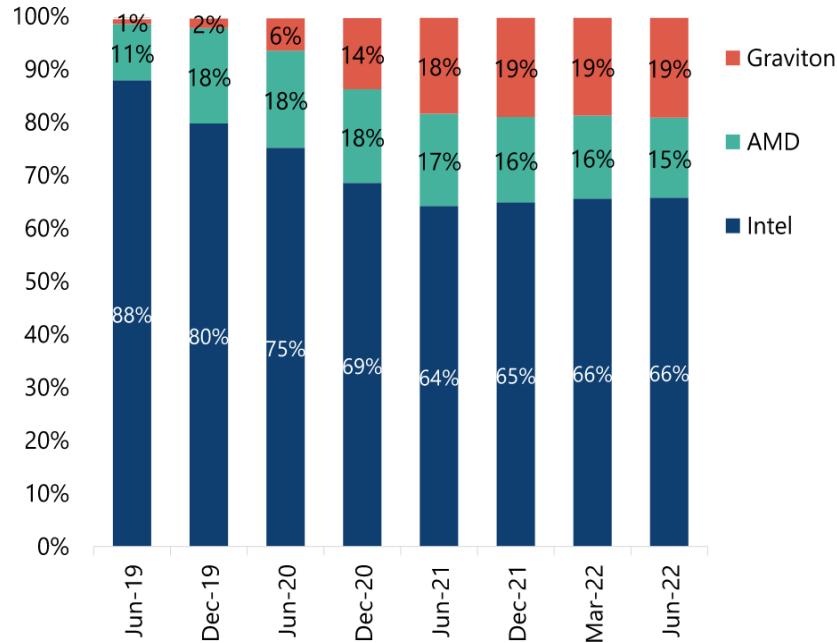


Intel's share decreased by 60bps MoM to 77.9% from 78.4% in Jun-22. AMD's share increased by 45bps MoM at 15.7% in Jun-22. AMD gained 40bps share in Jun-22Q, while Intel lost 30bps share in Jun-22Q. AMD and Intel grew by 5.6% and 1.9% this month and grew 20.5% and 17.0% in the Jun-22Q after growing 9.9% and 2.5% in the Mar-22Q respectively. This month, AMD accounted for 44% of new processor instances, while INTC made up 42% of new instances. AWS Graviton made up 13% of new instances and gained 15bps of share.

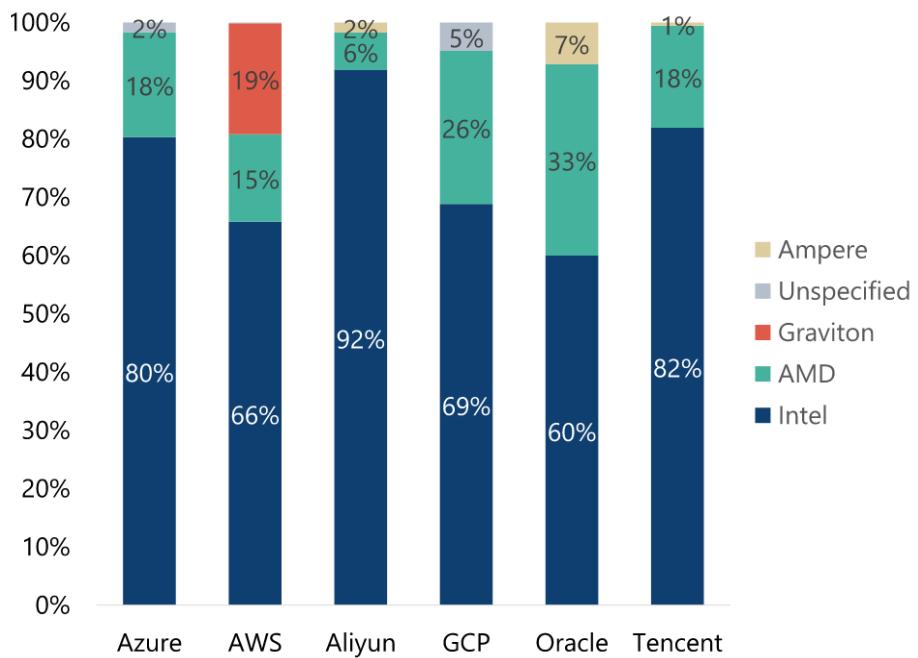
Source: Liftr Insights, Jefferies. More current and detailed data available by Liftr Insights.

Cloud Instance Analysis – Jun'22: Processor-Only Instances

AWS Cloud Processor-Only Instance Share



Processor Instance Share by CSP and Vendor at Jun-22



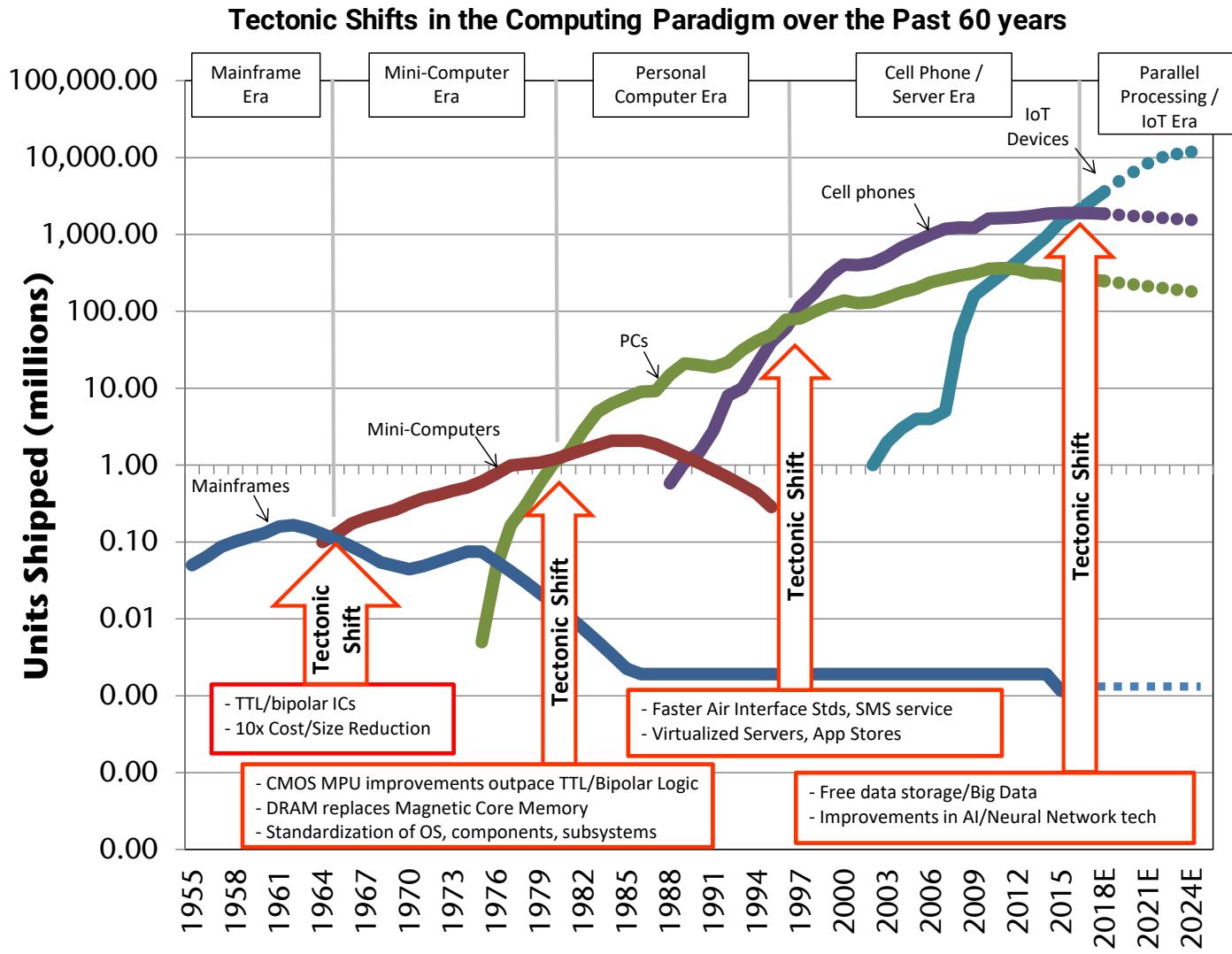
This month, AMD gained 120bps/30bps share at Azure and GCP, lost 30bps/10bps/10bps at GCP, Tencent and Aliyun, and was flat at Oracle. INTC gained 10bps share at Tencent and Alibaba, lost 120bps/30bps/30bps at Azure, AWS, and GCP, and was flat at Oracle. Within AWS, Graviton gained 65bps share. Within AWS, Graviton instances are now 19% of total CPU instances available as of Jun-22, taking share from INTC, which is down 22% share at AWS since Jun-19.

Graviton share gains align with our field work (see related research) on Graviton, which indicates an ecosystem inflection and a 40-50% price performance improvement over INTC instances.

Source: Liftr Insights, Jefferies. More current and detailed data available by Liftr Insights.

The 4th Tectonic Shift in Computing: To a Parallel Processing / IoT Model

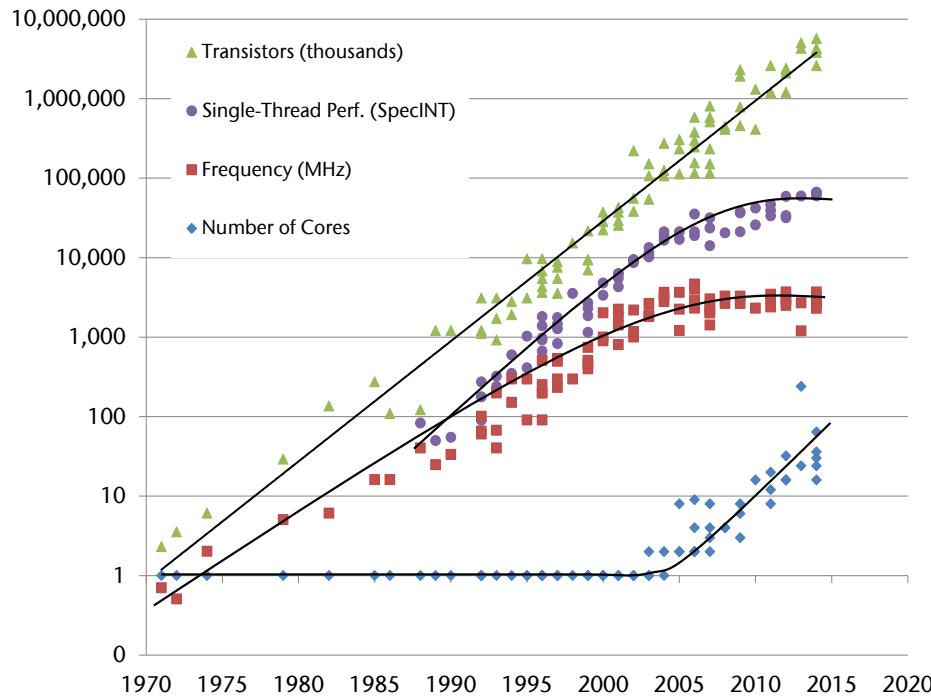
The 4th Tectonic Shift in Computing: To a Parallel Processing / IoT Model



Source: Jefferies Equity Research, Mainframe computer data sourced from IBM Company Filings, "The Early Computer Industry: Limitations of Scale and Scope", A. Gandy; Minicomputer "History of Computer Communications" J. Pelkey; Personal Computer data sourced from "Total Share: Personal Computer Market Share 1975-2010", J. Reimer, Gartner; Mobile devices sourced from Counterpoint Research, Canalys Research, "Smartphones" Research Report, M. Ilyas, S. Ahson; IoT devices sourced from Gartner.

The 4th Tectonic Shift in Computing: To a Parallel Processing / IoT Model

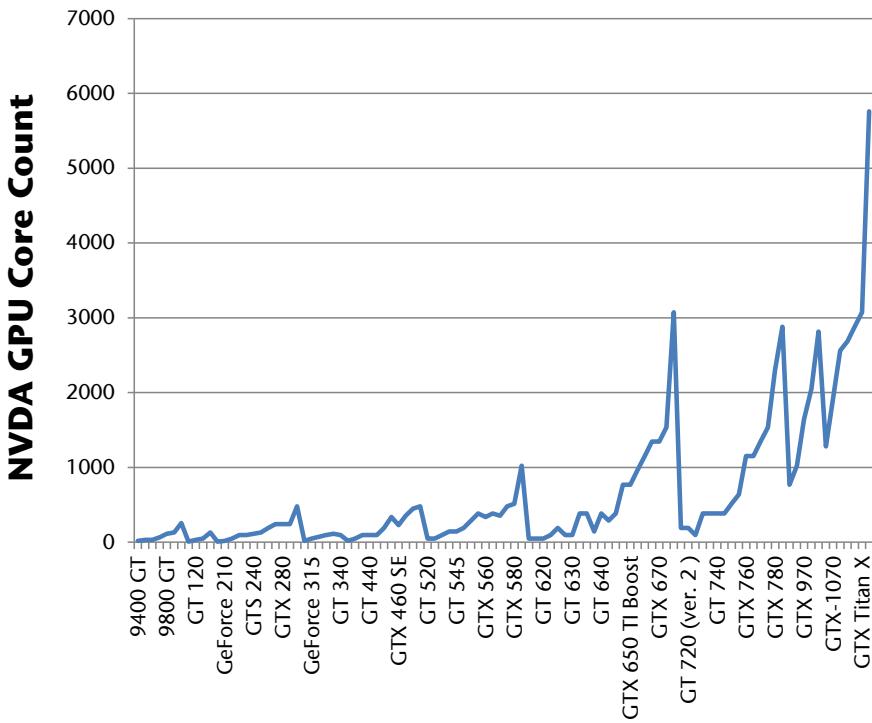
40 Years of Microprocessor Trend Data



The bottom line on this chart suggests that MPU makers are trying to make up for the stagnating single threaded performance with more processor cores per MPU – consistent with our thesis that the industry is moving to a parallel processing paradigm

Source: Jefferies. Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten. New plot and data collected for 2010-2015 by K. Rupp.

NVDA Discrete GPU Core Count (2008-2016)

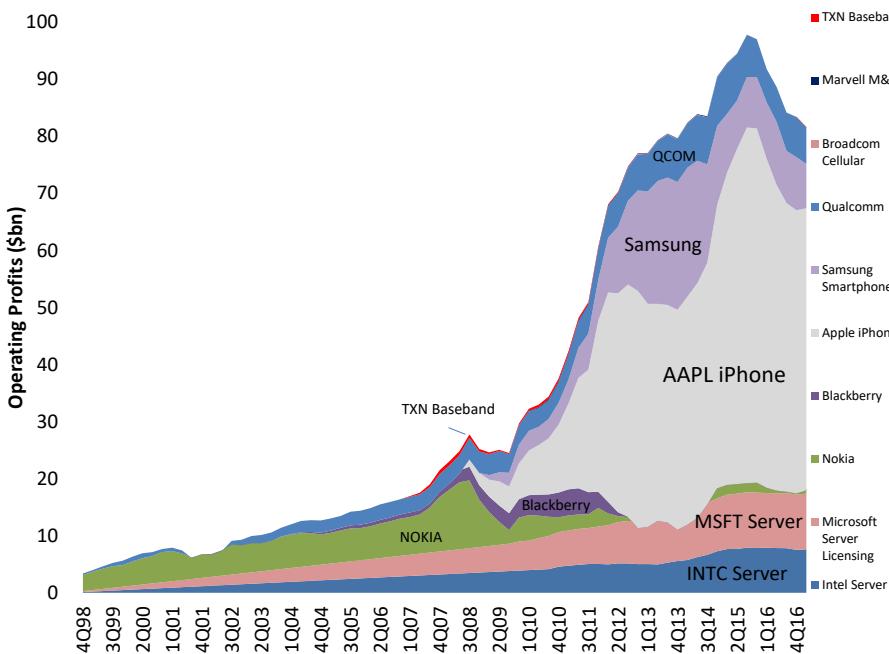


NVidia's Titan X can have up to 6,000 GPU cores – two full orders of magnitude higher than the highest core count MPUs

The 4th Tectonic Shift in Computing: To a Parallel Processing / IoT Model

Importance of the Platform – Case Studies

Cellphone / Server Operating Profits (\$B)



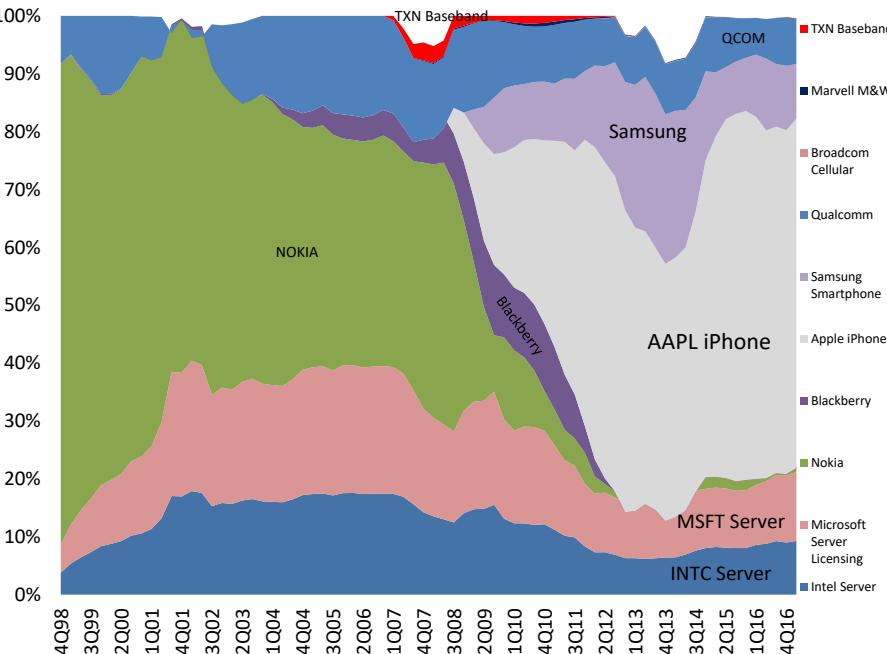
The smartphone and PC markets illustrate the importance of delivering a platform in order to capture industry profits.

Interestingly, while Nokia and its Symbian/Cellphone platform dominated up until 2008, Apple and its iPhone platform dominated since

Since an important part of the smartphone value proposition is its ability to harness the computing power of datacenters around the world, we include Intel and Microsoft as proxies for the other half of the Cell Phone / Datacenter computing paradigm

Source: Jefferies, company data

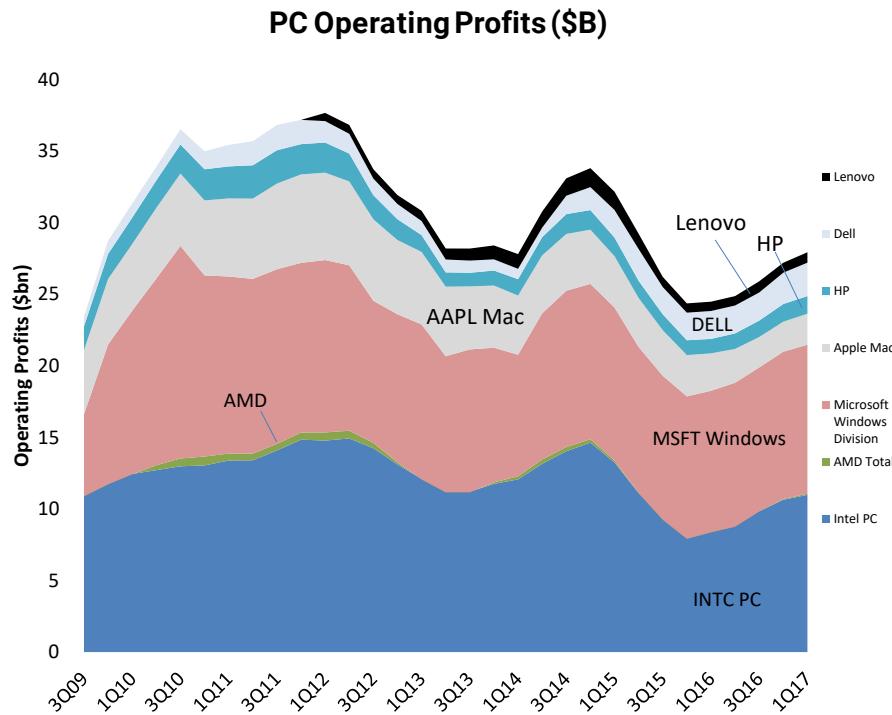
Cellphone / Server Operating Profits (% of Total)



Apple's iPhone emerges as the dominate platform of this computing model today, capturing the majority of profits as it owns all the critical components of the platform: the SoC (Apple's AX SoCs), operating system (iOS), system-level hardware (iPhone) and App Store

On the backend of the Datacenter, Intel and Microsoft account for about 20% of this computing models' industry profits

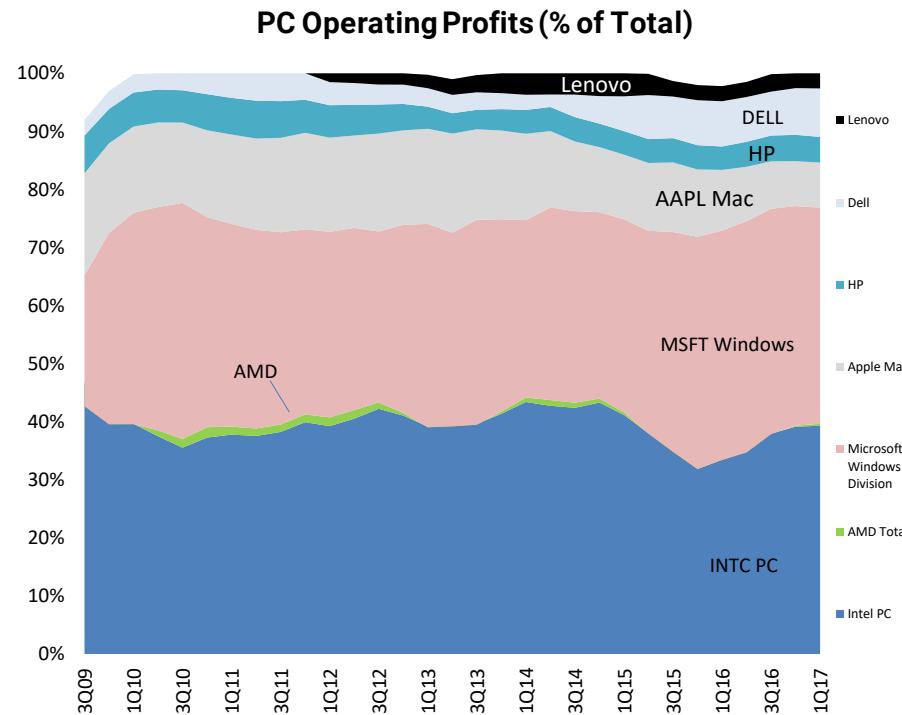
The 4th Tectonic Shift in Computing: To a Parallel Processing / IoT Model



In the PC computing era, IBM anointed Intel and Microsoft as the standards of their PC, and shared its architecture, which enabled the IBM PC clone industry, and exposed component and subsystem makers to global economies of scale

Intel and Microsoft largely define the PC platform (Wintel) and have captured the lion's share of the PC industry profits

Source: Jefferies, company data



PC OEMs capture the remaining 20% of the industry profits—only Apple, by virtue of developing its own OS (MacOS), capable of capturing an outsized portion relative to its size

The 4th Tectonic Shift in Computing: To a Parallel Processing / IoT Model

Parallel Processing Platform Map

Optimized Deep Learning Frameworks / Design Languages								
Apache Singa	Y						Y	
Caffe	Y			Y	Y	Y	Y	
Caffe2	Y			Under Development				
Deeplearning4j	Y						On Roadmap	
Dlib	Y						No	
Keras	Y						Under Development	
Microsoft Cognitive Toolkit CNTK	Y			Y			Y	
MXNet	Y			Y	Under Development		Y	
Neon				Y		Y		Y
OpenNN	Y						No	
Google TensorFlow	Y	Y	Y		Under Development		Y	
Theano	Y			Y			Y	
Torch	Y			Y			Y	
PLATFORM	Libraries / Primitives	Nvidia Deep Learning SDK (cuDNN...)	Google TPU Software Stack (API, Drivers...)	Intel MKL (MKL-DNN, DAAL...)	Xilinx reVISION, RAS (xfDNN, xfBLAS)		AMD MIOpen (OpenCL, HIP...)	Intel MKL (MKL-DNN, DAAL...)
	Native Languages / Drivers	CUDA	C++, CUDA	C++	OpenCL, C++ Vivado, SDAccel	OpenCL Quartas	ROCm (HCC, HIP, OpenCL, Python)	C++, Python
	Processor	Nvidia GPU	Google TPU	Intel Xeon Phi, Xeon	Xilinx "UltraScale" FPGA	Intel (Altera) "Arria 10" FPGA	AMD GPU	Intel Nervana "Lake Crest"

Source: Jefferies

Analog Renaissance 2.0 — Semis You Can Own Through the Next 4 Cycles

Analog Renaissance 2.0 — Semis You Can Own Through the Next 4 Cycles : Summary

- We have updated our Analog Renaissance Report from 2017. Four takes: 1) Consolidation is better and faster than we thought, 2) Big get bigger, rich get richer, 3) Expect more M&A, 4) Our 3-to-5-yr EPS Bull case is 50%/100% above CY19 consensus. We think the drivers are 15-yr secular ones (Consolidation + Tectonic Shift to IoT), and that TXN and ADI are ownable through the next 4 cycles. ON is our top mid-cap play..

- Many have Semiconductor Scars, but Evidence Compelling that Analog is Changing...

FCF/share for our analog group took a hit during the financial crisis, but stayed positive throughout. Furthermore, it largely increased monotonically through the 2015 and 2018 inventory corrections, and in 2018, was at the highest levels ever. Capital return per share has grown with FCF, FCF margins are expanding and fixed costs are easing. EBIT margins for our analog sample set have risen by 1,000 bps over the past five years and remain near all-time highs, despite the inventory correction.

- Two Secular Trends Driving the Change

We think there are two main secular drivers for analog companies that will remain in play for the next 10 years: 1) Consolidation - which is not only driving pricing power, but also leverage on OpEx; 2) Richer Product Mix - Our "4th Tectonic Shift in Computing" framework shows that growth in computing is shifting away from a highly concentrated handset and PC customer base with massive pricing power, to a set of highly fragmented IoT customers (Industrial, Auto, IoT) with low pricing power..

- Four Updates to our Original Analog Renaissance Report

1) Consolidation is Better Than We Thought. In this report we look at segment HHI vs aggregate. Through this lens, the industry looks more concentrated, and is consolidating faster than we originally thought.

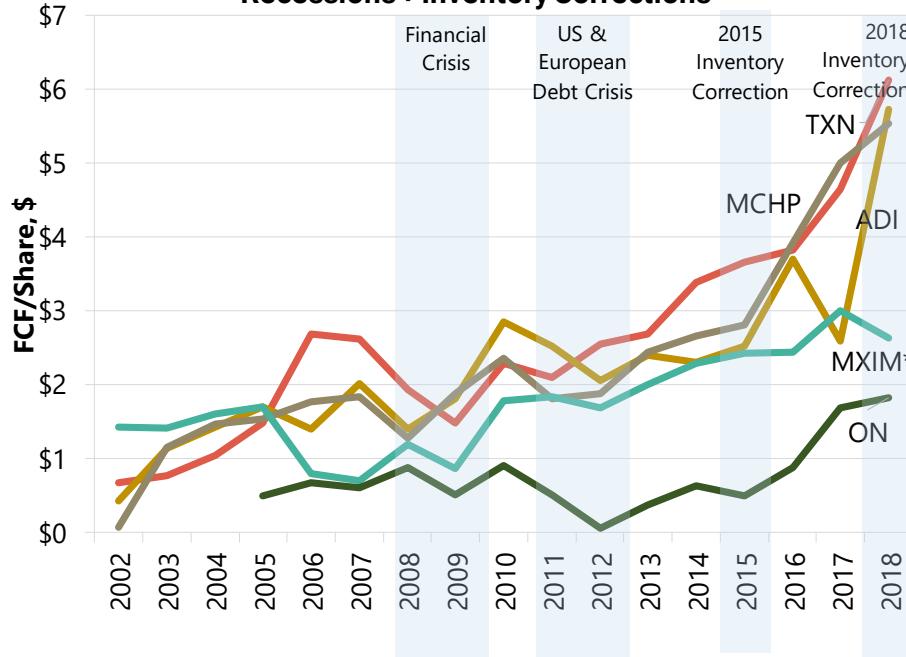
2) Big Get Bigger - Rich Get Richer. We show that over the past five years, the analog companies with the largest revenues, market share and composite HHI also had the highest share gain and largest positive change in operating margin. We view TXN and ADI as the best ideas on this theme. Our 3-yr EPS bull-case for ADI and TXN is \$8.47 and \$8.09, 60% above CY19 consensus.

3) Expect More M&A. We estimate there are still over 100 analog companies that account for over 50% of the analog market. Our updated M&A framework suggests that MTSI, SLAB, SMTA, LSCC, POWI, VICR, CRUS, DLG are potentially attractive targets.

4) EPS Sensitivity Analysis 50-100% EPS Upside over 3-5 years... for our larger-cap analog companies - We think TXN and ON have the best chance to hit our bull case based on the high percentage of their manufacturing that they do in-house, which should allow for lower cost structure and better fixed-cost absorption. In TXN's case, we also think it benefits from scale (see #2 above).

Analog Renaissance 2.0 — Semis You Can Own Through the Next 4 Cycles

Impressive FCF/share Growth For Analog Companies Even During Recessions + Inventory Corrections

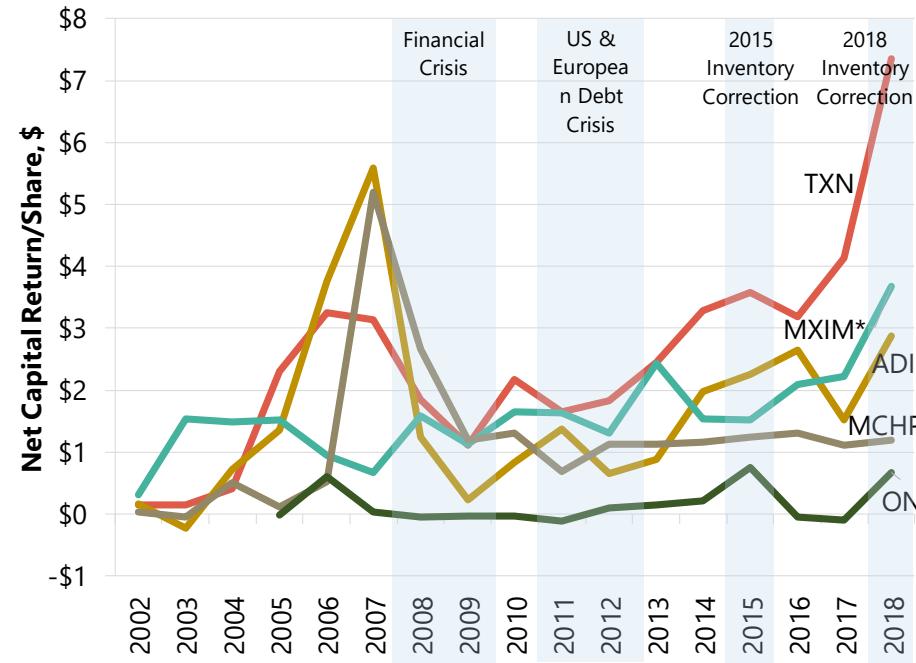


We plot Free Cash Flow per share for our sample of analog companies. Note that FCF/share took a hit during the financial crisis, but stayed positive throughout.

During the US and European debt crises, FCF/share declined slightly, but by and large not as much as during the financial crisis. FCF/share largely increased monotonically through the 2015 and 2018 inventory corrections, and for 2018, are at the highest levels ever, despite two quarters of downward revisions in 2H18

Source: Jefferies, FactSet and company data

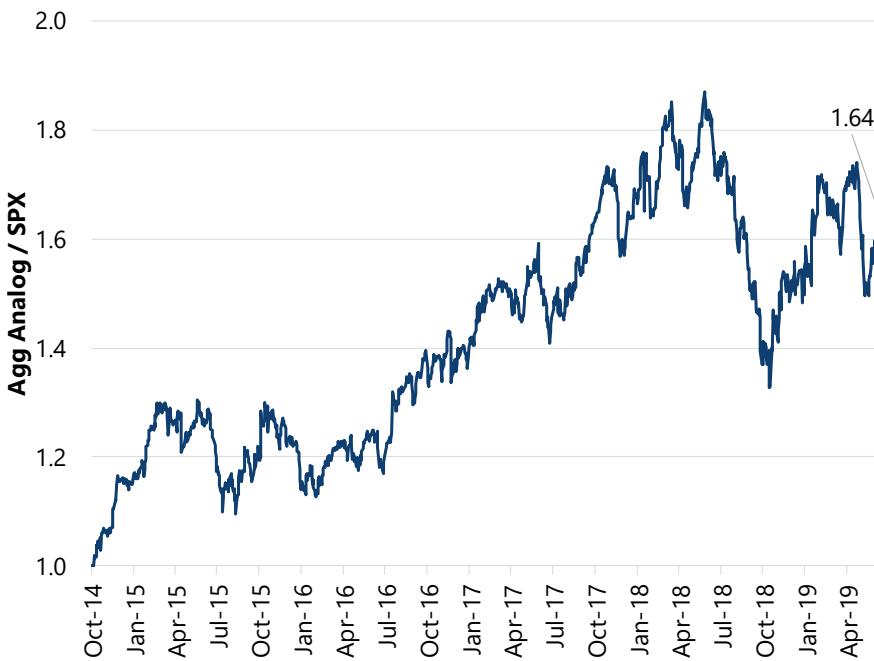
Net Capital Return per Share



Capital return per share has grown with FCF, and many have a policy to return 100% of it to shareholders - shareholders get 100% of the earnings

Analog Renaissance 2.0 — Semis You Can Own Through the Next 4 Cycles

Analog Stocks vs SPX Since 2015 Inventory Correction

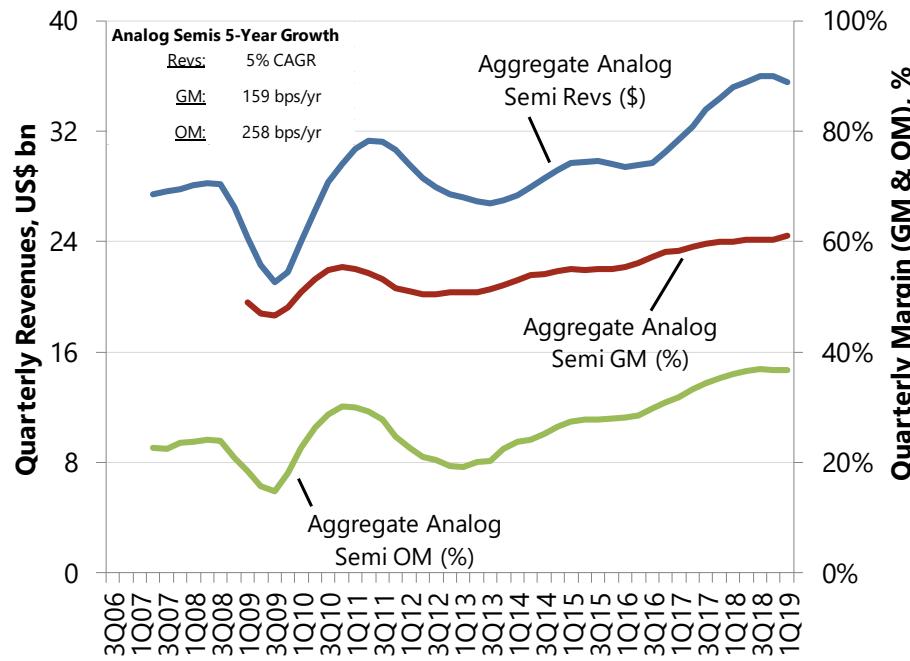


Source: Jefferies, FactSet. Composite includes: TXN, ADI, MCHP, MXIM, ON, indexed to 10-Oct-14, beginning of the 2015 inventory correction

Our index of analog companies has outperformed the S&P 500 since the 2015 inventory corrections

Source: Jefferies, FactSet and company data

Analog Semi Gross and Operating Margin (TTM)

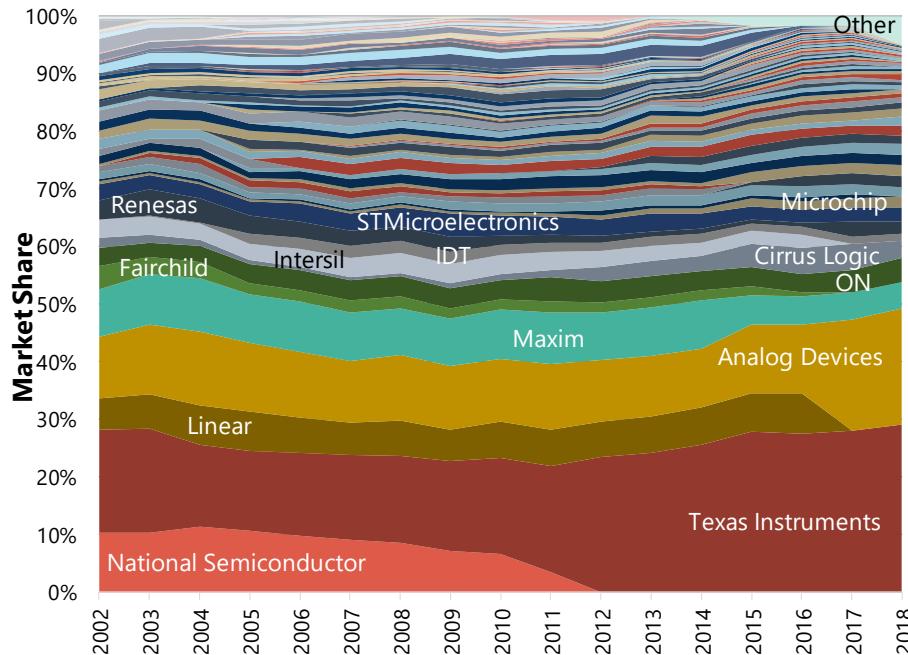


Source: Jefferies, company data, FactSet. Analog sample includes TXN+NSM, MXIM, ON+FCS, MCHP+ATML+MSCC, ADI+LLTC.

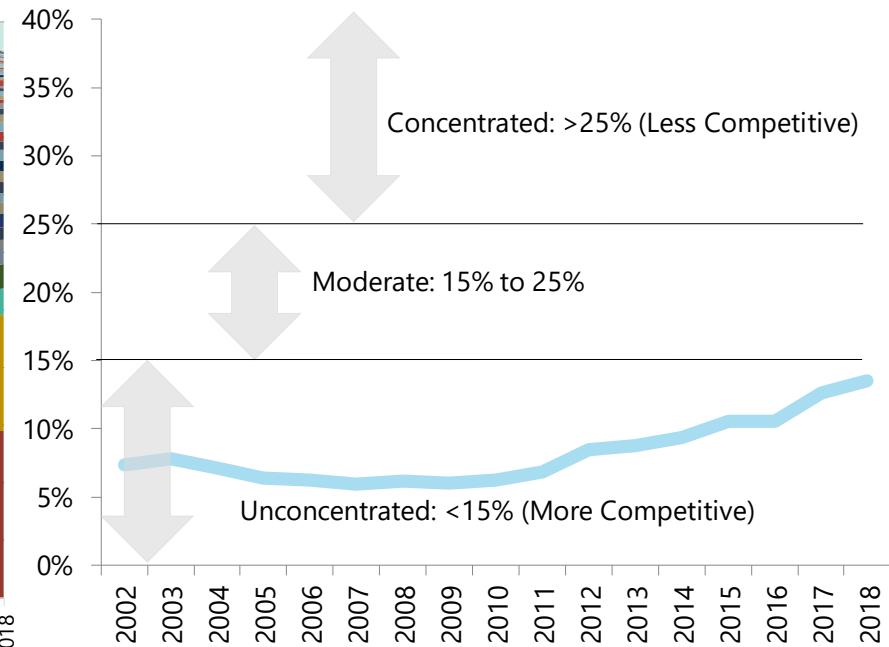
Over the past 5 years, aggregate gross and operating margins for our sample of companies increased by 8% and 13%, or by 159bps/yr and 258bps/yr. During that period, revenue growth for the group has been 30% or 5% CAGR

Analog Renaissance 2.0 — Semis You Can Own Through the Next 4 Cycles

Total Analog Market Share



Total Analog Herfindahl Index



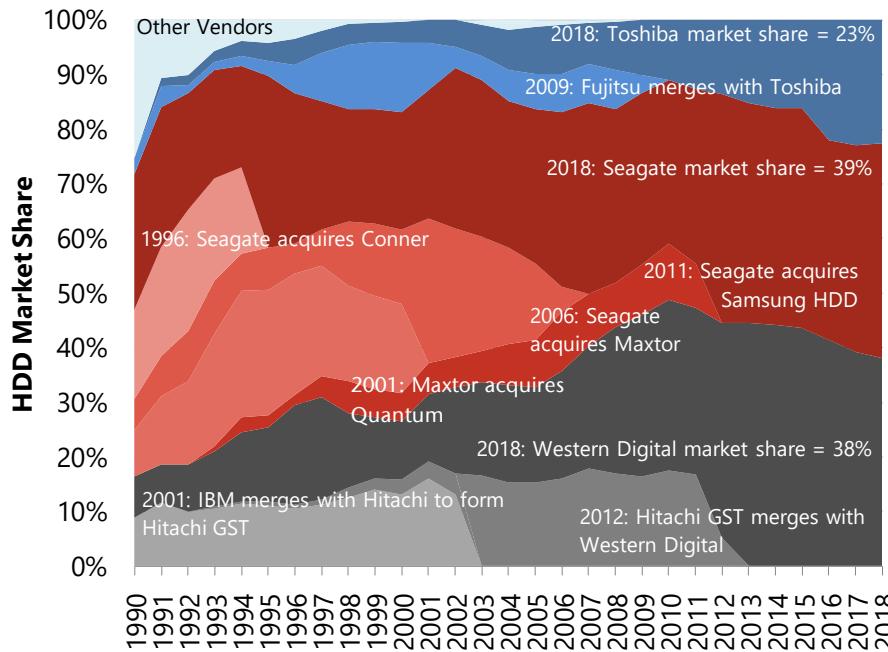
The total Analog market has 2 players with dominant market share (TXN, ADI) accounting for 49% of the market, with the 3rd place accounting only for 5% of the market

The Total Analog market HHI index has increased steadily with consolidation over the past 10 years, but is still in the "Unconcentrated Zone," suggesting more room for consolidation

Source: Jefferies, Gartner. Analog market share calculated based upon revenue. The Herfindahl Index is calculated by summing the squares of the market shares of top 50 industry participants

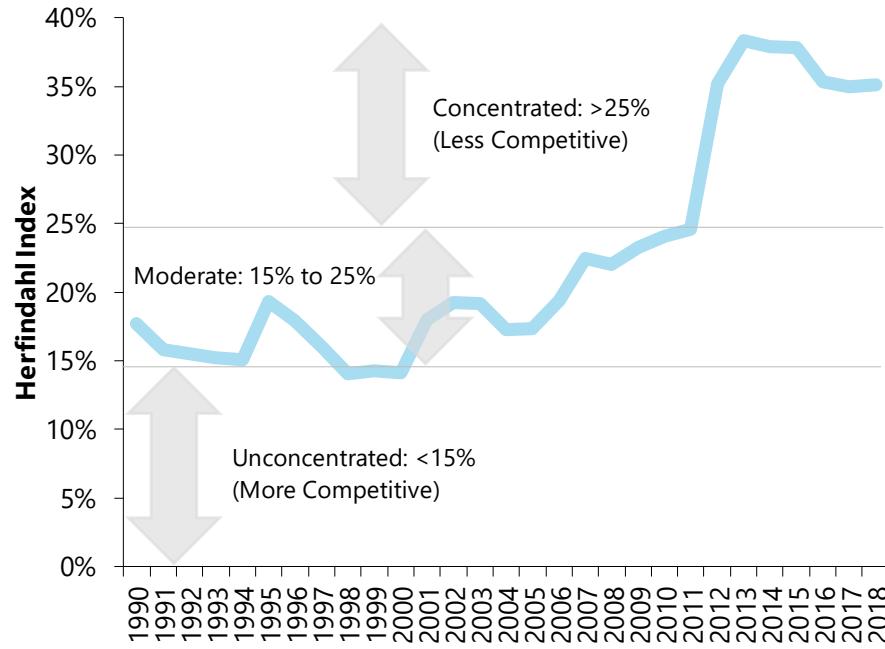
Analog Renaissance — This happened with HDDs

HDD Market Share Over Time



The HDD industry has consolidated from over a dozen companies 25 years ago, to three main competitors

HDD Herfindahl Index

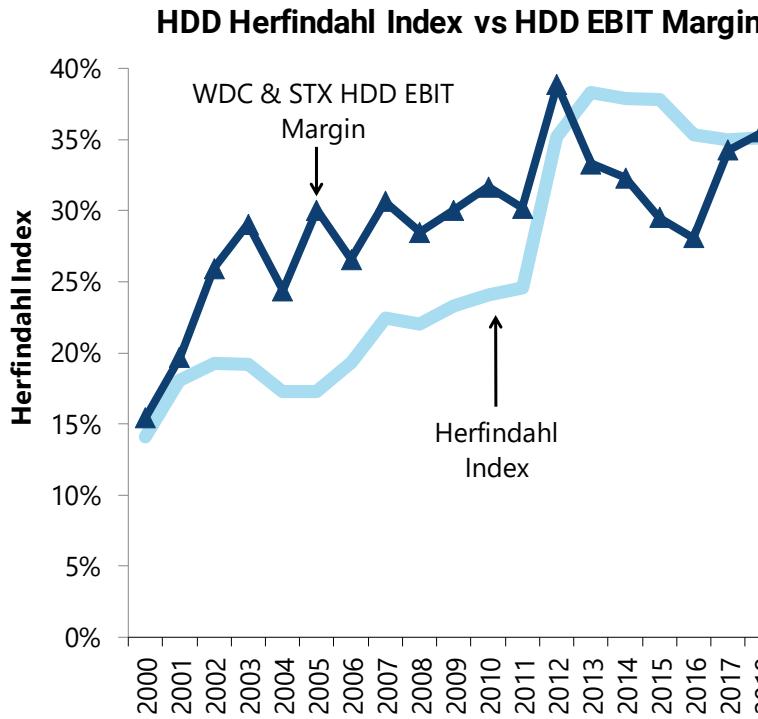


The Herfindahl Index inflected into the Concentrated tier in 2013 and has remained above 35% since

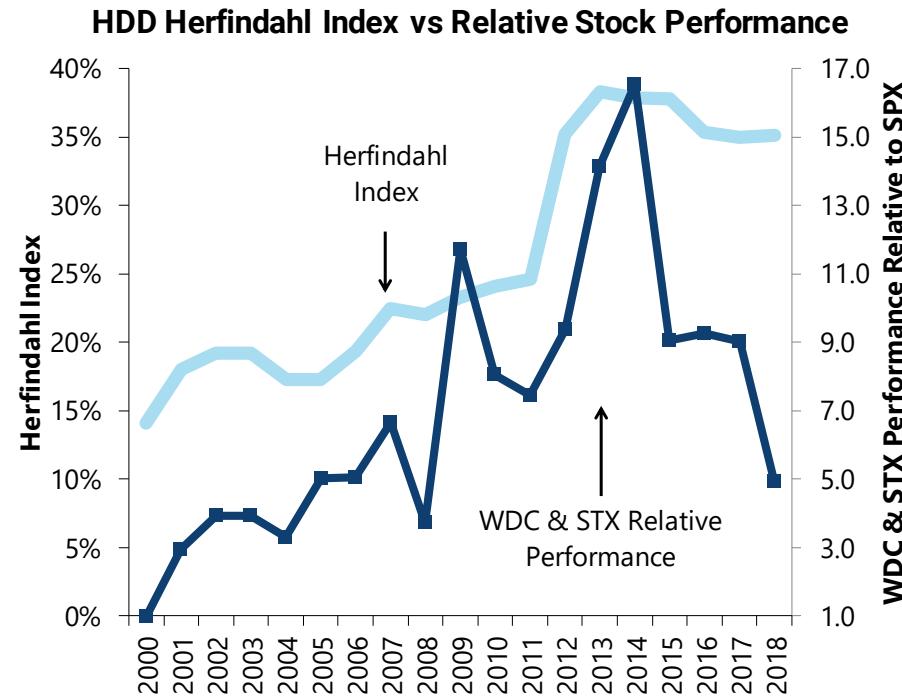
More recently, the HHI declined as Toshiba regained share

Source: Jefferies, Gartner, FactSet.

Analog Renaissance — This happened with HDDs



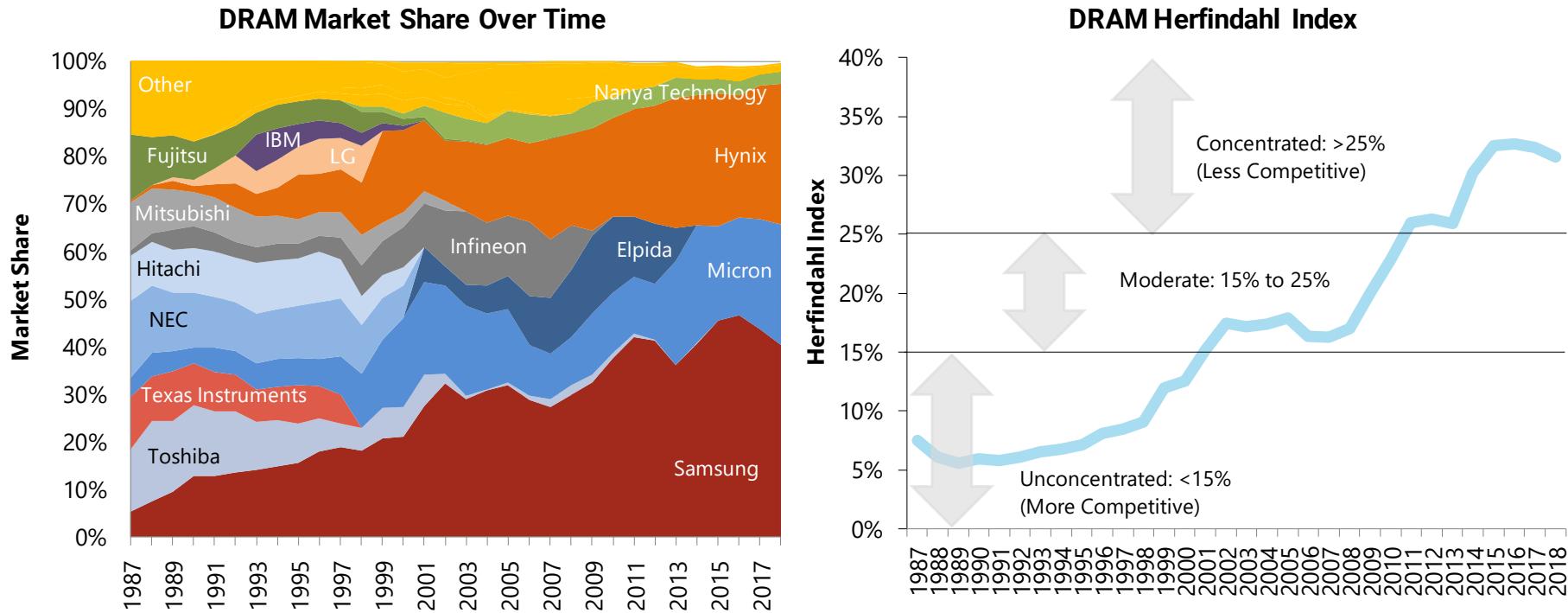
Profitability of WDC and STX improved as the industry consolidated, and then declined as Toshiba regained share



WDC and STX stock prices also improved with the increasing HDD Herfindahl Index, and then declined as Toshiba regained share

Source: Jefferies, Gartner, FactSet. HDD EBIT % is average of STX and WDC. HDD relative performance is composite of STX and WDC relative SPX

Analog Renaissance — This happened with DRAM



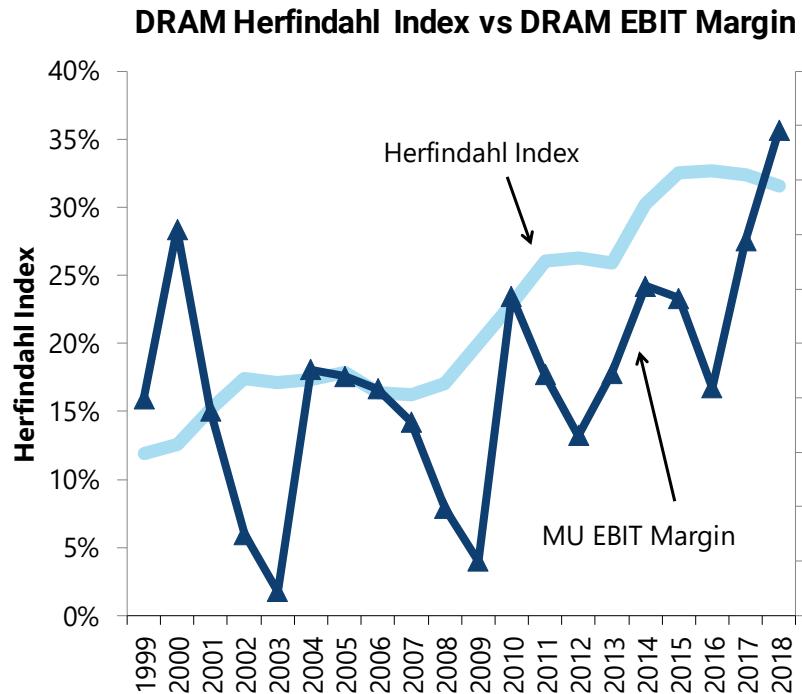
The DRAM industry has consolidated from 24 companies in 1987 to 3 major competitors with 95% of the market in 2018

The DRAM HHI has increased dramatically between 2008 and 2017 and remained above 30% since 2014, well into the "Concentrated" industry category

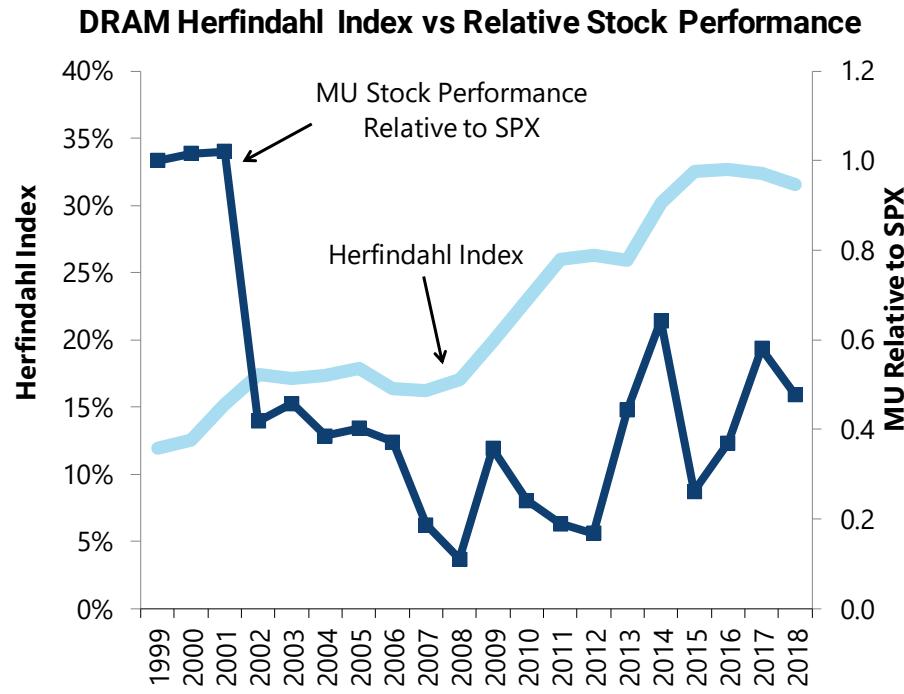
This suggests to us that the recent positive inflection in MU fundamentals are much more secular, rather than cyclical in nature

Source: Jefferies, Gartner. * DRAM market share calculated based upon revenue.

Analog Renaissance — This happened with DRAM



We look at MU EBIT margin as a proxy for the DRAM space given it is the only pure play DRAM company. The EBIT margin has increased with the Herfindahl Index, even if with a degree of volatility



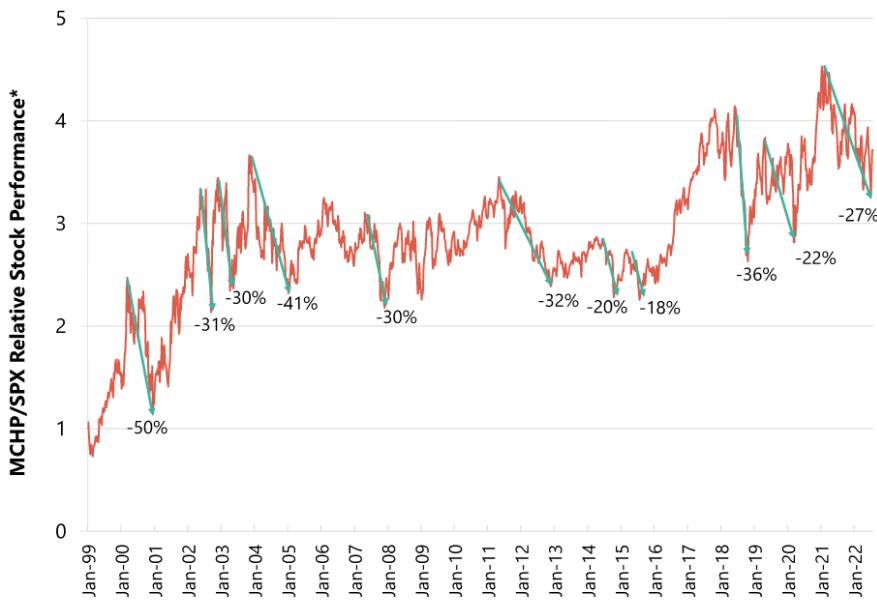
Pricing in DRAM has also improved as the industry has become more concentrated

Source: Jefferies, Gartner, FactSet. Relative performance is indexed to December 31, 1999

MCHP: De-Leverage and Cap Return Thesis Playing Out

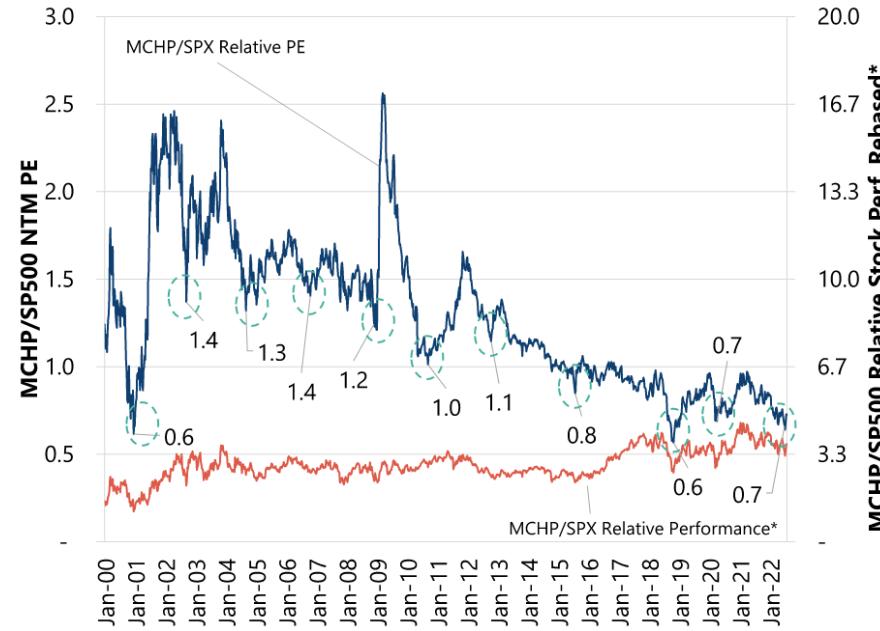
MCHP: MCHP Underperformed SPX By 27%, vs 22% and 36% In the Past 2 Cycles

MCHP/SPX Relative Stock Performance



MCHP has underperformed SPX by 27% over 510 days during this cycle vs 22% and 36% in the past 2 cycles during 314 and 147 days, respectively

MCHP/SPX Relative PE Multiple



MCHP is trading at a NTM P/E ratio of 12x, or 0.7x relative to the SPX. MCHP bottomed at a relative P/E ratio of 0.6x vs the SPX during the 2018-19 inventory correction, when its net leverage ratio was between 4x and 5x. It is currently at a relative P/E ratio of 0.7x with a net leverage ratio of 2.3x

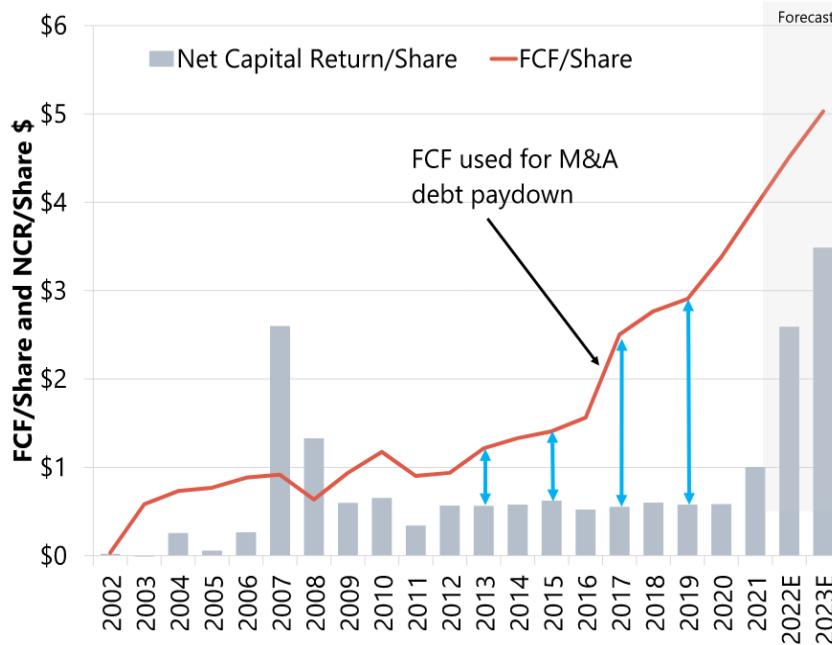
Post the Internet bubble bust in 2001, MCHP bottomed at a relative P/E ratio of 0.6x post the Internet bubble bust in 2001, at 1.2x the SPX during the World Financial Crisis, and at 1.0x the SPX during the European and US debt crises

Source: Jefferies, FactSet, company data; *Relative share price rebased to Jan-1999

Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

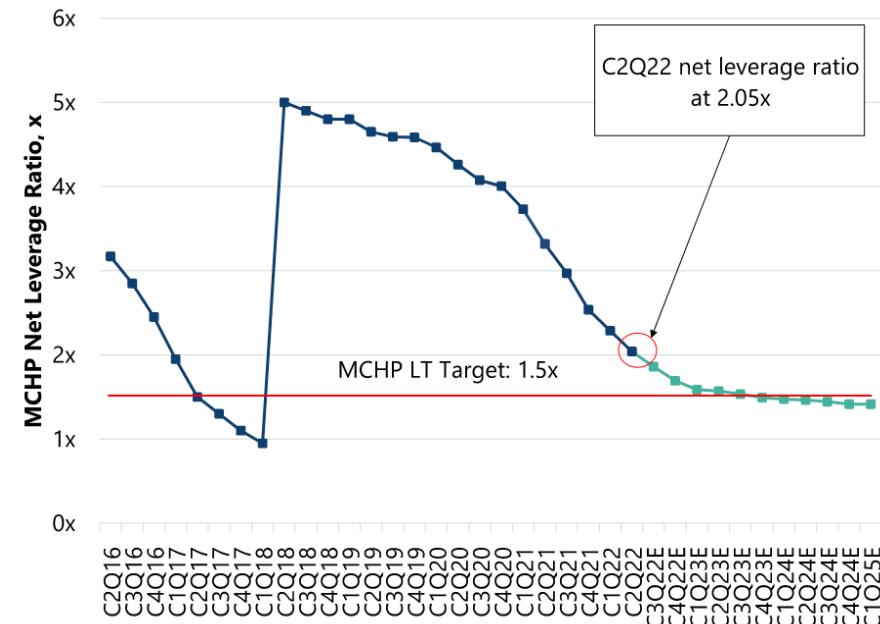
MCHP: De-Leverage and Cap Return Thesis

MCHP FCF/Share and Net Capital Return/Share



We model MCHP FCF/shr reaching \$4.51/shr in C2022 and \$5.03/shr in C2023.

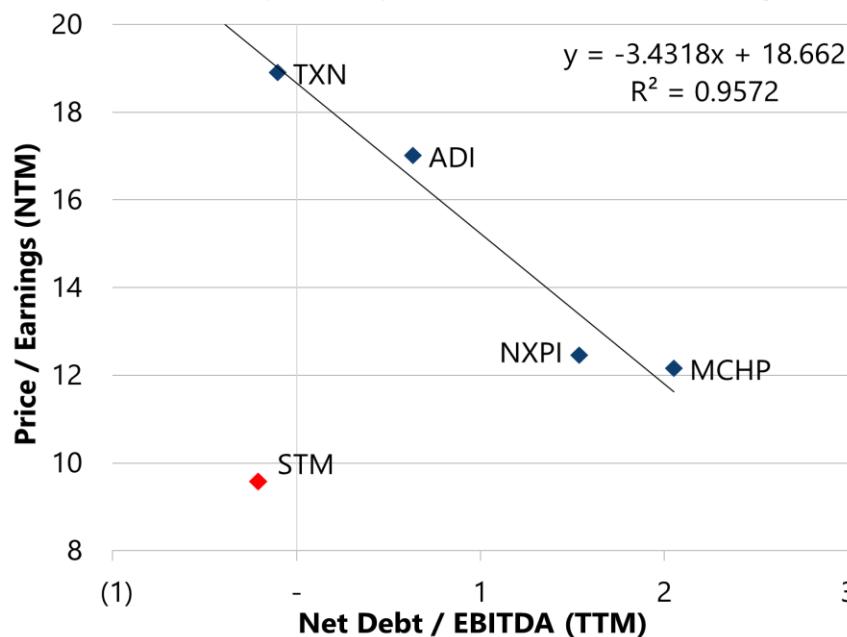
MCHP Has Reached Sub-3x Leverage Ratio



MCHP's net leverage ratio has declined from 5x to 2.05x over the past 4 years, and it received investment-grade credit ratings in Nov-21. We now model MCHP reaching a leverage ratio of 1.5x in C2023E.

MCHP: De-Leverage and Cap Return Thesis

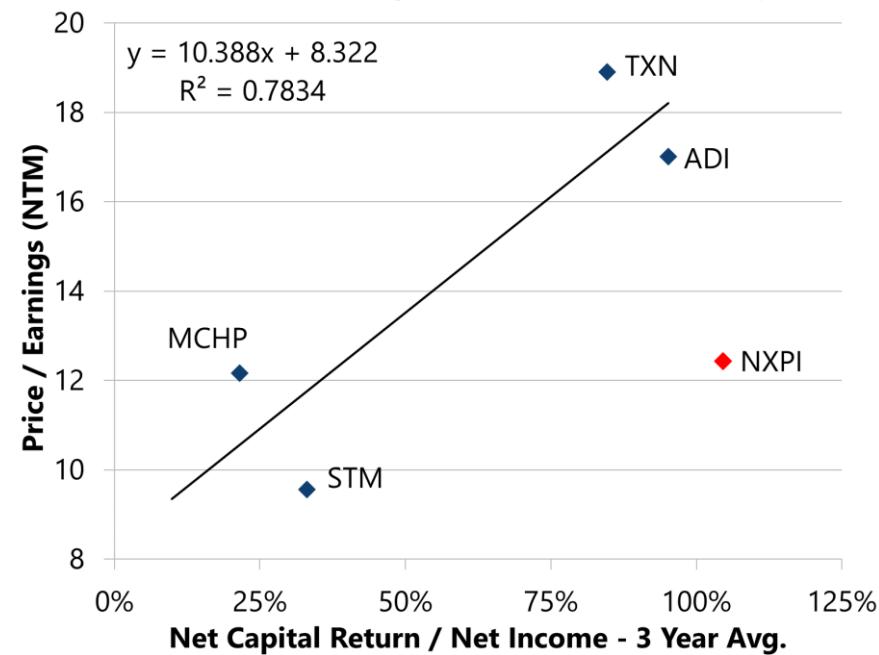
MCHP Decreasing Leverage Below 3x Would Aid P/E Expansion



Source: Jefferies, Factset, company data. Using latest reported Net Leverage and TTM EBITDA.

Broad-based large-cap semi P/E ratios are inversely correlated with leverage ratios (R-squared 96%). MCHP is targeting a 1.5x leverage in the long run

MCHP's Increased Capital Return To Drive P/E Higher



Source: Jefferies, company data, FactSet. Net Capital Return is dividend plus share buyback minus cash from share/options issuance. 3yr Avg for 2019-2021.

Broad-based analog semi P/E ratios are correlated with the capital return, measured by NCR/Net Income (R-squared 78%)

MCHP is targeting a capital return at 100% of FCF in the long run.

ADI: Capital Return Thesis Playing Out

ADI: 2027 EPS Power

At its Analyst Day in April, ADI articulated a new target operating model with a F27 earnings power of \$15, but tweaking its GM target to "70% Floor" from "70%+" suggesting that it would favor higher revenue growth at the expense of higher GMs.

We estimate a bull-case EPS earnings power of \$18, based on GM of 74%, Op Margins >50%, and 11% revenue CAGR.

We Model 2027E Base Case EPS Power of \$15 And Bull Case of \$18

	FY17 Model	New Model (Base Case)	Bull Case F'27 (Jefferies)
Revs growth	High-single-digit	7-10% CAGR F22-F27	11% CAGR F22-F27
Adj. GM	70%+	70% floor	74%
Adj. OpM	39-45%	42-50%	51-54%
FCF Margin	34-42%	34-40%	36%-42%
FCF Return	80-100% after debt reduction	100%	100%
Capex as % of revs	4%	4-6%	4-6%
EPS	\$9.41		
EPS Power (JEFF est)		\$15.04	\$18.00

Source: FactSet, Jefferies Research

Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

ADI: Capital Return Thesis Playing Out

Our Bull Case ADI+MXIM 2024 EPS Power is \$12.12, and assumes:

1. ADI's acquisition of MXIM is approved and closes in summer of 2021
2. ADI achieves \$420m of cost synergies (15% of MXIM 2021 sales) by 2024 (3.5 yrs)
3. Revenue synergies in 2024 at 5% of MXIM sales
4. Excess cash is used to repurchase stock. We assume all excess cash beyond \$1.5bn in cash on the b/sheet is used to repurchase stock.

ADI EPS Table – Bull Case

Non - GAAP metrics	2022E ADI+MXIM	2022E MXIM	2022E Synergies	2022E ADI+MXIM	2023E Synergies	2023E ADI+MXIM	2024E Synergies	2024E ADI+MXIM
Rev	12,393	2,965		15,358		16,433	140	17,723
Gross Income	9,182	2,017	105	11,304	53	12,148	53	13,155
GM%	74.1%	68.0%		73.6%		73.9%		74.2%
OpEx	2,964	785	(105)	3,644	(53)	3,832	(53)	4,009
Opex %	24%	26%		24%		23%		23%
EBIT	6,218	1,232	210	7,660	105	8,317	105	9,145
EBIT Margin	50.2%	41.6%		49.9%		50.6%		51.6%
Tax rate %	13%	13%	13%	13%	13%	13%	13%	13%
Net Income	5,233	1,046	183	6,484	91	7,055	91	7,776
Shares Outstanding (Year End)	520	277	168	663	0	649	0	634
Cash Available For Capital Return				8,163		6,807		7,503
Dividends				2,015		2,190		2,374
Cash Available For Share Repurchases				6,148		4,617		5,128
EPS	10.07	3.78		9.60		10.76		12.12

ADI EPS Table – Base Case

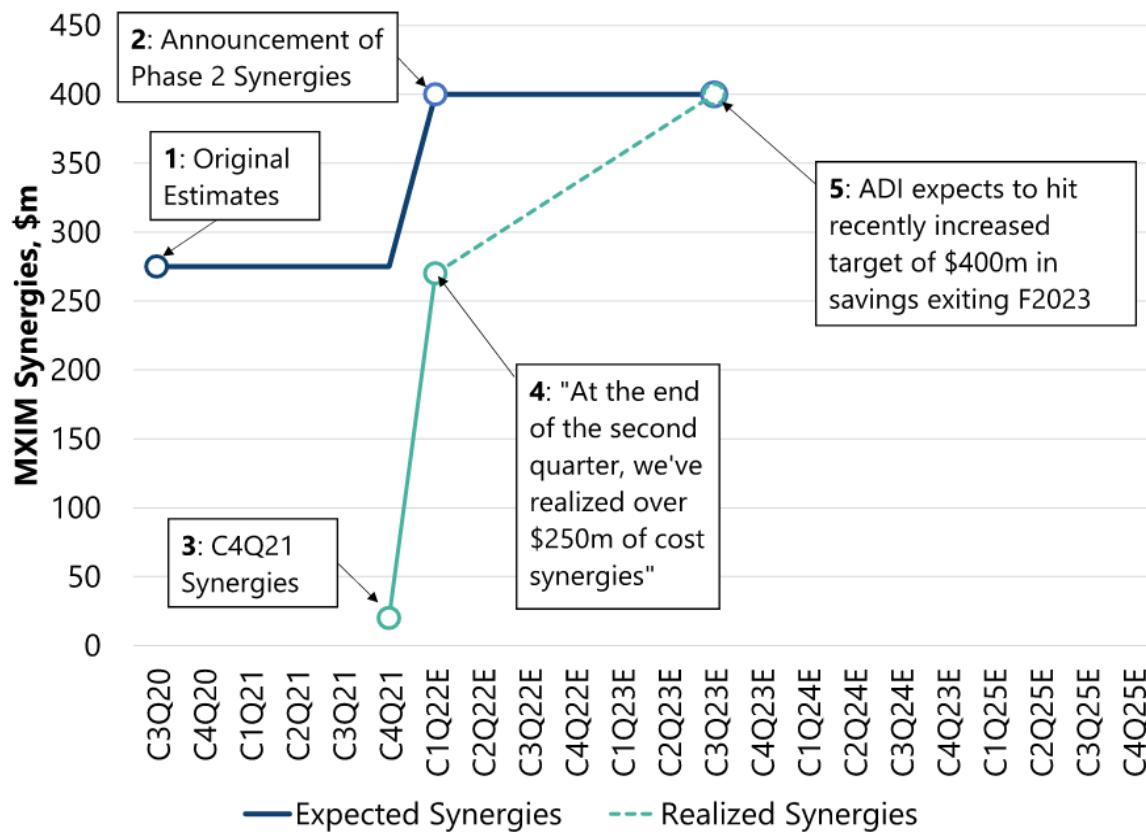
Non - GAAP metrics	2022E ADI+MXIM	2022E MXIM	2022E Synergies	2022E ADI+MXIM	2023E Synergies	2023E ADI+MXIM	2024E Synergies	2024E ADI+MXIM
Rev	12,393	2,965		15,358		16,433	0	17,583
Gross Income	9,182	2,017	105	11,304	53	12,148	53	13,051
GM%	74.1%	68.0%		73.6%		73.9%		74.2%
OpEx	2,964	785	(105)	3,644	(53)	3,832	(53)	3,977
Opex %	24%	26%		24%		23%		23%
EBIT	6,218	1,232	210	7,660	105	8,317	105	9,074
EBIT Margin	50.2%	41.6%		49.9%		50.6%		51.6%
Tax rate %	13%	13%	13%	13%	13%	13%	13%	13%
Net Income	5,233	1,046	183	6,484	91	7,055	91	7,714
Shares Outstanding (Year End)	520	277	168	663	0	649	0	634
Cash Available For Capital Return				8,163		6,807		7,443
Dividends				2,015		2,190		2,374
Cash Available For Share Repurchases				6,148		4,617		5,068
EPS	10.07	3.78		9.60		10.76		12.03

Source: Jefferies, FactSet, company data. Based on our analysis as of August 18th, prior to deal closing on august 26th

ADI: MXIM Case Study

ADI noted that at the end of AprQ, it realized over \$250m of cost synergies and has captured the entire \$275m of original synergies exiting AprQ. ADI now expects to achieve the remaining synergies of a total of \$400m exiting F2023.

ADI+MXIM M&A, Estimated, Realized and Forecasted Cost Synergies Over Time

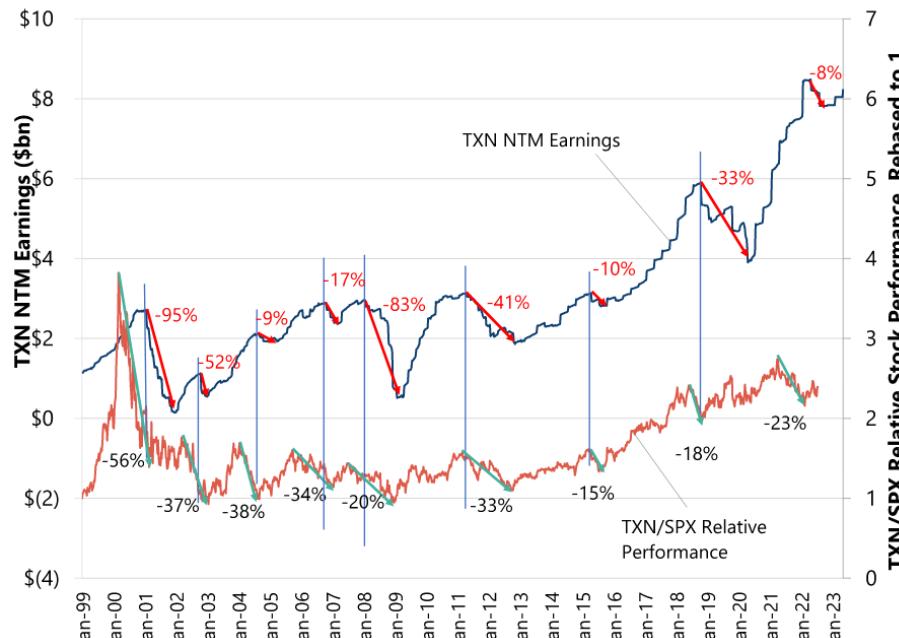




TXN

TXN Underperformed Peak-to-trough Over 322 Days This Cycle

TXN NTM Earnings vs TXN/SPX Relative Performance



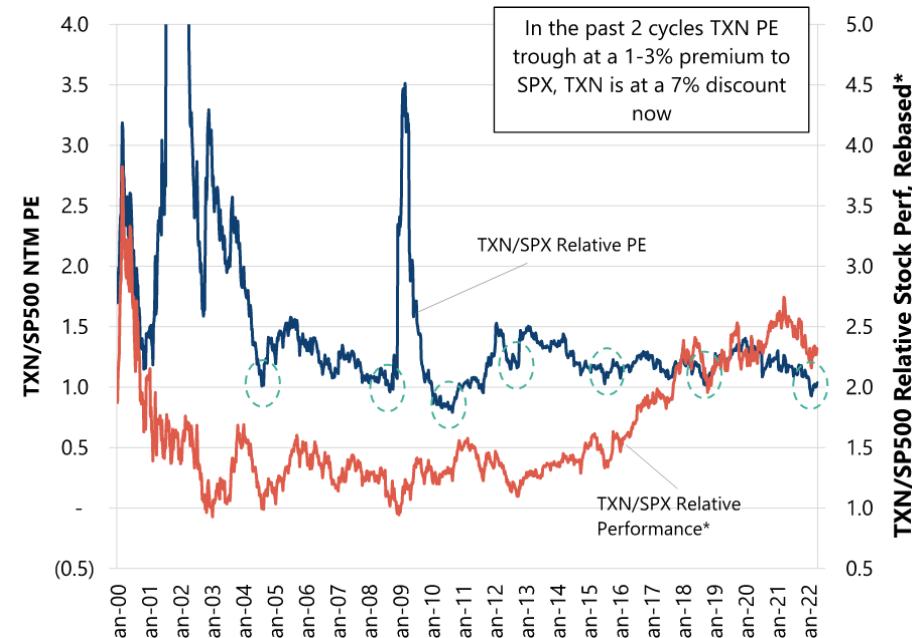
TXN underperformed the SPX peak-to-trough by 23% over 322 days this cycle, vs underperforming by 15% and 18% over 147 days the previous two cycles

We are modeling a rev decline of 13% QQ in 4Q22E to account for a potential inventory correction and lowering our GM estimates to better reflect depreciation increases from 2022 through 2025.

Our model forecasts NTM earnings estimates to decline by 8% in 2022.

TXN bottomed with-or shortly-after estimate cuts started in 4 of the past 8 cycles.

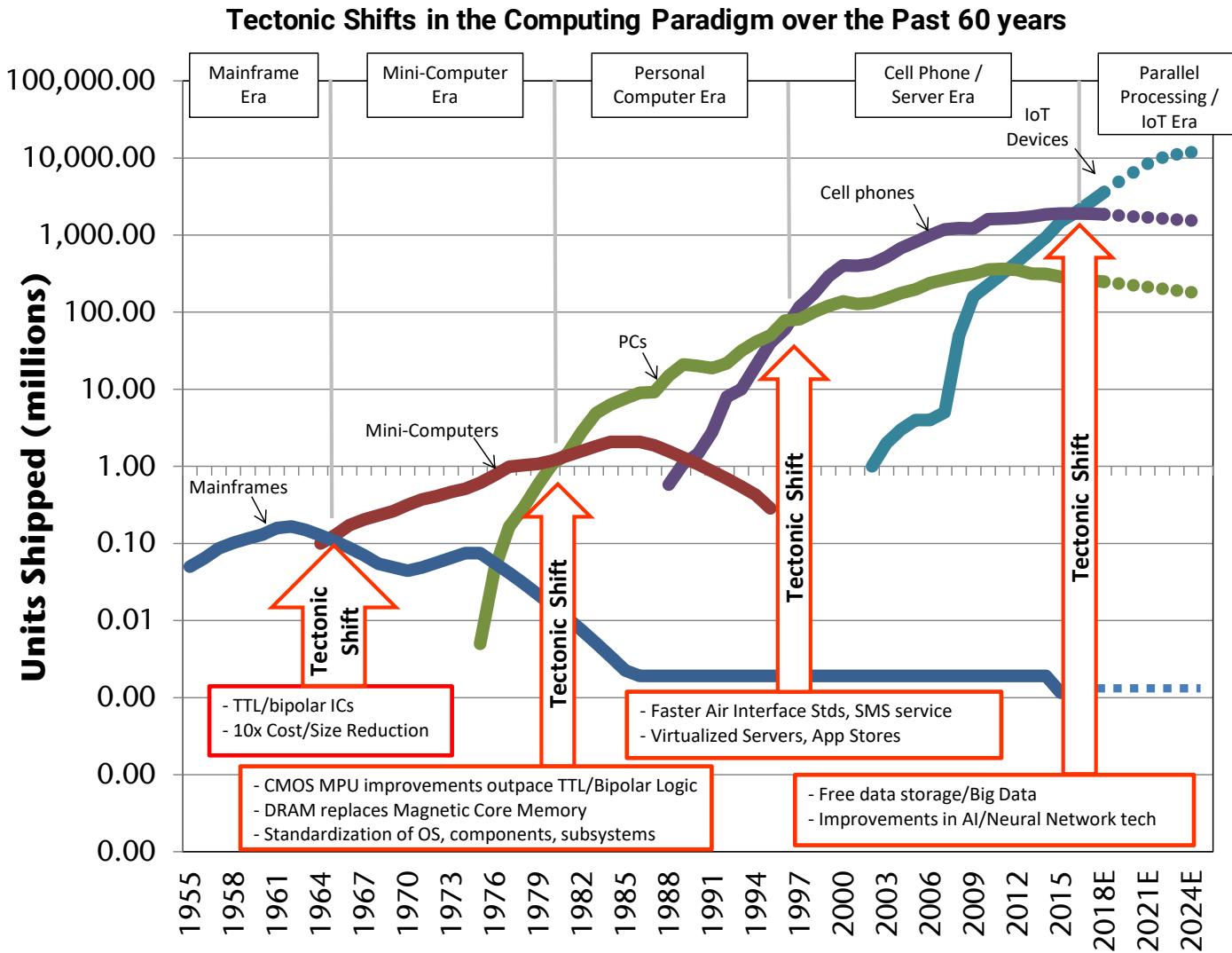
TXN/SPX Relative PE Multiple



Except for 2010, TXN's P/E historically troughed at the P/E of the SPX.

TXN's P/E recently dipped below the SPX, but is now at the SPX.

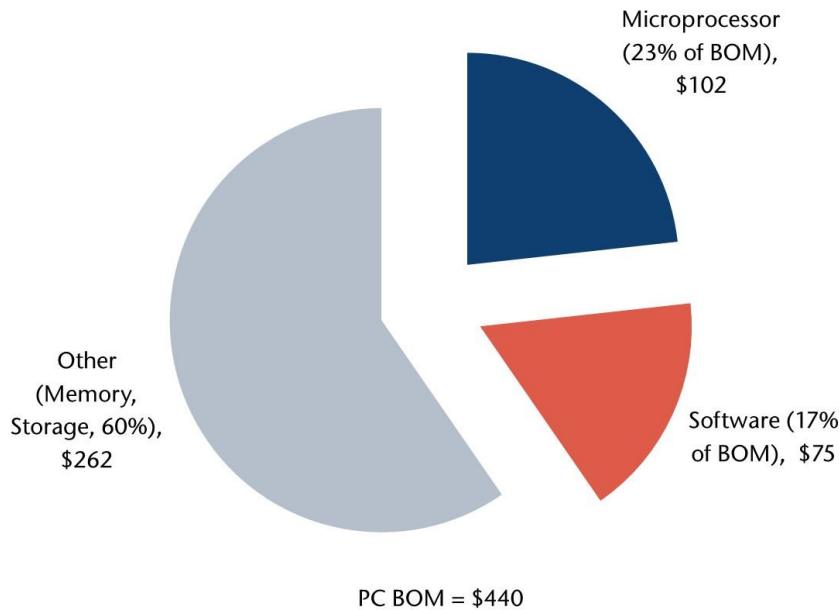
TXN: Expect Secular MCU+Analog Demand During IoT/Parallel Processing Era



Source: Jefferies Equity Research, Mainframe computer data sourced from IBM Company Filings, "The Early Computer Industry: Limitations of Scale and Scope", A. Gandy; Minicomputer "History of Computer Communications" J. Pelkey; Personal Computer data sourced from "Total Share: Personal Computer Market Share 1975-2010", J. Reimer, Gartner; Mobile devices sourced from Counterpoint Research, Canalys Research, "Smartphones" Research Report, M. Ilyas, S. Ahson; IoT devices sourced from Gartner.

TXN: PC BOM Plays and Performance During PC Era

Critical Components of PC BOM

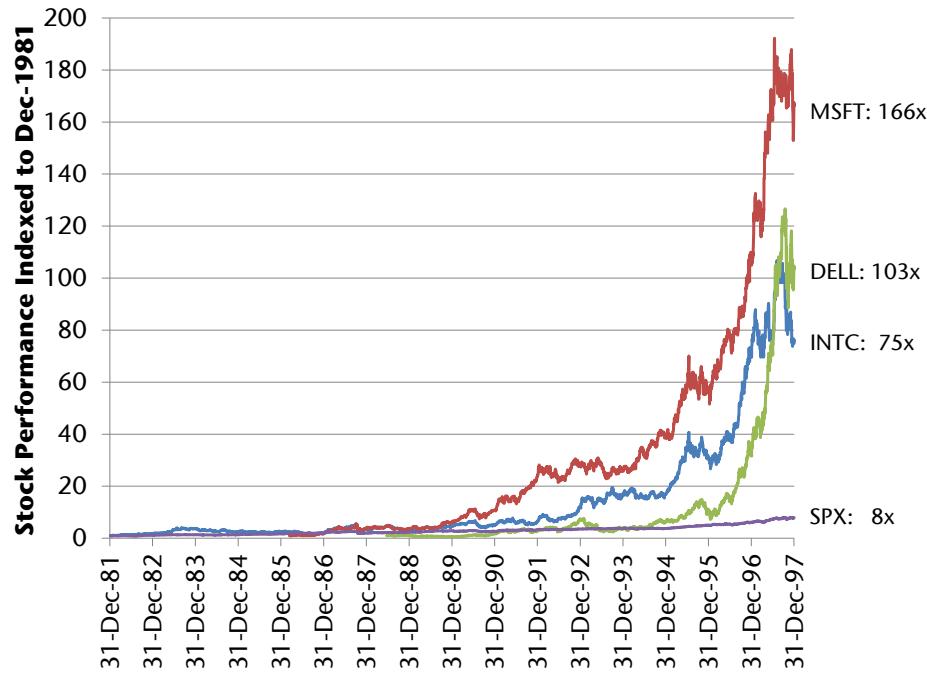


INTC and MSFT have been critical suppliers of components into the PC "Bill of Materials" or BOM, during the PC Era.
INTC's IPO was in 1971, MSFT's was in 1986

INTC supplies MPUs into PC, which can account for 20-25% of the total Bill-of-Materials of the PC

MSFT supplies software into the PC that can account for 15-20% of the PC BOM

Stock Performance of PC BOM Plays During PC Era (1981-1997)

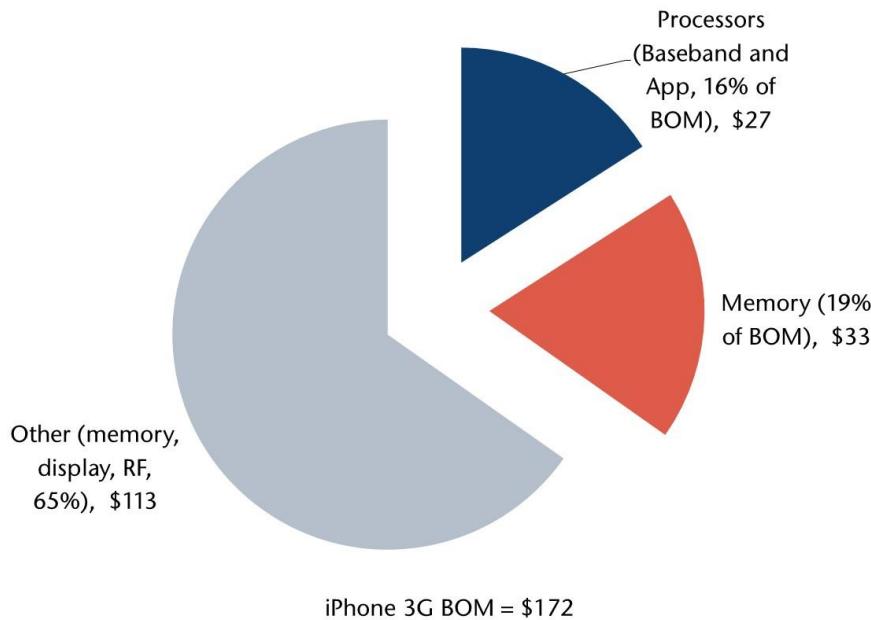


During the PC Era, as defined by unit shipments from the left chart, we estimate that MSFT stock appreciated by 166x, and INTC appreciated by 75x, both of which compare favorably to the SPX which appreciated by 8x

Source: Jefferies, ZDNet, FactSet

TXN: Cellphone BOM Plays and Performance During Cellphone Era

Critical Components of Cellphone BOM

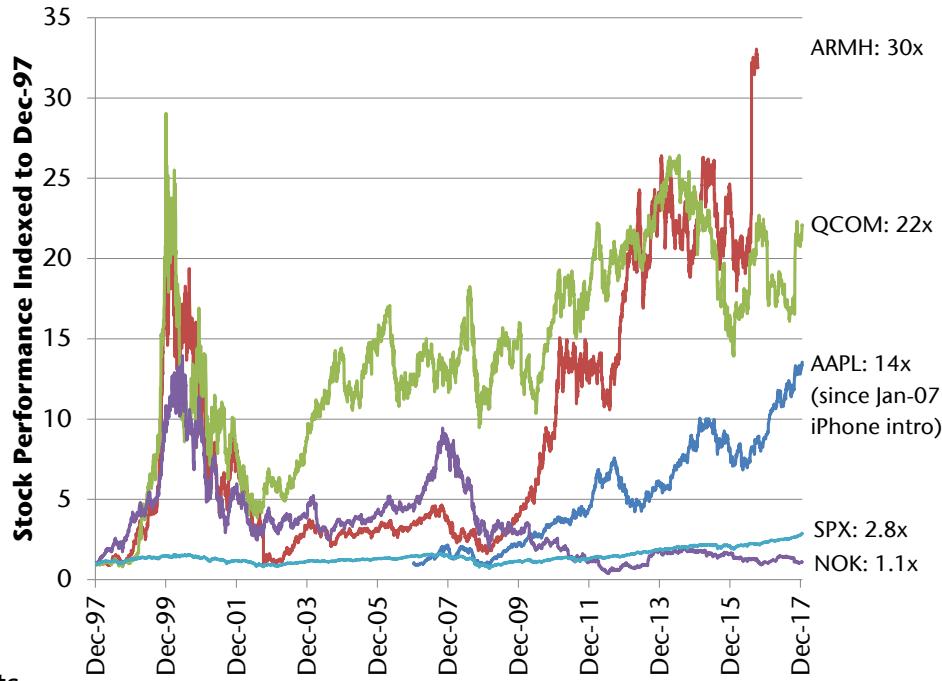


QCOM and ARMH have been critical suppliers of components into the cell phone. QCOM and ARMH went public in 1991 and 1998, respectively

QCOM supplies application and baseband processors into the cellphone, and both ARMH and QCOM have supplied critical IP that go into those cell phone processors

We estimate that their combined content can account for 15-20% of the BOM of a cell phone

Stock Performance of PC BOM Plays During PC Era (1981-1997)

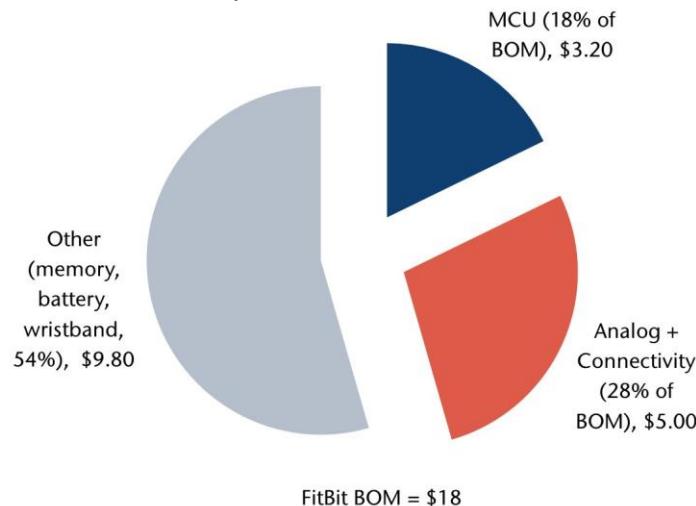


During the Cell Phone / Datacenter Era, we estimate that ARMH stock appreciated by 30x, and QCOM appreciated by 22, both of which compare favorably to the SPX which appreciated by 2.8x

Source: Jefferies, IHS, FactSet

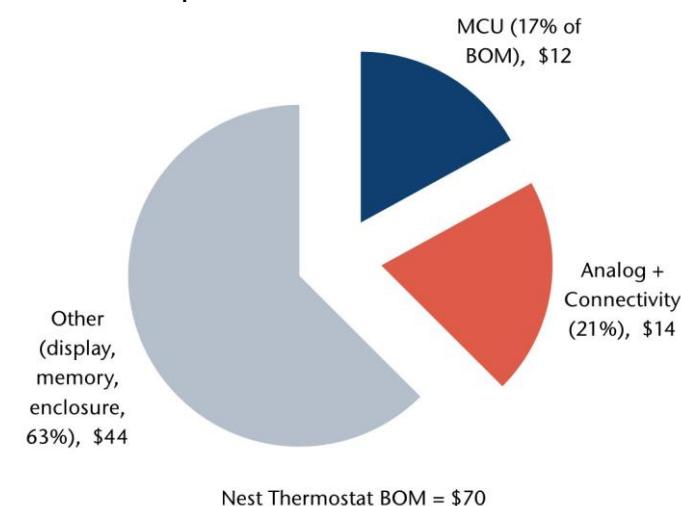
TXN: Critical Components of the IoT BOM

Critical Components of FitBit BOM



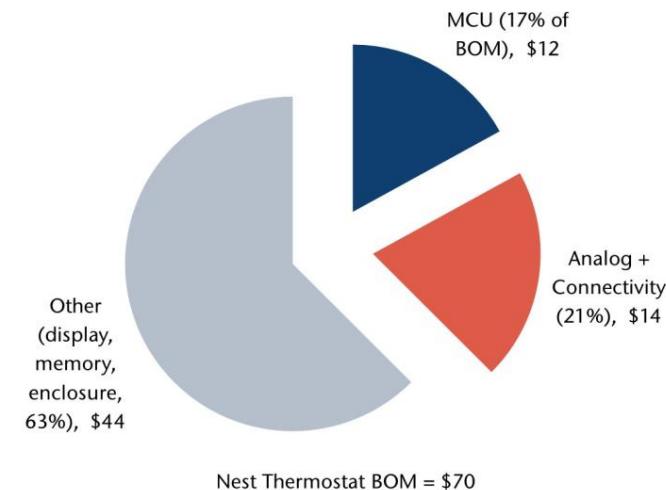
FitBit BOM = \$18

Critical Components of Nest Thermostat BOM



Nest Thermostat BOM = \$70

Critical Components of Average IoT BOM

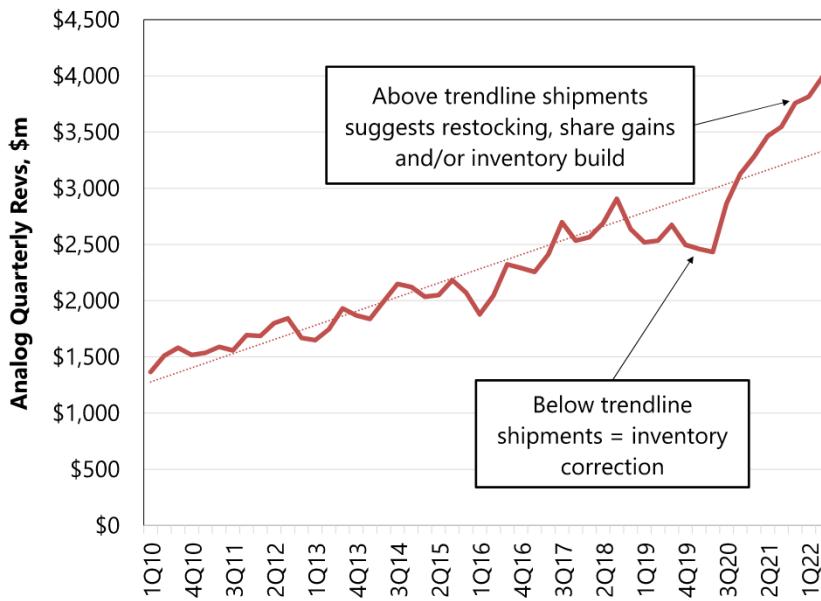


Nest Thermostat BOM = \$70

Source: Jefferies, Electronics360, MacRumors.com

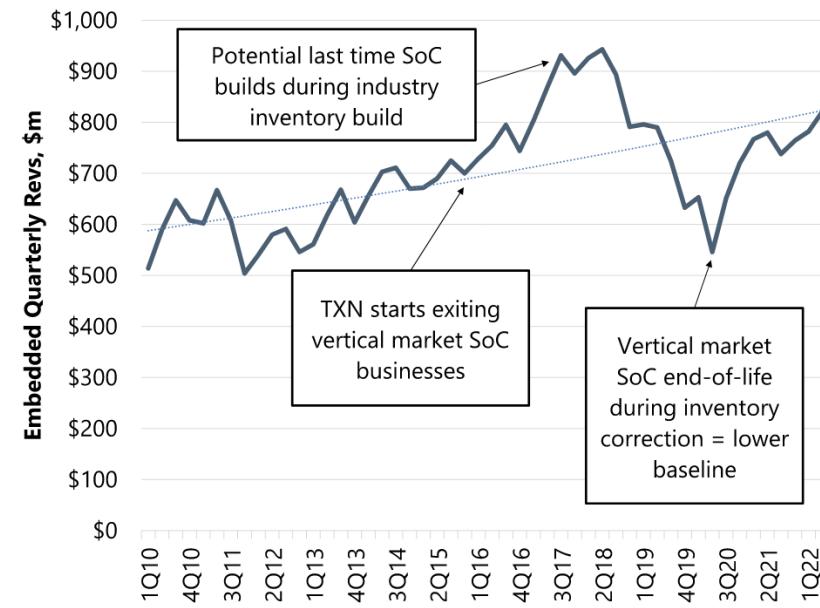
TXN: Analog and Embedded Revenues

Analog Segment Revenue Chart



TXN's analog revenues are ~20% above the trendline, which we attribute to higher ASPs and the supply chain inventory builds

Embedded Segment Revenue Chart



We note that TXN has restructured its Embedded business having exited (1) Comms Equipment Embedded entirely and (2) Specific SoCs for Personal Electronics end market. The Comms Equipment exit started in 2015 and was largely completed by YE2019. We think that TXN's Embedded business will continue growing off a new, lower baseline.

NVDA: \$20.50 of EPS Power in 2026 / Datacenter Acceleration

NVDA \$20.50 EPS Power in 2026

We think that with NVDA has a 5-year EPS power of \$20.50

We believe this is a differentiated interpretation of Nvidia's earnings potential which stems from our view that Nvidia is supplying an ecosystem in the data center, much like Apple is supplying an ecosystem to the smartphone market, or Intel and Microsoft did in PCs.

In contrast to other traditional semiconductor competitors, Nvidia's ecosystem extends beyond processors, to high speed interconnect (MLNX) and a software stack that starts with CUDA and cuDNN, and extends into vertical markets like CLARA, ISAAC, MERLIN, JARVIS, and DRIVE. As Nvidia transforms to a company that architects and supplies data center scale solutions, we expect it to gain capabilities in other key areas, either through growing them organically, or through acquisition.

	CY21 Rev Est (\$bn)	CAGR	5-yr Revenue Potential	Comments
Gaming	\$ 12.5	15%	\$ 25.1	Below 3-yr CAGR of 26%.
Pro Visualization	\$ 2.1	15%	\$ 4.2	Below 3-yr CAGR of 23%.
Datacenter Processor	\$ 10.6	35%	\$ 48.0	We assume DC processors revenues grow at CAGR of 15%.
Datacenter Ecosystem	\$ -		\$ 48.0	Consistent with the PC framework where INTC + MSFT capture 80% of the industry profits, we estimate that NVDA could capture an additional \$48bn from its ecosystem.
Auto	\$ 0.6	30%	\$ 2.1	Expanding \$11bn Auto Pipeline
OEM and Other	\$ 1.2	2%	\$ 1.3	Normalized growth of 2%
Omniverse	\$ -		\$ 15.0	Based on \$45bn TAM and 33% share assumptions
Total Revs	\$ 26.9		\$ 143.8	
EPS Power			\$ 20.5	Assume 36% Net Income, 2,500m shares

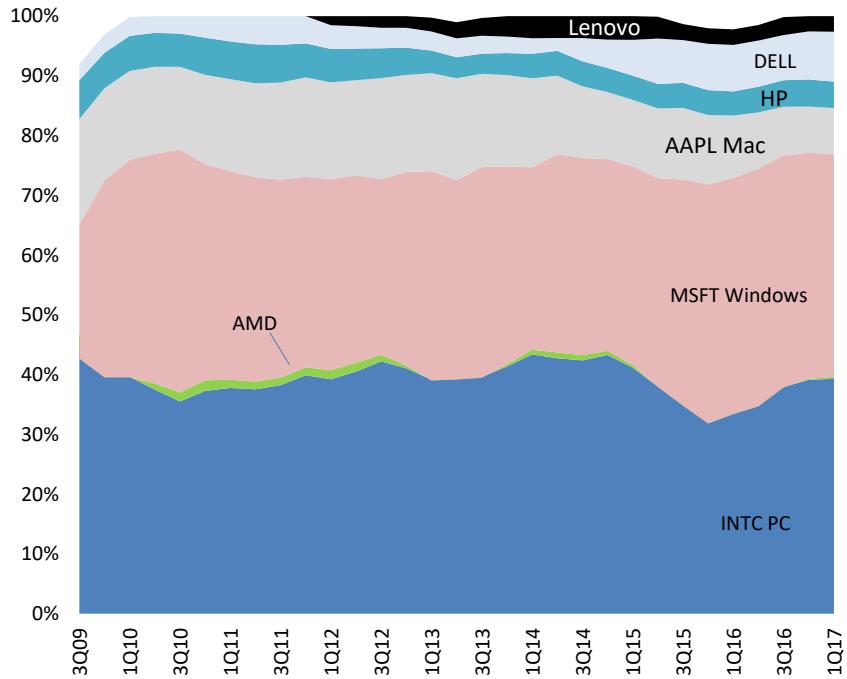
During the PC Era, Microsoft's operating profit was similar to Intel's, and we think Nvidia's earnings potential framework should be modeled more like Wintel, with half of its earnings power coming from the ecosystem that it created.

Aside from contribution from the Data Center Processor and Ecosystem, we use longer-term growth rates to estimate contribution of Nvidia's other businesses.

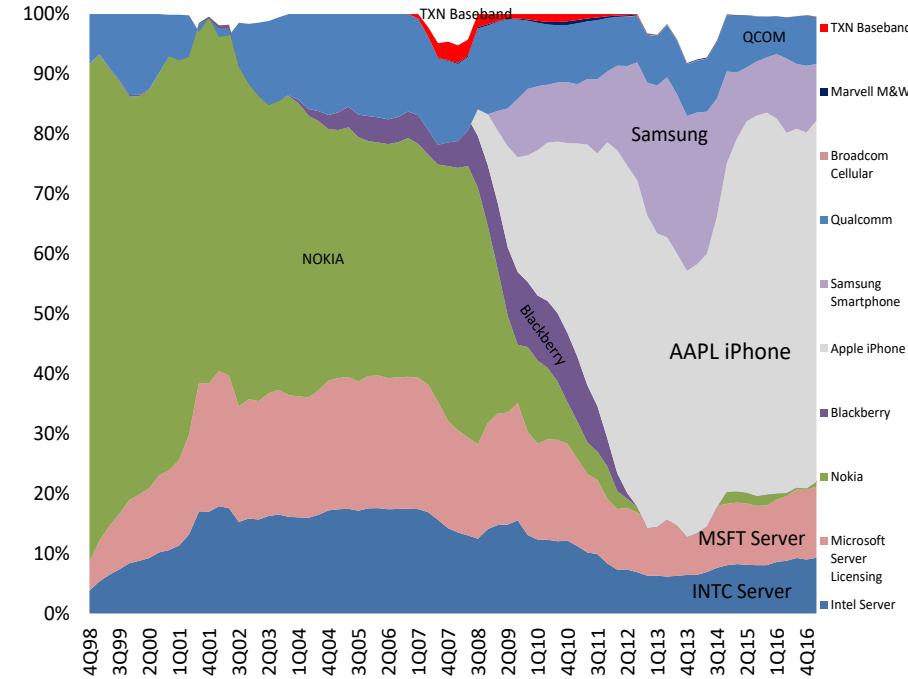
Source: The Atlantic, "Paul Otellini's Intel: Can the Company That Built the Future Survive It?", May 16, 2013, Alexis C. Madrigal Interview with Paul Otellini

One Ecosystem Typically Captures 80% of Each Computing Era

PC Operating Profit (% of total)



Cellphone / Server Operating Profits (% of total)



In the PC Era, Wintel realized 80% of the profits across the PC supply chain, and in the Cellphone Era, Apple realized 80% of the profits across the Smartphone supply chain. We previously expected NVDA to realize 80% of the profits across the Parallel Processing part of the Parallel Processing / IoT Era, but with ARM, we would expect it to ultimately realize 80% of the profits of both the parallel and serial processing parts of the data center, as well as a healthy part of the profit pool in the IoT part of the supply chain.

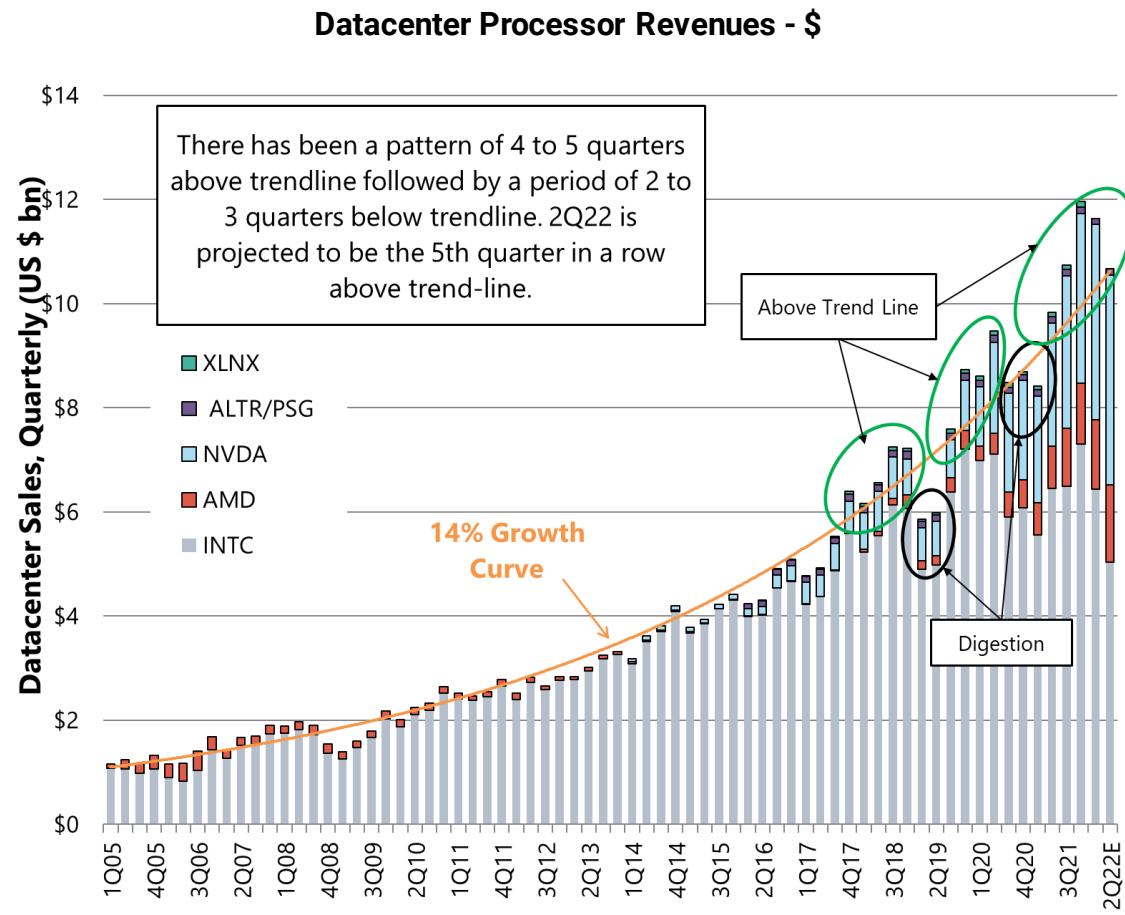
Source: Jefferies, company data, FactSet

INTC X86 Server CPUs are at 2016 Levels, NVDA and AMD are Taking Share

During the first 10 years of the Server part of the Cellphone/Server Era, Intel controlled nearly 100% of the market for processors.

However, starting in 2016, NVDA's GPUs started capturing share of Data Center compute cycles. In aggregate, we estimate that data center processor revenues have grown at a 13-14% CAGR over the past 15 years, and we expect that growth rate to continue for the next 5-to-10 years.

However, we expect growth in parallel processors to outpace growth in serial (x86) processors, and Nvidia to take share of processing cycles in the data center. We previously expected Nvidia to capture 80% of the profits of the parallel processing side of the data center ecosystem, but with ARM, we would expect that to extend into the serial processing side as well.

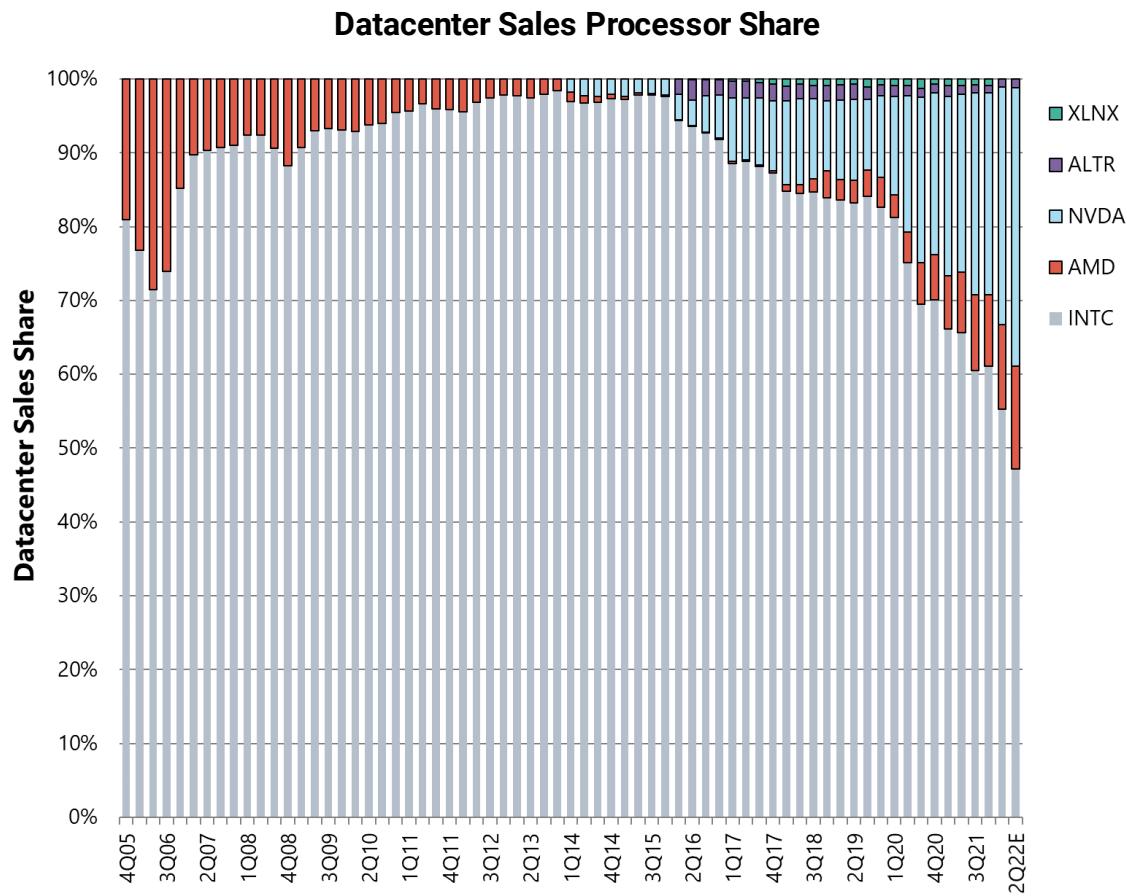


Source: Jefferies, company data.

INTC Has Gone from 98% to 45% Revenue Share in the Datacenter in 6 years

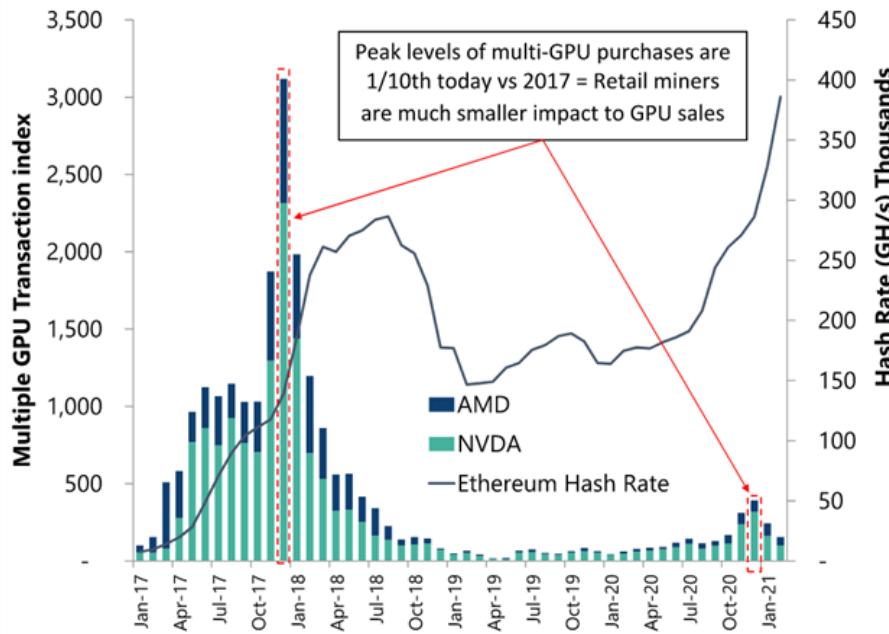
We expect growth in parallel processors to continue to outpace growth in serial (x86) processors, and Nvidia to take share of processing cycles in the data center.

We previously expected Nvidia to capture 80% of the profits of the parallel processing side of the data center ecosystem, but with its Grace ARM CPU and MLNX DPU, we would expect that to extend into the serial processing side as well.



Source: Jefferies, company data.

Retail Crypto Miners are not Driving Outsized NVDA Gaming-GPU Revenues

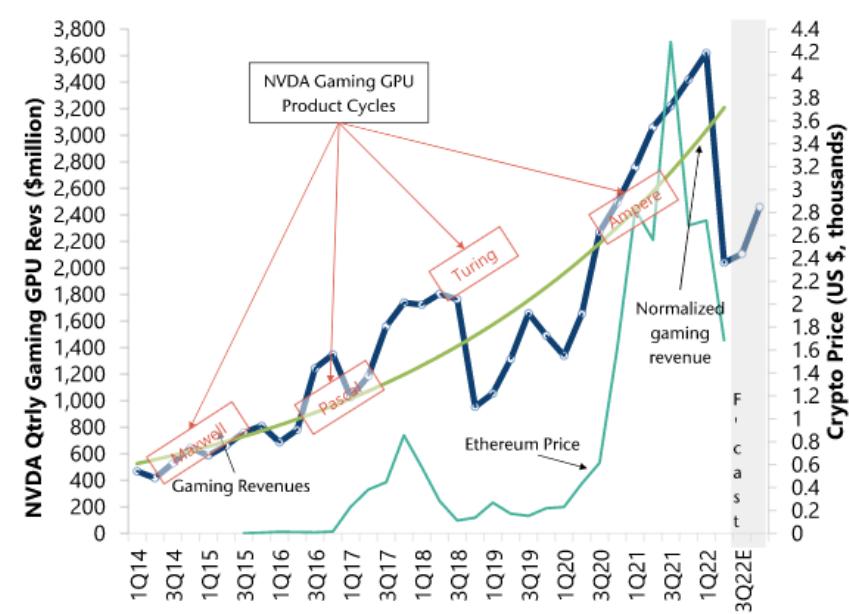


This chart is digital purchase data from M Science, which tracks multiple-GPU card purchases from a large database of anonymized receipts from US, Europe and Asia Pacific ex-China.

M Science believes that PC gamers purchase one GPU card at a time, and spikes in multiple-GPU card purchases that correlate with spikes in crypto prices, can largely be attributed to crypto miners.

Multiple-card purchases at the recent peak in 4Q20 are only 1/10th of peak levels in 4Q17. We agree with M Science conclusion that outsized demand for gaming-GPUs is not driven by crypto miners

Source: Jefferies estimates, Mercury and company data



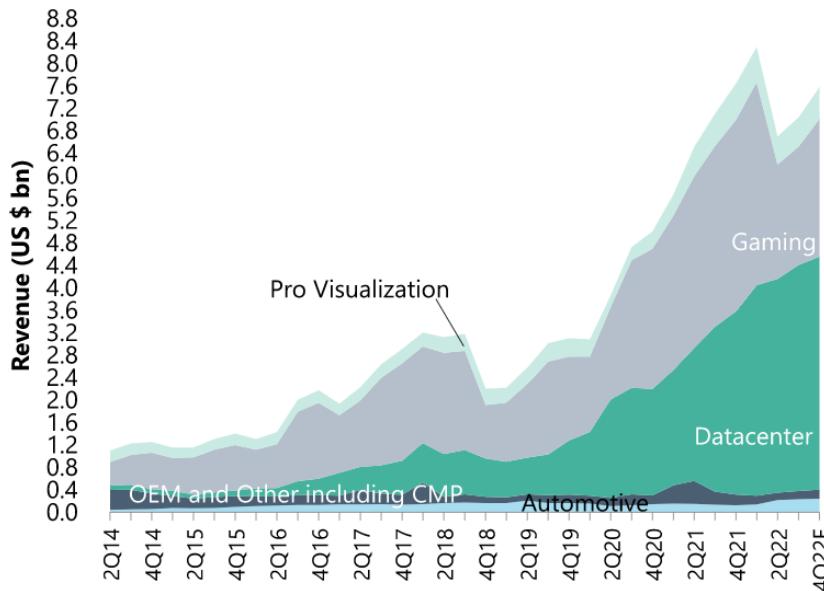
We think that 2020 growth in NVidia's gaming-GPU business can be explained by its Ampere product cycle.

In this chart we overlay NVidia gaming GPU products cycles (red boxes) on top of its gaming-GPU revenues

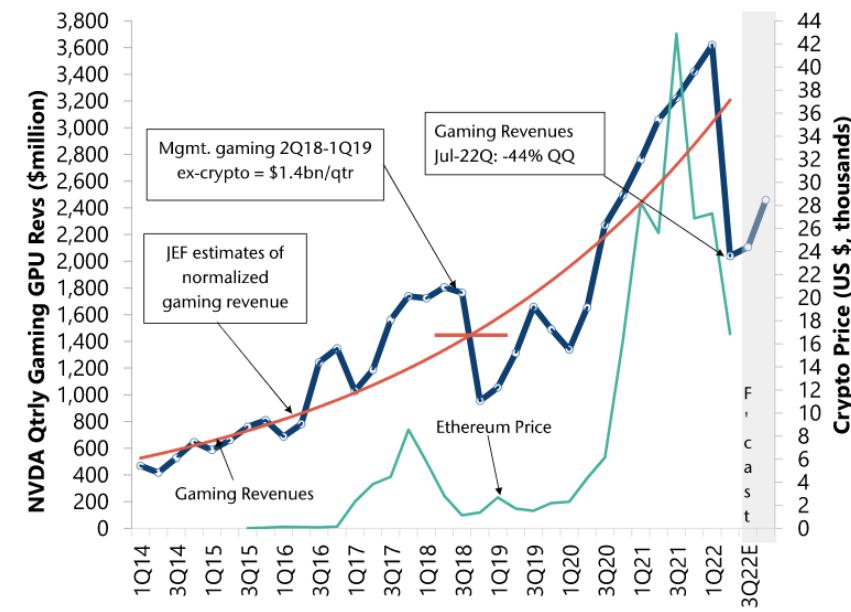
With NVDA's next gaming GPU platform, Lovelace ramping in 2H22-1H23, we expect that NVDA should benefit from the usual 40-60% revenue growth 4 quarters post launch and rising ASPs.

NVDA: End-Market Revenues and Gaming Revenues

NVDA End-Market Revenue



NVDA Gaming Revenues



After a 44% QQ cut to gaming in JulQ-22, we forecast gaming to be down 18% YY in CY2022. We continue to think that robust data center spend trends remain intact despite the slight miss in the JulQ due to supply chain disruptions.

Gaming GPU revenues declined 44% QQ growth. NVDA noted lower sell-in of gaming product and a reduction in channel partner sales due to macro headwinds. The company is implementing pricing programs with channel partners to reflect market conditions that are expected to persist in the 3rd quarter.

Source: Jefferies estimates, Mercury and company data

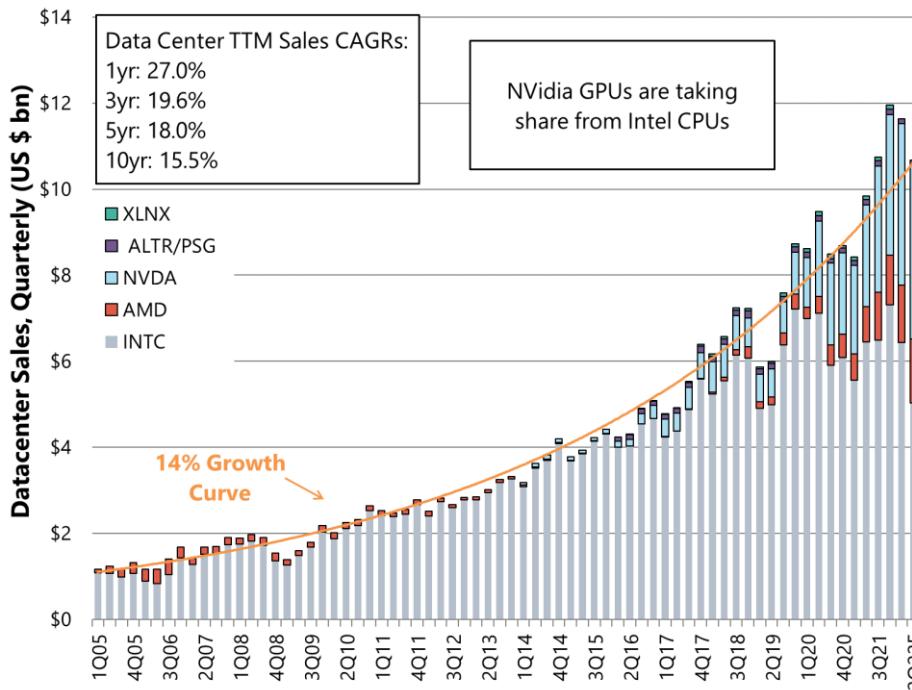
Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

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Jefferies

NVDA: Datacenter Revenues

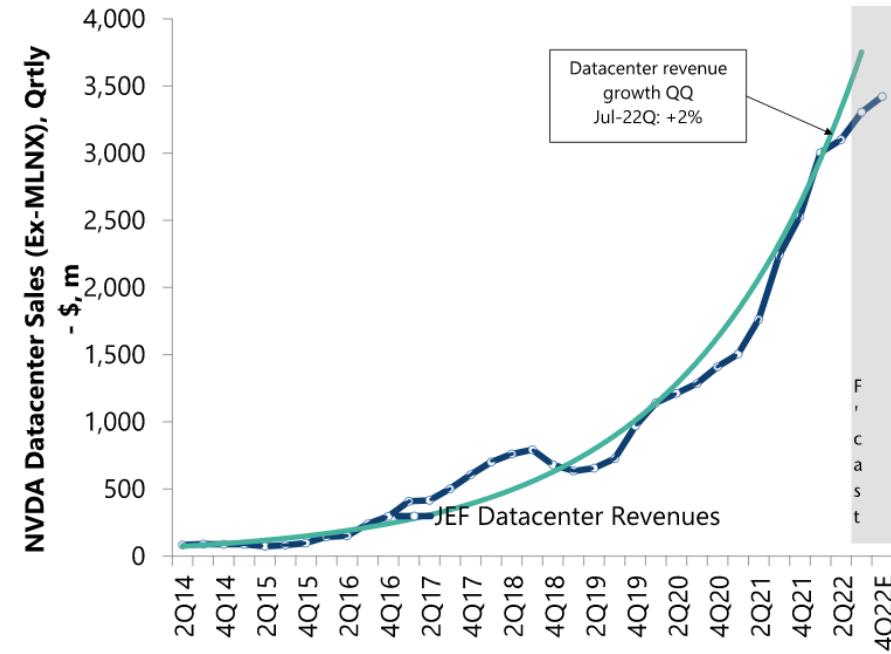
INTC + Competitors Datacenter Processor Revenues - \$



Starting in 2016, NVDA's GPUs started capturing share of Data Center compute cycles. In aggregate, we estimate that data center processor revenues have grown at a 14% CAGR over the past 15 years, and we expect that growth rate to continue for the next 5-to-10 years.

Since 3Q19, we estimate NVDA's market share in the datacenter increased to over 35% from 10%, while Intel's declined to 47% from 84%

NVDA Datacenter Revenues



While Data Center grew 2% QQ, NVDA noted it was short of company expectations due to supply chain disruptions.

Data center revenues were 550bps below consensus.

Source: Jefferies estimates, Mercury and company data

MRVL: Hyperscale Inflection - To Strategic Partner From Key Supplier

MRVL: Hyperscale Inflection - To Strategic Partner From Key Supplier

MRVL CY2024 and 2026 EPS Power

We estimate 3-yr and 5-yr EPS power of \$3.60 and \$5.06, assuming a CAGR of 17.5% from estimated FY23 revenues, GM at 66%, OpEx at 26%, and Tax Rates of 8% and 10%. Shares outstanding are modeled based on a 32% FCF margin and share repurchase using 50% of FCF, while maintaining a \$0.24 annual dividend per share.

	millions of \$	FY23 Est	LT Model Assumptions	Implied Target at High End of Range	
				FY25 Est	FY27 Est
Sales	\$6,221		15-20%	\$8,587	\$11,856
Gross Profit	4,068			5,668	7,825
GM %	65%		64-66%	66%	66%
R&D	1,464				
SG&A	316				
Total OpEx	1,781			2,233	3,083
OpEx %	29%		26-28%	26%	26%
Operating Profit	2,288			3,435	4,743
OM %	37%		38-40%	40%	40%
Interest Expense	135			135	135
Taxes	129		8% and 10% Est. Rate	264	461
Net Income	2,021			3,036	4,147
EPS	\$2.34			\$3.60	\$5.06
Shares	862		JEF Estimate	844	819
FCF	1,803			2,834	3,913
FCF margin	29%		>32%	33%	33%

Source: Jefferies, company data.

MRVL: Hyperscale Inflection - To Strategic Partner From Key Supplier

Business Unit	% of total revenue	QQ	Y/Y	Apr-22 Q Commentary	Jul-22E Q Outlook
Data Center	44.3%	11.6%	131.2%	Strong performance was broad-based with multiple product lines contributing to the results. Cloud optimized design win momentum continued in 1Q, and won a custom SmartNIC at a hyperscale customer.	Up QQ in the low single digits and up 50% YY
Carrier Infrastructure	17.4%	4.5%	50.4%	The growth in 5G deployment, combined with Marvell product ramps, at multiple base station customers continue to fuel strong growth in this end market.	Up high single digits QQ and approximately up 40% YY
Enterprise Networking	19.8%	9.0%	63.9%	Growth has been driven by share gains and the increase in content starting to materialize as customers began shipping their new platforms to address enterprise network modernization. Seen a large increase in the adoption of multi-gigabit 5s, which have a significantly higher selling price compared to gigabit products. Expect the penetration of multi-gigabit ports will continue to increase a tailwind to business	Up QQ in the mid-teens and approximately up 45% YY
Consumer	12.3%	-3.7%	7.1%	Growth in this end market is being driven by SSD controllers, partially offset by declines in PC HDD business.	Down QQ in the mid single-digits and flat YY.
Auto/Industrial	6.2%	12.4%	93.6%	All of the QQ growth came from automotive business, which drove over 50% of the total revenue from this end market.	Up mid single digit QQ and up over 60% YY. Expect strong growth to continue from automotive business with revenue projected to more than double YY.

Source: Jefferies, company data.

AMD Share Analysis: Expect Share Gains to Accelerate

AMD EPS Power Based on Mgmt Targets

Based on the LT targets set at the Analyst Day, we calculated a 2025 implied EPS of \$7.70.

AMD expects to grow at a 20% CAGR off of the 2021 AMD+XLNX Pro-Forma revs of \$20.1bn. Given expectations for 60% growth in 2022 over standalone AMD, revenue growth beyond 2022 to 2025 is implied to be 15.5%.

Additionally, mgmt expects data center and embedded to grow to greater than 50% of total revenues in the LT model from ~25% of AMD standalone and ~40% of AMD+XLNX 2021 revs. In our LT model, we estimate data center and embedded grows to 55% of revenues, implying 31% growth for data center and embedded and 11% growth for PC and gaming.

Given mgmt's target of returning greater than 40% FCF, we model ~1% per yr reduction in shares outstanding.

	2025 Long Term Model		Combined (ex-Synergies)	Target	(in \$bn, except share count)	
	2021	AMD			2025 Implied	
Data Center / Embedded PC & Gaming	\$4.0 \$12.4	\$3.7	\$7.7 \$12.4	>50% of total rev	\$22.9 \$18.8	
Pro Forma Revs	\$16.4	\$3.7	\$20.1	~20% CAGR		\$41.7
Gross Profit Gross Margin	\$7.9 48%	\$2.6 69%	\$10.5 52%			\$24.2 58%
SBC Adjustment OpEx		\$0.3 \$1.5	\$0.3 \$5.4	23-24%		\$9.8
Operating Profit Operating Margin	\$4.1 25%	\$1.3 35%	\$5.4 27%	mid-30s%		\$14.4 35%
Tax	\$0.4	\$0.1	\$0.5	~13%		\$1.8
NI Shares o/s	\$3.6 1229	\$1.2 250	\$4.8 1,660			\$12.1 1,574
EPS Power	\$2.94	\$4.82	\$2.90			\$7.70

Source: Jefferies, Mercury Data

AMD: EPS Power of \$10.15

Our sensitivity analysis suggests EPS power of \$6.50-\$8.80 from the x86 business under a 50% share scenario, \$1.90 from the GPU and Semi-Custom businesses, and \$1.50 for the Xilinx business for \$10.15 of total earnings power in 4-to-5 years.

We reflect AMD having a price premium to Intel to reflect mix shift differences given that the total server unit TAM includes Intel Atom, which AMD does not compete with today.

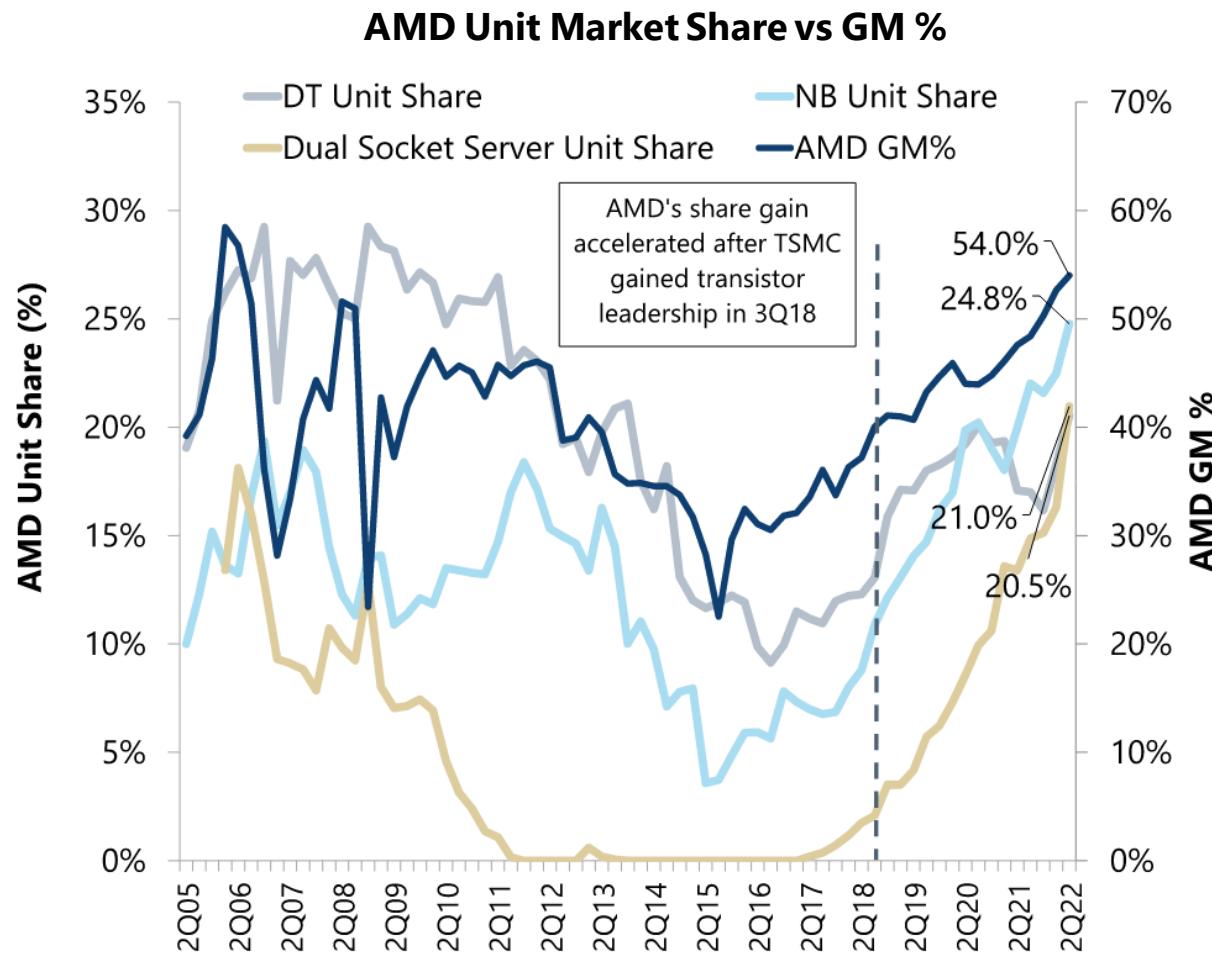
Market Size estimated for 2022							
AMD Zen Sales Opportunity (\$M):		AMD ASP (\$)	AMD Market Share (%)				Intel Server ASP 2022 \$1,002
Server Unit TAM (M)			10%	15%	25%	50%	
29	\$1,002		2,856	4,284	7,139	14,279	0% price discount to Intel
29	\$952		2,713	4,069	6,782	13,565	5% price discount to Intel
29	902		2,570	3,855	6,425	12,851	10% price discount to Intel
AMD Zen Sales Opportunity (\$M):		AMD ASP \$	AMD Market Share (%)				Intel Perf DT ASP 2022 \$160
Performance Desktop Unit TAM (M)			10%	20%	30%	50%	
76	160		1,216	2,432	3,648	6,080	0% price discount from Intel
76	144		1,094	2,189	3,283	5,472	10% price discount from Intel
76	128		973	1,946	2,918	4,864	20% price discount from Intel
AMD Zen Sales Opportunity (\$M):		AMD ASP \$	AMD Market Share (%)				Intel Perf NB ASP 2022 \$147
Performance Notebook Unit TAM (M)			10%	20%	30%	50%	
196	147		2,881	5,762	8,644	14,406	0% price discount from Intel
196	132		2,593	5,186	7,779	12,965	10% price discount from Intel
196	118		2,305	4,610	6,915	11,525	20% price discount from Intel
AMD Zen Sales Opportunity Total (\$M):			10%	20%	30%	50%	
			6,953	12,478	19,431	34,765	
			6,810	12,264	19,074	34,051	
			6,667	12,050	18,717	33,337	
Operating Profit (\$M) Assuming Incremental OM%:							
		35%	2,434	4,367	6,801	12,168	
		35%	2,384	4,292	6,676	11,918	
		35%	2,334	4,217	6,551	11,668	
x86 EPS (\$) Assuming Shares (M) of:							
		1,568	1.35	2.42	3.77	6.75	
		1,568	1.32	2.38	3.70	6.61	
		1,568	1.29	2.34	3.63	6.47	

Source: Jefferies, Mercury Data

AMD: GM Expansion

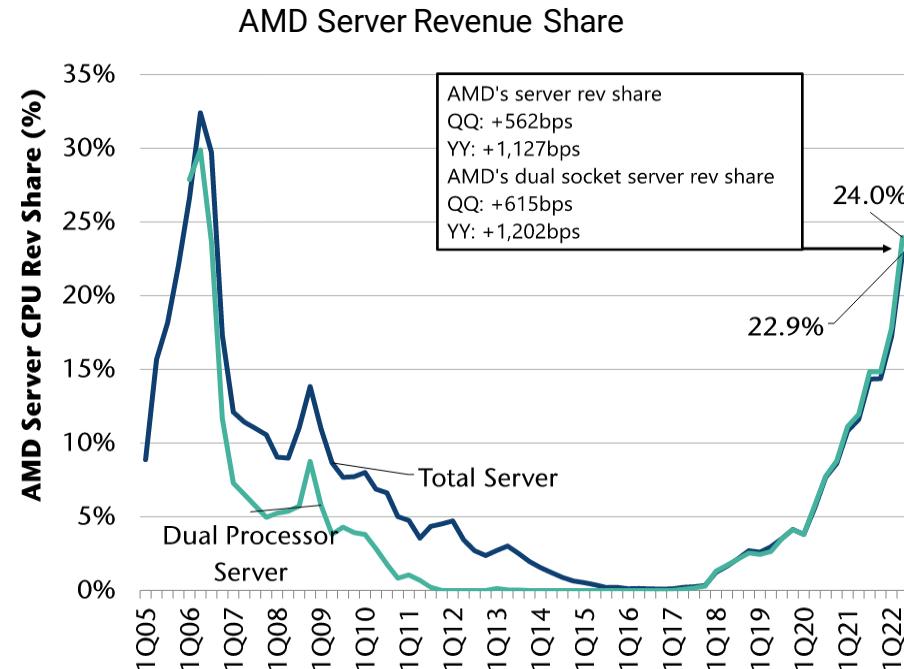
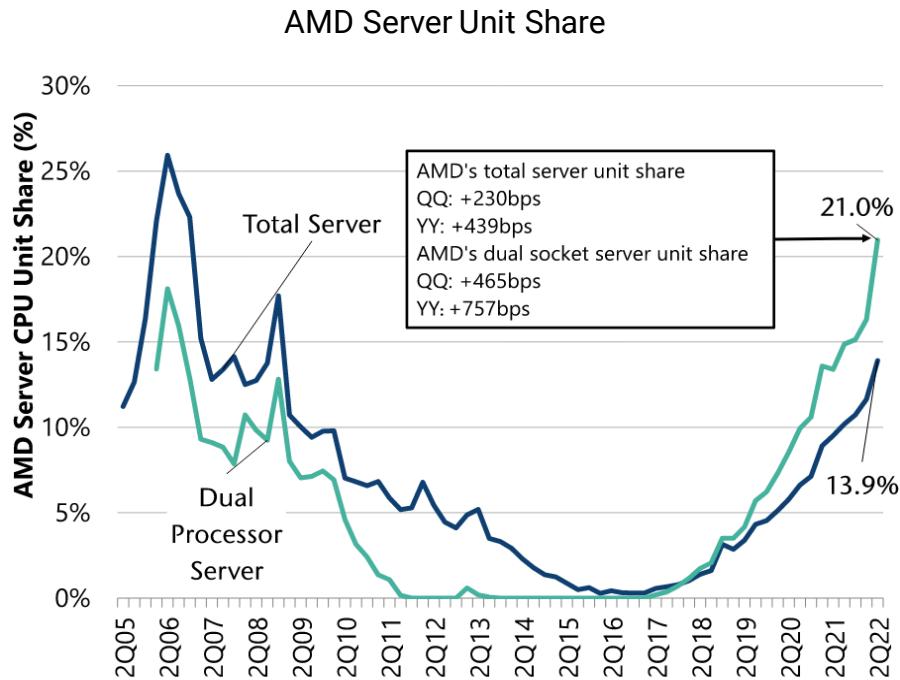
During its previous server product cycle in 2005-06, AMD's gross margins (GM) expanded materially as it gained share in servers. We expect AMD's GM to continue to expand during its current EPYC Server CPU product cycle as its server share increases. AMD's GM expand to 54% in 2Q22.

Please note that AMD's total server unit market share increased to 13.9% in 2Q22. Total server units includes server CPUs sold into networking and external storage products, where AMD doesn't compete.



Source: Jefferies, Mercury Research, company data. Note: MD's total server unit market share increased to 6.3% in 3Q20. Total server units includes server CPUs sold into networking and external storage products, where AMD doesn't compete

AMD Share Analysis: Expect Share Gains to Accelerate



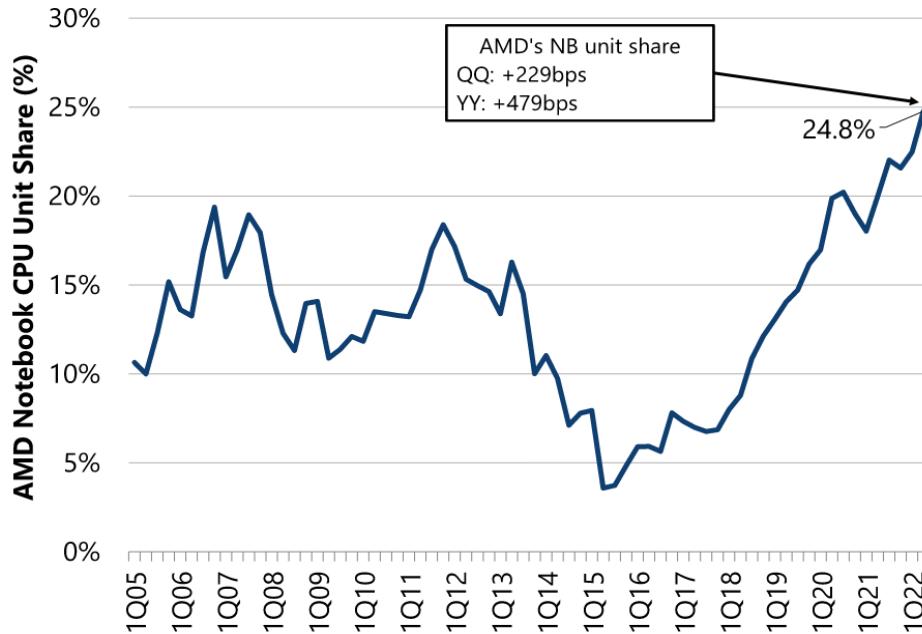
AMD's total server unit market share increased to 13.9% in 2Q22 (+230bps QQ; +439bps YY) and its dual-socket unit market share increased to 21.0% (+465bps QQ; +757bps YY). AMD's dual-socket revenue share (EPYC vs Intel Xeon SP) increased to 24.0% in 2Q22 (+615bps QQ; +1,202 bps YY). While INTC saw a 23% decline in data center / AI (DCAI) revs, AMD reported a new record for server revs as growth was driven by Milan shipments and higher ASPs from Milan and Milan-X. On latest gen server chips (Milan vs Ice Lake), Milan unit share was 36%, up from 31% in the prior quarter.

We expect AMD share gains, particularly in the server market, to accelerate from 50-100 bps/qtr they have seen over the past two years, to 150-300 bps per quarter going forward, at a higher rate as newer gen processors ramp and the transistor gap between TSMC/AMD and INTC widens.

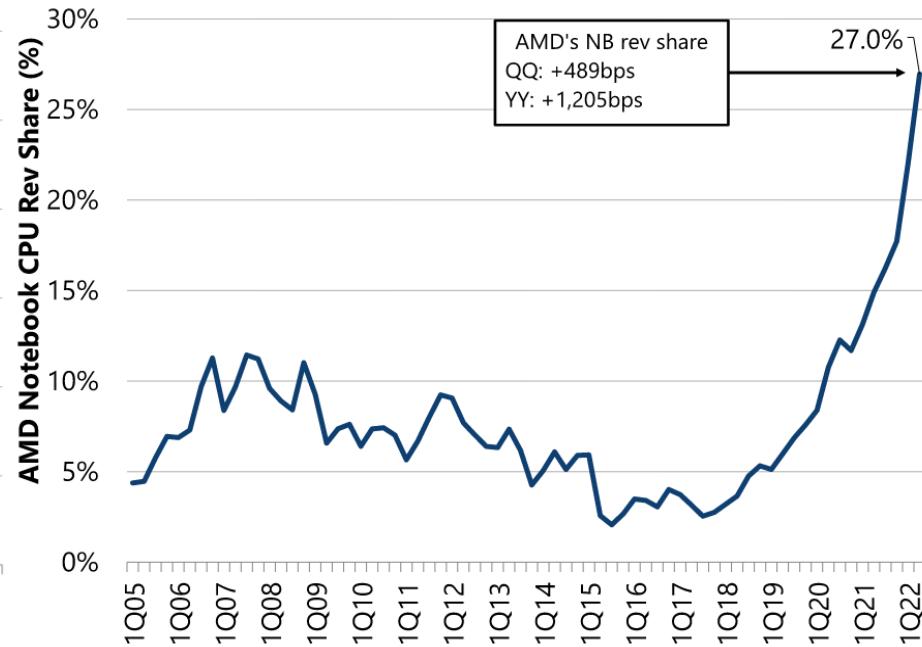
Source: Jefferies, Mercury Research

AMD Share Analysis: Expect Share Gains to Accelerate

AMD Notebook Unit Share



AMD Notebook Revenue Share



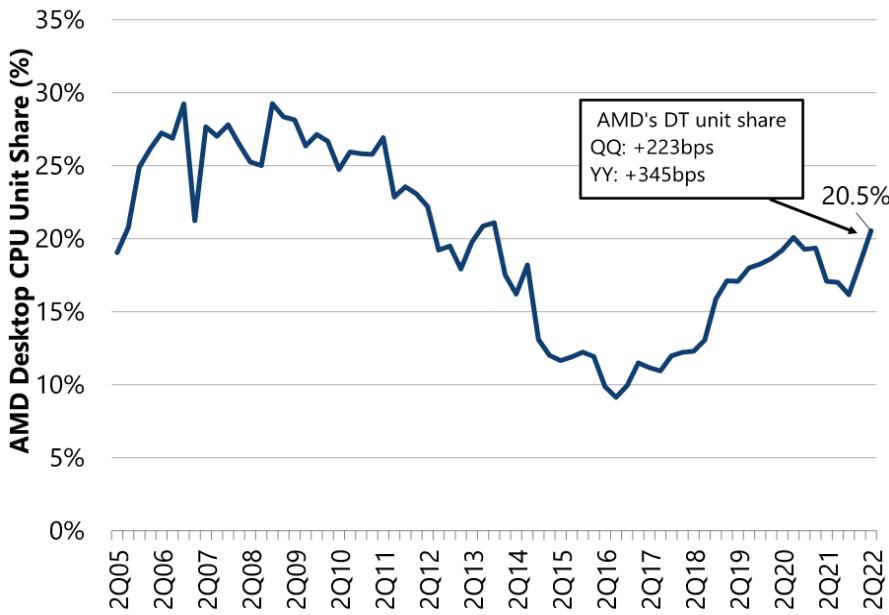
In 2Q22, AMD Notebook CPU unit share increased to 24.8% (+229bps QQ and +479bps YY), and revenue share increased to 27.0% (+489bps QQ and +1,205bps YY). INTC saw an 11% QQ decline in notebook unit shipments due to excess inventory at OEMs, which reduced sell-in over macro concerns. AMD shipments were up QQ slightly at 1%. Product mix was also lower for INTC as ASPs declined by 10% QQ vs AMD ASPs up 3% QQ. AMD continued to benefit from the ramp of Rembrandt and Barcelo in the commercial end-market. Notably, AMD ASPs were 12% higher than INTC's this quarter, despite competition vs INTC's Alder Lake.

The material ASP increase was partially helped by the mix moving away from entry level AMD "Stoney Ridge" and "Dali". AMD NB ASPs are now only 4% lower than INTC NB ASPs after being ~30% below in the previous quarter.

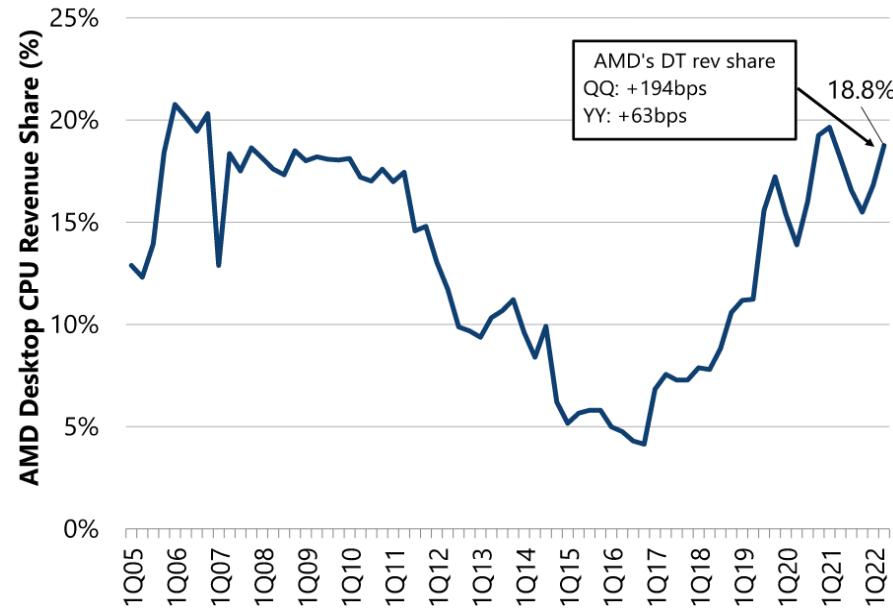
Source: Jefferies, Mercury Research

AMD Share Analysis: Expect Share Gains to Accelerate

AMD Desktop Unit Share



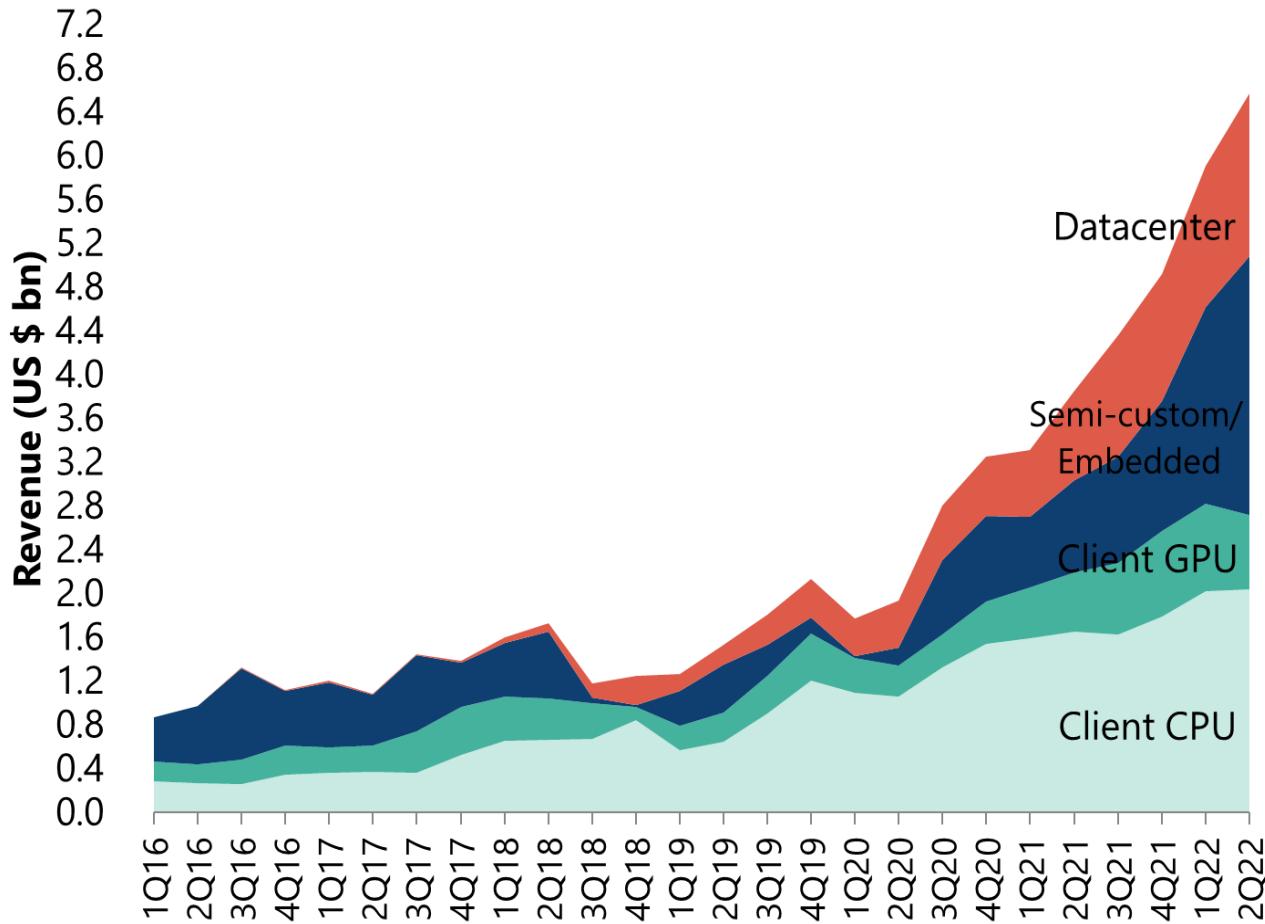
AMD Desktop Revenue Share



AMD desktop (DT) CPU unit share increased to 20.5% (+223bps QQ; +345bps YY), and AMD's desktop revenue share increased to 18.8% (+194bps QQ; +63bps YY). Overall desktop CPU shipments decreased by 4% QQ and 16% YY. AMD desktop units were up 7% QQ and 1% YY vs INTC desktop units down 7% QQ and 19% YY. INTC noted a historic correction of desktop CPU inventory within a deteriorating macro outlook. We attribute some of AMD's share desktop loss in 2021 likely due to significant excess inventory shipments from INTC. AMD ASPs remain ~10% lower than INTC's. We expect AMD's desktop share to recover after prioritizing server and notebook supply in the last year.

Source: Jefferies, Mercury Research

AMD Revenue by Business Segment



For 3Q22, we forecast Datacenter to grow by 7% QQ, driving QQ growth along with semi-custom console and embedded revenues.

Source: Jefferies, Mercury Research

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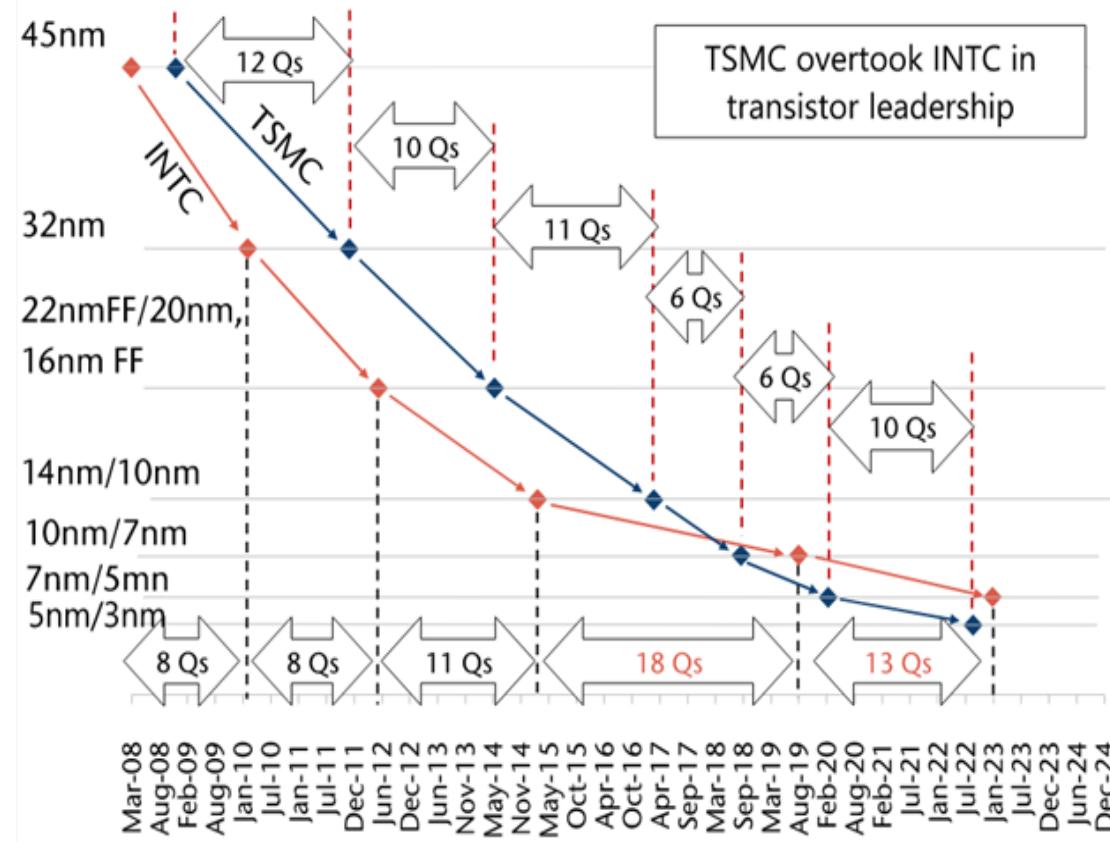
INTC: A Butterfly Flaps Its Wings in 2005... *(Aug-20)*

INTC: TSMC's Transistor Lead

Intel used to deliver a new transistor every eight quarters like clockwork, typically, at least two years ahead of everyone else in the industry

However, the move to 14nm FF transistors took 11 quarters, and the move to 10nm took nearly five years, as TSMC accelerated its transition time to its 7nm and 5nm nodes to six quarters

We chalk this dynamic up to the manufacturing learning curve, which based on higher wafer volumes at TSMC, would argue that TSMC should be a full node ahead of INTC



Source: Jefferies estimates, company data. y-axis represents INTC process node / Equivalent TSMC node.

INTC: A Butterfly Flaps Its Wings in 2005...

Paul Otellini gave an interview to the Atlantic in May, 2013, less than two weeks after he retired as Intel's CEO. Otellini said that Intel was presented with the opportunity to make chips for the iPhone in 2005, but Intel took a pass in part because they underestimated the volume of the iPhone by 100x. Furthermore, he said if Intel had manufactured the chip for the iPhone, "...the world would have been a lot different..."

The interviewer said, "Even Otellini betrayed a profound sense of disappointment over a decision he made about a then-unreleased product that became the iPhone."

We think that the decision Intel made in 2005 set the stage for TSMC to make more wafers than Intel and climb down the transistor manufacturing cost curve faster.

Comments

"We ended up not winning it or passing on it, depending on how you want to view it. And the world would have been a lot different if we'd done it,"

"The thing you have to remember is that this was before the iPhone was introduced and no one knew what the iPhone would do..."

"At the end of the day, there was a chip that they were interested in that they wanted to pay a certain price for and not a nickel more and that price was below our forecasted cost. I couldn't see it. It wasn't one of these things you can make up on volume."

"And in hindsight, the forecasted cost was wrong and the volume was 100x what anyone thought."

Our "**4th Tectonic Shift in Computing**" thesis argues that every generation of computing devices is 10x the size of the previous one. A company that is the leading manufacturer of chips for computing devices that ship 2.5 billion units a year (TSMC), is much better positioned to climb down the manufacturing cost curve than a company that is making chips for devices that are shipping 250 million units per year (Intel)

Source: The Atlantic, "Paul Otellini's Intel: Can the Company Tat uit the Future Survive It?", May 16, 2013, Alexis C. Madrigal Interview with Paul Otellini

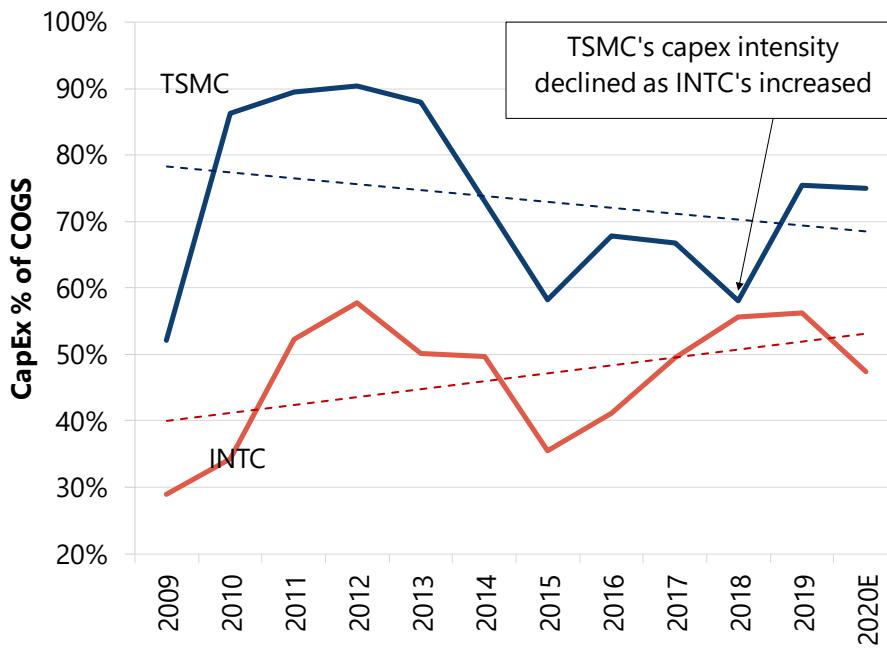
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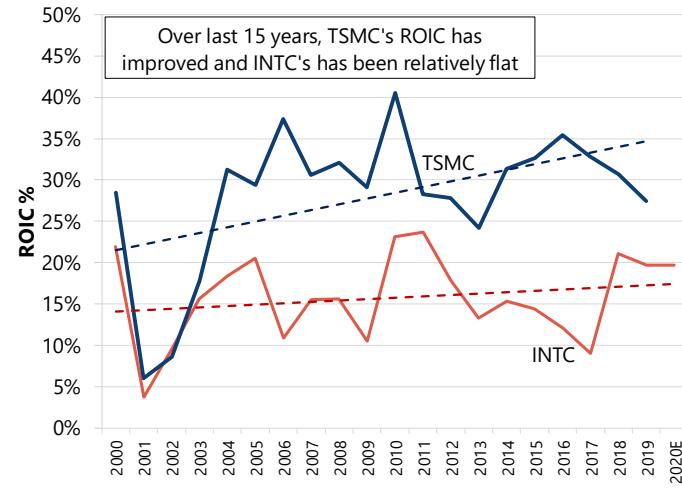
INTC: A Butterfly Flaps Its Wings in 2005...

TSMC's CapEx Intensity Improving

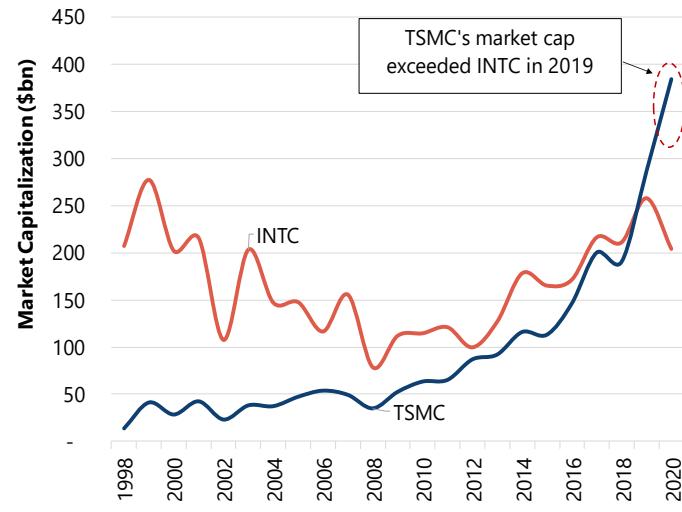


TSMC's market cap surpassed Intel's shortly after it surpassed Intel in transistor leadership

TSMC's ROIC Exceeded INTC for last 15 years



TSMC's Market Cap Eclipsed INTC

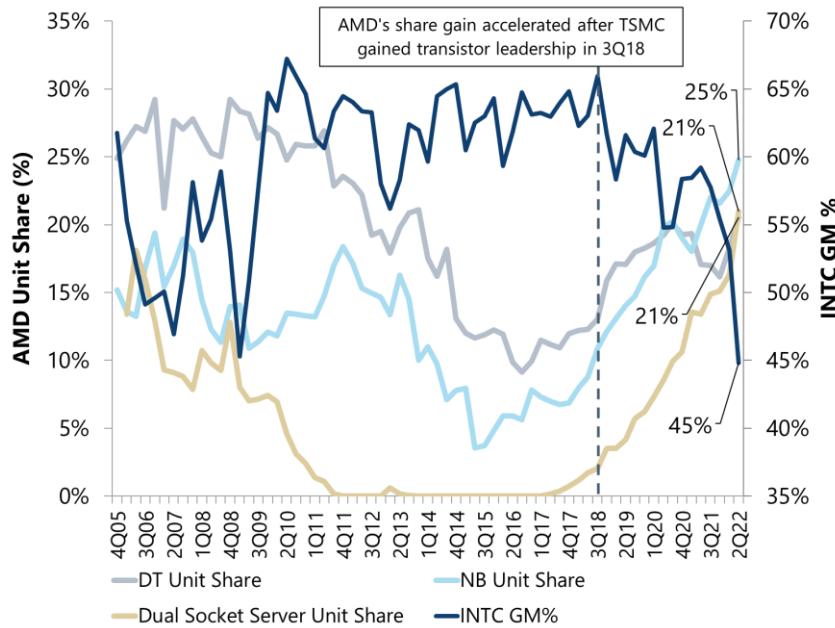


Source: Jefferies, company data

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INTC: 10nm Delay + Share Loss

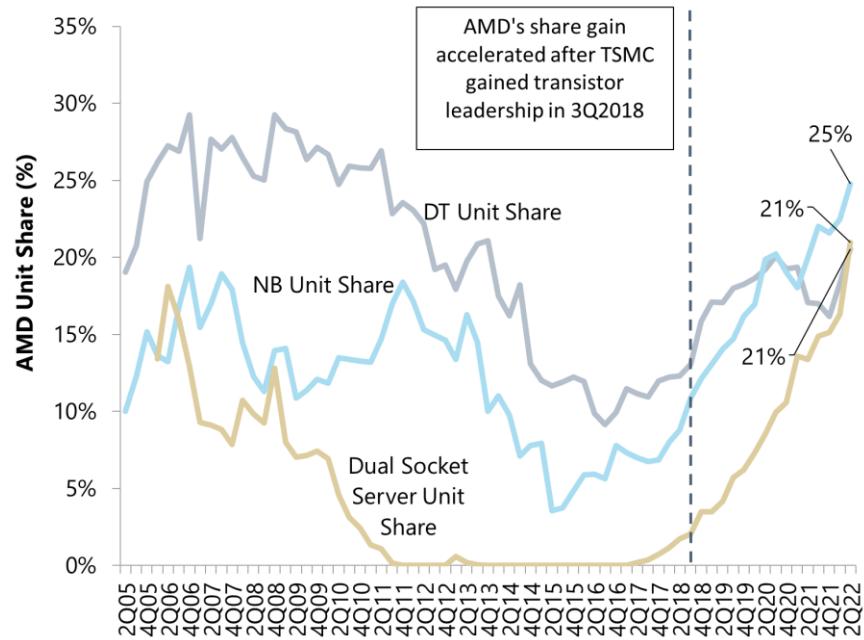
AMD Unit Share vs. INTC GM



We expect INTC's GM to remain under pressure from AMD EPYC Server CPU roadmap as AMD's server share increases.

Please note that AMD's total server unit market share increased to 13.9% in 2Q22. Total server units includes server CPUs sold into networking and external storage products, where AMD doesn't compete.

We Expect AMD to Continue Taking Share in Server



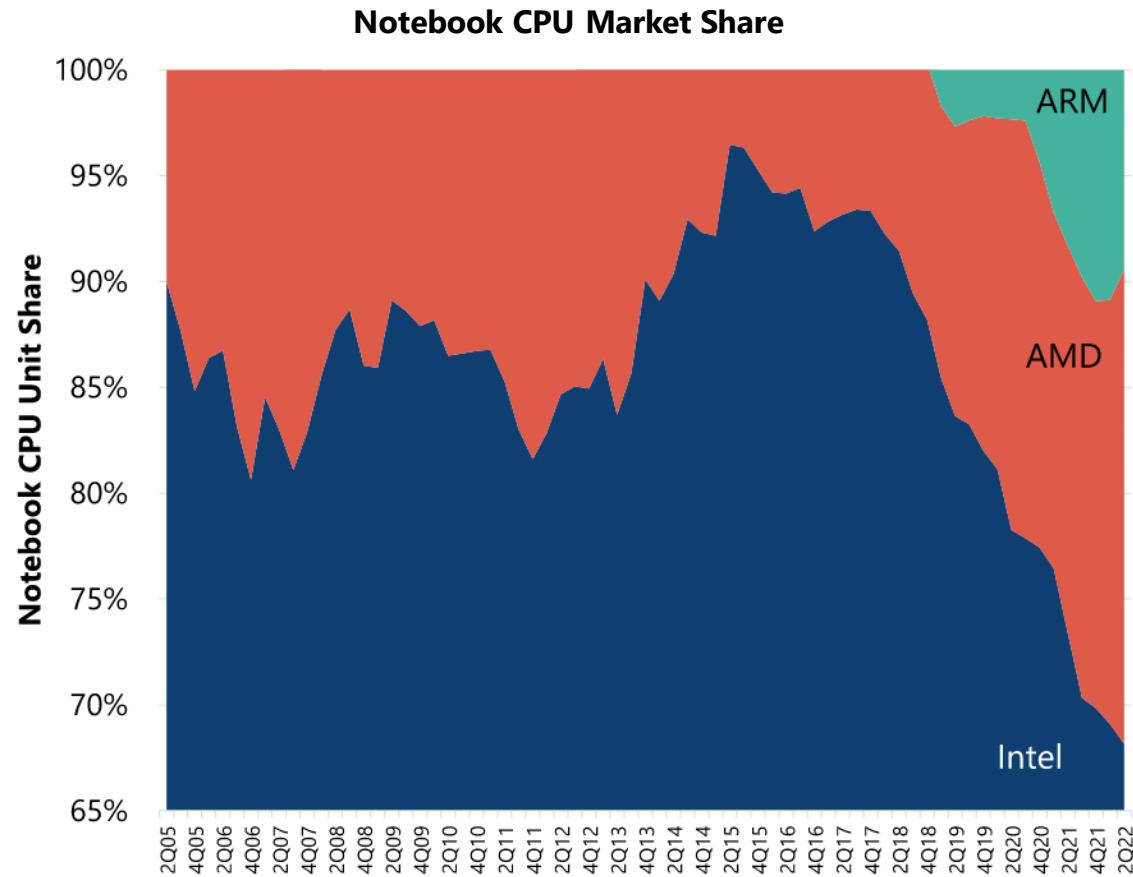
The dashed line shows when TSMC surpassed Intel for transistor leadership (3Q18), which was when AMD announced it was moving all its CPU and GPUs to TSMC's 7nm process, and about the time AMD share gains vs INTC inflected

Source: Jefferies, Mercury research and Company data

INTC Share Notebook Share Loss + ARMageddon

AMD and ARM have been gaining share at INTC's expense.

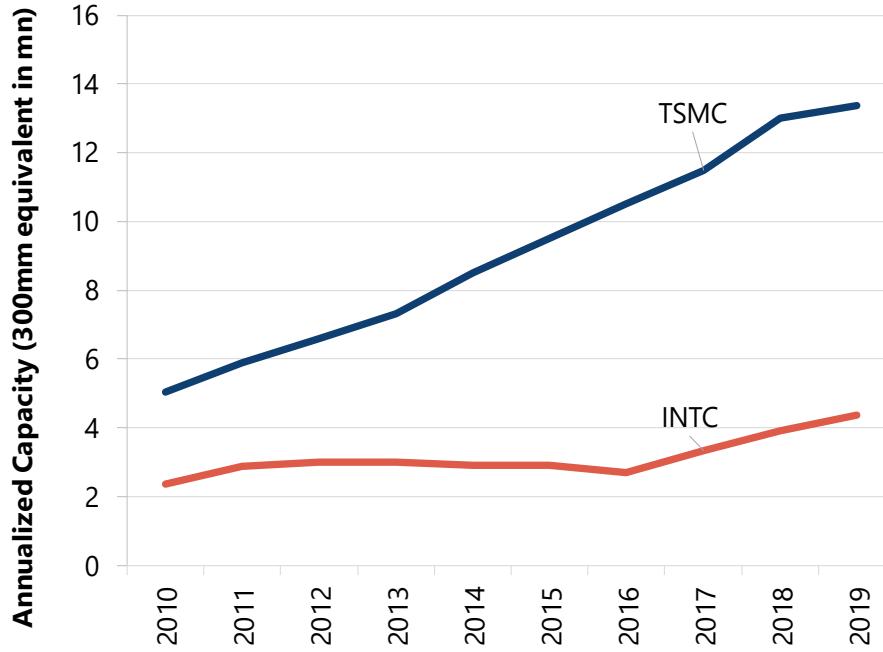
Our dataset tracks ARM notebook shipments (Apple M1 processor and ARM Chromebook market) from 1Q19. As of 2Q22, ARM makes up 9.4% share of overall notebooks. Apple's lower shipments in the second quarter dominated overall ARM PC shipments, resulting in declines for ARM NB units (-22% QQ, -24% YY) and ARM NB share (-150bps QQ). We expect the share to further increase, driven by Apple's transition to M1 processors as Apple moved away from x86 CPUs in the year-ago quarter. AMD and ARM have been gaining share at INTC's expense.



Source: Jefferies, Mercury Research.

TSMC Shipped 3x the wafers INTC did over the past 5 years

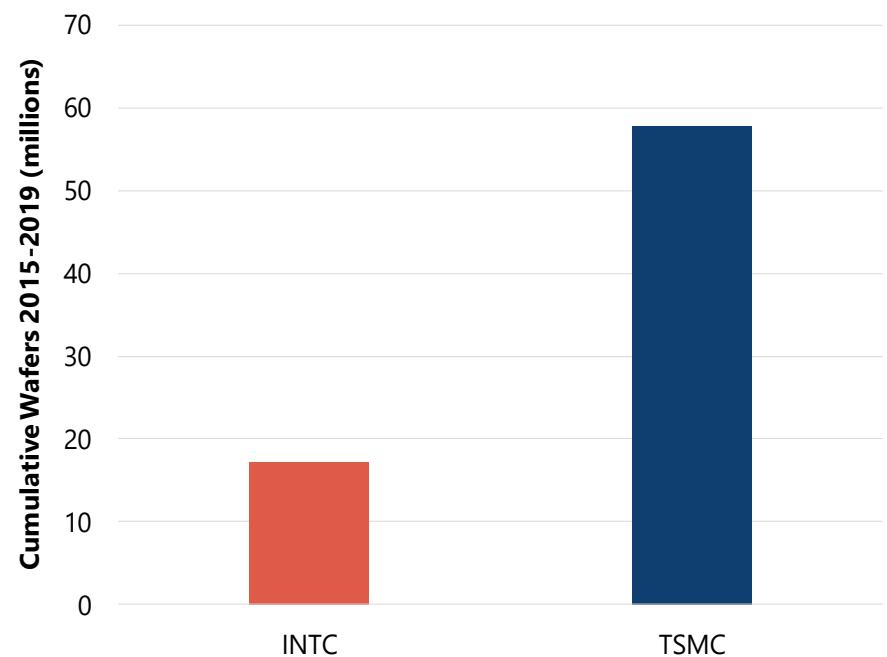
INTC vs. TSMC Annualized 300mm Equivalent Capacity (millions)



Source: Jefferies, Gartner, IC Insights. INTC's includes 3D NAND capacity of 840,000 wafers

We think the relative performance between TSMC and INTC on the transistor cost curve can be attributed to the manufacturing learning curve effect - i.e., the idea that the cost of an item manufactured by company drops by a consistent amount every time the production doubles. We estimate that TSMC wafer starts has exceeded Intel's each year for the past 10 years, and that TSMC made 3.3x more wafers than Intel did in 2019.

INTC vs. TSMC Cumulative Wafers Last 5 yrs



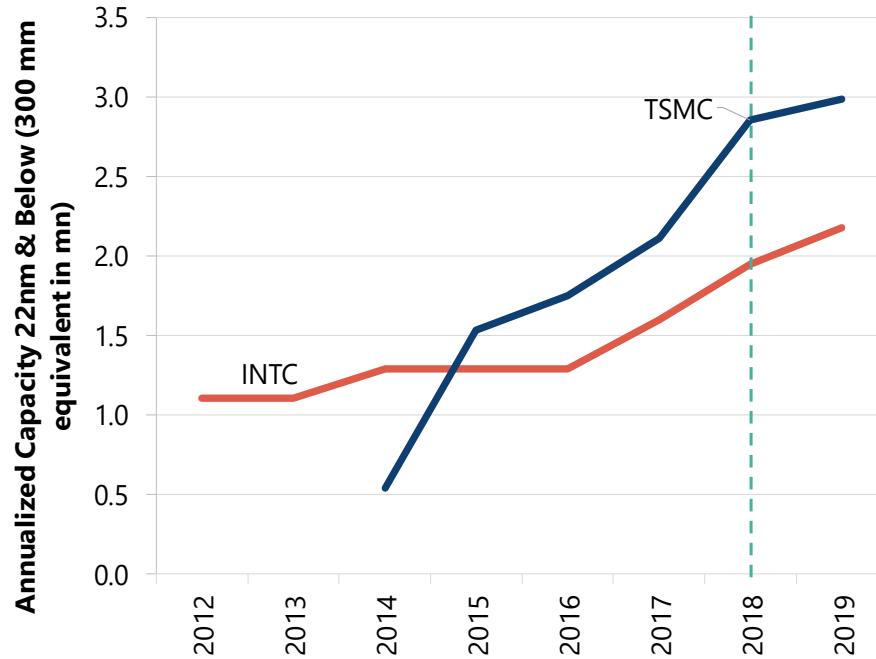
Source: Jefferies, Gartner, IC Insight

We estimate that over the past 5 yrs, TSMC processed nearly 60 million wafers, while Intel only processed about 20 million.

According to Learning Curve economics, this would put TSMC about 1.0-to-1.5 transistor nodes ahead of INTC, which is about how far ahead TSMC is ahead of INTC now.

INTC: TSMC vs INTC Capacity

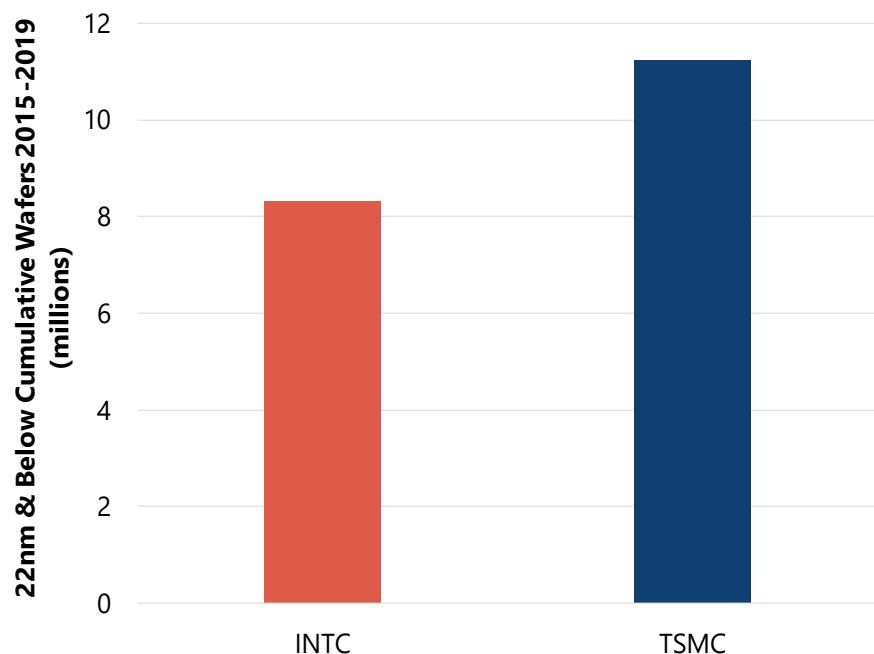
INTC vs. TSMC Annualized 300mm Equivalent Capacity 22nm & below (millions)



Source: Jefferies, Fubon, Gartner, IC Insights

We estimate that TSMC surpassed INTC on wafers manufactured on advanced process nodes (22nm and below) in 2015, about 3 years before TSMC took transistor leadership from INTC in 2018.

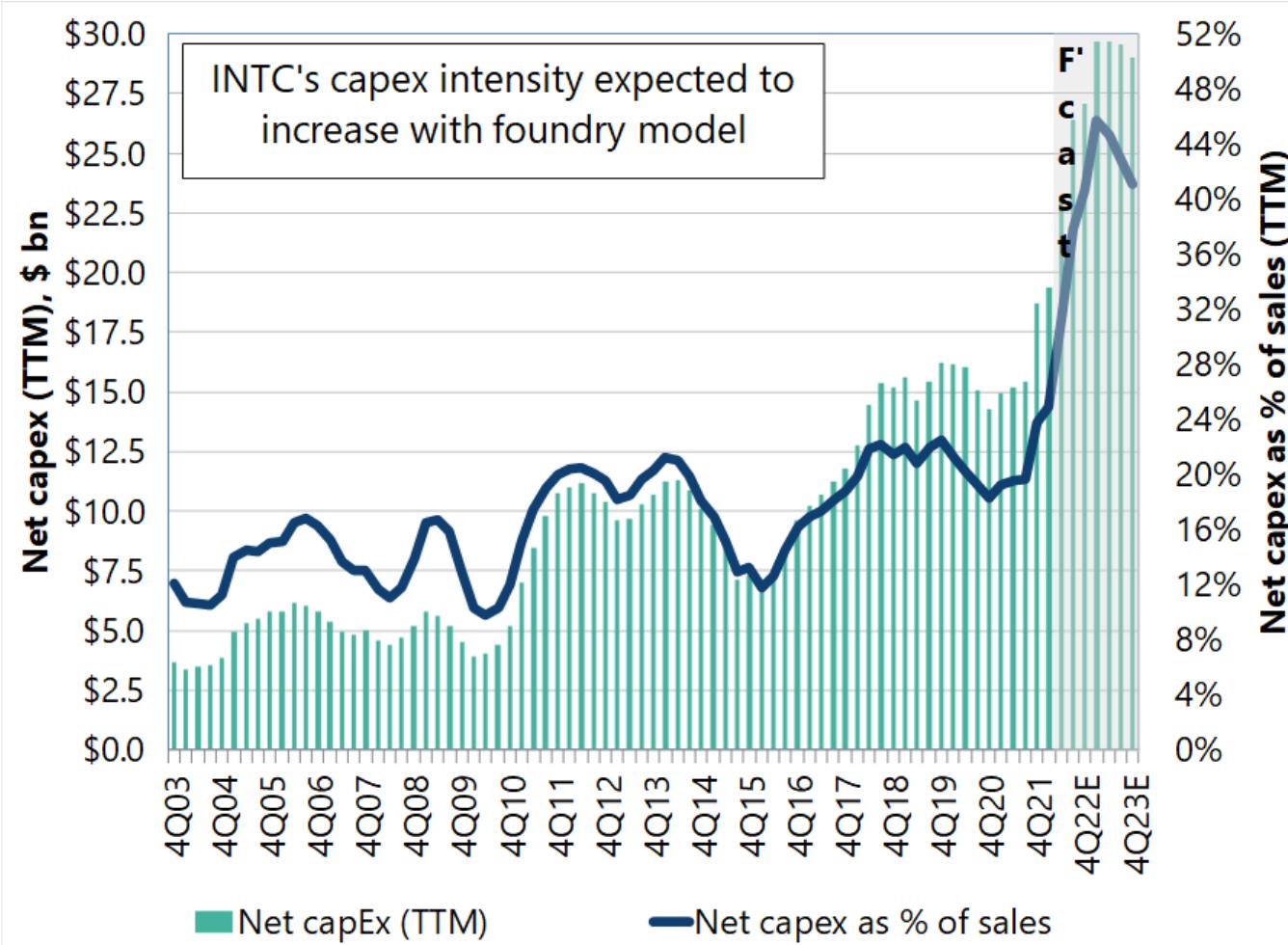
INTC vs TSCM 22nm & Below Cumulative Wafers Last 5 yrs



Source: Jefferies, Fubon, Gartner

Over the past 5 years, we estimate that TSMC has shipped about 3 million more wafers than INTC on advanced process nodes, which translates to 30%-to-40% more. Since TSMC is making chips for an end market (cell phones) that is 10x the size of Intel's (PCs/Servers), we think TSMC will continue to climb down the manufacturing cost curve at a faster rate and it will be difficult for INTC to close the gap with TSMC.

INTC: Capex + Capex Intensity at Historical Highs



Intel's CapEx intensity is expected to increase as it deploys its foundry model. We estimate capex as a % of sales before capital offsets to be 41% in both 2022 and 2023, up from 18% in 2020.

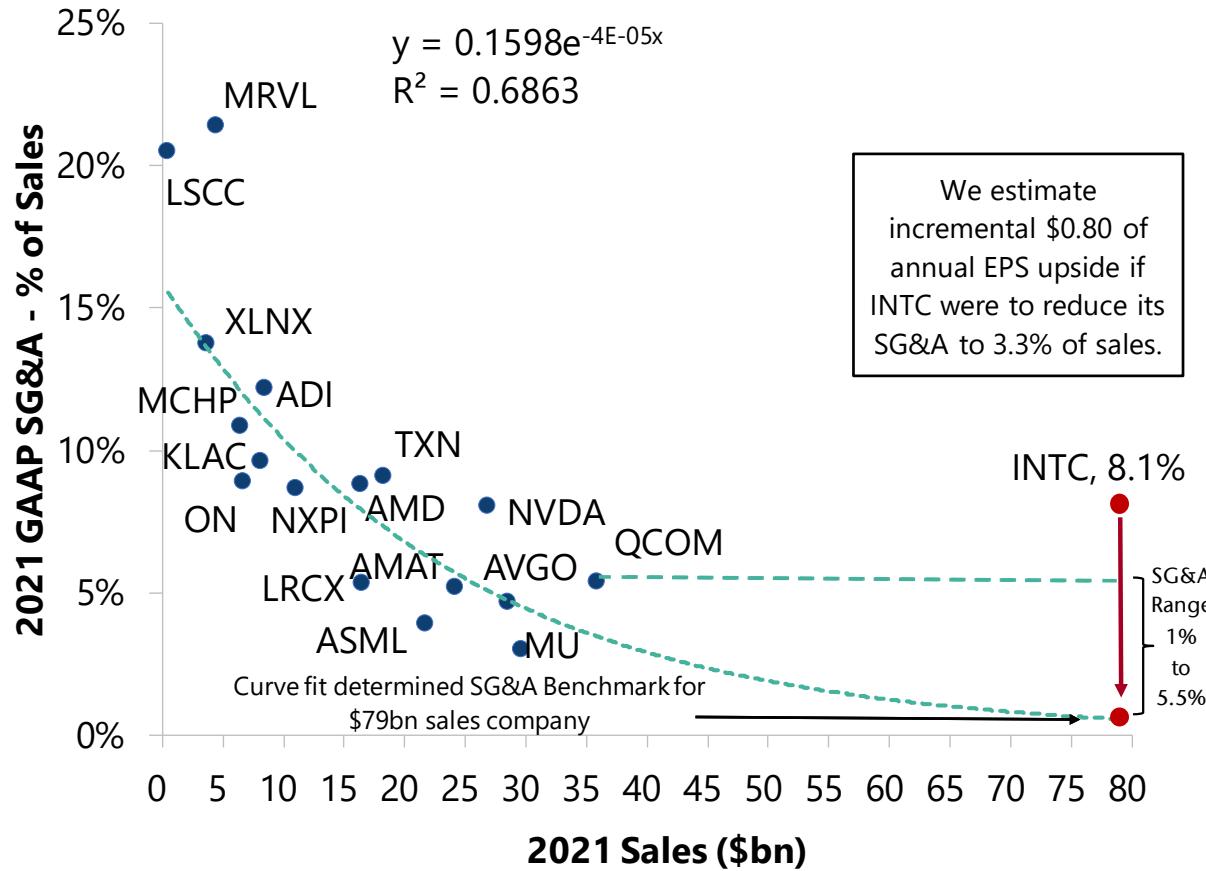
Source: Jefferies, company data

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INTC: SG&A is Well Above Industry Sales Adjusted Norm

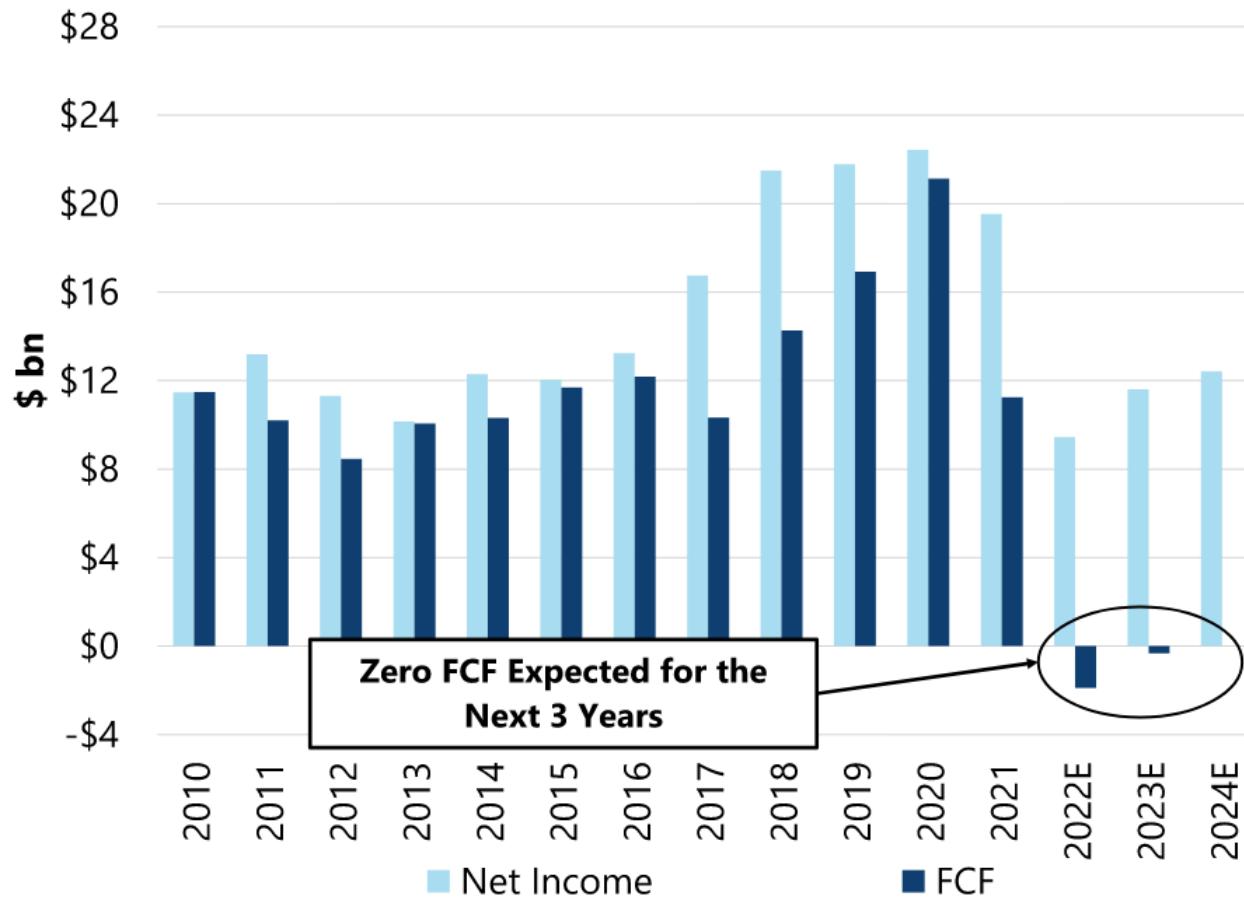


Source: Jefferies, company data

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INTC: FCF Near Zero – Low Quality of Earnings

INTC Free Cash Flow vs Net Income



Given pressure from AMD competitively and Intel's transition to a more CAPEX-intensive model, we expect Intel's quality of earnings to deteriorate.

Source: Jefferies, company data

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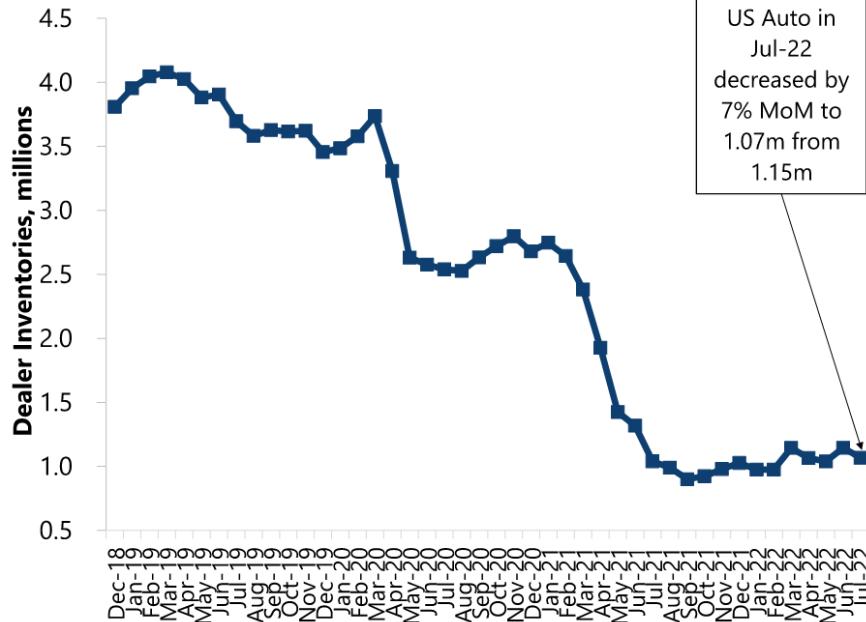
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NXPI: Unique Dislocation, Attractive Risk-Reward

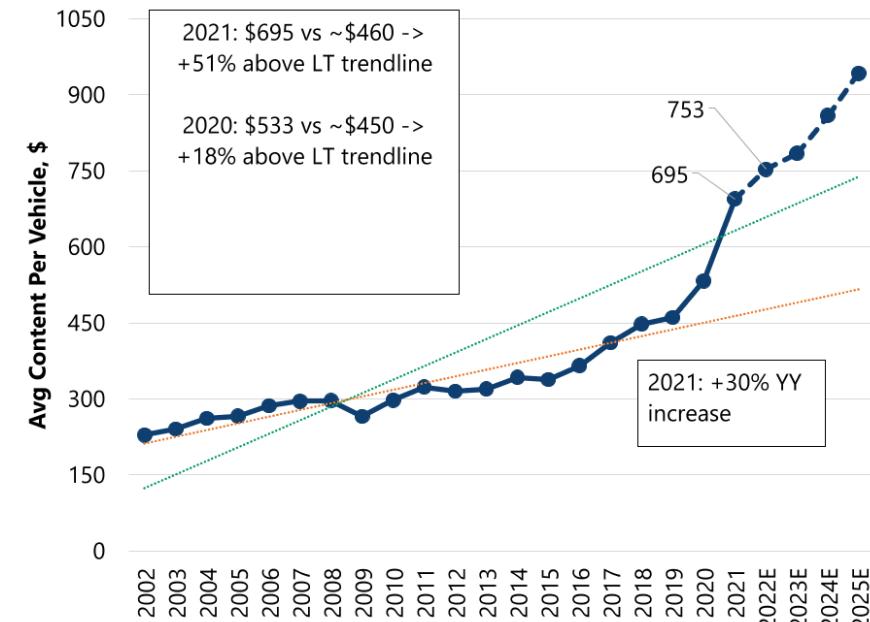
NXPI: Supply Chain Lean, Content Growth Accelerated

US Dealer Inventories



US Auto Dealer inventories decreased by 7% month-over-month in Jul-22 to 1.07m after hitting multi-year lows in Sep-21 of 0.900m.

Automotive Content Per Vehicle Notably Above Trendline



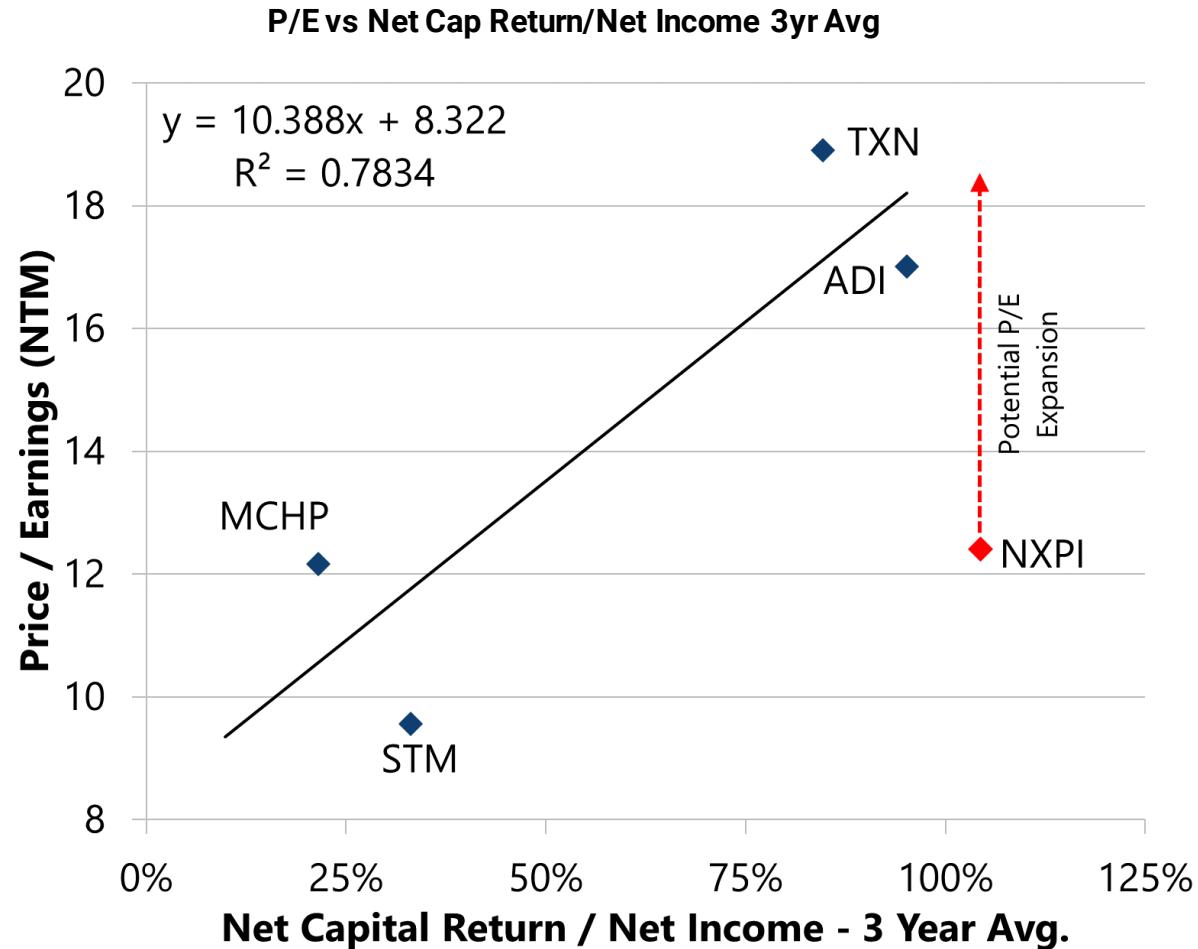
Content per vehicle increased by 30% YY in C2021, exceeding long-term trendline by 51%

NXPI: Capital Return Play - Expect P/E Expansion

Broad-based large-cap semi P/E ratios are correlated with Net Capital Return/Net Income. NXPI has 3-yr avg NCR/NI ratio of 104%, and the regression suggests that there is plenty of room for its P/E multiple to expand.

NXPI's stated capital allocation policy is that it will return all excess cash to shareholders up to a level of 2 times net debt to trailing 12 months EBITDA.

We believe NXPI will enter a capital return cycle which will also translate to P/E multiple expansion.

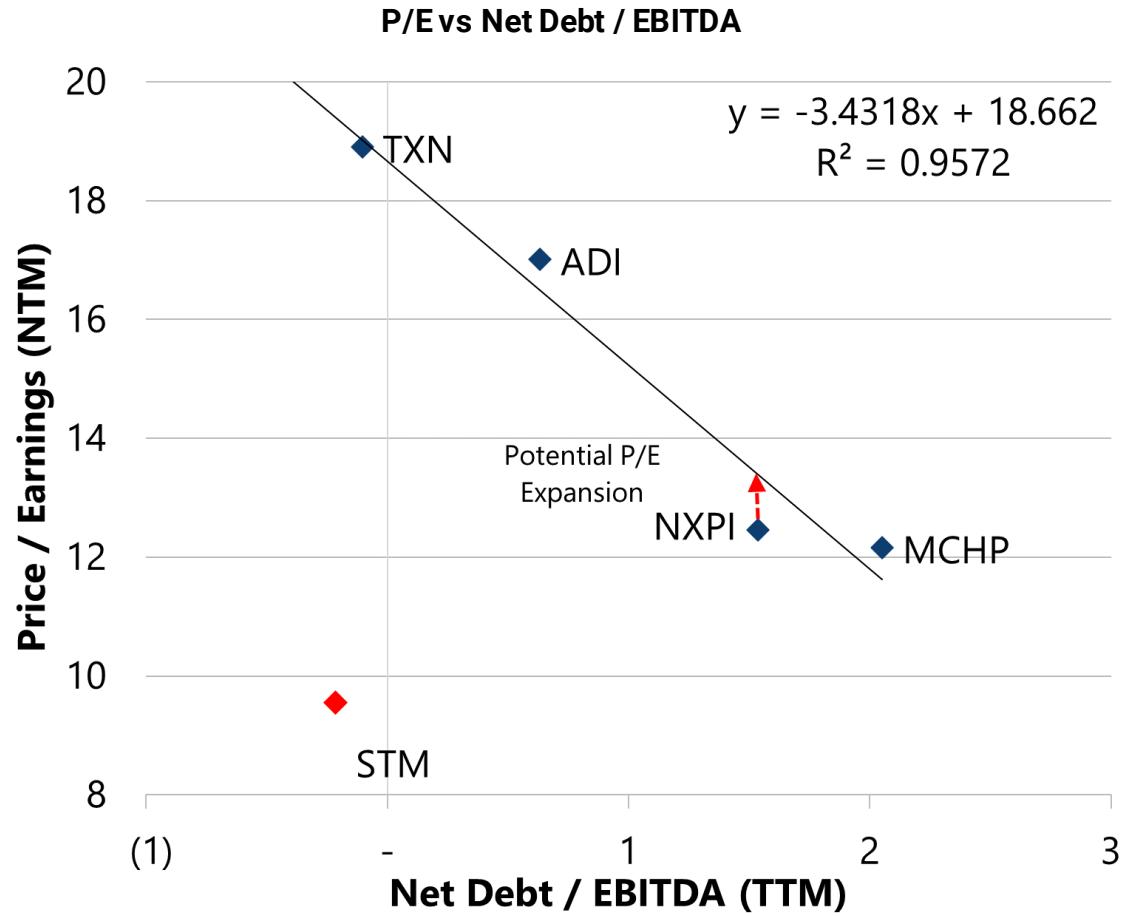


Source: Jefferies, FactSet, company data

NXPI: Large-cap Semi P/E Ratios Are Correlated with Leverage Ratios

Broad-based large-cap semi P/E ratios are inversely correlated with leverage ratios (R-squared 96%).

Based on this framework and NXPI's Net Debt/EBITDA of 1.53x, NXPI appears fairly valued



Source: Jefferies, FactSet, company data

ON: Upgrade – Tectonic Shift Play (*Apr 2019*)

ON: 5yr EPS Power

We assess ON's 2025E earnings power under a bull case scenario of 50% GM, at the top of the 48%-50% range, above the target that ON announced in February. Our 2025E EPS power is \$5.92, down from \$6.02 previously.

2025E EPS Power of \$5.92 Assuming 50% GM At The Top of 48-50% LT

Model	2022E	2025E EPS Power
Revenue, \$m	8,261	9,827
GM, %	49%	50%
OM, %	34%	33%
Other Expense	(86)	(129)
Pre-Tax Profit	2,689	3,114
Taxes	430	545
<i>tax rate, %</i>	16%	18%
Minority	(3)	(2)
Net Income	2,256	2,567
Shares count	441	433
EPS	5.11	5.92

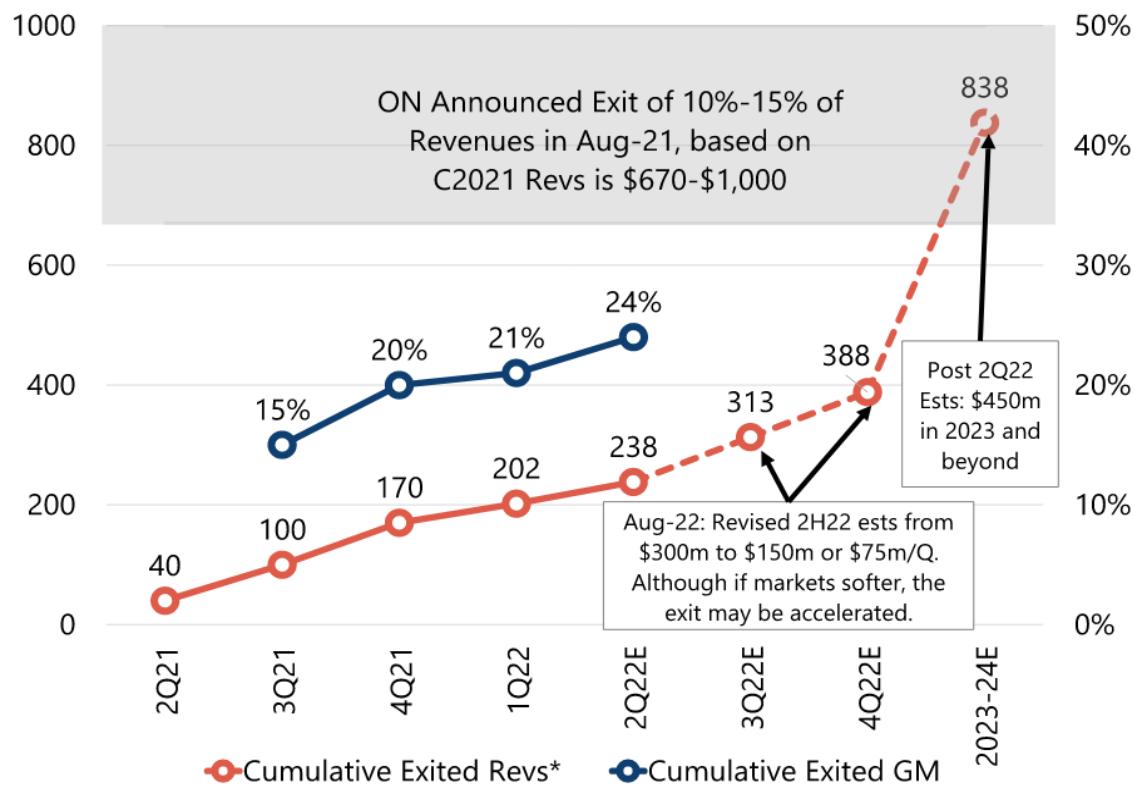
Source: FactSet, Jefferies Research

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ON: Exiting 10-15% of Low Margin Revenues

Back at its Analyst day in Aug 2021, ON announced that it will aim to exit 10%-15% of low margin non-target revenues in C2022-2023. It has already exited ~\$200m and expects to exit another \$300m later in the second part of the year.

ON Exited \$210m In Revs With Avg GM of 24%, Expects To Exit \$150m 2H22

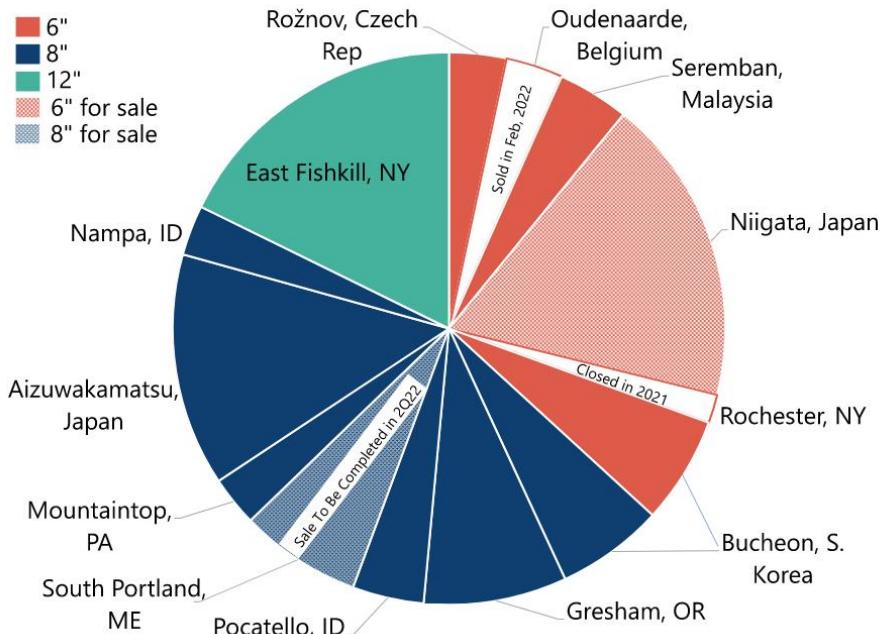


Source: FactSet, Jefferies Research

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ON: Manufacturing Footprint

ON Front-End Manufacturing Footprint



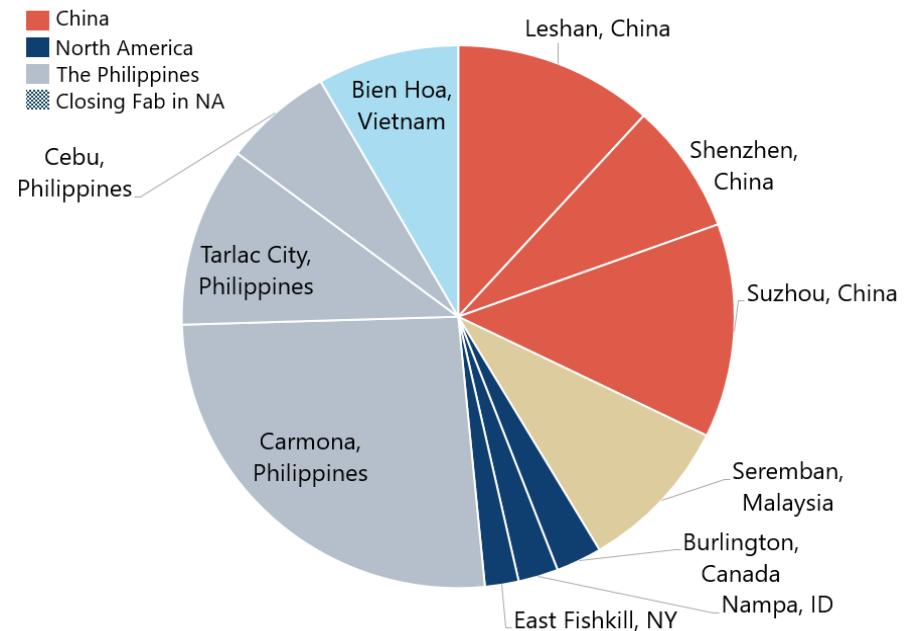
Source: Jefferies, FactSet. Composite includes: TXN, ADI, MCHP, MXIM, ON, indexed to 10-Oct-14, beginning of the 2015 inventory correction

Since 2021 ON has announced that it is divesting of 4 fabs:

Rochester (closed in C2021), Belgium (Sold in Feb 2022), Niigata (pending update), South Portland, ME (Sale exp in 2Q22) The 3 fabs (Belgium, Niigata, and Rochester) are expected to offer \$75m of fixed cost savings with Belgium being ~\$20m. ON estimates South Portland, ME sale to lead to \$35m/yr savings. In all the 4 cases, in cases of fab sale, ON estimates the benefits to come through in ~3 years since deal closing

Source: Jefferies, company data, public sources for East Fishkill and Roznov, Czech Re.

ON Back-End Manufacturing Footprint By Region



Source: Jefferies, company data, FactSet. Analog sample includes TXN+NSM, MXIM, ON+FCS, MCHP+ATML+MSCC, ADI+LLTC.

This pie chart shows ON's backend manufacturing footprint - 12 facilities on three continents

We think Starboard makes a fair point, and perhaps ON could realize cost synergies by consolidating/rationalizing its far-flung backend facilities as well

LSCC: Small-Cap Pure Play FPGA

Near Term/Long Term Strategy

In the near term, management has been "cleaning up" and shutting down low-ROI projects in R&D, and has increased its focus on helping to get critical design wins currently in the pipeline to the market faster.

Management highlighted three longer-term areas of strategic focus:

- 1) Consistent cadence of new products. Feedback from customers has been that Lattice products are good, but that execution of new product releases has been erratic and unreliable. The CEO believes that large OEM customers buy roadmaps over specific products, and is focused on delivering innovation on a consistent and reliable basis at Lattice.
- 2) More discipline on pricing to help gross margins. The CEO believes there is potential to stabilize or increase pricing on older products, to decelerate price declines on newer products, and optimize pricing with distributors.
- 3) R&D focus on high-margin, long-lifecycle products. Management has shifted the R&D focus away from shorter- lifecycle consumer markets, and toward longer-lifecycle, higher margin Industrial, Automotive, Compute (datacenter) and Communications, markets.

3 yr. LSCC EPS Power

3 yr EPS Power	Implied Long Term Model		
	Target	15% Rev Growth	20% Rev Growth
Revenue	Double-digits	784	890
Gross Margin	73.0%	572	650
R&D	19.5%	153	174
SG&A	13.0%	102	116
OpEx	32.5%	255	289
EBIT	40.5%	317	361
Interest	Debt leverage <2x	(4)	(4)
Tax	Assumed @ 5%	(16)	(18)
NI		298	339
Shares o/s		141	141
EPS Power	\$	2.12	\$ 2.41

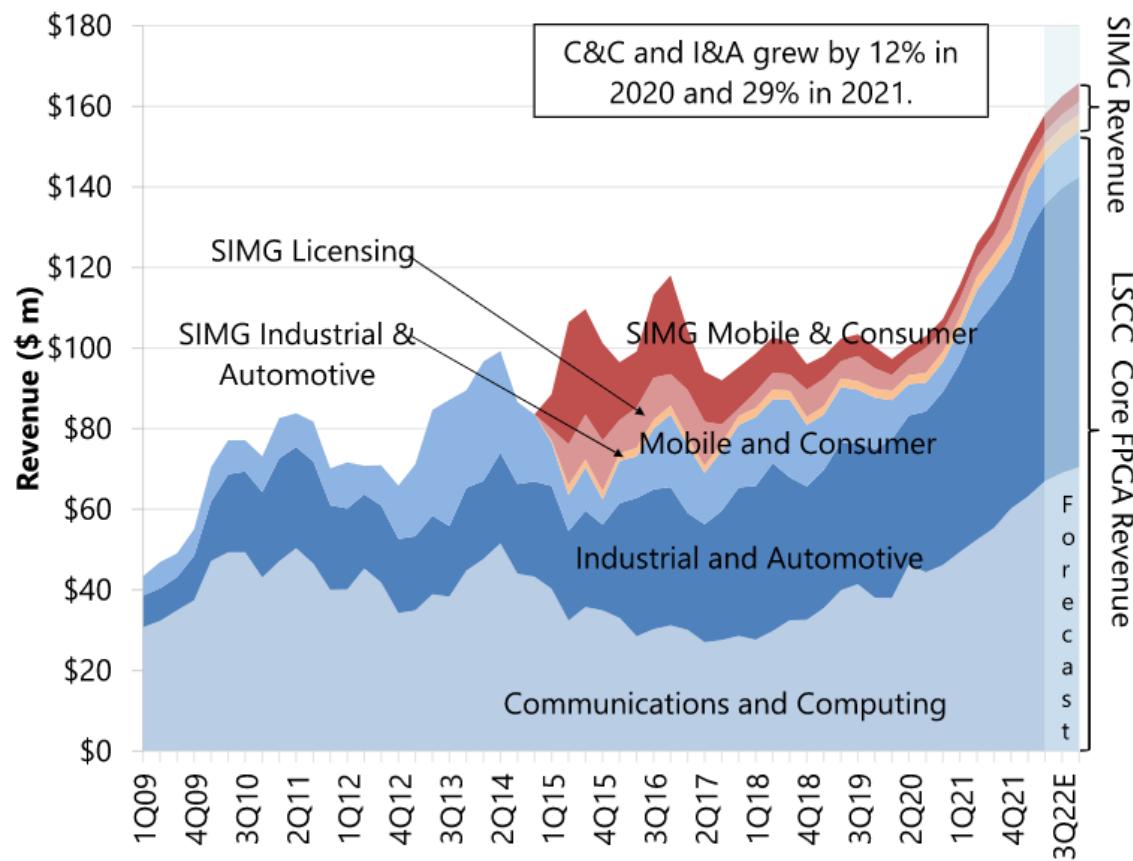
We estimate LSCC 2024 EPS of \$2.41, assuming a 3-yr CAGR of 20% from 2021 revenues, GM of 73% and OpEx of 40.5%. Given LSCC's continued strong execution of its price optimization strategy, we raise the long-term GM target to 73% vs. prior 66.5%. We think LSCC GM can expand to XLNX's margin levels

Source: Jefferies estimates, company data

LSCC: Revenue by End-Market

We show that the SIMG acquisition and M&C decline due to reduced demand during the pandemic and the company's strategy shift mask the expansion of LSCC's long-term growth businesses (C&C and I&A). C&C and I&A revenue grew 10% YY in 2019, 12% in 2020, and 29% in 2021. In 2022, we project C&C and I&A to grow by 24% and 30% YY, respectively.

LSCC Revenue Segment



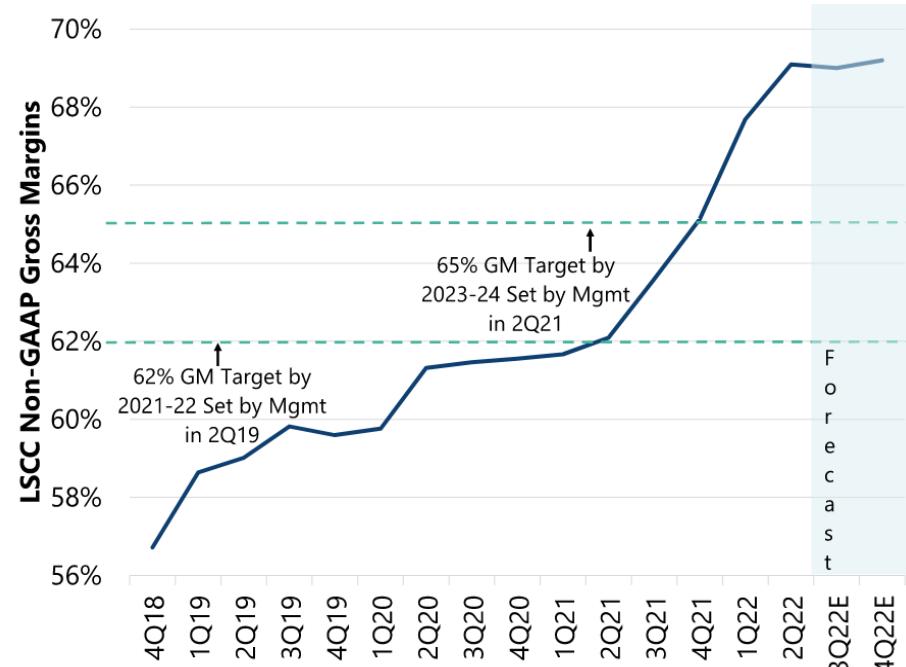
Source: Jefferies estimates, company data

LSCC Product Cycle and Gross Margins

Product Cycle	Growth Drivers	Timeline
Avant Platform	Mid-Range Platform	
		Launching in 2H22
Nexus Platform	28nm FD-SOI Platform	
CrossLink - NX	Low power FPGAs for embedded vision. Initially focused in consumer markets expected to penetrate into industrial IoT for factory automation applications	Launched in 4Q19. Rev ramp in 2021. First revenue achieved in 4Q20 and grew in 1Q21. Currently ramping
Certus-NX	General Purpose low power FPGAs targeting all end-markets	Launched production in 1Q21. Currently ramping
Mach - NX	Second generation security FPGA	Launched in December 2020. Entered production in 4Q21
CertusPro-NX	Advanced General Purpose FPGAs that leverages architecture of Certus-NX	Launched in June 2021. On track to generate revenues in 1H22
MachXO5-NX	Enhances system monitoring and control in LSCC's core markets	Launched in May 2022
Nexus #6		TBA
Software		
Sense AI	Enables the deployment of machine learning applications on FPGAs	Currently ramping
mVision	Enables embedded vision across multiple end-markets	Launched in 1Q20
Sentry	Focused on security application	Launched in August 2020
Automate	Focused on accelerating factory automation and robotics	Launched in May 2021
5G ORAN Stack	Focused on open radio access networks standard for more rapid build-out of 5G network	Launched in May 2022
Next Solution Stack		TBA

We think the company's increased focus on delivering software stacks create a moat, accelerate revenue growth, enhance visibility through 2022. Avant is on track to launch in 2H22 and ramp in 2023

Source: Jefferies estimates, company data



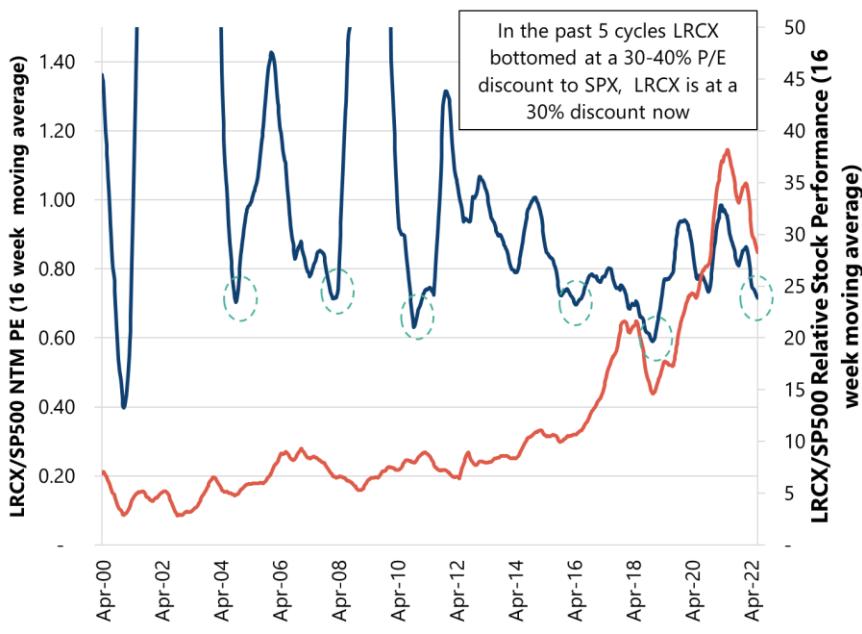
Since LSCC's CEO joined in September 2018, gross margins have expanded by ~280bps on average per year. We expect gross margin to continue increasing through 2022 after LSCC guided 3Q22 non-GAAP gross margins to be 69.0%. Mgmt noted pricing optimization, better mix and contribution from higher-margin newer products driving expansion in GM.

Mgmt noted pricing optimization, better mix and contribution from higher-margin newer products driving expansion in GM.

LRCX: Moore's Bend Play – Buy the Confession

LRCX: Buy the Confession

LRCX is Trading at a 30% Discount to SPX

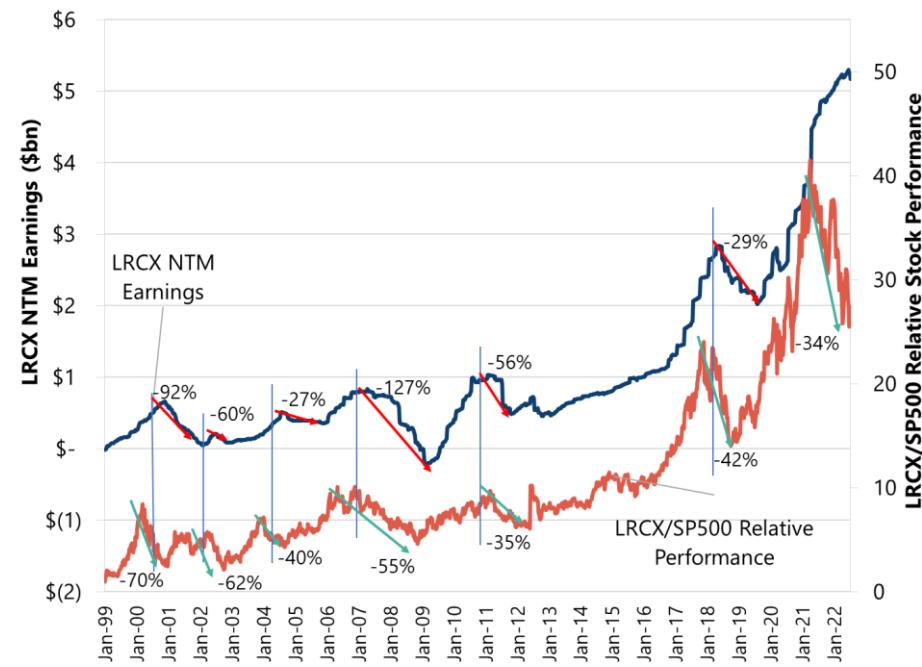


Source: Jefferies, FactSet

Over the past 5 cycles, relative to the SPX, LRCX bottomed at a 30-40% P/E discount to the SPX. LRCX is currently trading at a 30% discount to SPX.

We think LRCX's PE has bottomed, and the secular demand drivers of WFE such as rising semiconductor content, increasing device complexity and larger die size remain intact

LRCX has Underperformed the SPX by 34%



Since the peak in Apr-21, LRCX has underperformed the SPX by 34%, compared to 42% and 35% in the previous two cycles

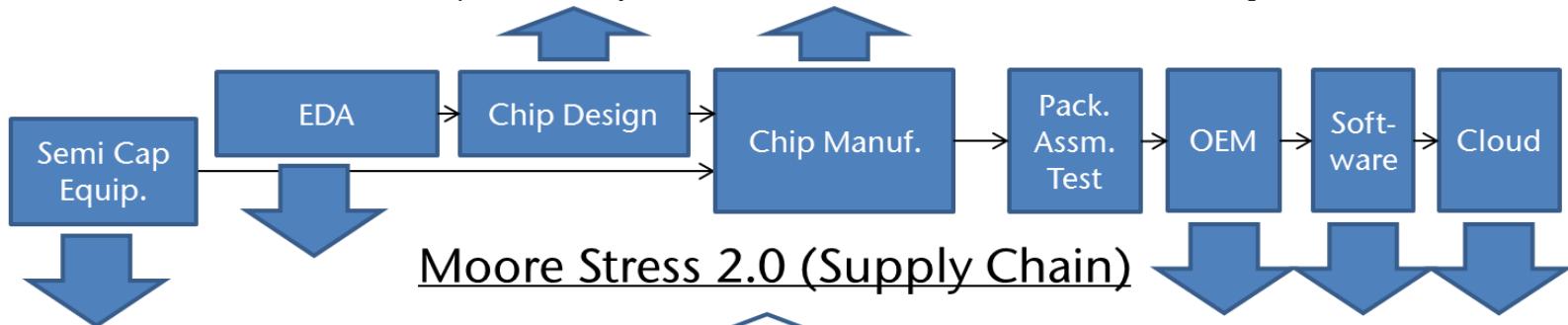
Source: Jefferies, FactSet

Moore Stress 2.0: Follow the Money

Moore Stress 2.0: Follow the Money

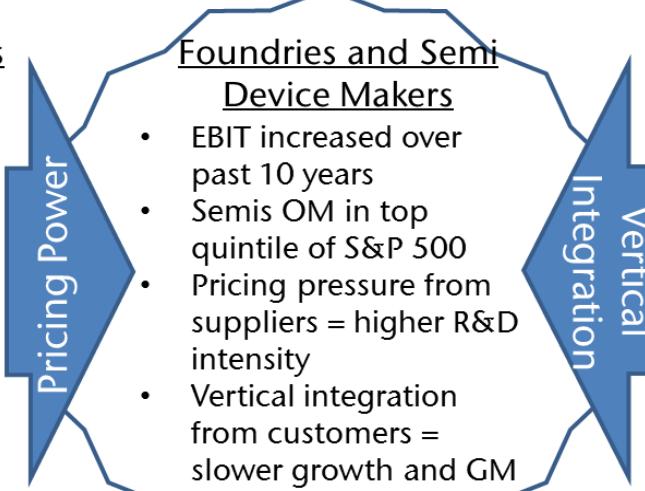
Moore Stress (Impact on Semis)

- Slower transistor cost reductions = structural industry shift within Semis
- Slower memory supply growth means Memory stocks transition to investment vehicles from trading vehicles
- Slower growth from Leading Edge Fabless and Pure Play Foundry
- Higher growth from Analog Integrators
- Critical mass required to stay on transistor cost curve = Intel and Samsung benefit



Semiconductor Suppliers

- SPE EBIT declined over past 10 years
- Slower industry growth has lead to consolidation in EDA and Semi-Cap Equipment
- Moderating transistor cost curve makes EDA and Semi-Cap Equipment upgrades more valuable
- Expect increased pricing power and increased profitability for EDA and Semi-Cap industries



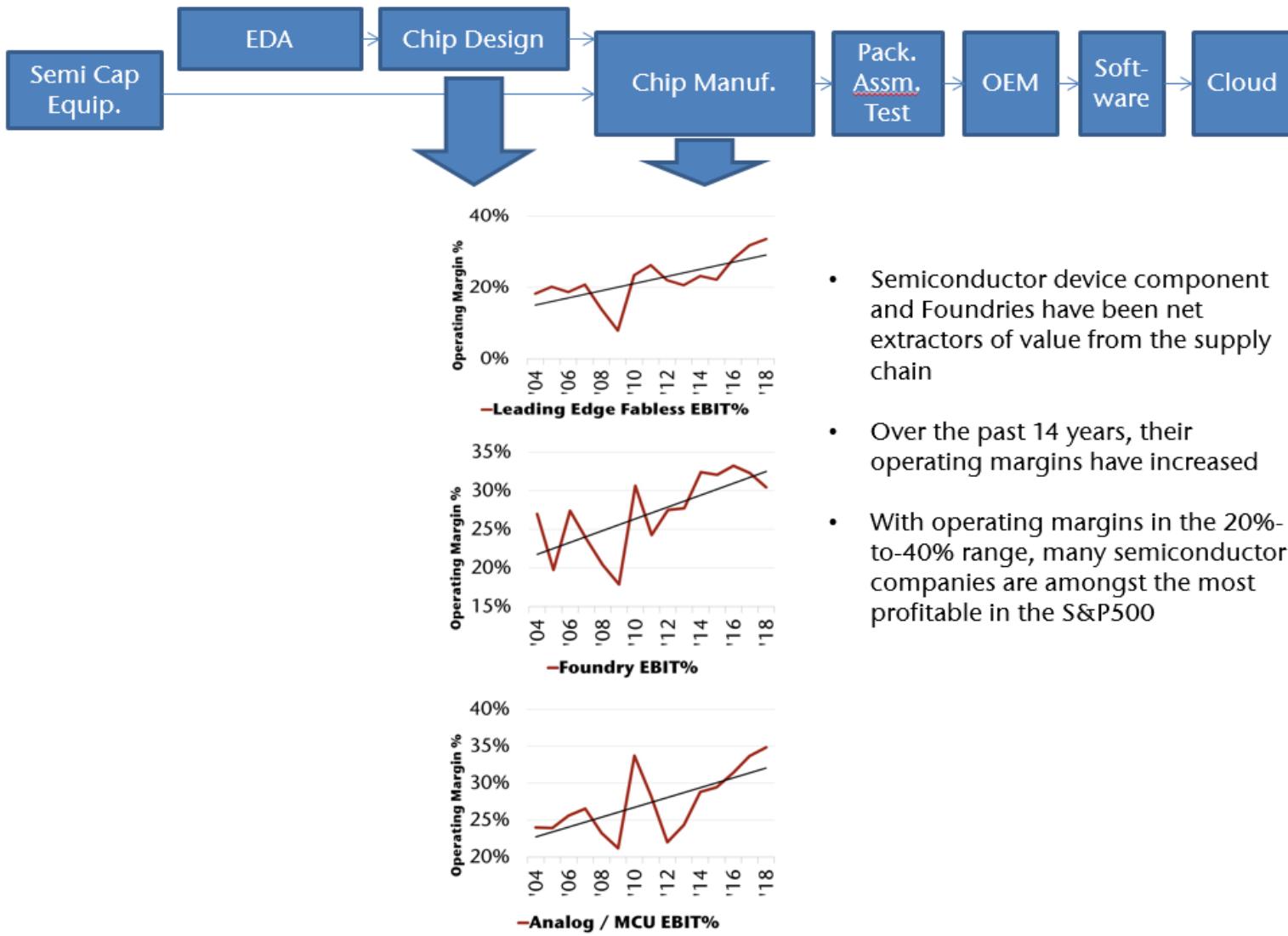
Semiconductor Customers

- EBIT declined over past 10 years
- Slower transistor cost reductions levels playing field in circuit design
- Expect more vertical integration
- Higher volume chips designed by OEM's

Source: Jefferies

Mark Lipacis, Equity Analyst, (415) 229-1438, mlipacis@jefferies.com

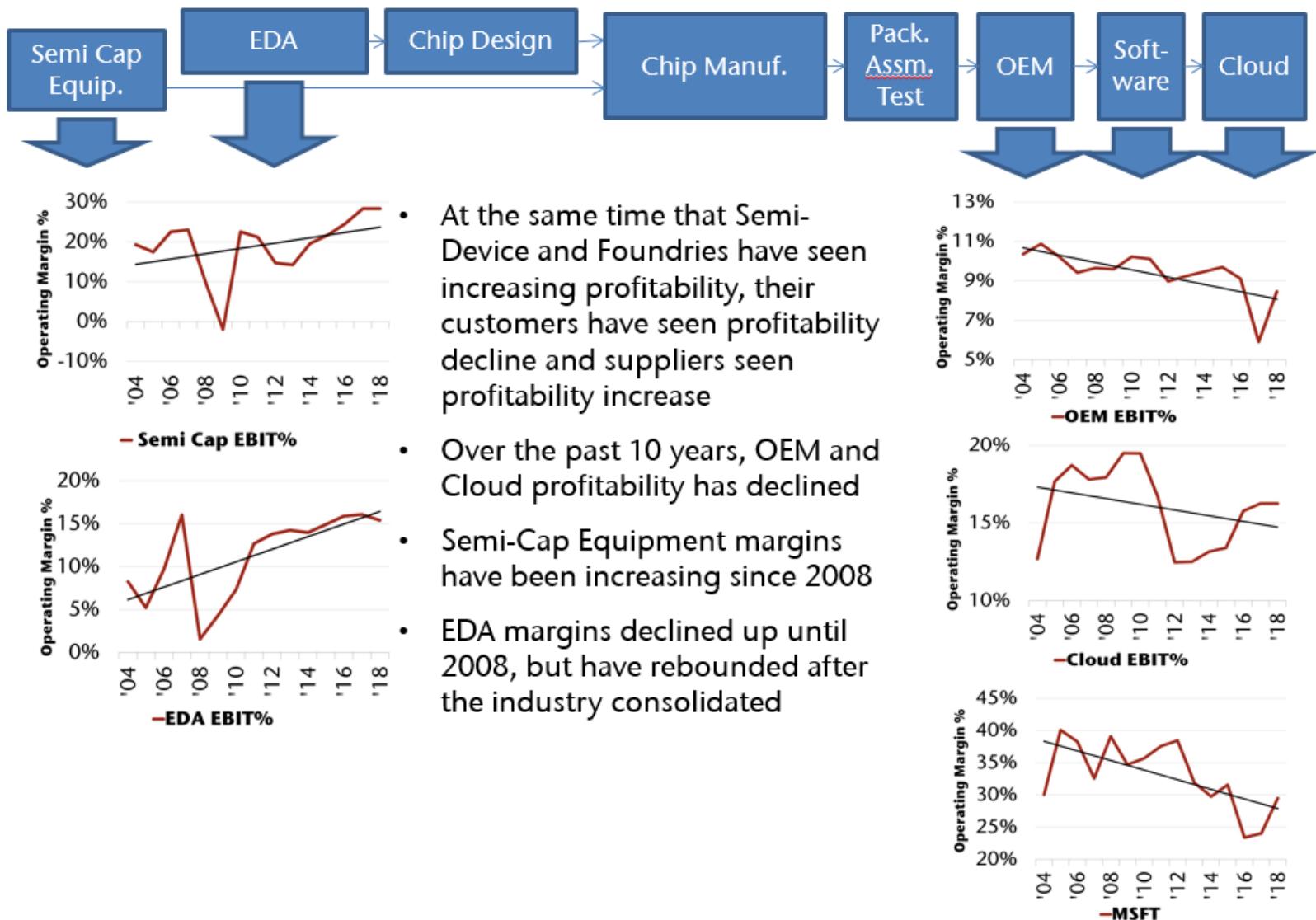
Moore Stress 2.0: Follow the Money



- Semiconductor device component and Foundries have been net extractors of value from the supply chain
- Over the past 14 years, their operating margins have increased
- With operating margins in the 20%-to-40% range, many semiconductor companies are amongst the most profitable in the S&P500

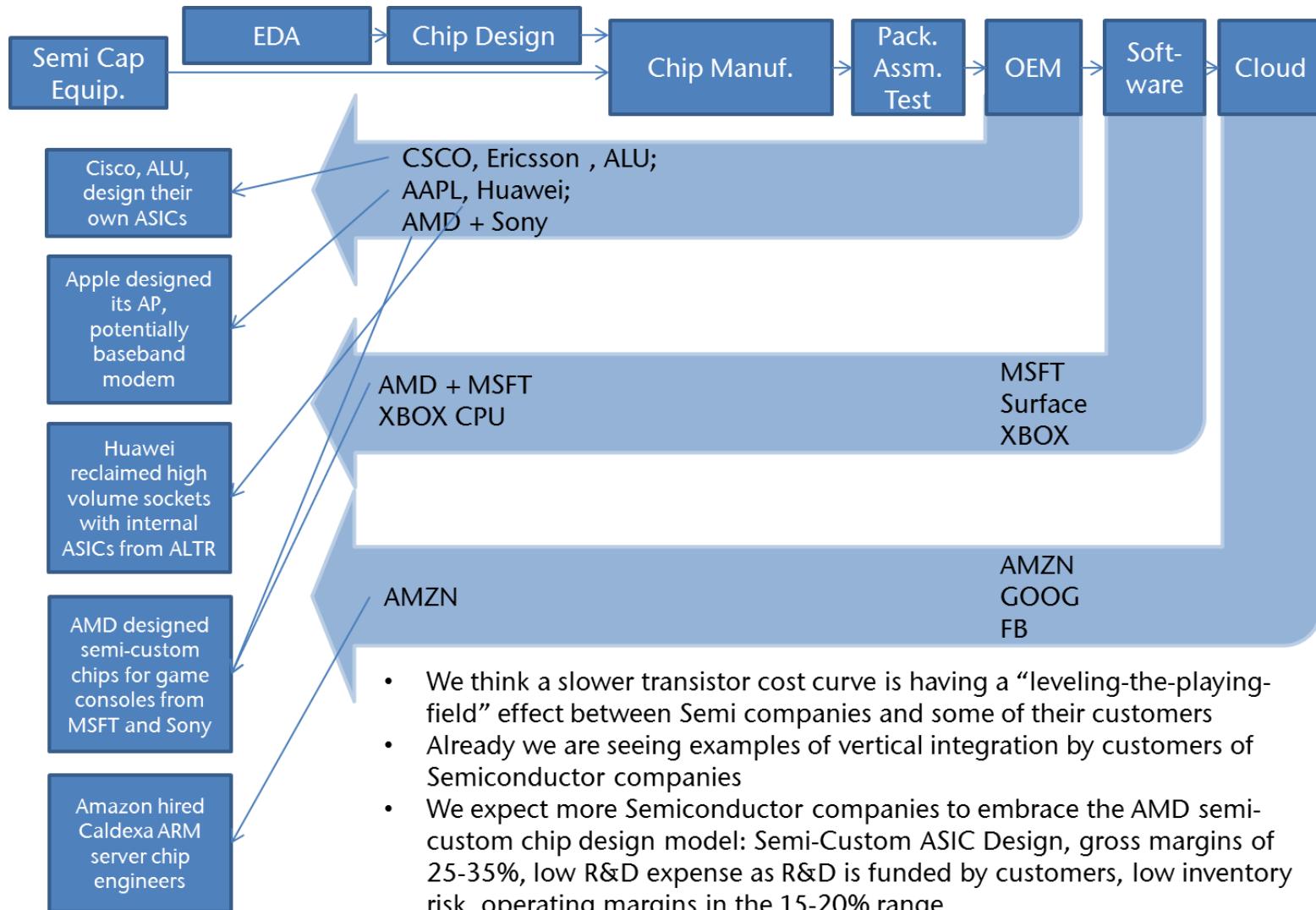
Source: Jefferies, company data

Moore Stress 2.0: Follow the Money



Source: Jefferies, company data

Moore Stress 2.0: Follow the Money



Source: Jefferies, company data

Data Points on OEMs Moving to Chip Design

Microsoft & Sony	<ul style="list-style-type: none"> Engaged AMD to design custom chips for Xbox One and PS4 	Moor Insights: The Real Reasons Microsoft, Sony Chose AMD For The Xbox One And PS4
Apple	<ul style="list-style-type: none"> Acquired SoC designer PA Semi (April 2008) Acquired core accelerator chip designer Intrinsity (April 2010) 	Wired: Four Reasons Apple Bought PA Semi The New York Times: Apple Buys Intrinsity, a Maker of Fast Chips
Amazon	<ul style="list-style-type: none"> Hired former Calxeda engineers Posted job openings for CPU Architects (April 2014) 	GigaOm: Amazon joins other web giants trying to design its own chips
Google	<ul style="list-style-type: none"> Acquired Agnilux (April 2010) Designed data center switches 	Ars Technica: Google Buys Secret Chip Startup Wired: Mystery Google Device Appears in Small-Town Iowa
Huawei	<ul style="list-style-type: none"> Huawei's internal ASIC design team, HiSilicon, licensed ARM (2011) Captured high-volume design wins from Altera (2H12) 	ARM: HiSilicon Licenses ARM Technology for use in Innovative 3G/4G Base Station, Networking Infrastructure and Mobile Computing Applications eetimes: Huawei Using ASICs for First Time
Facebook	<ul style="list-style-type: none"> Collaborates with Intel on server chip designs 	Wired: The Facebook Special: How Intel Builds Custom Chips for Giants of the Web
ZTE	<ul style="list-style-type: none"> Signs license to use CEVA DSP cores in internal ASIC designs 	eetimes: Ceva-ZTE Deal Hints Home-Grown ASIC Is Back
Cisco	<ul style="list-style-type: none"> Has large internal team actively engaged in ASIC design 	Seeking Alpha: Cisco announces new network processor, EZchip tumbles
Alcatel-Lucent	<ul style="list-style-type: none"> Also has an internal ASIC design team 	Itweb: Alcatel-Lucent Enterprise to address network application challenge with new access switch, added analytics, SDN capabilities

Source: Jefferies; "Rise and Fall of Minicomputers", Engineering and Technology History Wiki

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