

Semis Weekly 29-Sep-23: Channel Checks, Marketing Feedback

In our "Semis on Fire" videos, we strive to highlight differentiated insights and distill them into a short video format. This week, we highlight takeaways from our [latest channel checks](#) and marketing. Inventories are high across the supply chain, but pricing is stable, and end demand is OK. Investor sentiment is cautious with SOX strong relative performance YTD and inventory concerns. Our top picks are NVDA, AMAT, TXN, CAMT, and ONTO. Video link [here](#).

Lots of Inventory, Backlogs Are Declining, But End-Demand Is "OK". We spoke with two contacts in the supply chain, a distributor in the US and a component procurement officer for a European car maker. The main takes are that there is a lot of inventory everywhere, lead times are normal, backlogs are declining, and most want to reduce inventories. On the positive side, pricing is stable, end demand is OK, and we heard that at least one auto-maker plans to increase production in the fall.

Investors Concerned Another Inventory Shoe Will Drop. Our read after a week of marketing is investors seem cautious on semis, largely because the SOX materially outperformed over the past year, and most feel another inventory shoe has yet to drop, especially with an Auto workers' strike and what seems to be an elevated risk of a recession next year.

#1 Question From Investors: Are NVDA DC Expectations Justified vs. CSP CapEx?

- The most common topic was NVDA, with debates around whether buy-side forecasts for datacenter revenues of \$80 billion next year could be justified compared to hyperscaler CapEx, whether \$25K GPU cards open the door for homegrown solutions, and whether more efficient GPUs lowers unit demand. Investors also wanted to discuss the prospects for AMD's MI300 next year, and whether Auto chip revs would ultimately have to roll over, given risk of a strike.
- On the SemiCap Equipment side, investors are concerned that demand would roll over, either due to overbuild or geopolitically driven restrictions. Investors also seemed to be concerned about Auto revenues, which are largely above trendline.

SOX Pattern: Sell-off Before Earnings -> Trade Up Through Earnings. Heading into earnings seasons, we've observed a SOX trading pattern that we want to put on your radar. In eight of the last 10 earnings seasons the SOX underperformed heading into earnings season, and then bottomed and traded up through earnings season. This pattern took a pause last quarter, but given that the SOX has underperformed over the past three weeks, and sentiment is cautious,

Buy: NVDA, AMAT, TXN, CAMT and ONTO. We view the weakness as an opportunity to add our top picks: NVDA, AMAT, TXN, CAMT, and ONTO. We think NVDA and AMAT have the best chance to post upside surprises.

Join Our Channel Checks Call on October 18, at 10am ET / 7am PT / 2pm GMT with electronics components supply chain expert Richard Kwartek, who is conducting a series of checks across the supply chain. Topics will include order and inventory trends, demand trends across geographies and vertical markets, and an update on supply and logistics constraints. **Registration Link:** [here](#)



Register for Our Next Channel Checks Call on 18-Oct-23 at 10am ET: <https://www.com/webcast/cc/jef29/1359360>

Links to Related Research:

25-Sep-23: [Channel Checks 25-Sep-23: Inventories Flush, Backlogs Declining, Demand "OK"](#)

22-Sep-23: [Semis Weekly 22-Sep-23: Updated Cycle Charts](#)

18-Sep-23: [CAMT Building Metrology Portfolio for Packaging - Buying FORM's FRT Metrology](#)

14-Sep-23: [Advanced Packaging and Tectonic Shifts - a 10x Opportunity \(or is it 100x?\)](#)

13-Sep-23: [Cloud Instance Jul '23: Graviton, Ampere Yitian 40% of CPU Instances](#)

8-Sep-23: [Sep '23 Lead Times Shrink, ASPs Flatten](#)

1-Sep-23: [Semis on Fire: Chicago Semi Conf. Recap](#)

30/31-Aug-23: [Notes from Day 2 of 2023 Jefferies Semis Conference, Day 1](#)

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

Vedvati Shrotre * | Equity Analyst
(415) 229-1574 | vshrotre@jefferies.com

Natalia Winkler, CFA * | Equity Analyst
(415) 229-1511 | nwinkler@jefferies.com

Brian Chen, CFA * | Equity Associate
(415) 229-1478 | bchen1@jefferies.com

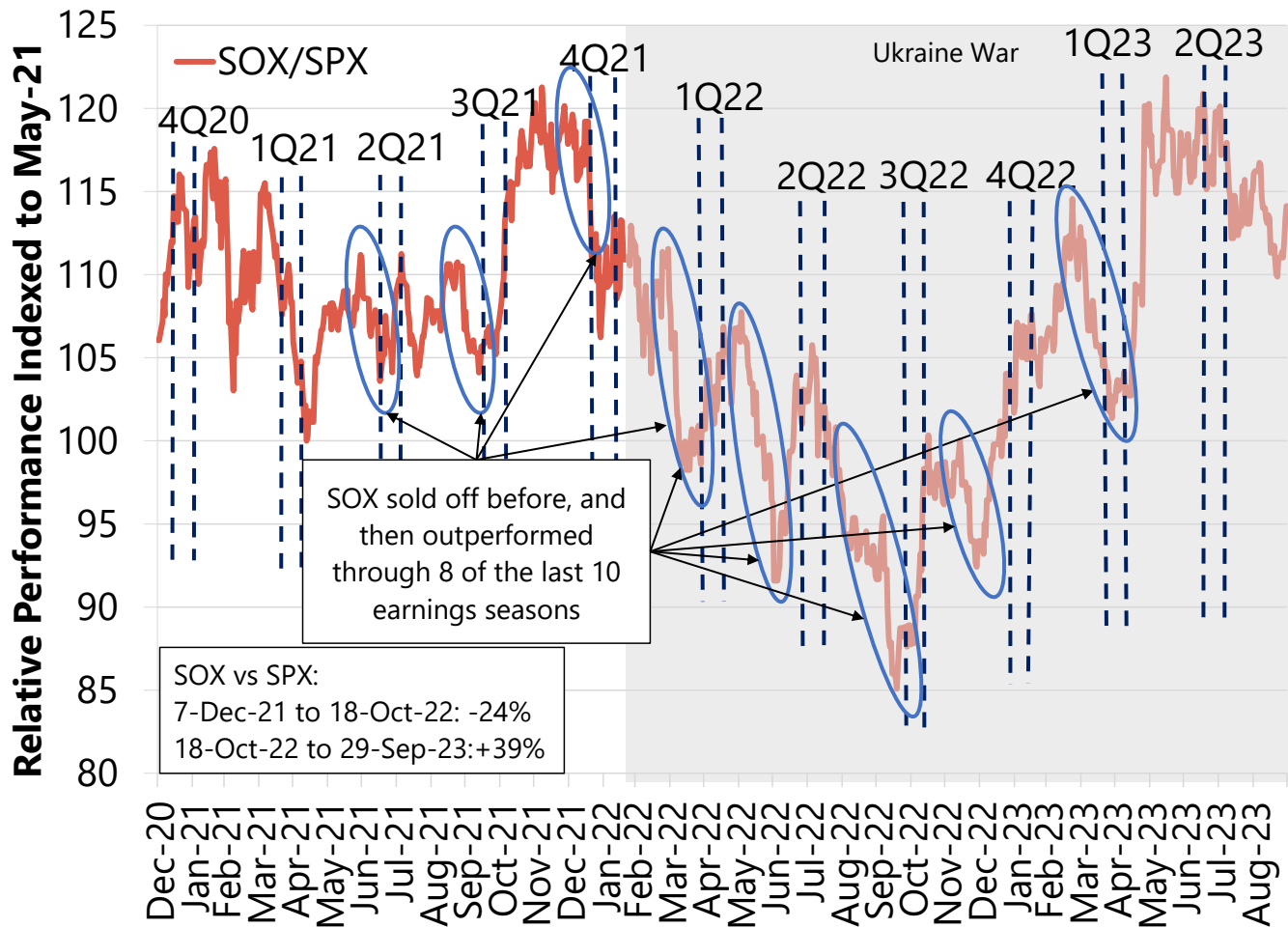
Table of Contents

(ToC below is hypertext linked)

	Page
Highlighted Charts	3
Inventory and Lead Time Charts	15
Broad-based Semis Performance	22
Highlighted Semi-Cap Charts	24
2Q23 Earnings Season Summary	27
Datacenter Trends	29
Semis Cycle Charts	34
Semis Comp Tables	37

Highlighted Charts

Chart 1 - After underperforming the SPX by 12% between 23-Mar-23 and 27-Apr-23, the SOX recaptured its underperformance, outperforming the SPX by 19% to 30-May-23 since the local trough in April. SOX has outperformed 280bps this week
SOX-SPX Relative Performance Indexed to May-2021



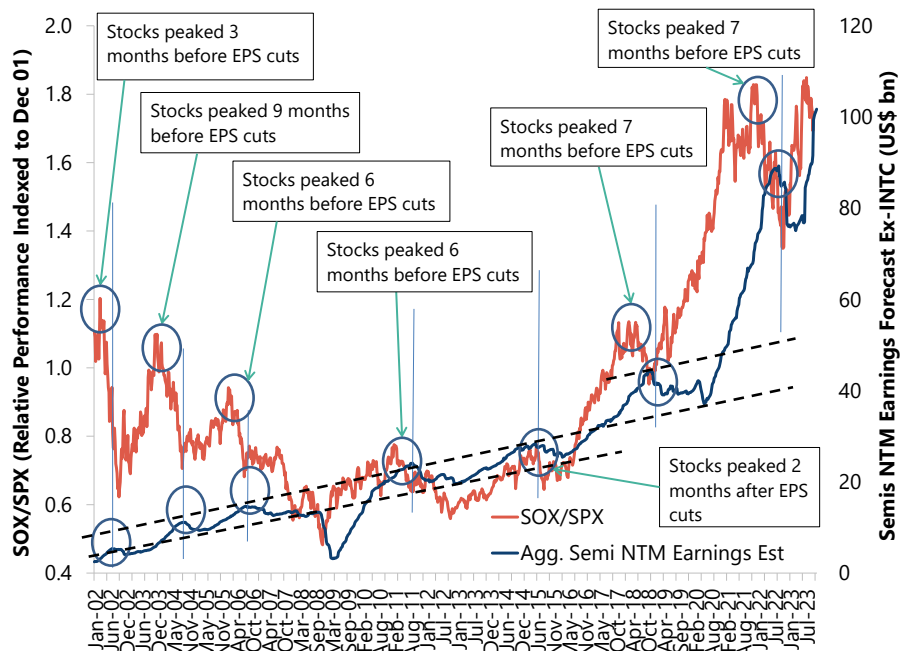
Source: Source: Jefferies, FactSet

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

The SOX outperformed the SPX by 50% since bottoming in Oct '22, and hit its first higher-low in Dec '22, first higher-high in Feb '23 and subsequent higher-highs in mid-March and mid-June

The SOX outperformed the SPX by 280bps this week. After underperforming the SPX by 12% between 23-Mar and 27-Apr, SOX outperformed the SPX by 19% to 30-May since the local trough on 27-Apr, and SOX outperformed SPX by 6% trough to peak from 5-Jun to 14-Jun.

Chart 2 - Semis Peak 6 Months Before Cuts, and Bottom When Cuts Start
Semiconductor NTM Net Income Forecast



Source: FactSet, Jefferies

Blue Line: Aggregate NTM earnings estimates for a large sample of semiconductor stocks

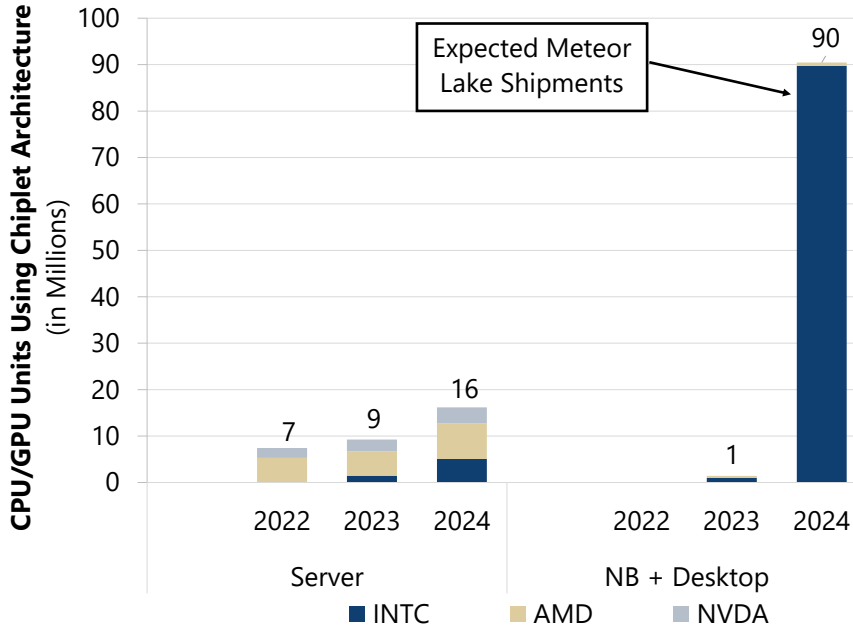
Red Line: Relative performance of the SOX vs SPX

Over the past 20 years, the SOX relative performance vs SPX has typically peaked 3-9 months before aggregate semiconductor earnings cuts

In this cycle, estimate cuts started in July '22, and the SOX bottomed in Oct '22 after underperforming for 10.5 months.

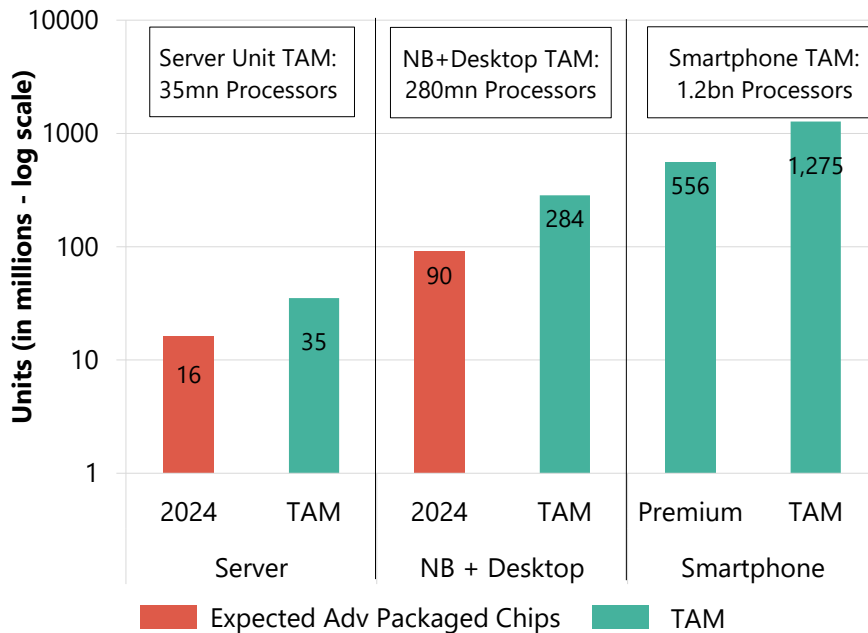
We highlight that EPS downward revisions have paused recently. We note that pauses in EPS downward revisions in 2002, 2004, and 2019 coincided with a give-back of initial outperformance for 5-12 weeks in the early part of the cycle.

Chart 3 - We Expect The Number of Chips That Ship Using Advanced Packaging Will Increase by 10x Over The Next 18 Months



Source: Jefferies, Mercury

Chart 4 - Should Advanced Packaging Penetrate Handsets, That Would Present a 100x Unit Opportunity over 2023



Source: Jefferies, Mercury, Gartner

AMD was one of the early volume users of advanced packaging for its server CPUs. NVDA embraced the technology for its A100/H100 processors, which use HBM and TSMC's CoWoS/2.5D packaging techniques. More recently, Intel's Sapphire Rapids server CPU shipped using advanced packaging to stitch together four 400mm² die, with some versions also using HBM, and we expect this will be followed by its Emerald Rapids server CPU in 4Q23

In aggregate, we estimate that in 2023, about 9 million datacenter processors will ship using advanced packaging technology, and that will expand to 16m in 2024

Perhaps more exciting, is that INTC expects to launch its first high-volume CPU that uses advanced packaging in 2H24, called Meteor Lake

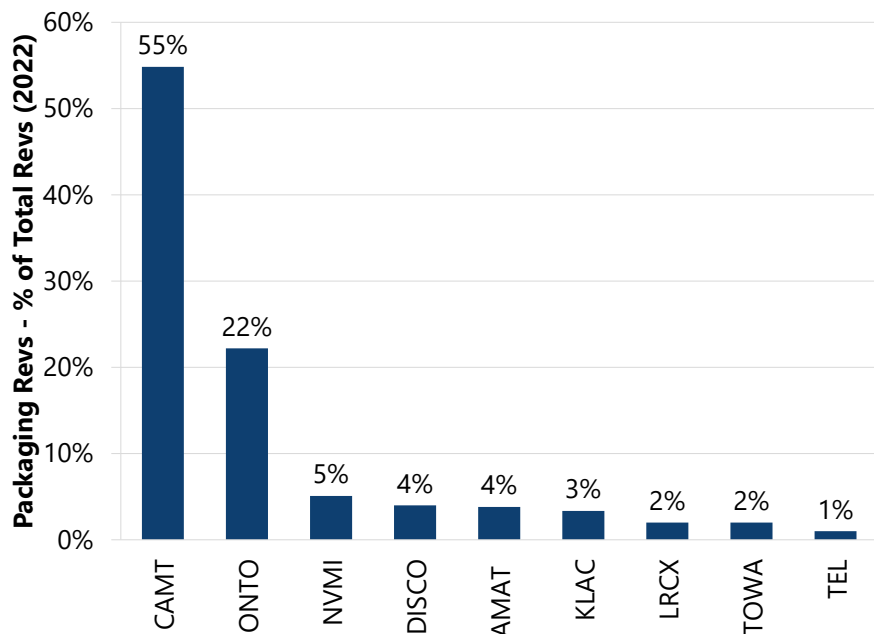
Meteor Lake uses a quad-tiled chiplet architecture using INTC's Foveros packaging technology. Post Meteor Lake, Intel's Arrow Lake is expected to launch late 2024 and is also expected to be a chiplet design. In 2024, Mercury expects INTC to ship 90m Meteor Lake and Arrow Lake CPUs

In the next 3-to-5 years, we expect chiplet architectures to capture 90-100% of the server and notebook/desktop units sold annually. This implies chiplet designed server processors units could grow 2x from 16mn to 35mn. In NB/desktop markets chiplet designed processor units could grow 3x from 90m to 280m

The dream scenario for the advanced packaging players would be the handset market. We believe that advanced packaging penetration into this market could potentially be driven by the demand for Large-Language-Models to be inferred locally in handsets, for the purposes of lower latency response to GenAI queries or the need to use LLMs while offline. We estimate the premium Smartphone market at over 500m units annually, while the TAM of all Smartphones to be approach 1.3bn units

Chart 5 - CAMT, ONTO Have Highest Rev Exposure to Packaging

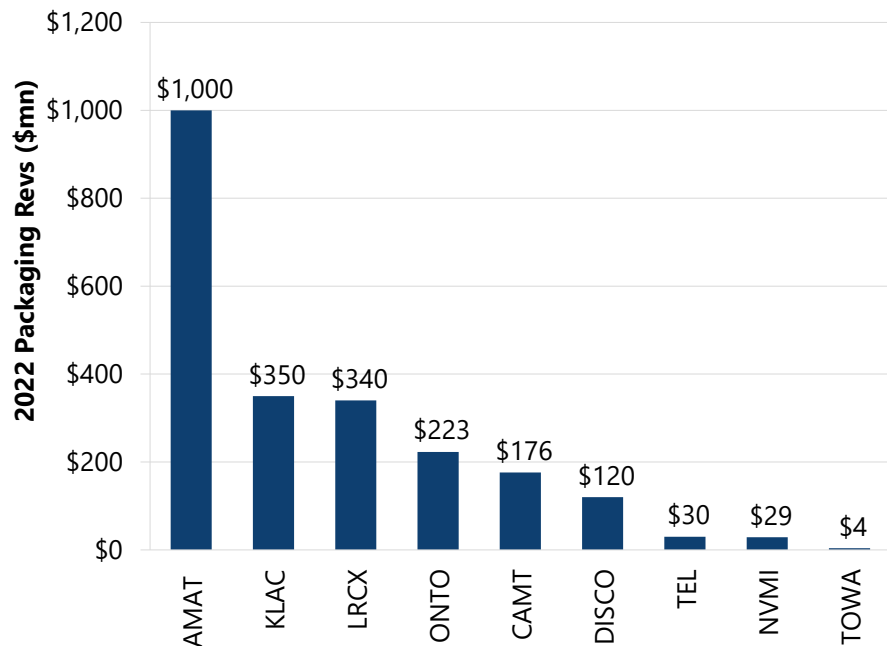
CAMT and ONTO have the highest packaging revenue exposure in our coverage universe



Source: Jefferies, Mgmt. Commentary, TechInsights

Chart 6 - AMAT has Highest Revs from Advanced Packages

AMAT has the highest revenues from packaging applications



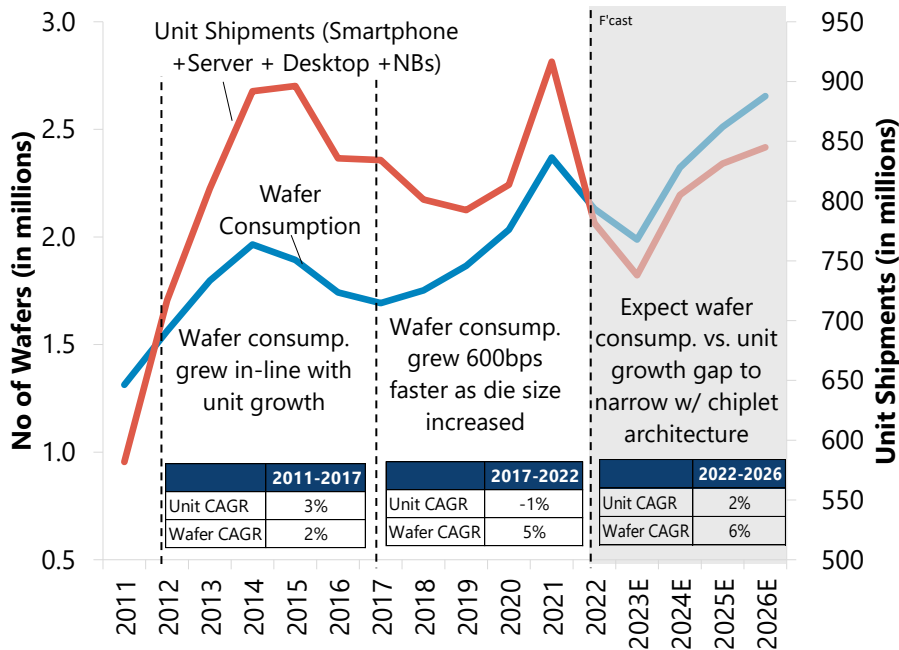
Source: Jefferies, Mgmt. commentary, TechInsights

Chart 7 - Semicap Earnings Recap

WFE Outlook		
2023 WFE Outlook: ~\$75bn	LRCX	"We see WFE spending in 2023 tracking to mid-\$70B range vs. prior low \$70s range, with the upside coming from domestic China-related spending, and strong growth in HBM demand"
	KLAC	"WFE outlook for 2023 remains largely unchanged at down approximately 20% from \$95 million in 2022."
Advanced Packaging		
All SCE companies in our coverage noted strong growth in packaging with growing investment in HBM and chiplet architectures. Most expect growth to continue into 2024	LRCX	"HBM and 3D chip stacking is a very fast-growing part of our business. "what I would say is in this environment, those are the tool sets that people are actually pulling for in terms of accelerated deliveries "
	KLAC	" Packaging is a small part of the business right now but is growing "
	TER	" ...Although HBM represents a small portion of the overall memory market, it is in a rapid growth phase, moving from under 5% of the test market last year to 10% to 15% of the market in 2023 "
	CAMT	" We're definitely seeing customers are more ready to place orders. We're seeing a much higher conversion from the pipeline into the backlog. And if we look at the overall backlog for 2024 plus the pipelines , so we think we have a good visibility moving forward, and this goes to our expectation towards 2024"
	ONTO	"...surging demand for our Dragonfly inspection systems to support heterogeneous packaging and high-bandwidth memory customers..." "...our support specifically for AI devices, i.e., NVIDIA and some of the CoWoS and HBM that were mentioned that we can see continuing to strengthen straight through the year... "
	AMAT	" Packaging, that's \$1 billion business for us now and we see an opportunity to double that over the next few years "
Trailing Node Demand		
SCE Companies noted continued strength in trailing node demand. Most companies haven't seen signs of this demand rolling over	LRCX	" ...continued strength in the specialty node investments , which are serviced by our Reliant systems business" " ...We haven't yet seen demand for those trailing-edge technologies to really be rolling over. "
	TER	"Automotive demand has remained strong "
	NVMI	Spread across IoT, automotive and advanced packaging
	ONTO	" Revenue from our power device customers grew over 35% and included our product portfolio of inspection, metrology and software solutions. This was our largest market in the quarter " " we see power semiconductors for the fourth quarter remaining fairly strong "
	AMAT	"...The ICAPS business growth has been strong enough to offset weakness in NAND and leading logic... " "We see ICAPS demand as sustainable , as these customers are delivering enabling technology for large, global inflections that will play out over the next decade.
Memory & Leading Edge Logic Spending		
Utilization remain low; limited signs of recovery in memory market. In Leading-edge logic, KLAC noted seeing higher forecast for utilization vs. prior Qtr	LRCX	" ...NAND spending is at the lowest levels we've seen since the advent of the 3D NAND architecture... " " ...we haven't really seen utilizations getting any better "
	KLAC	"...While the timing of a meaningful resumption in WFE investment growth remains unclear " " ...where utilization rates are higher than what have been forecasted by our customers at the beginning of the year, specifically in leading-edge logic foundry. So that has been an upside. " ...Memory looks a little bit slower in that regard...not really seeing any changes in overall utilization rates in memory "
	TER	"Memory Test, the growth of DDR5 and HBM devices for data center applications are driving retooling" " continued weakness in mobility has been offset by sustained strength in the automotive segment "
	ONTO	" We still see headwinds in the advanced nodes, primarily from DRAM manufacturers, and we expect revenue to decline again in the third quarter, which we believe will mark a bottom for front-end memory overall. We're optimistic for a possible recovery in the second half next year as customers like Samsung are beginning to talk about the launch of new smartphones and PC promotions in the second half of 2023 being a catalyst for customer inventory reductions going into next year"

Source: Jefferies, Company data, FactSet

Chart 8 - We Expect Wafer Consumption to Grow 400bps Faster than Unit Shipments



Source: Jefferies analysis. Unit shipments based on Counterpoint, Mercury and Gartner. Wafer consumption calculated based on die size data from Anandtech, techpowerup.com, wccftech.com, Locuza, Company data

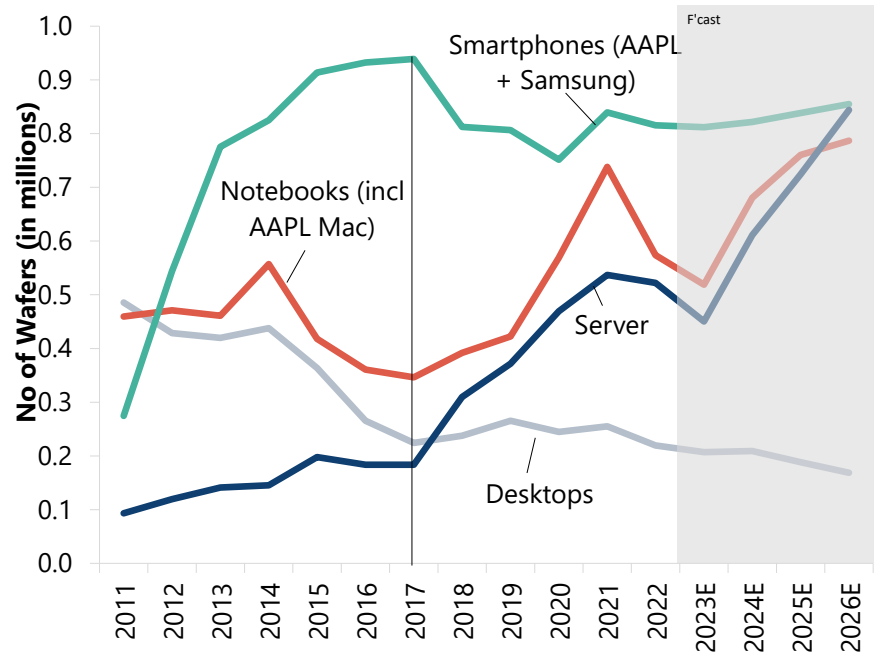
We use chip size data coupled with unit shipment data to calculate the increased demand for wafers for the Server and Client CPU and Smartphone markets

We show that from 2011 to 2017, when the die size remained constant, wafer consumption grew at CAGR of 2% in-line with chip unit growth of 3%.

From 2017 to 2022, the wafer consumption grew at a CAGR of 5%, 600bps faster than chip unit growth as the die sizes increased.

Over the next 4 years, we forecast wafer to consumption to continue to grow faster than chip unit growth. However, we expect the gap in growth rates to narrow, as chipmakers have adopted advanced packaging techniques such as chiplet architectures that consist of a larger number of smaller dies connected in a high performance package.

Chart 9 - Expect Server Wafer Volumes to Match Smartphone Wafer Volumes by 2026



Source: Jefferies analysis. Unit shipments based on Counterpoint, Mercury and Gartner. Wafer consumption calculated based on die size data from Anandtech, techpowerup.com, wccftech.com, Locuza, Company data

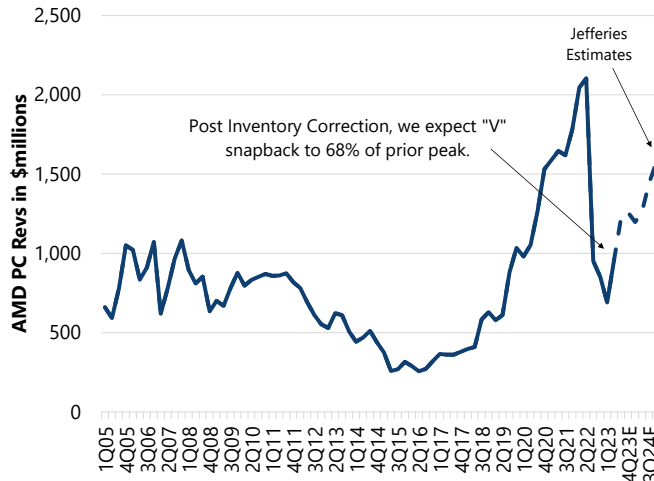
With faster CPU/GPU unit growth in server market coupled with die size increases, we expect server wafer volumes to approach smartphone wafer volumes by 2026 growing to ~845k wafers.

We estimate that server wafer consumption has grown at a CAGR of 23% from 2017 to 2022, with die size increases and 4% unit growth.

Over next 4 years, we expect server wafer consumption to grow at a CAGR of 13%; and we expect server wafer volumes to match smartphone volumes,

Chart 10 - AMD PC Revs Well Below Trendline

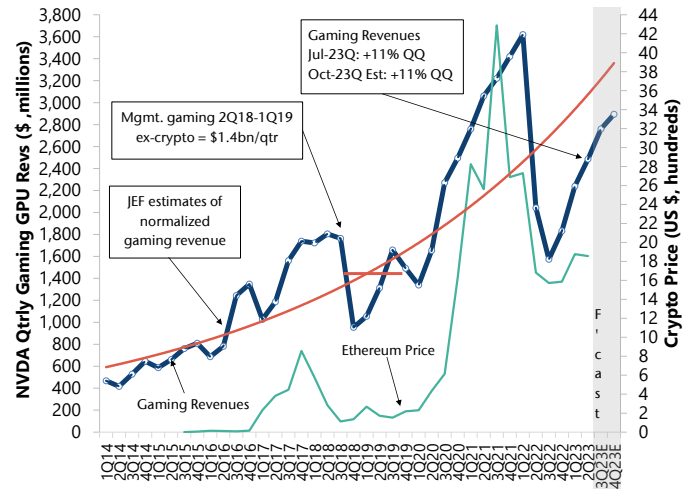
AMD Quarterly PC Revs in \$ millions



Source: Jefferies, company data

We estimate 2023 client revs of \$4.4bn, with 2H over 1H snapback on channel normalization. AMD reiterated its 2023 PC market guidance of down ~10% YY or ~260m units.

Chart 11 - NVDA Gaming Revenues Well Below Trendline



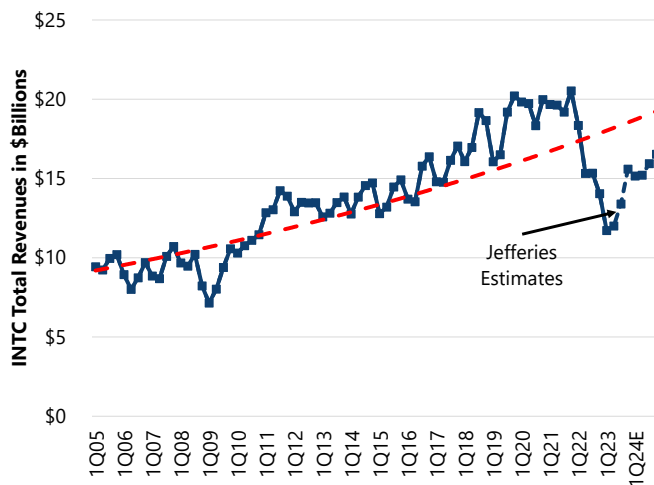
Source: Jefferies estimates, company data. Red line is exponential curve fit to NVDA gaming revs.

Gaming GPU revenues posted a stronger than expected 16% QQ increase, primarily attributable to ramp of new Ada Lovelace GPUs, partly offset by lower shipments of SoCs for game consoles.

Mgmt expects gaming to grow up QQ with strong growth in the Apr-23Q. For Apr-23Q, we model 8% QQ growth for gaming.

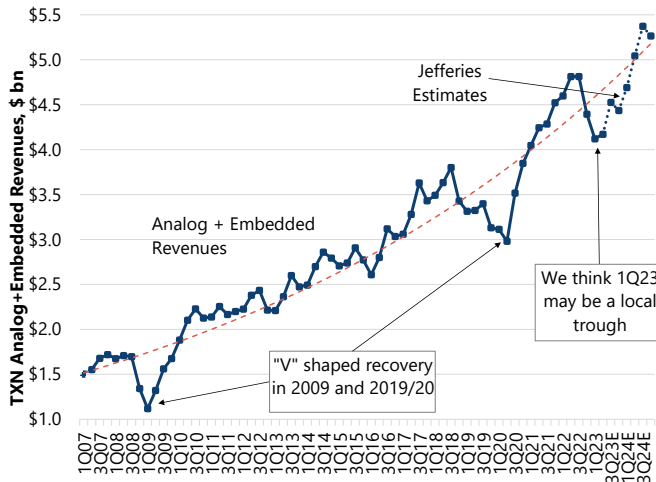
We believe INTC is materially undershipping end demand in 1H23; thus, we model a "V"-shaped snapback post inventory correction. We model snapback in 2H23 with 2H v 1H rev growth of 29%.

Chart 12 - INTC Revenues Well Below Trendline



Source: Jefferies, company data

Chart 13 - TXN Core Semi Revs Well Below Trendline

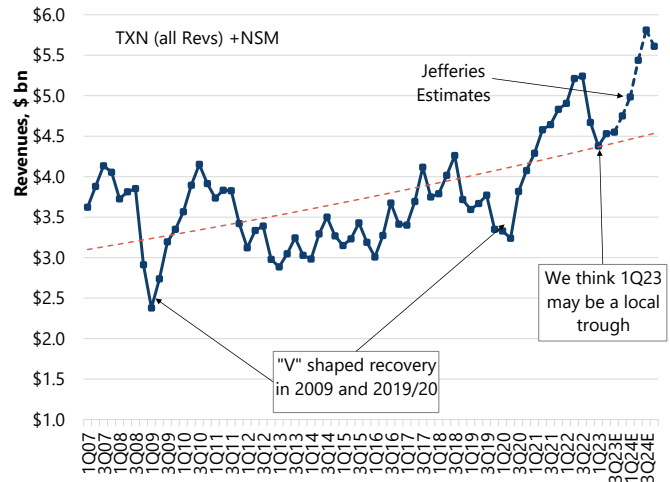


Source: Jefferies, company data; Jefferies estimates post 1Q23

We model a "V" recovery to start in 2H23, similar to the 2009 and 2019/20 cycles. TXN revs took 2 quarters to find the bottom in 2009 and again in 2019 before COVID hit and drove another leg down. TXN revs only took 2-to-4 quarters off the bottom to exceed previous peak revenues in both 2009/10 and 2021 recovery periods.

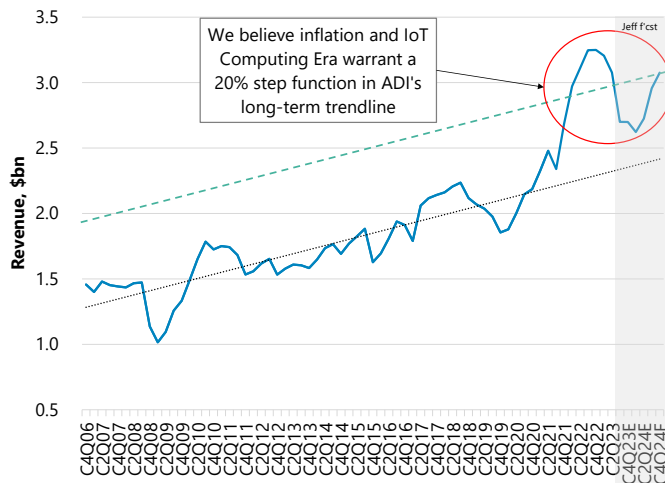
TXN's Core i.e. Analog+Embedded revs appear to be a low long-term trendline, but when considering all TXN revs and pro-forma revs of National Semiconductor (acquired in Apr-2011), TXN revs are at the long-term trendline.

Chart 14 - TXN Revenues At Trendline, When Looking on Pro-Forma Basis



Source: Jefferies, company data; Jefferies, company data; TXN revs adjusted pro-forma for NSM

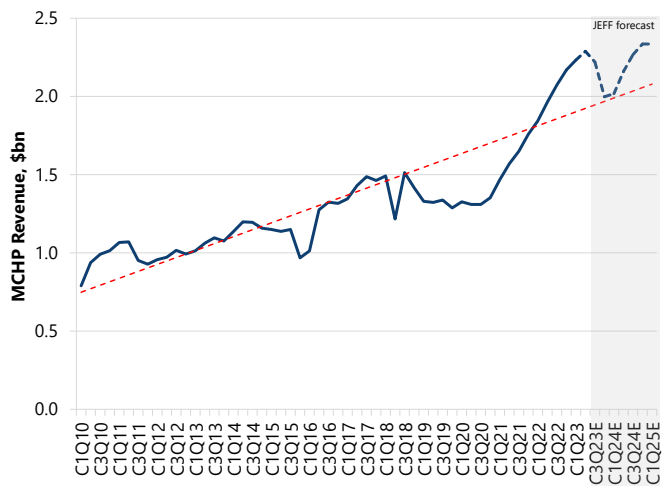
Chart 15 - We Model ADI Revs Decline by 17% Peak-to-Trough before Asymptoting to a Level 20% Higher than Historical



Source: Jefferies forecast C2Q23-onwards, FactSet. Pro-forma ADI+LLTC+MXIM revenues through MXIM acquisition closure in Sep-21

We forecast ADI QQ revenues decline by 8% QQ in the JulQ and by 10% in the AugQ before rebounding in the JanQ and through CY2024, back to what we view as its new normalized growth level

Chart 16 - We Model MCHP's Revs to Decline 3% QQ in SepQ and 10% QQ in DecQ

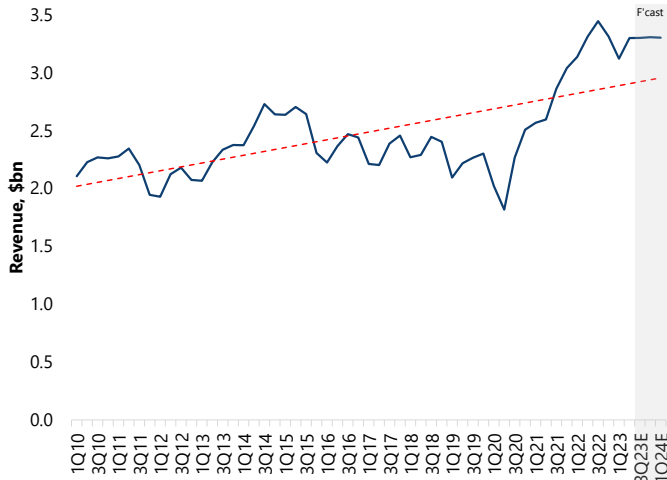


Source: Jefferies, company data; MCHP revs pro-forma for ATML and MSCC acquisitions

MCHP guided SepQ growing revs in the range of -3% to 1% QQ and expects DecQ weaker than seasonal (DecQ - weakest Q in the year)

We model MCHP's revs declining 10% QQ in DecQ reflecting a 13% peak-to-trough revs decline followed by a snapback in C2024

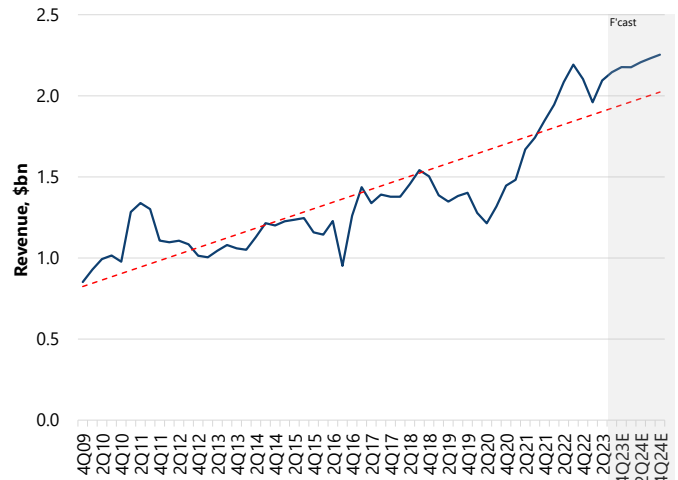
Chart 17 - NXPI's Revenues Above Trendline in 2H23



Source: Jefferies, company data; NXPI revs pro-forma for FSL acquisition

We are modeling a rev decline of 1% YY in C2023 to account for an inventory correction. Our model forecasts NTM earnings estimates to decrease by 2% in 2023. NXPI bottomed with-or-shortly-after estimate cuts started in past 4 cycles

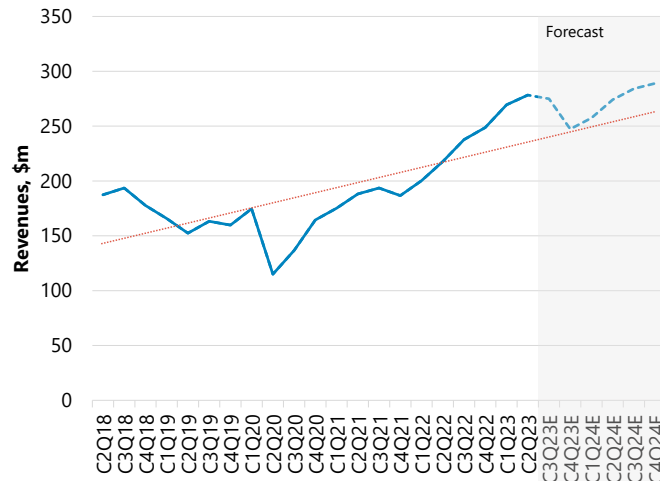
Chart 18 - We Model ON's Revenues Above LT Trendline



Source: Jefferies, company data; ON revs pro-forma for FCS

ON is expecting 3Q23 Revs to grow by 2% QQ, with growth expected from Auto and Industrial segments, while Other down mid to high single digits. We note that ON is expecting SiC revenues to be a growth driver in C23 and beyond while it expects to continue exiting non-core low-margin businesses

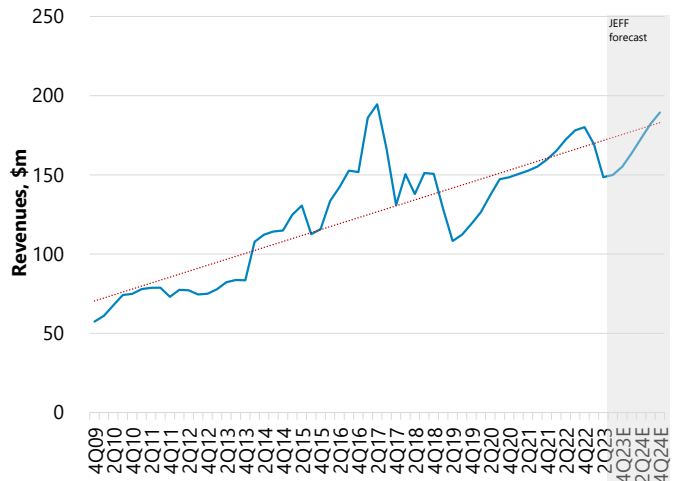
Chart 19 - We model ALGM's revs to increase 18% in C2023 and 3% in C2024, being at and above trendline levels



Source: Jefferies, company data

ALGM expects QQ revenues to decline by 1% in C3Q23, and we expect revenues to trough in C4Q23 with a 10% QQ decline before rebounding in C1Q24

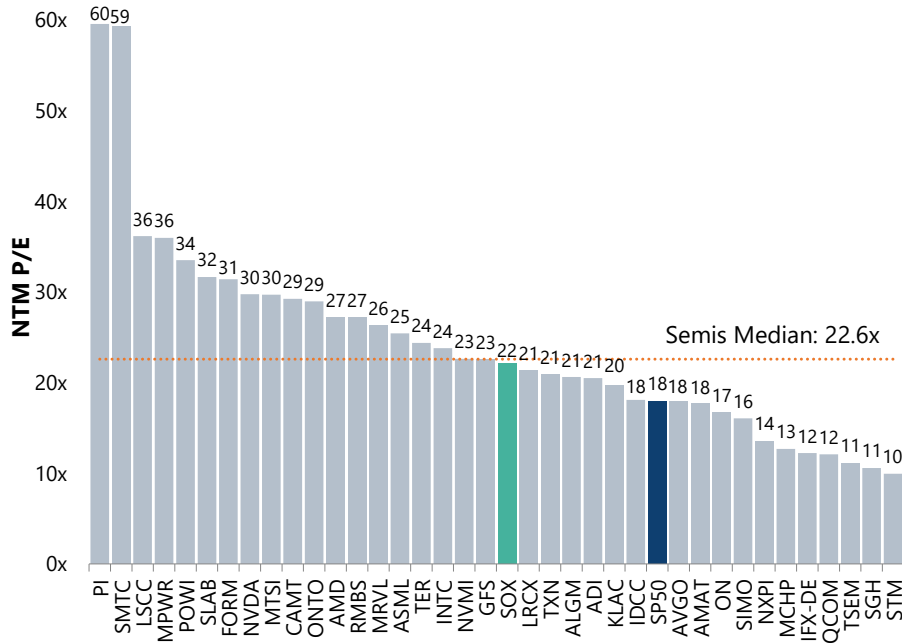
Chart 20 - We model MTSI revenues to decline by -10% in C2023, and to increase by 14% in C2024, exiting the year above trendline



Source: Jefferies, company data

MTSI guided 1% QQ revenue growth in 3Q23, and we expect QQ revenue growth from there onwards, being below trendline in C2023, and exiting C2024 above trendline

Chart 21 - Semis Companies' Valuations on NTM P/E



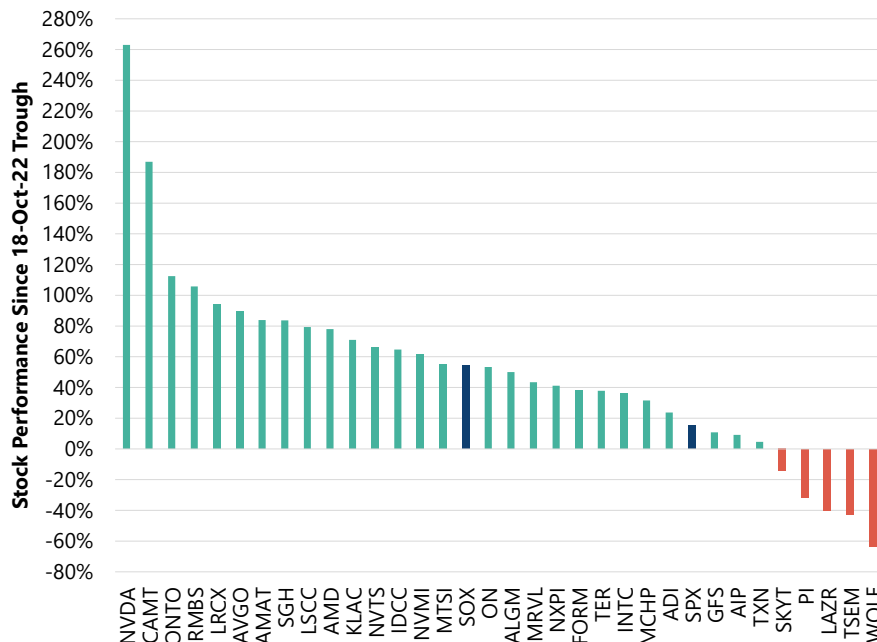
The SOX P/E currently trades at a 23% premium vs the SP50 PE.

The median P/E in this semiconductor sample is 22.6x, 26% higher than the SPX and 2% higher than SOX, reflecting the skew of the index toward higher P/E, larger cap stocks like NVDA.

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

Source: Jefferies, FactSet. Footnote: The chart includes companies that are outside of our coverage.

Chart 22 - Stock Performance of Coverage Universe Since 18-Oct-22 Relative Trough of SOX vs SPX

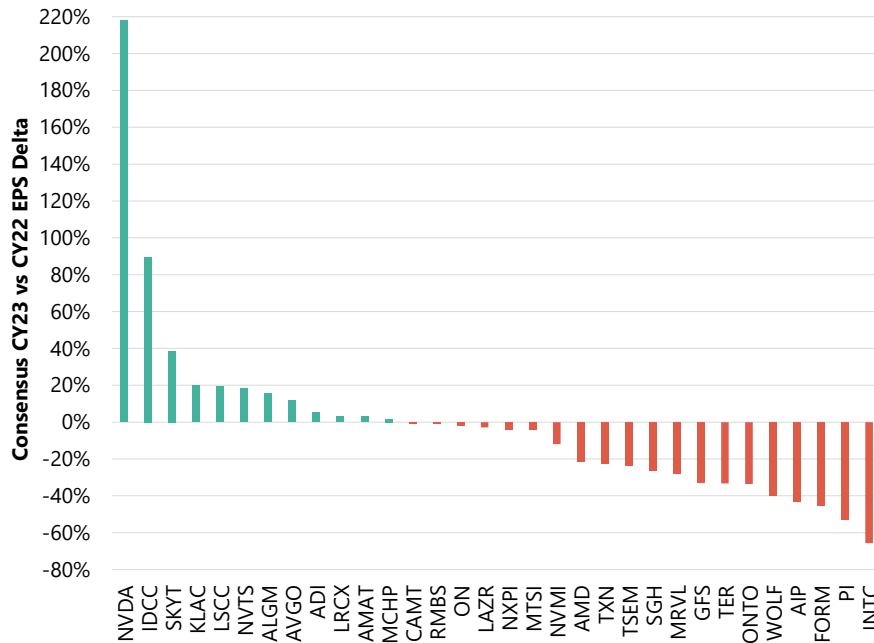


Source: Jefferies, FactSet

NVDA and CAMT lead performance in coverage group since the 18-Oct-22 relative trough of SOX vs SPX, each with 263% and 187% growth since the 18-Oct-22 trough respectively.

WOLF, TSEM, LAZR, PI and SKYT are the only ones that have underperformed since the 18-Oct-22 trough.

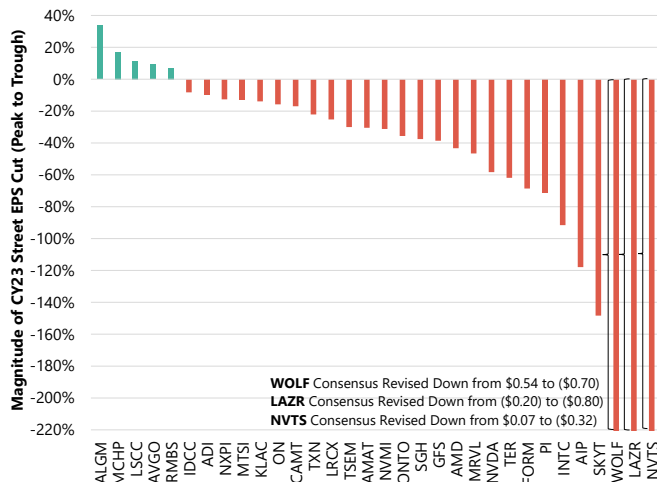
Chart 23 - CY23 vs CY22 EPS Delta for Covered Companies



NVDA, IDCC and SKYT leads expected CY23 EPS change over CY22, while INTC, PI, FORM and AIP are expected to see CY23 EPS decline the most over CY22.

Source: Jefferies, FactSet

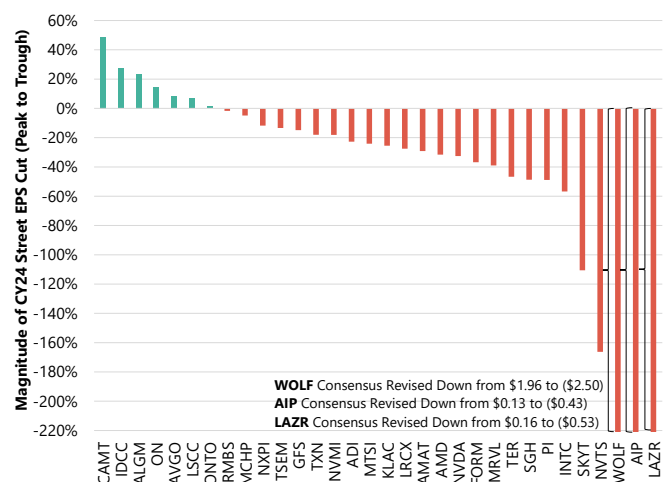
Chart 24 - CY23 EPS Peak to Trough Revisions



Source: Jefferies, FactSet. For companies with positive EPS revisions, we utilize May-22 as the reference date to calculate upward revisions from.

ALGM, MCHP, LSCC, AVGO and RMBS, have not seen their estimates for CY23 EPS cut materially by consensus. For these companies, we compare EPS estimates as of May-22 vs today's EPS estimates.

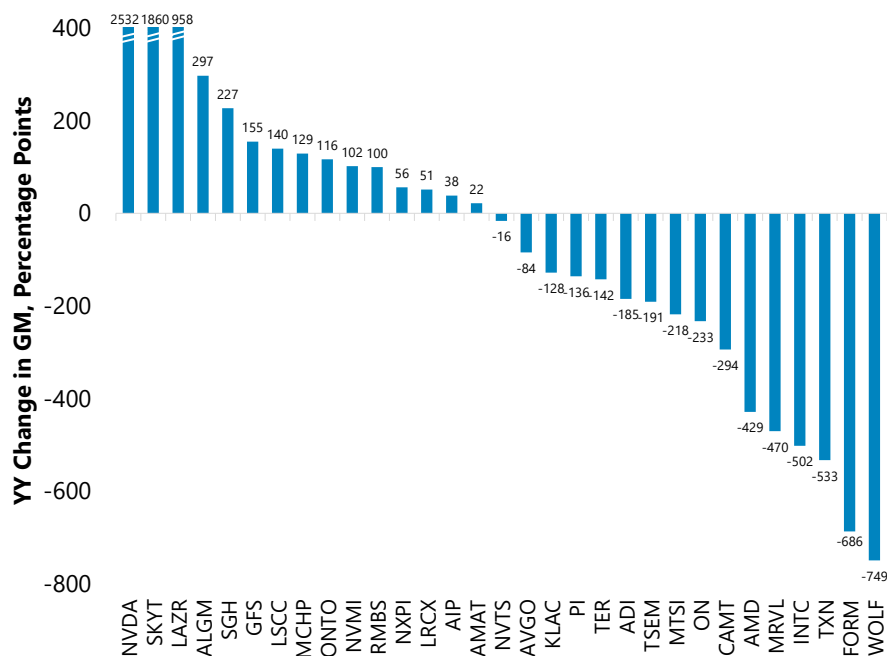
Chart 25 - CY24 EPS Peak to Trough Revisions



Source: Jefferies, FactSet

CAMT, IDCC, ALGM, ON, AVGO, and LSCC have not seen their estimates for CY23 EPS cut materially by consensus. For these companies, we compare EPS estimates as of Feb-23 vs today's EPS estimates.

Chart 26 - Change in GM from 2Q22 to 2Q23



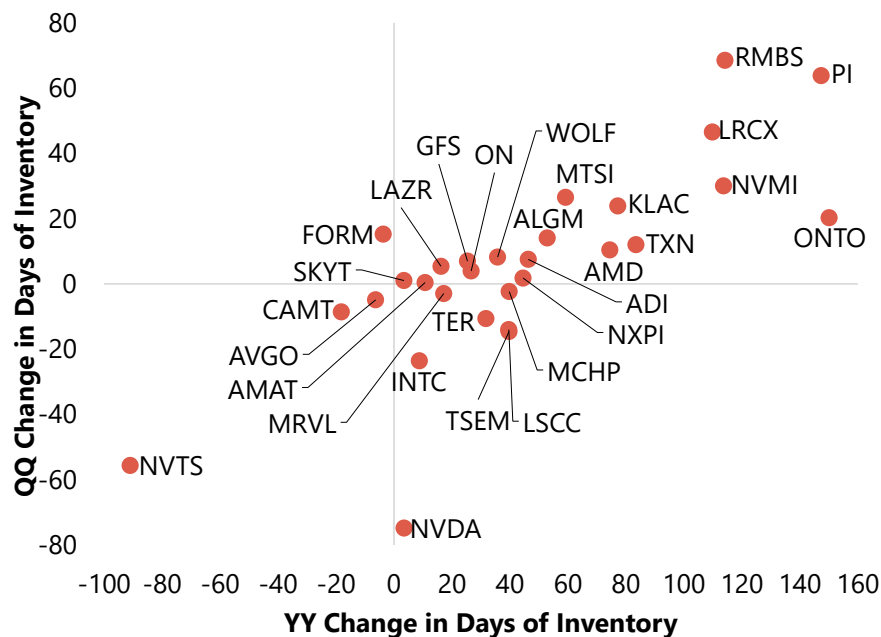
Source: Jefferies, company data; Non-GAAP GM

In 2Q23, NVDA saw the largest margin increase (~2530bps), followed by SKYT (~1860bps) and LAZR (~960bps).

WOLF and FORM saw the largest GM declines in 2Q22 vs 2Q23 as the GM delined by ~750bps and ~685bps, respectively

Inventory and Lead Time Charts

Chart 27 - Thus far, 18 out of 29 companies have reported QQ and YY increase
QQ/YY Change in Days of Inventory

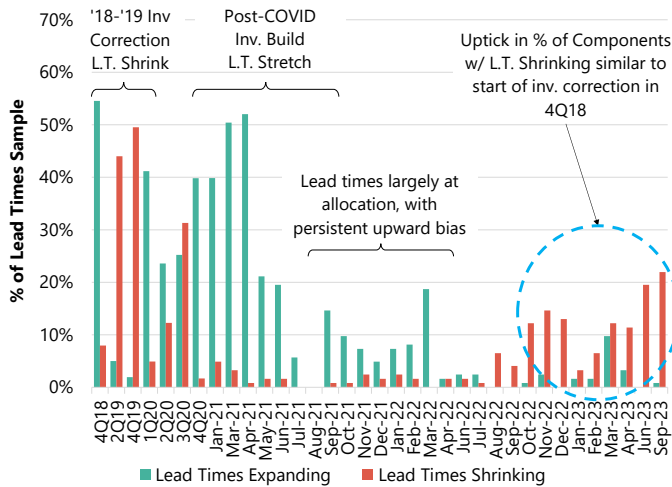


Source: Jefferies, company data

Within our coverage, all semis except NVTS, FORM, CAMT, INTC, MCHP, TER, TSEM, LSCC, MRVL, AVGO and NVDA reported 2Q23 earnings saw QQ and YY DOI increases.

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

Chart 28 - Lead Times Declining for 22% of Our Sample in Sep

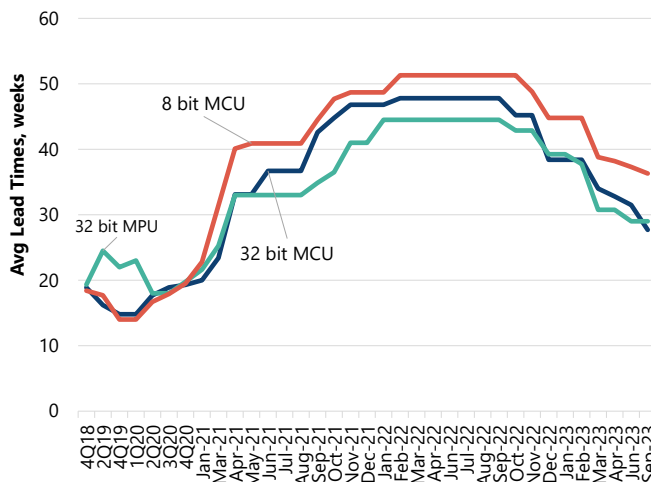


Source: Jefferies, Future Electronics Market Conditions Reports

Lead times started contracting in August 2022. In Sep-23, lead times contracted for 22% of our sample vs 20% in May-June, the highest level this cycle. We expect the inventory correction to play out for most analog and MCU companies during 2H23

Chart 30 - 8 bit MCU and 32 bit MCU Lead Times Down in Sep

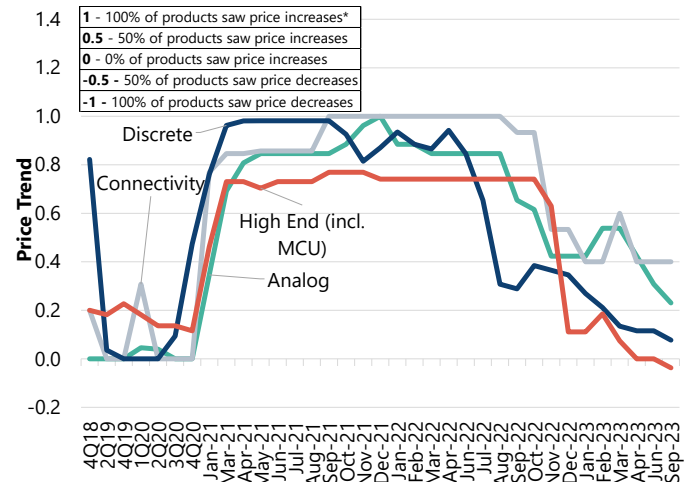
Avg Lead Times Across Players in the MCU/MPU Selected Categories



Source: Jefferies, Future Electronics Markets Conditions Reports

32-bit and 8-bit MCU lead times continued to decline in September, while 32-bit MPUs lead times were stable

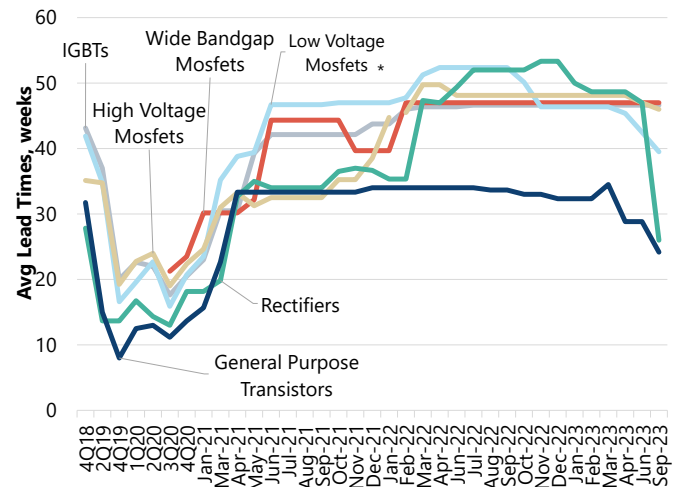
Chart 29 - Except for Connectivity, Analog Trended Down in Sep-23 Pricing Trends



Source: Jefferies, Future Electronics Markets Conditions Reports; *during the reported period

Although we do not have raw ASP data, we plotted directional indicators for semiconductor pricing ("down," "flat," "up" as a score "-1", "0", "1"). We note that pricing started the flattening process in August - September with only 1 in 8 components seeing price increases vs 4 out 5 a year ago. In Sep, the overall score for the data set was 0.13 (down from 0.17 in June), with 1 component (in High-end/MCUs) indicating negative pricing trends. This is consistent with our channel checks that indicate much lower tolerance in the supply chain for premium pricing.

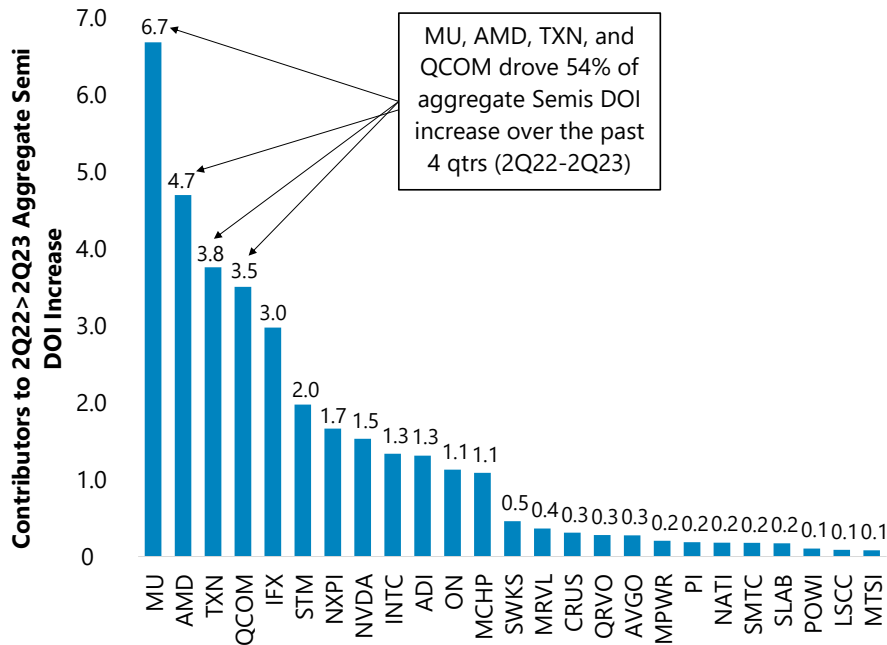
Chart 31 - High/Low Voltage Mosfets, Rectifiers and General Purpose Transistors Lead Times Down in Sep



Source: Jefferies, Future Electronics Markets Conditions Report; * in Feb-2022 FEMC report has stopped tracking ON-Fairchild MOSFETs resetting the lead times for the group, ex-ON-Fairchild Jan-22 level was at 45 weeks increased by 1 week in Feb-22

In Discretes, lead times declined for 17 components, 12 of them from ON. Lead times increased for MCHP's WBG MOSFETs by 4 weeks on average.

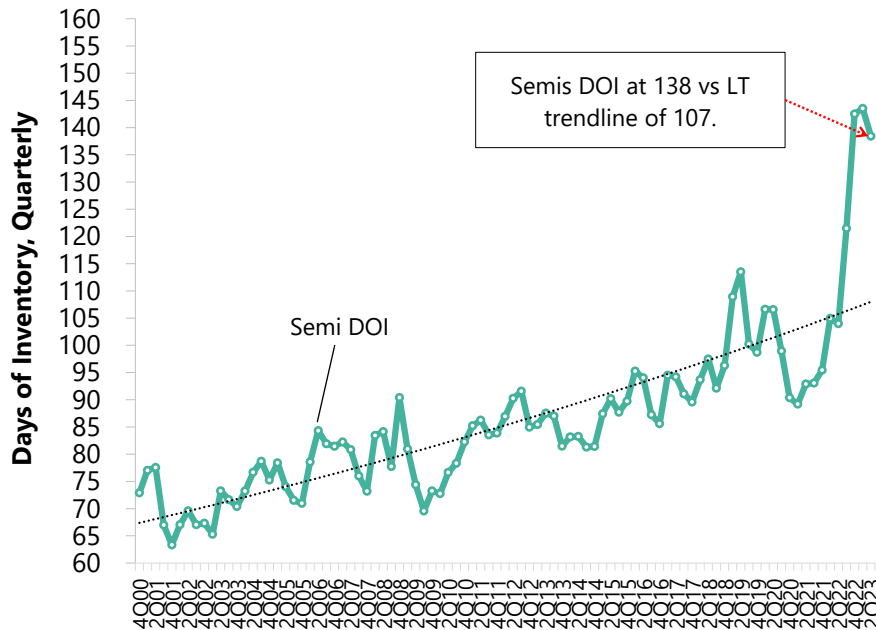
Chart 32 - 54% of the Past 4Qs Increase Comes from 4 Players



The largest contributors to the DOI increase over the past 4 quarters were MU, AMD, TXN, and QCOM

Source: Jefferies, FactSet

Chart 33 - Semis Days of Inventory



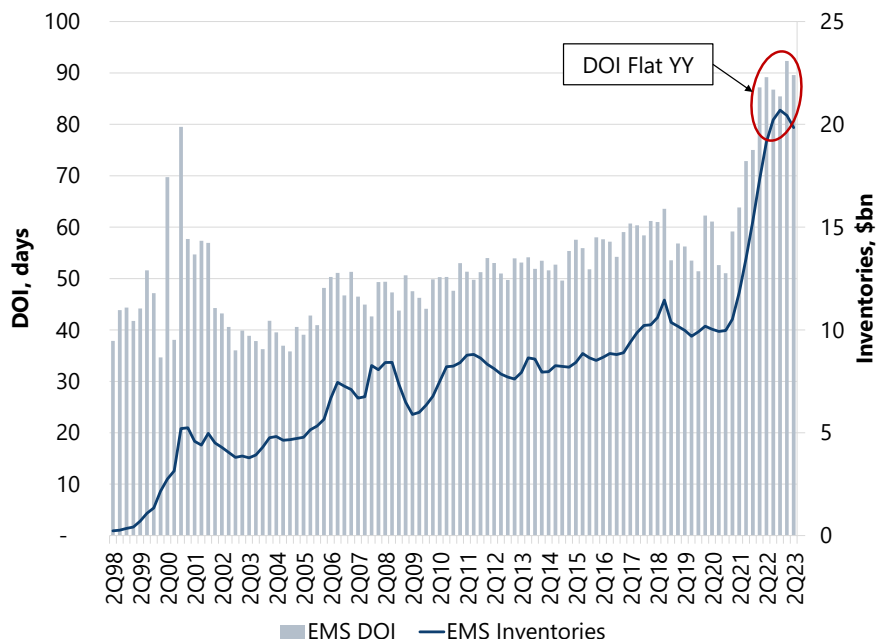
Source: Jefferies, company data, FactSet

Semis DOI is at 138 days in 2Q23, down 5 day QQ, far above the LT trendline of 107 days.

In 1Q23, DOI increased by 1 day QQ to 144 days. In 4Q22, DOI increased by 21 days and was at 143 days. This followed a 17 days increase in 3Q22.

We believe higher Semi DOI will ultimately lead to a loosening of component availability in 2023.

Chart 34 - EMS DOI Decreased 3 Days QQ from 1Q23
EMS Inventory and DOI

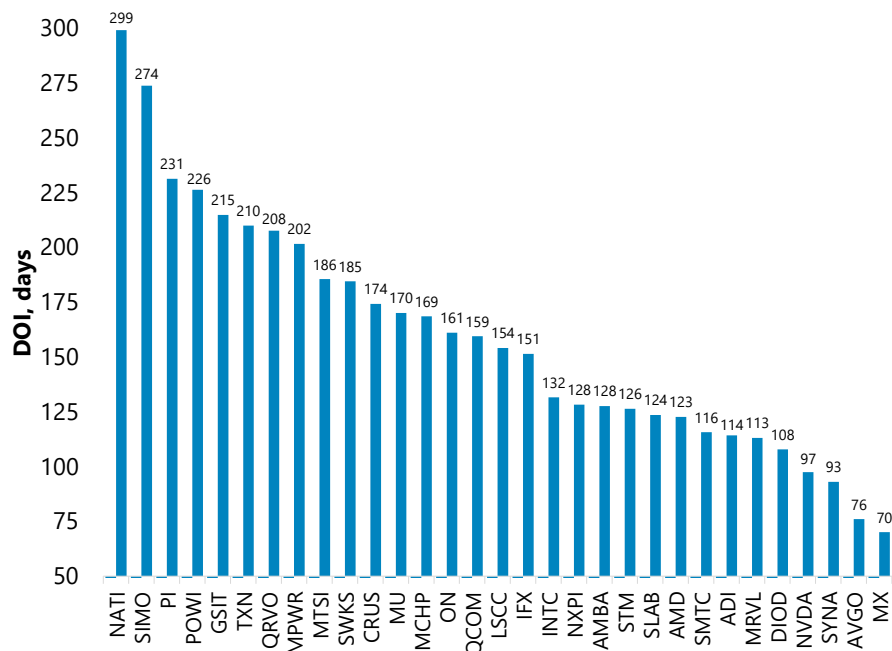


In 2Q23, EMS DOI remained flat YY and decreased by 3 days QQ to 90 days. In dollar terms, Inventories increased by \$692m YY and decreased by \$590m QQ. We believe that buildup of partly-built manufacturing kits is driving the increase.

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

Source: Jefferies, Factset, company data; EMS sample includes CLS, JBL, FLEX, SANM, PLXS, BHE.

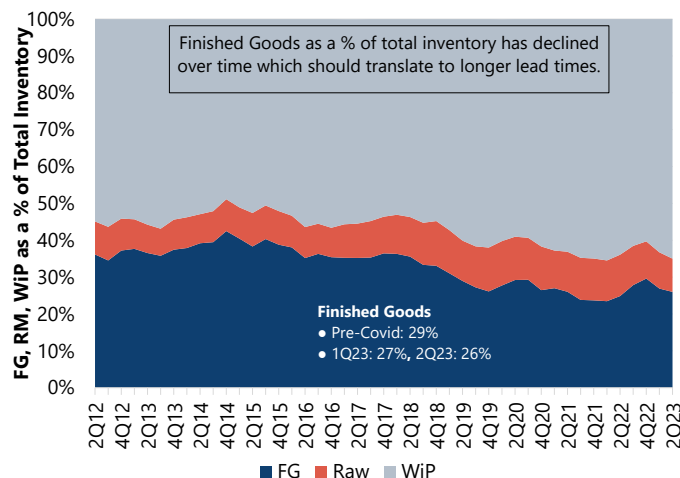
Chart 35 - 2Q23 DOI Inventory for Semiconductors



Source: Jefferies, FactSet

Median DOI for sample is 154 days

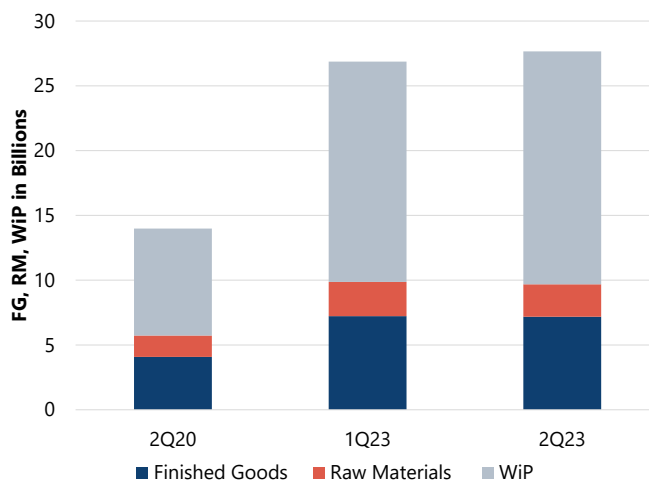
Chart 36 - Finished Goods as a % of Total Inventory Decreased to 26% in 2Q23 from 27% in 1Q23, below pre-covid levels



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.

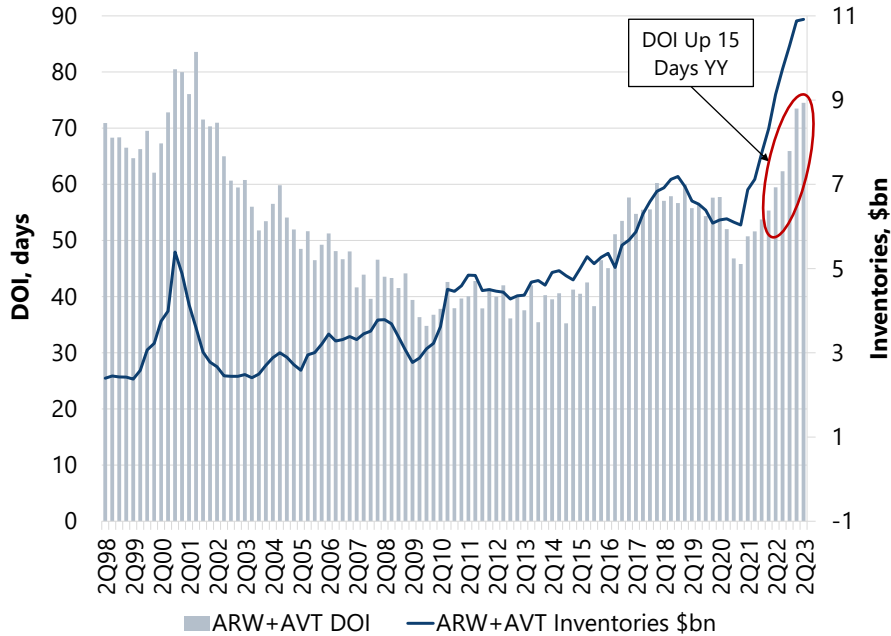
While aggregate Semi-DOI went above the trendline in 1Q22 for the first time in 1.5 yrs, lead times have not materially improved yet. We believe the reason is that all the inventory build was in WiP, while Finished Goods Inventories are at the lowest levels in at least 10 years. Finished Goods as a % of Total Inventory has begun to show some decline, now 26% in 2Q23, down from 27% in 1Q23 and from 30% in 4Q22.

Chart 37 - Finished Goods as a % of Total Inventory Decreased by 1% in 2Q23



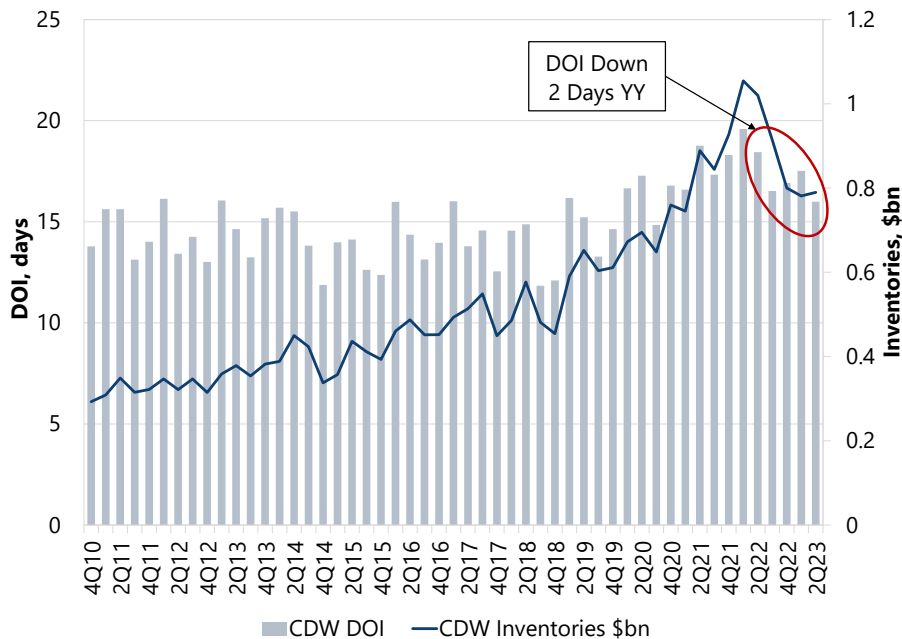
Source: Jefferies, Factset. Jefferies, Factset. Sample Set includes 12 semis companies (MU, AMD, DIOD, LSCC, MTSI, NATI, ON, POWI, QCOM, SLAB, SWKS, TXN) that have reported inventory breakdown.

Chart 38 - Chip Distributor Inventory Days Increased 1 Day QQ from 1Q23
Chip Distributor Inventory and DOI



Source: Jefferies, Factset, company data.

Chart 39 - Electronic Equipment Distributor DOI Decreased 2 Days QQ from 1Q23
Electronic Equipment Distributor Inventory and DOI



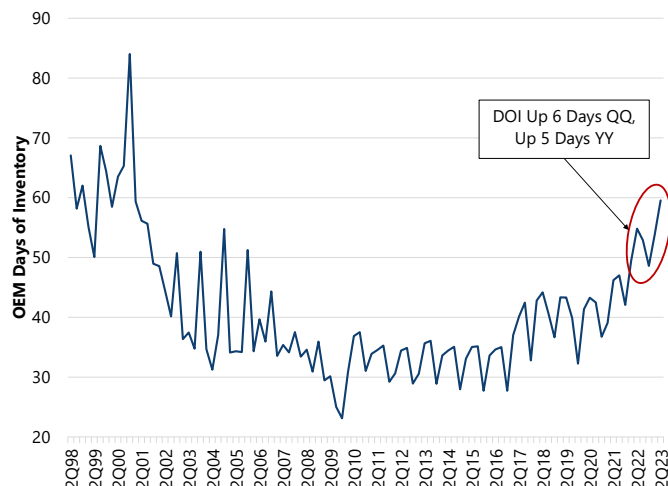
Source: Jefferies, Factset, company data

In 2Q23, chip distributor DOI increased 15 days YY and 1 day QQ to 75 days. Balance Sheet inventories increased by \$1.80bn YY and \$37m QQ to \$10.92bn.

In 2Q23, Electronics distributor CDW's DOI decreased 2 days YY and decreased 2 days QQ. Balance sheet inventories decreased by \$230m YY and by \$9m QQ.

Chart 40 - 2Q23 OEM DOI 5 Days Higher YY

OEM Days of Inventory

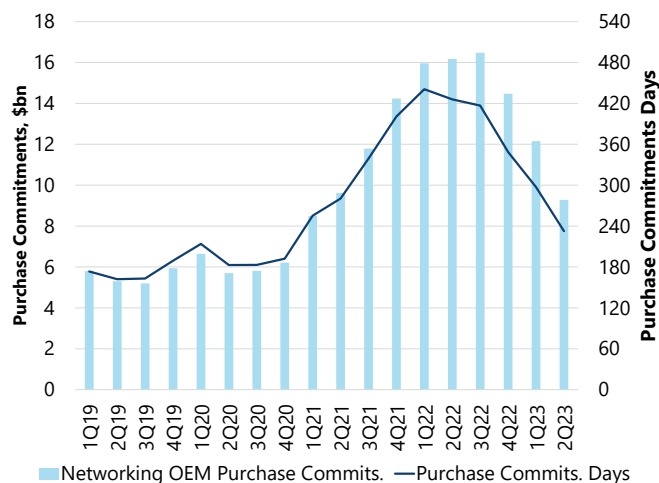


Source: Jefferies, Factset, company data

OEM DOI increased by 6 days QQ and by 5 days YY in 2Q23. In dollar terms, inventories decreased by \$1.39bn QQ, and by \$937m YY.

Chart 41 - Networking OEM Purchase Commitment Days have Decreased 193 Days YY and 64 Days QQ in 2Q23.

Networking OEM Total Purchase Commitments and Days

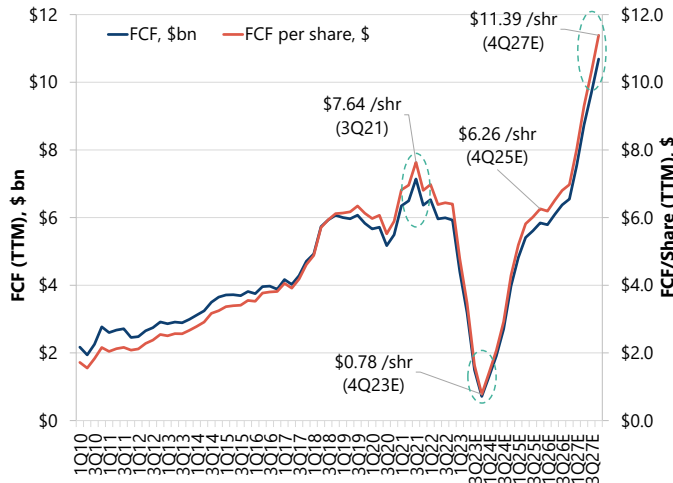


Source: Jefferies, Factset, company data

OEM purchase commitment days decreased by 64 days QQ and by 193 days YY in 2Q23. In dollar terms, purchase commitments decreased by \$2.3bn QQ and \$6.9bn YY.

Broad-based Semis Performance

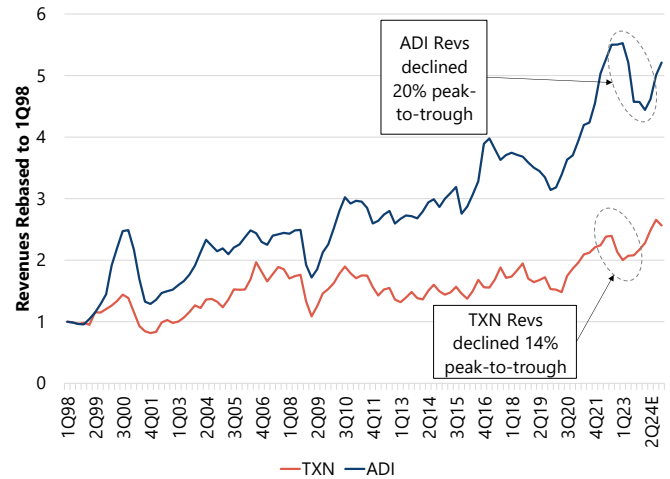
Chart 42 - TXN FCF vs FCF/Share Since 2010



Source: Jefferies, FactSet, company data

We model 2026E as a "steady state" TXN year, reaching 8% revs growth and capex at 21% of revs. We estimate TXN TTM FCF/shr to reach \$11.39 from the trough of \$0.78 in 4Q23E.

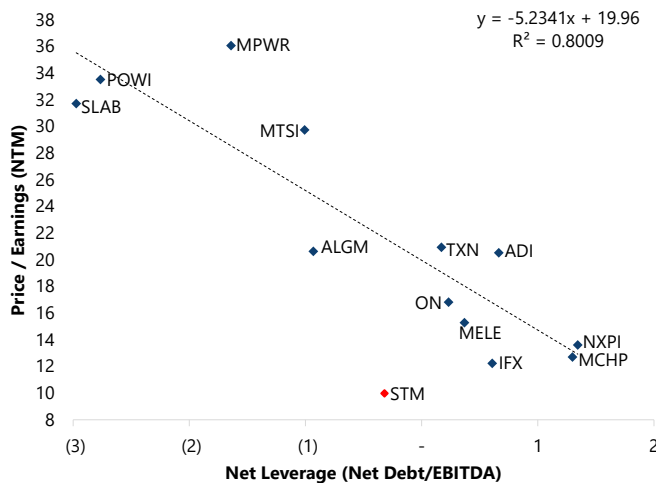
Chart 43 - Our Model Suggests a TXN/ADI Revs Declining 14%/20% Peak-to-Trough



Source: Jefferies, company data; ADI revs adjusted pro-forma for LLTC and MXIM acquisitions, TXN revs adjusted pro-forma for NSM acquisition

We estimate TXN Qtrly revenues declining 14% peak-to-trough, compared to ADI's 20%.

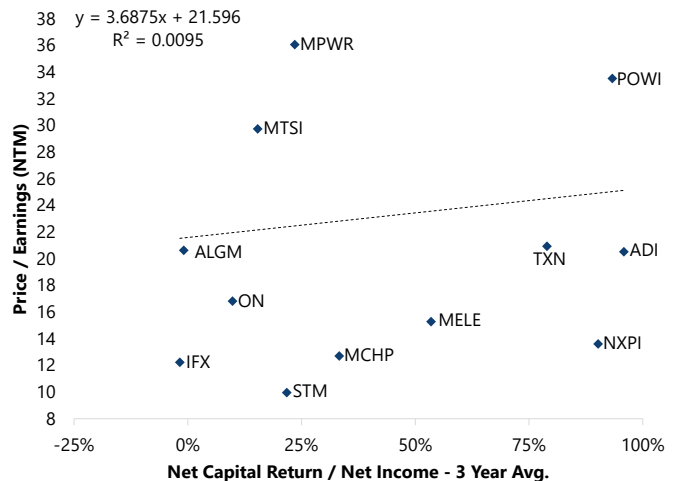
Chart 44 - The Correlation Between Analog PE and Net Leverage Has Increased Over the Past 12 months



Source: Jefferies, Factset, company data. Using latest reported Net Leverage and TTM EBITDA. Excluded from regression STM and SMTC

Broad-based large-cap semi P/E ratios are inversely correlated with leverage ratios (R-squared 80%). MCHP is targeting a 1.5x leverage in the long run, and ADI targeting to keep leverage below 1.0x.

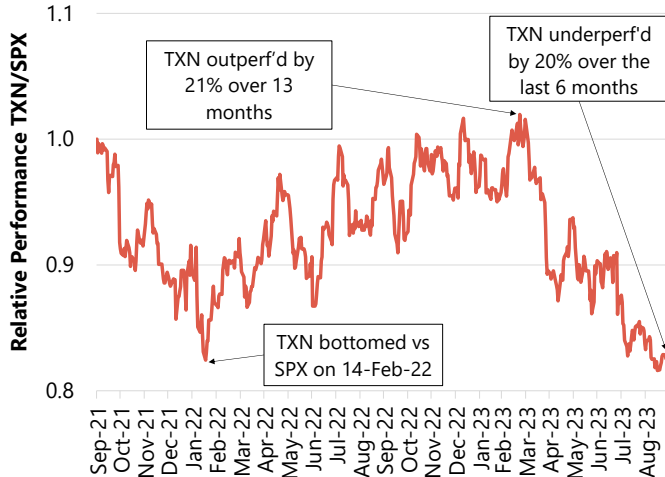
Chart 45 - The Correlation Between Analog PE vs Capital Return Has Broken Down



Source: Jefferies, Factset, company data. Net Cap Return/Net Income 3 yr. Avg (2020-2022). Net Capital Return is dividend plus share buyback minus cash from share/options issuance. Ex SLAB

We have observed a high correlation (Rsq of 80%) between P/E and Net Leverage Ratio. We find that leverage regression typically has a tighter fit than Net Capital Return ratio during a challenging macro environment.

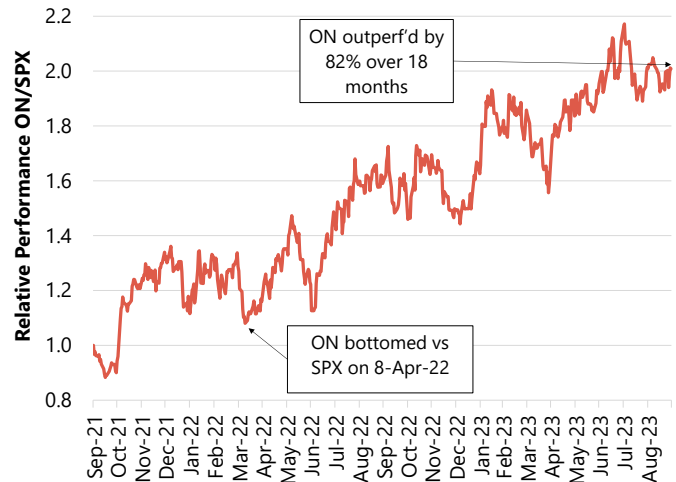
Chart 46 - TXN Outperformed SPX by 21% peak-to-trough over 13 months, and has underperformed by 20% the last 6 months as of today



Source: Jefferies, FactSet. Relative performance rebased to Sep-21 or 24 months ago

TXN Outperformed SPX by 21% peak-to-trough over 13 months, and has underperformed by 20% the last 6 months as of today

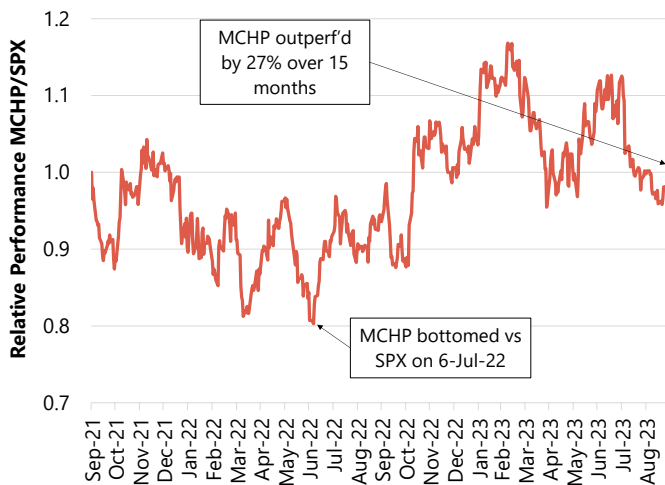
Chart 47 - ON Outperformed by 82% over the past 18 months



Source: Jefferies, FactSet. Relative performance rebased to Sep-21 or 24 months ago

ON bottomed vs SPX on 8-Apr-22 and has outperformed SPX by 82% over the past 18 months

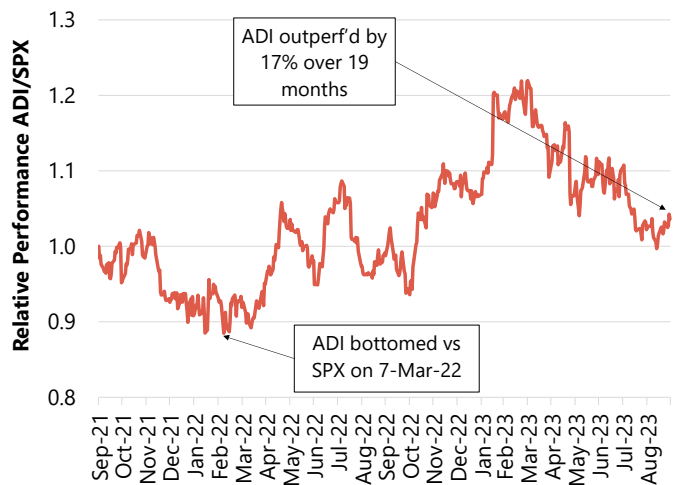
Chart 48 - MCHP Outperformed SPX by 27% over the past 15 months



Source: Jefferies, FactSet. Relative performance rebased to Sep-21 or 24 months ago

MCHP bottomed vs SPX on 6-Jul-22 and has outperformed SPX by 27% over the past 15 months.

Chart 49 - ADI Outperformed SPX by 17% over the past 19 months

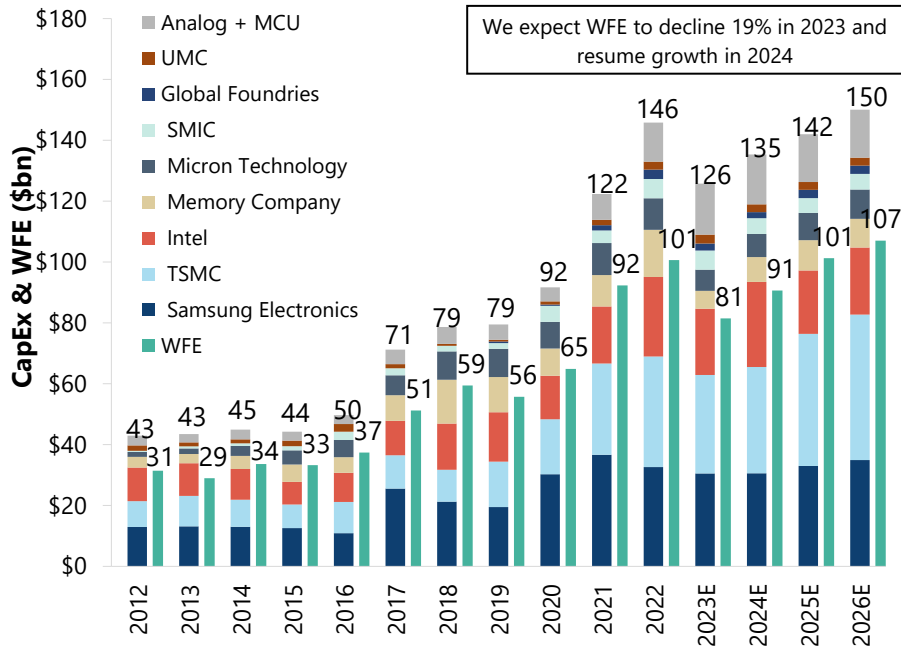


Source: Jefferies, FactSet. Relative performance rebased to Sep-21 or 24 months ago

ADI bottomed vs SPX on 7-Mar-22 and has outperformed SPX by 17% over the past 19 months.

Highlighted Semi-Cap Charts

Chart 50 - We Revised 2023 WFE Spend to \$81bn vs prior estimate of \$75bn

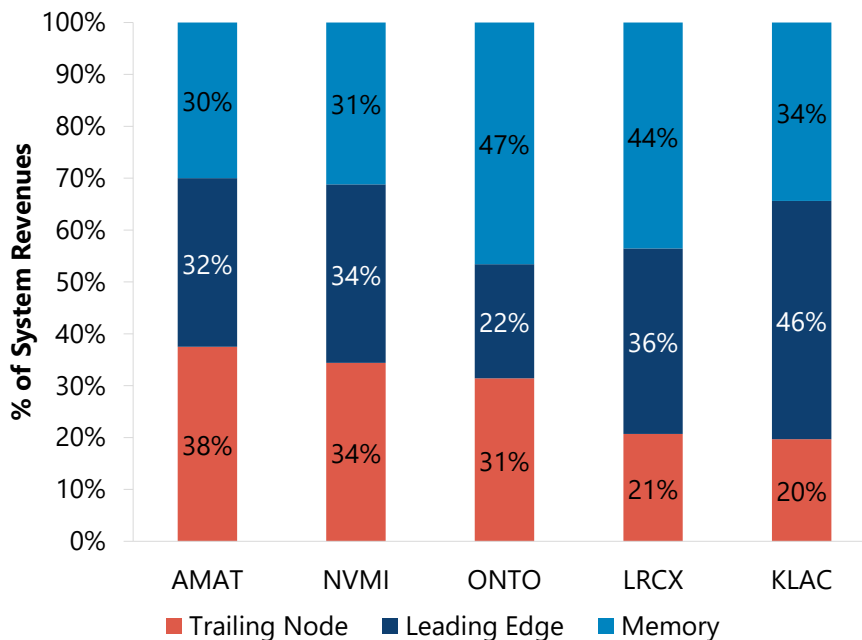


Source: Jefferies, Gartner, FactSet

We revised our 2023 WFE estimate to \$81bn vs prior \$75bn driven by the strength in trailing node investments driven by "The 4th Tectonic Shift to an IoT Computing Era" which are being powered by chips manufactured on trailing node WFE. We think most investors are underestimating the impact this computing era will have on trailing node WFE demand

We updated our bottom-up model to include CapEx of analog and MCU players. Our sample set includes 17 semiconductor companies, which represent ~80-82% of total semiconductor industry CapEx. Of the total industry CapEx, ~55-60% is spent on front-end equipment and the remainder is spent on facilities and back-end. For 2023 and 2024, we are assuming ~56% of the spend is front-end equipment as most companies are investing in shells.

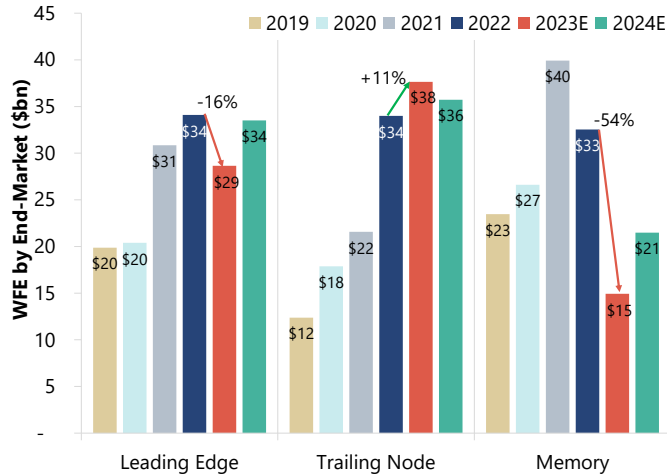
Chart 51 - AMAT has the Highest Exposure to Trailing Nodes



Source: Jefferies, Company data

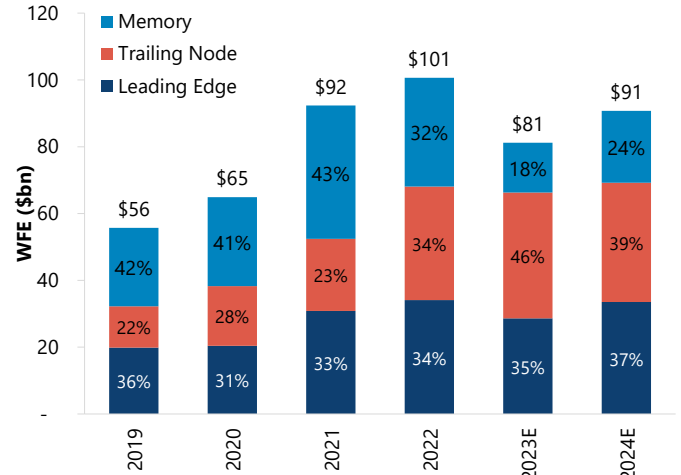
Within our coverage of SCE companies, AMAT has the highest exposure to Trailing nodes, followed by NVMI and ONTO

Chart 52 - Trailing Node Are Becoming More Important Part of WFE Aggregating to \$38bn in 2023



Source: Jefferies, Historicals based on SEMI (2019-2022)

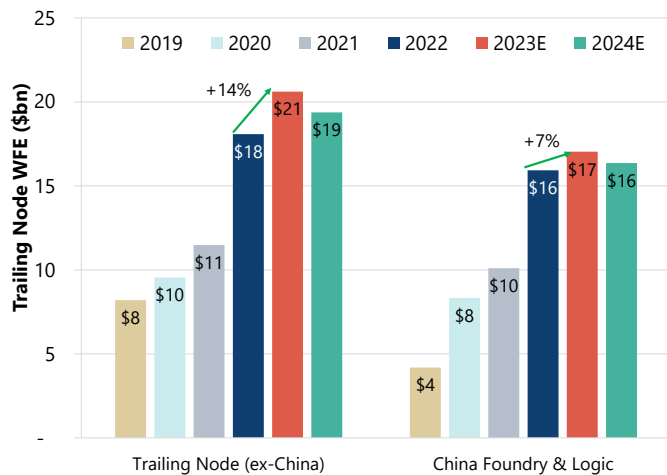
Chart 53 - Trailing Node Spend Share Expected to Increase to 46%; And Memory Expected to Decline to 18%



Source: Jefferies, Historical data (2019-2022) based on SEMI

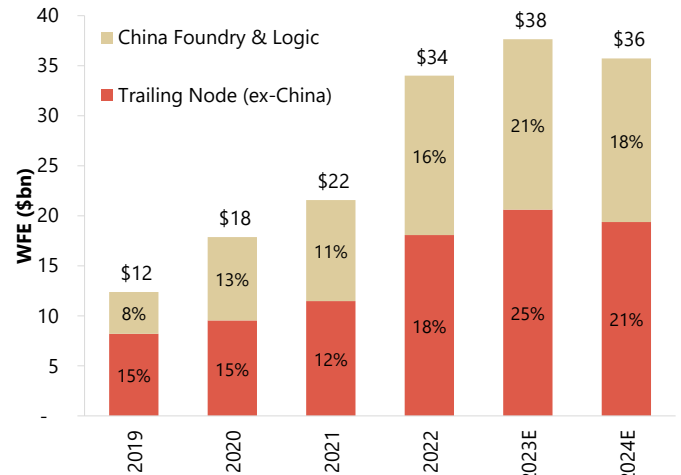
In 2019 & 2020, leading edge node and memory captured ~75% of total WFE spend aggregating to \$43-47bn and trailing nodes captured ~25% of WFE spend. With the shift to IoT era, trailing nodes have become an important part of WFE. In 2022, WFE spend was spread evenly between leading edge, trailing node and memory, and in 2023, we expect trailing nodes to be 46% of total WFE, growing 11% vs. 2022. We also note that in 2023, memory spend is expected to be 18% of WFE at \$15bn, which is the lowest levels since 2019. We expect memory spend to recover in 2024, growing to \$21bn up 44%YoY.

Chart 54 - Trailing Node Demand is Driven by Both Non-China & China Spend



Source: Jefferies, Historical data (2019-2022) based on SEMI








Chart 55 - Trailing Node Non-China /China Split was 53%/47% in 2022



Source: Jefferies. Historicals (2019-2022) based on SEMI data

We show that the strength in trailing node WFE spend is driven by strength in both China and non-China (US & EU) regions. We show that in 2022, the trailing node spend was split 53/47 between non-China and China. In 2023, we expect the split to be 55/45.

Chart 56 - Global Semiconductor Manufacturing Incentives Aggregate to \$66bn/yr

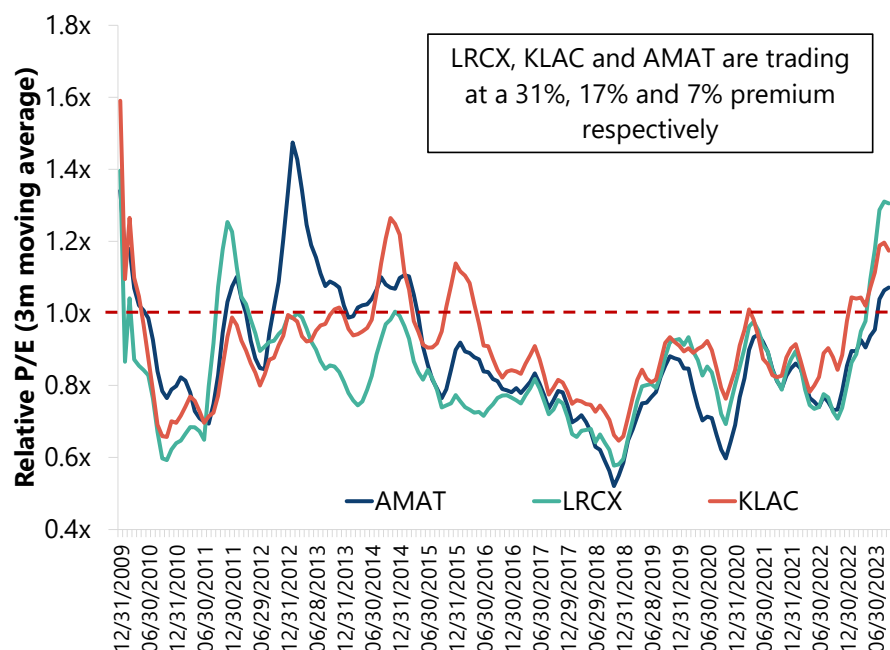
Global Annual Incentives over next 5 years = ~\$66bn Annually							
							
Manufacturing Capacity*	USA 12%	Europe 9%	S. Korea 21%	Japan 15%	Taiwan 22%	China 15%	India 0%
Value of Incentives	\$66bn	\$47bn	\$3bn/year	\$15bn	N.A	\$143bn	\$30bn
Incentives Structure	\$39bn grants \$2.5bn adv pkg \$24bn tax credits of 25%	~\$33bn directed to new fab construction	Tax credit 15% (vs. prior 8%) for large companies & 25% (vs. prior 16%) mid to small companies	\$3.6bn TSMC & Sony \$2bn Rapidus \$0.7bn Kioxia \$0.3bn Micron	Tax break 25% (vs. prior 15%) for R&D investments - 5% tax credit for spend on new equipment	- subsidies and tax credits to domestic semiconductor production & research	- 50% subsidy on eligible expenditures
Period	2022-2026	2023-2030	N.A	2022-2023	2023-2030	2022-2027	2022-2027
Annual Incentive	\$13bn	\$7bn	\$3bn	\$7bn	\$2bn	\$28bn	\$6bn

Source: Jefferies, Gov't reports

300mm equivalent capacity as of 2020. Manufacturing capacity based on BCGxSIA report "Government Incentives and US Competitiveness in Semiconductor Manufacturing Sept 2020"

We updated our survey of incentives offered by governments to build semiconductor manufacturing facilities in local markets. We estimate over \$300bn of total incentives, which translates to \$66bn/yr for the next 5 years

Chart 57 - SemiCap Relative P/E



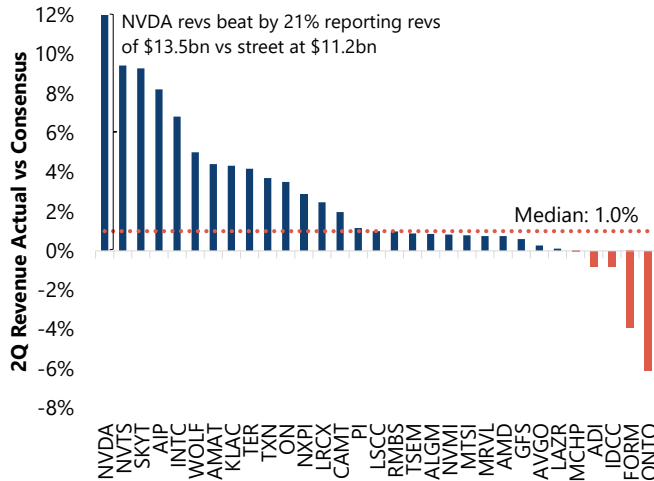
Source: Jefferies, FactSet

LRCX, KLAC and AMAT are trading at a 31%, 17% and 7% premium respectively.

We continue to expect SCE companies to re-rate higher as the market appreciates secular growth from: 1) "Moore's Bend"/bigger chips; 2) increasing manufacturing complexity; 3) trailing node demand; and 4) semi-nationalization à la CHIPS Act et.al.

2Q23 Earnings Season Summary

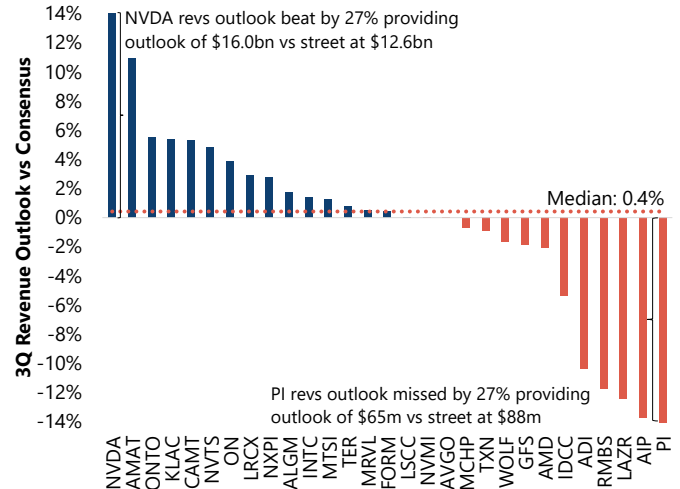
Chart 58 - Median 2Q23 Revenue Beat = 1.0%



Source: Jefferies, FactSet, company data

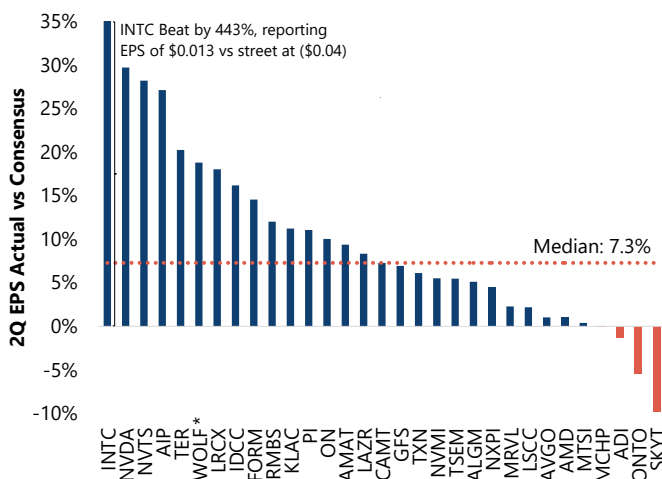
All companies except ONTO, FORM, IDCC, ADI and MCHP reported 2Q23 revs above Street estimates, and at the median, 2Q23 revs beat by 1.0%. All companies except PI, AIP, LAZR, RMBS, ADI, IDCC, AMD, GFS, WOLF, TXN, MCHP, NVMI and AVGO reported 3Q23 revs outlooks that were above consensus expectations, and at the median, 3Q23 revs outlook was 0.4% above consensus.

Chart 59 - Median 3Q23 Rev Outlook = 0.4% Above Consensus



Source: Jefferies, FactSet, company data

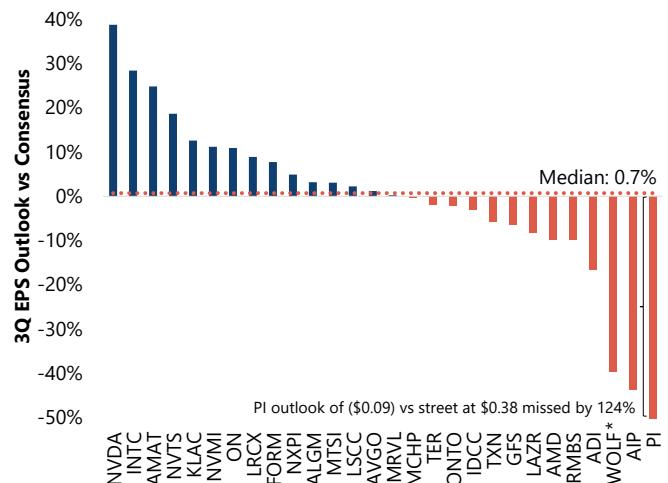
Chart 60 - Median 2Q23 EPS Beat =17.1%



Source: Jefferies, FactSet, company data. *WOLF Pro-forma as prior presentation excluding start-up costs from Non-GAAP OpEx

All companies except MCHP that was in-line, and SKYT, ONTO and ADI which were below consensus, reported 2Q23 EPS above Street estimates. At the median, semis beat 2Q23 consensus EPS by 17.1%.

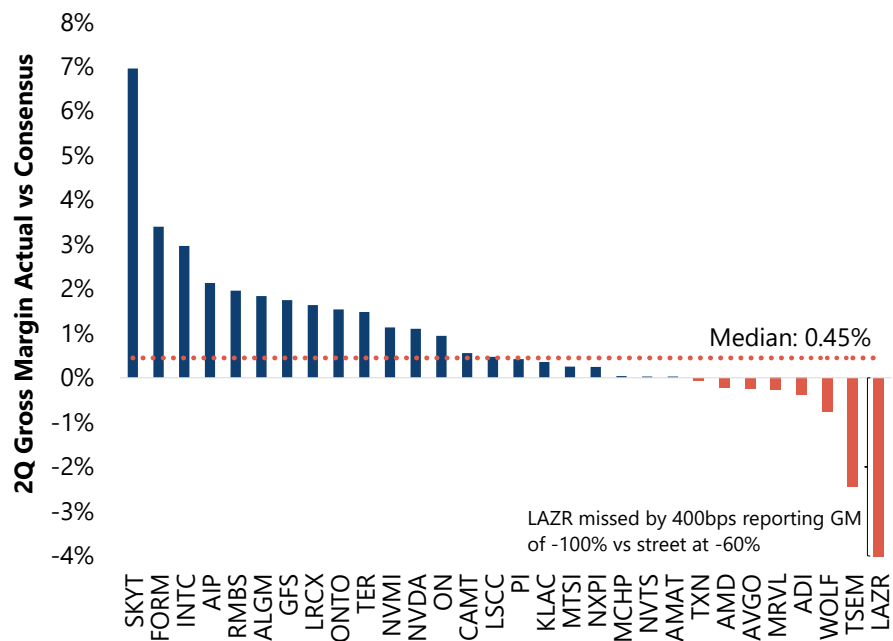
Chart 61 - Median 3Q EPS Outlook = 0.7% Above Consensus



Source: Jefferies, FactSet, company data. *WOLF Pro-forma excludes \$37m underutilization from GM and \$8m start-up costs from OpEx

All companies except PI, AIP, WOLF, ADI, RMBS, AMD, LAZR, GFS, TXN, IDCC, ONTO, TER and MCHP reported EPS outlook above street estimates. At the median, semis provided a 3Q23 EPS outlook, (explicitly or implied) that was 0.7% above consensus.

Chart 62 - Median 2Q23 Gross Margin Beat Consensus by 45bps



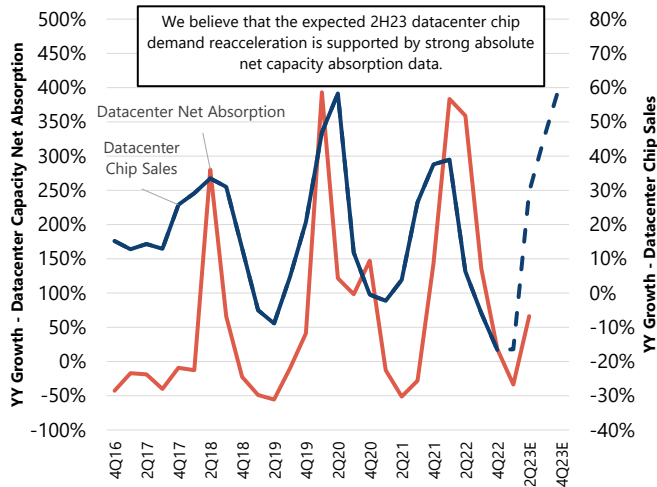
Source: Jefferies, FactSet, company data

All companies in our coverage universe except LAZR, TSEM, WOLF, ADI, MRVL, AVGO, AMD and TXN beat gross margin consensus expectations.

At the median, 2Q23 gross margin beat consensus by 45bps.

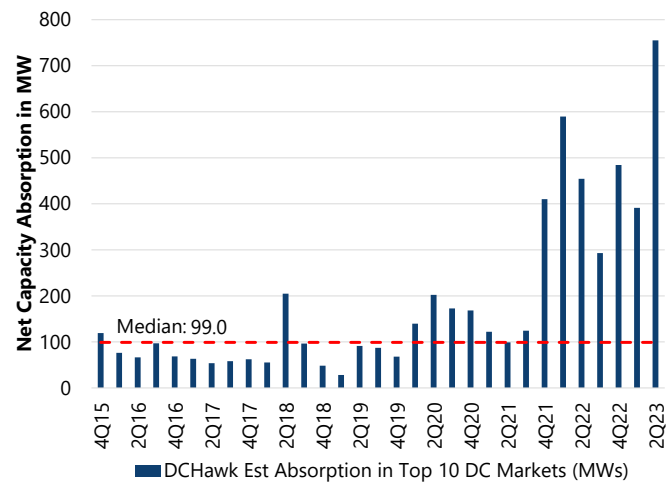
Datacenter Trends

Chart 63 - YY Growth for Datacenter Net Absorption and Datacenter Chip Sales are Correlated



Source: DatacenterHawk via Factset, Jefferies

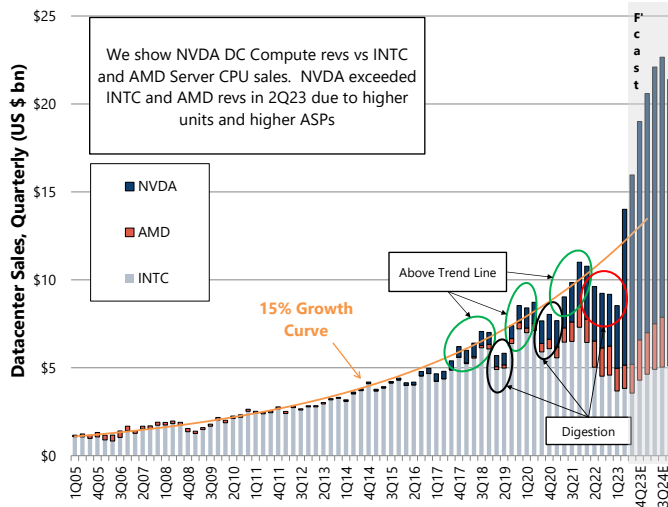
Chart 64 - 2Q23 US leasing volume increased 93% QQ and 66% YY and set a new quarterly record for leasing volume.
Net Capacity Absorption in MW



Source: DatacenterHawk via Factset, Jefferies

DatacenterHawk reports that the top 10 datacenter markets had aggregate net absorption of 755MW of space in 2Q23, up 93% QQ from 391MW in 1Q23 and up 66% YY from 454MW in 2Q22. Over the past 6 quarters, the absorption levels continue to be much higher than the LT median absorption of 99MW. 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 datacenter processors (blue line) sold by **INTC**, **NVDA** and **AMD/XLNX**. We also view networking chip companies **AVGO** and **MRVL** as beneficiaries of this absorption.

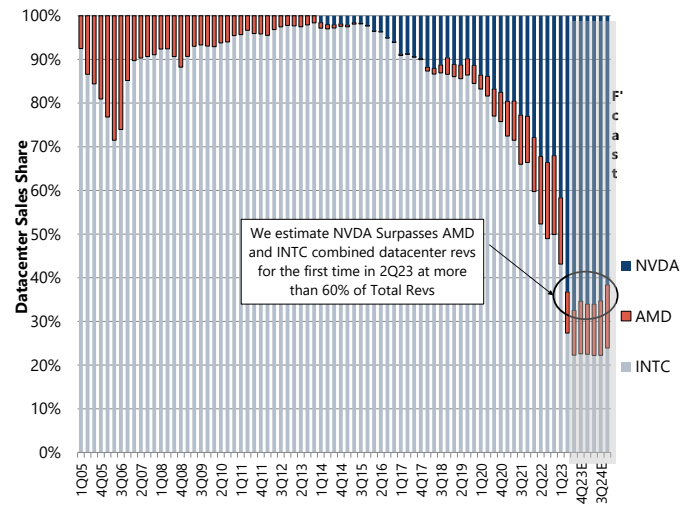
Chart 65 - Datacenter Processor Revenues



Source: Jefferies, company data

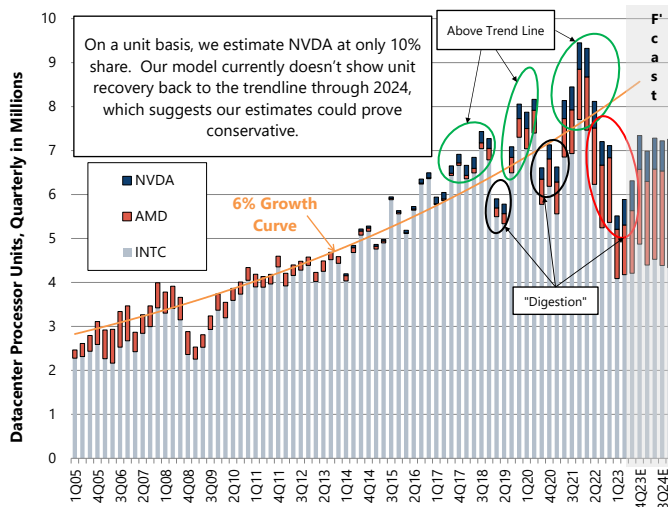
After 4 quarters of below trend line datacenter processors revenues between 2Q23 and 1Q23 primarily on x86 server digestion, revenues are expected to accelerate significantly through the rest of this year primarily on NVDA's generative AI tailwinds and secondarily on x86 server 2H over 1H recovery. NVDA surpassed AMD and INTC combined datacenter revs for the first time in 2Q23 at more than 60% of total revs, officially marking a Tectonic Shift in Computing to a Parallel Processing Era

Chart 66 - Datacenter Revenues Processor Share



Source: Jefferies, company data

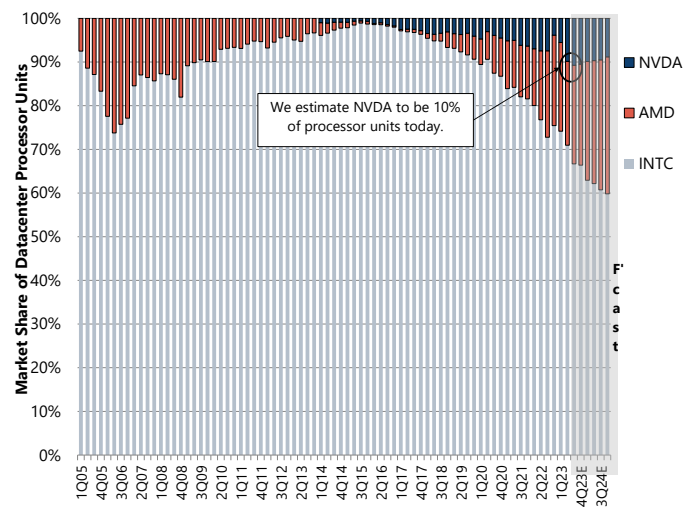
Chart 67 - Datacenter Processor Units



Source: Jefferies, company data

On a units basis (GPUs + CPUs), we estimate NVDA is still only 10% share. As such, our models for NVDA, AMD, INTC don't embed unit recovery back to trendline through 2024 which may prove conservative.

Chart 68 - Datacenter Processor Units

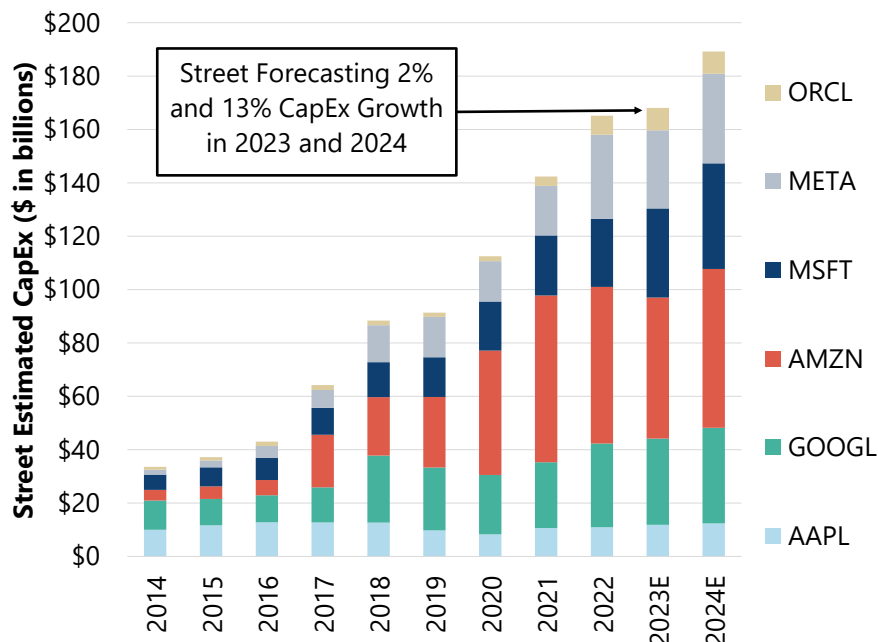


Source: Jefferies, company data

Chart 69 - North American Cloud CapEx is now modeled by Street to increase by 2% and 13% YY in 2023 and 2024.

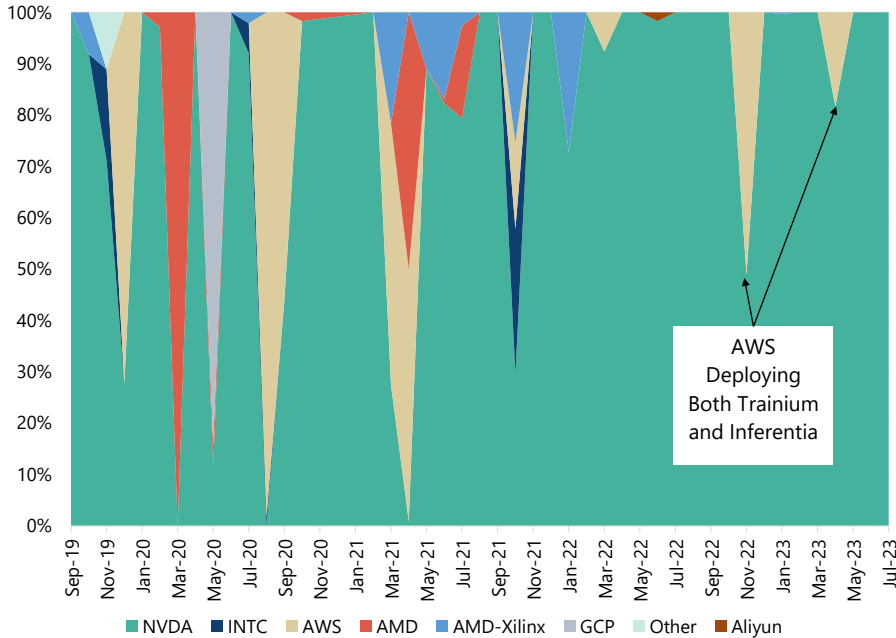
Street Estimated CapEx for CSPs

Street forecasts for our set of six top North American cloud companies now estimate CapEx to rise by 2% and 13% YY in 2023 and 2024.



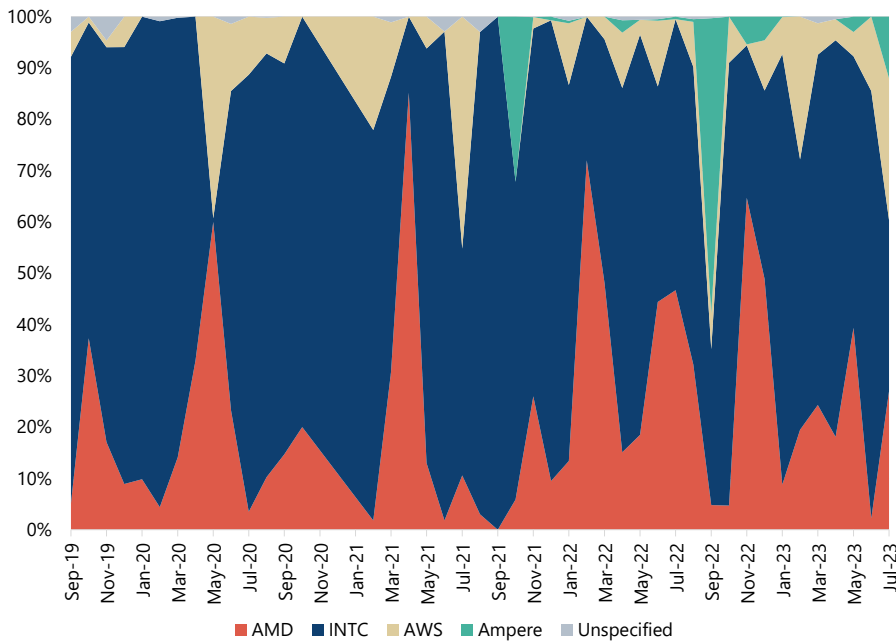
Source: Jefferies, Factset, company data

Chart 70 - NVDA has made up nearly 100% of incremental accelerator deployments over the past 15 months
Incremental Accelerator Instances Deployed by Month



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

Chart 71 - Over the past year, AMD's percentage of total incremental instances deployed has averaged ~26% vs INTC at 57%, AWS at 10%, and Ampere at 6%
Incremental CPU Processor Instances Deployed by Month



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

We look at processor and accelerator instances made available to rent in public cloud at 6 top CSPs. This chart shows incremental accelerator instances deployed each month

NVDA Accelerators have accounted for nearly 100% of new deployments since Feb-22. It accounted for 49% in Nov-22 (AWS Trainium launch), 98% in Jun-22, 82% in Apr-23 and 100% in all other months since Feb-22.

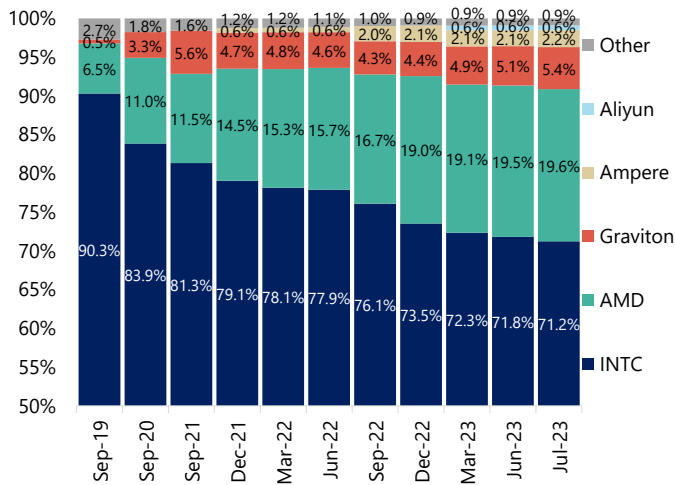
This chart shows incremental CPU instances deployed each month across the top 6 CSPs. AWS and Ampere CPU deployments are in brown and green, INTC CPU in dark blue, and AMD is in orange

AWS (tan) started deploying its Graviton CPU instances in 2019, while Ampere (green) started deploying in 2021

AMD's cumulative share of total instances has increased from 15% in Apr-22 to 20% in Jul-23

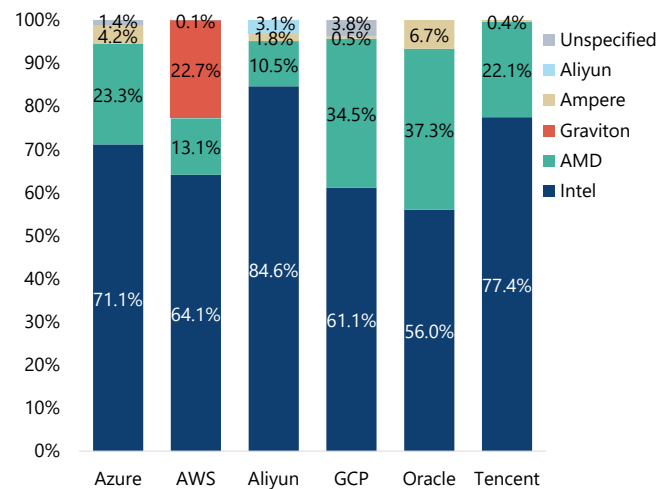
INTC's cumulative share has decreased from 78% in Apr-22 to 71% in Jul-23

Chart 72 - INTC vs. AMD vs. Graviton Share of CPU Instances



Source: Liftr Insights, Jefferies. More current and detailed data available by Liftr Insights. Footnote: Jul-22 is first month in chart that tracks Tencent instances and Jan-23 is first month in chart that tracks Aliyun instances.

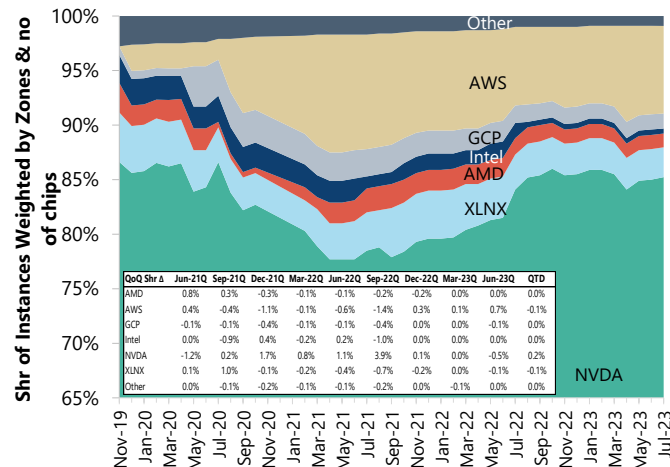
Chart 73 - Processor Instance Share by CSP and Vendor at Jun-23



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

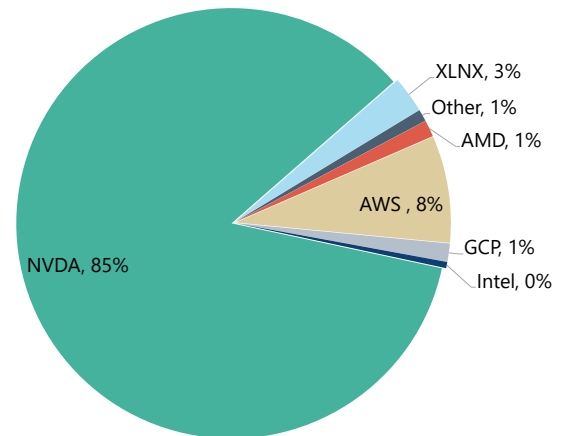
This month, AMD gained 450/50bps at Oracle and GCP, lost 15/10/5bps at AWS, Aliyun and Azure, and was flat at Tencent. INTC gained 10bps at Aliyun, lost 400/110/45/35bps at Oracle, AWS, GCP and Azure, and was flat at Tencent. Within AWS, Graviton gained 125bps share. Within AWS, Graviton instances are 22.7% of total CPU instances available as of Jul-23, taking share from INTC, which is down 24% 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.

Chart 74 - Dedicated Accelerator Share



Source: Liftr Insights, Jefferies. Footnote: Sep-22 QoQ share is inclusive of Tencent Instances for first time. More current and detailed data available by Liftr Insights. Please note that we did not obtain monthly data between Oct-20 and Feb-21.

Chart 75 - Accelerator-based Share as of Jun-23

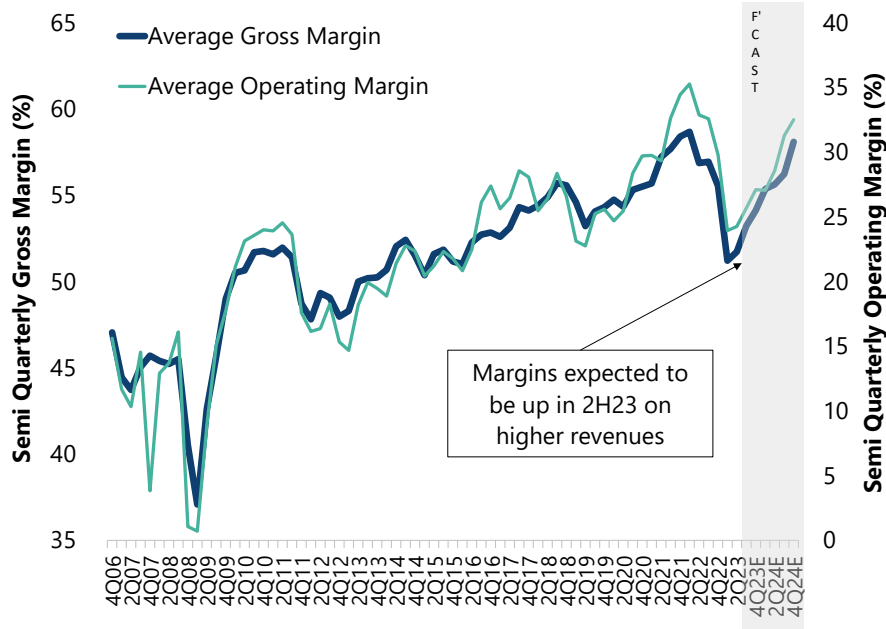


Source: Liftr Insight, Jefferies. More current and detailed data available by Liftr Insights.

NVDA dominates Dedicated Accelerator instances with approx. 85% share. NVDA share was up 20bps in Jul-23. NVDA made up 100% of incremental overall accelerator deployments in Jul-23. After announcing general availability in Oct-22, AWS Trainium, purpose-built for training of ML models, was detected for the first time in our data set, and made up 51% of new accelerator instances deployed in Nov-22. NVDA made up nearly all of incremental overall accelerator deployments since Feb-22, except for Nov-22 (49%) and Apr-23 (82%). GPUs are 87.4% of the total accelerator instances available as of Jul-23.

Semis Cycle Charts

Chart 76 - Consensus Semiconductor Gross and Operating Margins Project Recovery that started in 2Q23
Semis Gross and Operating Margins

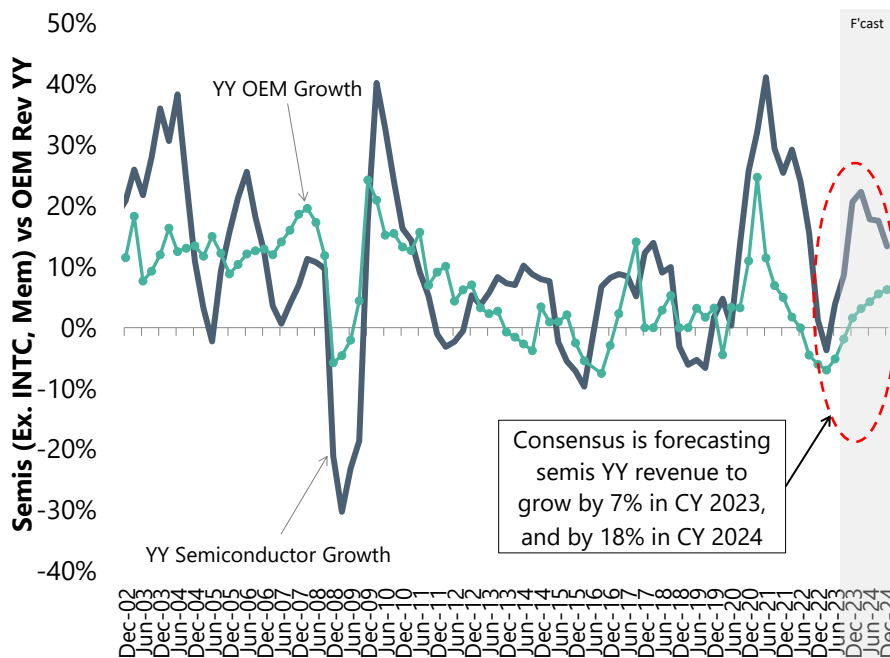


Semiconductor Operating Margins have increased by 2,000bps over the past 10 years as the group has consolidated

Margins bottomed in 1Q23 and consensus forecasts margins to recover after rebounding in 2Q23 and grow back to 2022 levels by the end of 2024

Source: Jefferies, company data, Factset

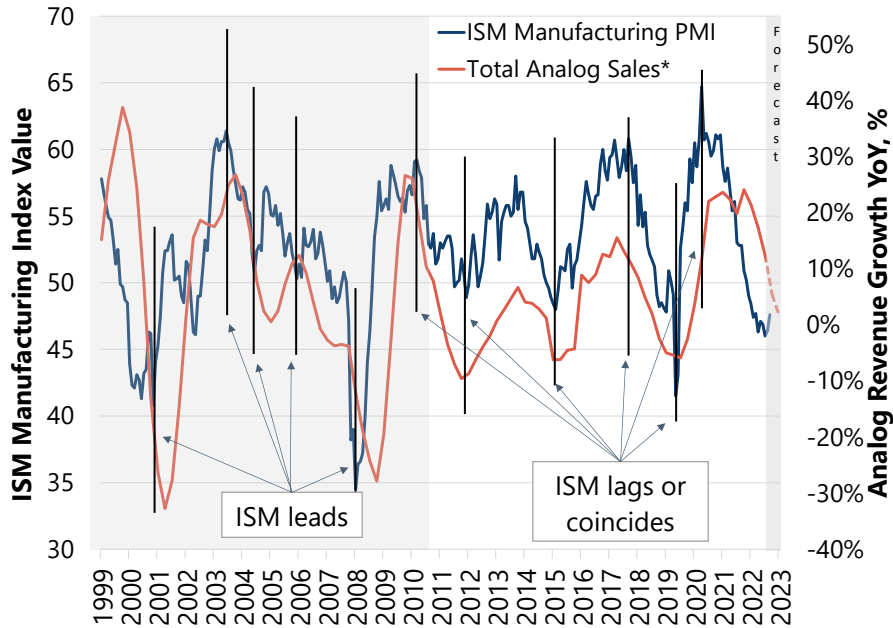
Chart 77 - Semis vs. OEMs revenue growth (YY)



Consensus is currently forecasting 7% growth YY in CY 2023 and 18% in CY 2024 vs. 17% growth in CY 2022 and 31% YY in C2021. Consensus expects semis YY growth to closely match YY OEM growth.

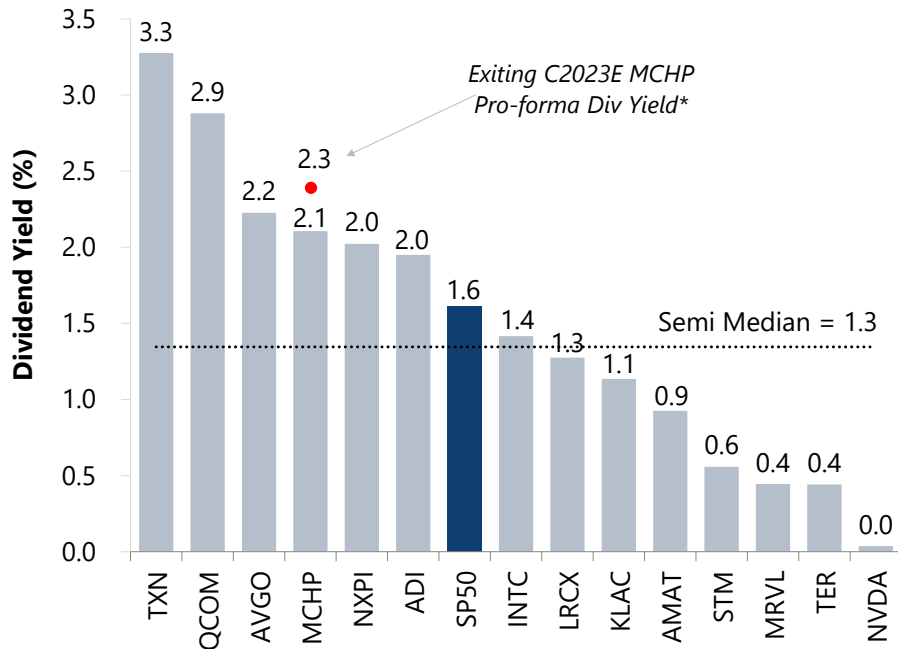
Source: Jefferies, FactSet, company data

Chart 78 - ISM Manufacturing PMI vs Total Analog Sales Growth YY



Source: Jefferies, Bloomberg, FactSet, *Total Analog sales include TTM sales for TXN, NSM, ADI, LLTC, MXIM, MCHP, IRF, ON, STM, FCS, IFX, FSL, NXPI, AMIS, MCSS, ATML, MCRL

Chart 79 - Semis Dividend Yield



Source: Jefferies, FactSet, C2023E MCHP Pro-forma Div Yield based on C3Q23E Dividend, assuming 9%/Q increases and current share price

We plotted ISM Manufacturing PMI and Analog semis YoY growth rates. ISM Manufacturing PMI has been a leading indicator for analog semis revenues growth rate in 2000-2011 and a coinciding/lagging indicator from 2012 onwards.

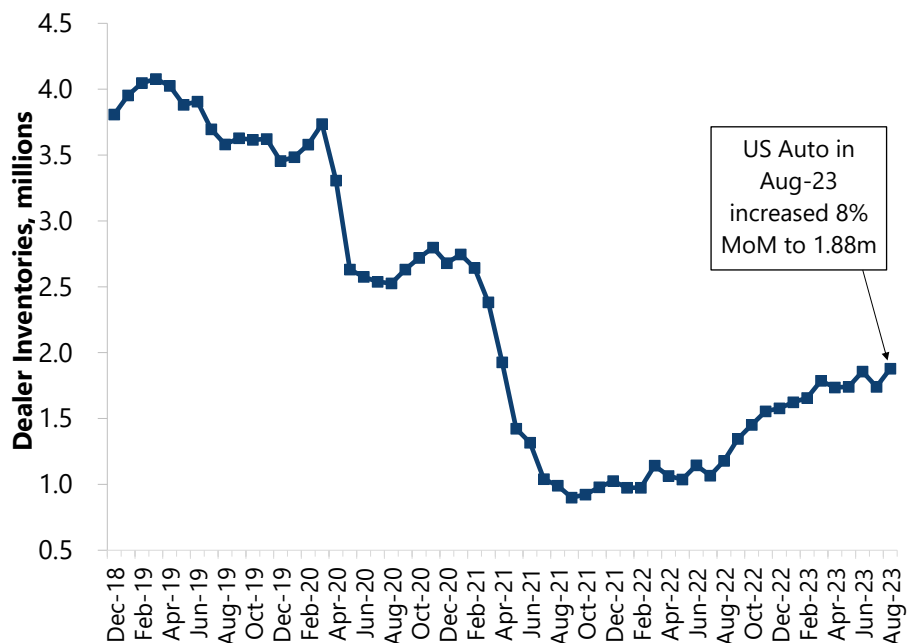
We think TXN and AVGO offer compelling dividend yields.

MCHP is our top dividend-growth story, having committed to increasing the dividend by 9% per quarter until reaching 50% of free cash flow. We estimate MCHP's dividend will increase at a 40% CAGR in 2022 and 2023, bringing its dividend yield to 2.3% exiting C2023, assuming the current share price.

TXN has recently increased its dividend by 5% to \$1.30, reaching a 3.2% dividend yield.

AVGO also recently raised its dividend by 12% to \$18.40, reaching a 2.2% dividend yield.

Chart 80 - U.S. Dealer Inventories increased 8% MoM in Aug
U.S. Dealer Inventories



US Auto Dealer inventories decreased 8% MoM in August 2023 after decreasing in July, increasing in June, remaining flat in May, decreasing in April and after 8 months of continuous increases before that.

Source: Motor Intelligence, Jefferies

Chart 81 - Semis Comp Table

Company	Rating	Market Cap (bn)	Price Target	9/29/23 Price	P/E 2023 2024	EV/FCF 2023 2024	EV/S 2023 2024	P/TanBk	Gross Margin [1]	Operating Margin [1]
Logic / Neural Networking:										
AMD	Buy	\$ 167	\$ 145	\$ 103	37x 25x	64x 40x	7x 6x	20x	34%	-1%
INTC	Hold	\$ 148	\$ 38	\$ 35	56x 20x	n.m. 243x	3x 3x	2x	38%	-4%
NVDA	Buy	\$ 1,072	\$ 610	\$ 434	40x 26x	44x 27x	20x 13x	49x	65%	33%
LSCC	Buy	\$ 12	\$ 105	\$ 86	41x 35x	44x 30x	15x 14x	49x	65%	30%
Analog / MCU:										
<i>Large Cap</i>										
ADI	Buy	\$ 88	\$ 209	\$ 174	19x 20x	26x 21x	8x 8x	n.a	57%	34%
Infineon	Hold	EUR 41	EUR 40	EUR 31	12x 12x	46x 25x	3x 3x	8x	46%	24%
MCHP	Buy	\$ 42	\$ 104	\$ 78	12x 13x	15x 18x	5x 6x	n.a	60%	38%
NXPI	Buy	\$ 51	\$ 257	\$ 199	14x 13x	19x 16x	4x 4x	n.a	54%	28%
STM	Hold	\$ 39	\$ 53	\$ 43	10x 10x	30x 18x	2x 2x	3x	49%	28%
TXN	Buy	\$ 144	\$ 216	\$ 159	22x 20x	77x 31x	8x 8x	13x	66%	47%
ON	Buy	\$ 40	\$ 125	\$ 93	18x 16x	55x 20x	5x 5x	8x	47%	33%
<i>SMID Cap</i>										
ALGM	Buy	\$ 6	\$ 54	\$ 32	21x 21x	36x 21x	5x 5x	7x	57%	21%
ams OSRAM	Hold	CHF 1	CHF 6	CHF 4	20x 7x	n.m. 15x	1x 1x	n.a	30%	7%
LAZR	Buy	\$ 1	\$ 10	\$ 4	n.m. n.m.	n.m. n.m.	19x 6x	n.a	-120%	-991%
Melexis	Hold	EUR 3	EUR 98	EUR 82	16x 18x	65x 21x	4x 4x	7x	45%	27%
MTSI	Buy	\$ 6	\$ 95	\$ 82	33x 28x	41x 31x	9x 8x	11x	57%	19%
NVTS	Buy	\$ 1	\$ 12	\$ 7	n.m. n.m.	n.m. n.m.	13x 7x	10x	8%	-238%
PI	Buy	\$ 1	\$ 91	\$ 54	115x 50x	n.m. n.m.	5x 5x	2132x	51%	-4%
WOLF	Hold	\$ 5	\$ 46	\$ 38	n.m. n.m.	n.m. n.m.	7x 5x	4x	29%	-21%
Comms:										
AVGO	Buy	\$ 341	\$ 1,035	\$ 826	19x 17x	20x 18x	10x 9x	n.a	64%	46%
MRVL	Buy	\$ 47	\$ 68	\$ 54	35x 23x	57x 29x	9x 8x	n.a	45%	-2%
Memory:										
RMBS [2]	Buy	\$ 6	\$ 66	\$ 56	38x 26x	27x 29x	10x 9x	10x	67%	17%
SGH	Buy	\$ 1	\$ 31	\$ 24	11x 9x	n.m. n.m.	1x 1x	n.a	25%	5%
Foundry:										
GFS	Buy	\$ 32	\$ 73	\$ 58	28x 21x	43x 31x	4x 4x	3x	29%	17%
Hua Hong - 1347	Hold	HKD 26	HKD 25	HKD 20	11x 19x	n.m. n.m.	1x 1x	1x	34%	22%
SKYT	Hold	\$ 0.3	\$ 10	\$ 6	n.m. 32x	n.m. 46x	1x 1x	5x	23%	-3%
SMIC - 981	Hold	HKD 159	HKD 20	HKD 20	21x 25x	n.m. n.m.	3x 2x	n.a	34%	20%
TSEM	Hold	\$ 3	\$ 31	\$ 24	12x 11x	n.m. 355x	1x 1x	1x	28%	18%
IP:										
AIP	Buy	\$ 0.2	\$ 14	\$ 7	n.m. n.m.	n.m. n.m.	3x 3x	13x	88%	-66%
Alphawave	Buy	GBP 0.8	GBP 2.7	GBP 1.1	0x 0x	256x 22x	3x 2x	n.a	46%	0%
IDCC	Buy	\$ 2.1	\$ 106	\$ 80	14x 20x	12x 8x	4x 4x	9x	60%	29%
Wafers:										
Shin-Etsu - 4063	Buy	JPY 8,791	JPY 5,500	JPY 4,343	15x 15x	13x 15x	3x 3x	2x	42%	34%
Siltronic	Buy	EUR 2	EUR 100	EUR 81	14x 19x	n.m. n.m.	1x 1x	1x	33%	22%
Soitec	Buy	EUR 6	EUR 270	EUR 158	35x 19x	35x 70x	5x 4x	5x	35%	23%
Sumco - 3436	Hold	JPY 682	JPY 2,100	JPY 1,949	11x 14x	n.m. n.m.	1x 1x	1x	31%	23%

[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.

Source: Jefferies, FactSet, company data

Chart 82 - Semis Comp Table

Company	Rating	Market Cap (bn)	Price Target	9/29/23 Price	P/E		EV/FCF		EV/S		P/TanBk	Gross Margin [1]	Operating Margin [1]
					2023	2024	2023	2024	2023	2024			
Semi Cap Equipment:													
<i>Front-End</i>													
ACMR	Buy	\$ 1	\$ 25	\$ 18	14x	14x	n.m.	7x	1x	1x	2x	50%	19%
Adv Micro - 688012	Buy	CNY 93	CNY 230	CNY 151	61x	44x	191x	98x	14x	10x	6x	45%	21%
Aixtron	Buy	EUR 4	EUR 52	EUR 35	26x	22x	42x	28x	6x	5x	6x	43%	21%
AMAT	Buy	\$ 116	\$ 175	\$ 138	18x	18x	15x	22x	4x	4x	10x	46%	29%
ASM International	Buy	EUR 20	EUR 600	EUR 398	32x	25x	35x	36x	7x	6x	9x	48%	26%
ASML Holding	Buy	EUR 225	EUR 950	EUR 559	29x	26x	63x	42x	8x	8x	41x	51%	33%
Canon - 7751	Hold	JPY 4,808	JPY 3,600	JPY 3,605	14x	12x	19x	15x	1x	1x	2x	46%	9%
KLAC	Buy	\$ 63	\$ 580	\$ 459	21x	20x	18x	21x	7x	7x	n.a.	59%	39%
Lasertec - 6920	Buy	JPY 2,194	JPY 28,000	JPY 23,270	41x	29x	77x	54x	12x	8x	20x	55%	41%
LRCX	Buy	\$ 83	\$ 750	\$ 627	24x	21x	19x	23x	6x	5x	13x	45%	30%
Nikon - 7731	Buy	JPY 554	JPY 2,200	JPY 1,577	15x	13x	n.m.	64x	1x	1x	1x	45%	7%
NVMI	Buy	\$ 3	\$ 140	\$ 113	25x	22x	41x	29x	6x	5x	6x	56%	26%
ONTO	Buy	\$ 6	\$ 160	\$ 128	35x	27x	39x	20x	7x	6x	6x	47%	19%
TEL - 8035	Buy	JPY 9,640	JPY 24,000	JPY 20,440	28x	25x	22x	28x	5x	5x	6x	44%	27%
<i>Back-End</i>													
Advantest - 6857	Buy	JPY 3,203	JPY 5,750	JPY 4,181	38x	7x	35x	30x	7x	6x	11x	55%	26%
A&D Holon - 7745	Buy	JPY 47	JPY 2,400	JPY 1,702	8x	7x	13x	12x	1x	1x	1x	46%	15%
CAMT	Buy	\$ 3	\$ 67	\$ 63	34x	28x	43x	35x	8x	7x	7x	48%	23%
Disco - 6146	Buy	JPY 2,988	JPY 30,000	JPY 27,580	38x	35x	39x	37x	10x	9x	9x	65%	38%
FORM	Hold	\$ 3	\$ 35	\$ 35	52x	27x	n.m.	41x	4x	3x	5x	36%	0%
TER	Buy	\$ 15	\$ 135	\$ 100	35x	22x	46x	30x	6x	5x	8x	59%	22%
Tokyo Seimitsu - 7729	Buy	JPY 315	JPY 9,300	JPY 7,490	15x	14x	31x	23x	2x	2x	2x	42%	23%
TOWA - 6315	Buy	JPY 104	JPY 3,600	JPY 4,155	17x	14x	n.m.	n.m.	2x	2x	2x	35%	17%
USHIO - 6925	Buy	JPY 224	JPY 2,300	JPY 1,817	19x	17x	36x	19x	1x	1x	1x	36%	8%

Source: Jefferies, FactSet, company data

Chart 83 - Semis Comp Table

Company		Consensus Sales (m)		Cash (m)	Debt (m)	Net Debt /EBITDA	Net Debt /Shr	JEF EPS		Cons. EPS		ROIC									
		2023	2024					2023	2024	2023	2024		2023	2024							
Logic / Neural Networking:																					
	AMD	\$	22,818	\$	27,612	\$	6,285	\$	2,860	-0.92x	\$	(2.12)	\$	2.69	\$	4.28	\$	2.75	\$	4.16	7%
	INTC	\$	52,499	\$	59,157	\$	24,257	\$	49,046	2.71x	\$	5.92	\$	0.66	\$	2.51	\$	0.63	\$	1.75	2%
	NVDA	\$	54,252	\$	83,591	\$	16,023	\$	10,954	-0.51x	\$	(2.05)	\$	10.87	\$	17.02	\$	10.74	\$	16.90	37%
	LSCC	\$	762	\$	859	\$	104	\$	61	-0.23x	\$	(0.31)	\$	2.09	\$	2.43	\$	2.09	\$	2.44	46%
Analog / MCU:																					
Large Cap																					
	ADI	\$	11,750	\$	11,189	\$	1,149	\$	6,982	0.66x	\$	11.53	\$	9.24	\$	8.68	\$	9.25	\$	8.60	13%
	Infineon	EUR	16,333	EUR	17,614	EUR	2,986	EUR	6,241	0.58x	EUR	2.49	EUR	2.37	EUR	2.53	EUR	2.55	EUR	2.72	16%
	MCHP	\$	8,906	\$	8,578	\$	271	\$	6,063	1.30x	\$	10.64	\$	6.18	\$	5.93	\$	6.35	\$	5.86	28%
	NXPI	\$	13,254	\$	14,072	\$	3,863	\$	11,170	1.34x	\$	28.34	\$	13.44	\$	14.57	\$	13.88	\$	14.91	20%
	STM	\$	17,387	\$	17,929	\$	4,563	\$	2,862	-0.28x	\$	(1.87)	\$	4.30	\$	3.16	\$	4.33	\$	4.34	29%
	TXN	\$	18,000	\$	19,174	\$	9,552	\$	11,219	0.17x	\$	1.84	\$	7.44	\$	9.04	\$	7.30	\$	7.82	32%
	ON	\$	8,382	\$	8,954	\$	2,633	\$	3,746	0.23x	\$	2.58	\$	5.23	\$	5.56	\$	5.22	\$	5.71	26%
SMID Cap																					
	ALGM	\$	1,092	\$	1,140	\$	362	\$	46	-0.93x	\$	(1.64)	\$	1.44	\$	1.48	\$	1.49	\$	1.54	30%
	ams OSRAM	CHF	3,478	CHF	3,669	CHF	875	CHF	2,779	1.90x	CHF	6.94	CHF	0.48	CHF	0.62	CHF	0.21	CHF	0.62	0%
	LAZR	\$	84	\$	244	\$	368	\$	637	-0.79x	\$	0.92	\$	(0.84)	\$	(0.64)	\$	(0.80)	\$	(0.57)	-56%
	Melexis	EUR	954	EUR	953	EUR	36	EUR	139	0.35x	EUR	2.55	EUR	5.21	EUR	4.40	EUR	5.14	EUR	4.67	37%
	MTSI	\$	624	\$	699	\$	588	\$	614	-1.01x	\$	0.37	\$	2.46	\$	2.87	\$	2.48	\$	2.97	16%
	NVTS	\$	77	\$	149	\$	178	\$	6	7.71x	\$	(0.99)	\$	(0.23)	\$	(0.17)	\$	(0.23)	\$	(0.12)	-11%
	PI	\$	303	\$	347	\$	109	\$	295	4.29x	\$	6.94	\$	0.48	\$	0.87	\$	0.47	\$	1.07	11%
	WOLF	\$	883	\$	1,166	\$	2,955	\$	4,310	53.01x	\$	10.82	\$	(1.83)	\$	(2.14)	\$	(1.90)	\$	(1.91)	-2%
Comms:																					
	AVGO	\$	36,315	\$	39,600	\$	12,055	\$	39,341	1.19x	\$	66.11	\$	42.99	\$	47.09	\$	42.92	\$	47.28	30%
	MRVL	\$	5,523	\$	6,513	\$	423	\$	4,688	1.52x	\$	4.94	\$	1.50	\$	2.28	\$	1.53	\$	2.33	7%
Memory:																					
	RMBS	\$	560	\$	660	\$	333	\$	31	-1.26x	\$	(2.76)	\$	1.76	\$	2.22	\$	1.47	\$	2.11	22%
	SGH	\$	1,573	\$	1,856	\$	401	\$	888	1.81x	\$	9.72	\$	2.23	\$	3.05	\$	2.27	\$	2.57	14%
Foundry:																					
	GFS	\$	7,426	\$	8,242	\$	2,787	\$	2,429	-0.03x	\$	(0.65)	\$	2.02	\$	2.47	\$	2.08	\$	2.74	6%
	Hua Hong - 1347	HKD	19,001	HKD	19,675	HKD	15,815	HKD	14,255	-0.19x	HKD	(1.19)	HKD	1.56	HKD	0.94	HKD	1.84	HKD	1.07	11%
	SKYT	\$	271	\$	320	\$	16	\$	101	2.60x	\$	1.84	\$	(0.50)	\$	0.04	\$	(0.45)	\$	0.19	-14%
	SMIC - 981	HKD	49,541	HKD	57,457	HKD	103,816	HKD	72,675	-1.06x	HKD	(3.93)	HKD	0.94	HKD	0.86	HKD	0.95	HKD	0.81	6%
	TSEM	\$	1,430	\$	1,540	\$	914	\$	220	-0.17x	\$	(6.30)	\$	2.10	\$	2.19	\$	2.04	\$	2.26	14%
IP:																					
	AIP	\$	55	\$	69	\$	55	\$	5	2.70x	\$	(1.39)	\$	(0.65)	\$	(0.41)	\$	(0.65)	\$	(0.41)	-50%
	Alphawave	GBP	286.94	GBP	386.14	GBP	96.56	GBP	189.08	2.38x	GBP	0.13	GBP	6.73	GBP	11.63	GBP	5.50	GBP	8.52	166%
	IDCC	\$	505	\$	450	\$	841	\$	610	-0.70x	\$	(8.76)	\$	5.86	\$	6.13	\$	5.72	\$	4.05	14%
Wafers:																					
	Shin-Etsu - 4063	JPY	2,518,468	JPY	2,793,833	JPY	1,557,453	JPY	29,789	-1.32x	JPY	(755)	JPY	300	JPY	318	JPY	282	JPY	294	19%
	Siltronic	EUR	1,528	EUR	1,705	EUR	950	EUR	771	-0.30x	EUR	(5.95)	EUR	5.59	EUR	6.40	EUR	5.99	EUR	4.32	15%
	Soitec	EUR	1,018	EUR	1,443	EUR	789	EUR	648	-0.40x	EUR	(3.96)	EUR	5.58	EUR	8.09	EUR	4.49	EUR	8.21	13%
	Sumco - 3436	JPY	429,639	JPY	496,191	JPY	208,273	JPY	166,113	-0.25x	JPY	(120)	JPY	189	JPY	157	JPY	172	JPY	137	14%

Source: Jefferies, FactSet, company data

Chart 84 - Semis Comp Table

Company	Consensus Sales (m)		Cash (m)	Debt (m)	Net Debt /EBITDA	Net Debt /Shr	JEF EPS		Cons. EPS		ROIC									
	2023	2024					2023	2024	2023	2024										
Semi Cap Equipment:																				
Front-End																				
ACMR	\$	560	\$	661	\$	270	\$	81	-2.10x	\$	(3.44)	\$	1.12	\$	1.17	\$	1.29	\$	1.29	9%
Adv Micro - 688012	CNY	6,076	CNY	8,263	CNY	9,785	CNY	522	-8.26x	CNY	(14.98)	CNY	3.18	CNY	3.44	CNY	2.47	CNY	3.43	8%
Aixtron	EUR	632	EUR	699	EUR	210	EUR	-	-1.72x	EUR	(1.86)	EUR	1.33	EUR	1.54	EUR	1.35	EUR	1.56	14%
AMAT	\$	25,952	\$	26,747	\$	6,535	\$	6,099	-0.11x	\$	(0.52)	\$	7.79	\$	8.34	\$	7.72	\$	7.89	35%
ASM International	EUR	2,609	EUR	3,092	EUR	490	EUR	21	-0.54x	EUR	(9.50)	EUR	12.01	EUR	13.98	EUR	12.26	EUR	15.78	24%
ASML Holding	EUR	27,060	EUR	28,908	EUR	6,346	EUR	4,518	-0.20x	EUR	(4.54)	EUR	19.65	EUR	23.33	EUR	19.30	EUR	21.70	50%
Canon - 7751	JPY	4,307,705	JPY	4,489,600	JPY	545,275	JPY	662,839	-0.01x	JPY	88	JPY	281	JPY	264	JPY	257	JPY	289	7%
KLAC	\$	9,523	\$	9,960	\$	3,243	\$	6,063	0.60x	\$	20.69	\$	22.15	\$	25.38	\$	21.70	\$	23.47	41%
Lasertec - 6920	JPY	186,618	JPY	256,070	JPY	29,773	JPY	5,040	-0.38x	JPY	(262)	JPY	537	JPY	707	JPY	564	JPY	807	89%
LRCX	\$	14,139	\$	15,812	\$	5,375	\$	5,249	-0.07x	\$	(0.95)	\$	25.67	\$	34.12	\$	25.81	\$	30.49	37%
Nikon - 7731	JPY	666,132	JPY	683,587	JPY	209,959	JPY	136,619	-0.95x	JPY	(209)	JPY	102	JPY	109	JPY	108	JPY	123	6%
NVMI	\$	505	\$	585	\$	416	\$	243	-1.41x	\$	(6.01)	\$	4.49	\$	5.58	\$	4.47	\$	5.23	21%
ONTO	\$	820	\$	934	\$	610	\$	19	-2.54x	\$	(12.03)	\$	3.61	\$	4.50	\$	3.67	\$	4.65	14%
TEL - 8035	JPY	1,787,088	JPY	1,906,528	JPY	401,029	JPY	16,170	-0.58x	JPY	(816)	JPY	718	JPY	839	JPY	719	JPY	816	32%
Back-End																				
Advantest - 6857	JPY	487,526	JPY	529,366	JPY	78,873	JPY	71,745	-0.04x	JPY	(9)	JPY	134	JPY	151	JPY	110	JPY	635	34%
A&D Holon - 7745	JPY	61,715	JPY	63,805	JPY	14,867	JPY	20,842	0.56x	JPY	215	JPY	203	JPY	221	JPY	206	JPY	227	16%
CAMT	\$	307	\$	360	\$	431	\$	196	-3.16x	\$	(5.26)	\$	1.90	\$	2.30	\$	1.86	\$	2.26	16%
Disco - 6146	JPY	277,075	JPY	312,316	JPY	153,201	JPY	-	-1.27x	JPY	(1,414)	JPY	691	JPY	734	JPY	723	JPY	790	26%
FORM	\$	664	\$	751	\$	238	\$	49	-8.56x	\$	(2.43)	\$	0.67	\$	1.34	\$	0.68	\$	1.28	5%
TER	\$	2,680	\$	3,293	\$	708	\$	118	-0.91x	\$	(3.83)	\$	2.78	\$	4.57	\$	2.84	\$	4.59	23%
Tokyo Seimitsu - 7729	JPY	136,672	JPY	136,177	JPY	28,433	JPY	12,300	-0.44x	JPY	(384)	JPY	481	JPY	529	JPY	511	JPY	525	17%
TOWA - 6315	JPY	47,021	JPY	56,655	JPY	17,134	JPY	14,795	-0.22x	JPY	(93)	JPY	245	JPY	308	JPY	244	JPY	297	15%
USHIO - 6925	JPY	178,163	JPY	187,760	JPY	64,568	JPY	21,146	-2.04x	JPY	(352)	JPY	84	JPY	99	JPY	95	JPY	110	6%

Source: Jefferies, FactSet, company data

Company Valuation/Risks

For Important Disclosure information on companies recommended in this report, please visit our website at <https://javatar.bluematrix.com/sellside/Disclosures.action> or call 212.284.2300.

Analyst Certification:

I, Mark Lipacis, certify that all of the views expressed in this research report accurately reflect my personal views about the subject security(ies) and subject company(ies). I also certify that no part of my compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed in this research report.

I, Vedvati Shrotre, certify that all of the views expressed in this research report accurately reflect my personal views about the subject security(ies) and subject company(ies). I also certify that no part of my compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed in this research report.

I, Natalia Winkler, CFA, certify that all of the views expressed in this research report accurately reflect my personal views about the subject security(ies) and subject company(ies). I also certify that no part of my compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed in this research report.

I, Brian Chen, CFA, certify that all of the views expressed in this research report accurately reflect my personal views about the subject security(ies) and subject company(ies). I also certify that no part of my compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed in this research report.

As is the case with all Jefferies employees, the analyst(s) responsible for the coverage of the financial instruments discussed in this report receives compensation based in part on the overall performance of the firm, including investment banking income. We seek to update our research as appropriate, but various regulations may prevent us from doing so. Aside from certain industry reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst's judgement.

Investment Recommendation Record

(Article 3(1)e and Article 7 of MAR)

Recommendation Published	September 29, 2023 , 18:01 ET.
Recommendation Distributed	September 29, 2023 , 18:01 ET.
Recommendation Recalled	September 29, 2023 , 18:55 ET.
Recalled Recommendation Distributed	September 29, 2023 , 18:55 ET.

Company Specific Disclosures

Steven DeSanctis owns shares of Apple Inc. common shares.

David Lustberg owns shares of Amazon.com common stock.

David Lustberg owns shares of Amazon.com common stock. Steven DeSanctis owns shares of Amazon.com common shares.

Steven DeSanctis owns shares of Alphabet Inc. common shares.

JEF is acting as financial advisor to Oclaro Inc. in the proposed sale of the company to Lumentum.

James Heaney has a long position in Facebook.

Steven DeSanctis owns shares of Microsoft Inc. common shares.

Jefferies Group LLC makes a market in the securities or ADRs of TSMC.

Jefferies Group LLC makes a market in the securities or ADRs of Arteris, Inc.

Jefferies Group LLC makes a market in the securities or ADRs of Allegro MicroSystems, Inc.

Jefferies Group LLC makes a market in the securities or ADRs of Alibaba Group Holding Limited.

Jefferies Group LLC makes a market in the securities or ADRs of Calix Inc.

Jefferies Group LLC makes a market in the securities or ADRs of GLOBALFOUNDRIES Inc.

Jefferies Group LLC makes a market in the securities or ADRs of Navitas Semiconductor Corporation.

Jefferies Group LLC makes a market in the securities or ADRs of Impinj, Inc.

Jefferies Group LLC makes a market in the securities or ADRs of SMART Global Holdings, Inc.

Within the past twelve months, Jefferies LLC and/or its affiliates received compensation for products and services other than investment banking services from non-investment banking, securities related compensation for client services it provided to Analog Devices, Inc..

Jefferies Group LLC, its affiliates or subsidiaries expect to receive or intend to seek compensation for investment banking services from Arteris, Inc. within the next three months.

Within the past 12 months, Jefferies Group LLC, its affiliates or subsidiaries has received compensation from investment banking services from Arteris, Inc..

Jefferies Group LLC, its affiliates or subsidiaries is acting as a manager or co-manager in the underwriting or placement of securities for Arteris, Inc. or one of its affiliates.

Within the past twelve months, Arteris, Inc. has been a client of Jefferies LLC and investment banking services are being or have been provided.

Jefferies Group LLC, its affiliates or subsidiaries has acted as a manager or co-manager in the underwriting or placement of securities for Arteris, Inc. or one of its affiliates within the past twelve months.

Within the past twelve months, Jefferies LLC and/or its affiliates received compensation for products and services other than investment banking services from non-investment banking, securities related compensation for client services it provided to Advanced Micro Devices, Inc..

Within the past twelve months, Jefferies LLC and/or its affiliates received compensation for products and services other than investment banking services from non-investment banking, securities related compensation for client services it provided to Intel Corporation.

Jefferies Group LLC, its affiliates or subsidiaries expect to receive or intend to seek compensation for investment banking services from Microchip Technology Inc. within the next three months.

Within the past twelve months, Jefferies LLC and/or its affiliates received compensation for products and services other than investment banking services from non-investment banking, securities related compensation for client services it provided to Marvell Technology Group Ltd..

Within the past twelve months, Jefferies LLC and/or its affiliates received compensation for products and services other than investment banking services from non-investment banking, securities related compensation for client services it provided to Microsoft Corporation.

Within the past 12 months, Jefferies Group LLC, its affiliates or subsidiaries has received compensation from investment banking services from Navitas Semiconductor Corporation.

Within the past twelve months, Navitas Semiconductor Corporation has been a client of Jefferies LLC and investment banking services are being or have been provided.

Jefferies Group LLC, its affiliates or subsidiaries has acted as a manager or co-manager in the underwriting or placement of securities for Navitas Semiconductor Corporation or one of its affiliates within the past twelve months.

Jefferies Group LLC, its affiliates or subsidiaries beneficially owned 1% or more of the common equity of SMART Global Holdings, Inc. as of last month's end (or the prior month's end if this report is dated later than 10 days after the most recent month end).

Jefferies Group LLC, its affiliates or subsidiaries expect to receive or intend to seek compensation for investment banking services from SkyWater Technology, Inc. within the next three months.

Within the past 12 months, Jefferies Group LLC, its affiliates or subsidiaries has received compensation from investment banking services from SkyWater Technology, Inc..

Jefferies Group LLC, its affiliates or subsidiaries is acting as a manager or co-manager in the underwriting or placement of securities for SkyWater Technology, Inc. or one of its affiliates.

Within the past twelve months, SkyWater Technology, Inc. has been a client of Jefferies LLC and investment banking services are being or have been provided. Jefferies Group LLC, its affiliates or subsidiaries has acted as a manager or co-manager in the underwriting or placement of securities for SkyWater Technology, Inc. or one of its affiliates within the past twelve months.

Within the past twelve months, Jefferies LLC and/or its affiliates received compensation for products and services other than investment banking services from non-investment banking, securities related compensation for client services it provided to STMicroelectronics N.V..

For Important Disclosure information on companies recommended in this report, please visit our website at [https://javatar.bluematrix.com/sellside/ Disclosures.action](https://javatar.bluematrix.com/sellside/Disclosures.action) or call 212.284.2300.

Explanation of Jefferies Ratings

Buy - Describes securities that we expect to provide a total return (price appreciation plus yield) of 15% or more within a 12-month period.

Hold - Describes securities that we expect to provide a total return (price appreciation plus yield) of plus 15% or minus 10% within a 12-month period.

Underperform - Describes securities that we expect to provide a total return (price appreciation plus yield) of minus 10% or less within a 12-month period.

The expected total return (price appreciation plus yield) for Buy rated securities with an average security price consistently below \$10 is 20% or more within a 12-month period as these companies are typically more volatile than the overall stock market. For Hold rated securities with an average security price consistently below \$10, the expected total return (price appreciation plus yield) is plus or minus 20% within a 12-month period. For Underperform rated securities with an average security price consistently below \$10, the expected total return (price appreciation plus yield) is minus 20% or less within a 12-month period.

NR - The investment rating and price target have been temporarily suspended. Such suspensions are in compliance with applicable regulations and/or Jefferies policies.

CS - Coverage Suspended. Jefferies has suspended coverage of this company.

NC - Not covered. Jefferies does not cover this company.

Restricted - Describes issuers where, in conjunction with Jefferies engagement in certain transactions, company policy or applicable securities regulations prohibit certain types of communications, including investment recommendations.

Monitor - Describes securities whose company fundamentals and financials are being monitored, and for which no financial projections or opinions on the investment merits of the company are provided.

Valuation Methodology

Jefferies' methodology for assigning ratings may include the following: market capitalization, maturity, growth/value, volatility and expected total return over the next 12 months. The price targets are based on several methodologies, which may include, but are not restricted to, analyses of market risk, growth rate, revenue stream, discounted cash flow (DCF), EBITDA, EPS, cash flow (CF), free cash flow (FCF), EV/EBITDA, P/E, PE/growth, P/CF, P/FCF, premium (discount)/average group EV/EBITDA, premium (discount)/average group P/E, sum of the parts, net asset value, dividend returns, and return on equity (ROE) over the next 12 months.

Jefferies Franchise Picks

Jefferies Franchise Picks include stock selections from among the best stock ideas from our equity analysts over a 12 month period. Stock selection is based on fundamental analysis and may take into account other factors such as analyst conviction, differentiated analysis, a favorable risk/reward ratio and investment themes that Jefferies analysts are recommending. Jefferies Franchise Picks will include only Buy rated stocks and the number can vary depending on analyst recommendations for inclusion. Stocks will be added as new opportunities arise and removed when the reason for inclusion changes, the stock has met its desired return, if it is no longer rated Buy and/or if it triggers a stop loss. Stocks having 120 day volatility in the bottom quartile of S&P stocks will continue to have a 15% stop loss, and the remainder will have a 20% stop. Franchise Picks are not intended to represent a recommended portfolio of stocks and is not sector based, but we may note where we believe a Pick falls within an investment style such as growth or value.

Risks which may impede the achievement of our Price Target

This report was prepared for general circulation and does not provide investment recommendations specific to individual investors. As such, the financial instruments discussed in this report may not be suitable for all investors and investors must make their own investment decisions based upon their specific investment objectives and financial situation utilizing their own financial advisors as they deem necessary. Past performance of the financial instruments recommended in this report should not be taken as an indication or guarantee of future results. The price, value of, and income from, any of the financial instruments mentioned in this report can rise as well as fall and may be affected by changes in economic, financial and political factors. If a financial instrument is denominated in a currency other than the investor's home currency, a change in exchange rates may adversely affect the price of, value of, or income derived from the financial instrument described in this report. In addition, investors in securities such as ADRs, whose values are affected by the currency of the underlying security, effectively assume currency risk.

Other Companies Mentioned in This Report

- A&D Holon HD (7745 JP: ¥1,702, BUY)
- ACM Research Inc (ACMR: \$18.11, BUY)
- Advanced Micro Devices, Inc. (AMD: \$102.82, BUY)
- Advanced Micro-Fabrication Eqp Inc China (688012 CH: CNY150.55, BUY)
- Advantest (6857 JP: ¥4,181, BUY)
- Aixtron SE (AIXA GR: €34.82, BUY)
- Alibaba Group Holding Limited (BABA: \$86.74, BUY)
- Allegro MicroSystems, Inc. (ALGM: \$31.94, BUY)
- Alphabet, Inc. (GOOGL: \$130.86, BUY)
- Alphawave Semi (AWE LN: p114.20, BUY)
- Amazon.com, Inc (AMZN: \$127.12, BUY)
- Ambarella, Inc. (AMBA: \$53.03, BUY)
- ams OSRAM (AMS SW: CHF4.32, HOLD)
- Analog Devices, Inc. (ADI: \$175.09, BUY)
- Apple Inc. (AAPL: \$171.21, BUY)
- Applied Materials Inc. (AMAT: \$138.45, BUY)
- Arista Networks, Inc. (ANET: \$183.93, HOLD)
- Arteris, Inc. (AIP: \$6.51, BUY)
- ASM International N.V. (ASM NA: €397.50, BUY)
- ASML Holding NV (ASML NA: €559.10, BUY)
- Broadcom (AVGO: \$830.58, BUY)
- Calix Inc. (CALX: \$45.84, BUY)
- Camtek Ltd (CAMT: \$62.26, BUY)
- Canon Inc. (7751 JP: ¥3,605, HOLD)
- Cisco Systems, Inc. (CSCO: \$53.76, BUY)
- Disco (6146 JP: ¥27,580, BUY)
- FormFactor Inc (FORM: \$34.94, HOLD)
- GLOBALFOUNDRIES Inc. (GFS: \$58.19, BUY)
- Harmonic Inc. (HLIT: \$9.63, BUY)
- Hua Hong Semiconductor (1347 HK: HK\$19.84, HOLD)
- Impinj, Inc. (PI: \$55.03, BUY)
- Infineon Technologies (IFX GR: €31.36, HOLD)

- Intel Corporation (INTC: \$35.55, HOLD)
- InterDigital (IDCC: \$80.24, BUY)
- JEOL (6951 JP: ¥4,458, BUY)
- Juniper, Inc. (JNPR: \$27.79, BUY)
- Kakaku.com, Inc. (2371 JP: ¥1,517, BUY)
- KLA Corporation (KLAC: \$458.66, BUY)
- LAM Research Corporation (LRCX: \$626.77, BUY)
- Lasertec Corp (6920 JP: ¥23,270, BUY)
- Lattice Semiconductor Corporation (LSCC: \$85.93, BUY)
- Lumentum Holdings Inc. (LITE: \$45.18, BUY)
- Luminar Technologies, Inc. (LAZR: \$4.55, BUY)
- M/A-COM Technology Solutions Holdings, Inc. (MTSI: \$81.58, BUY)
- Marvell Technology Group Ltd. (MRVL: \$54.13, BUY)
- Melexis NV (MELE BB: €81.70, HOLD)
- Meta Platforms, Inc. (META: \$300.21, BUY)
- Microchip Technology Inc. (MCHP: \$78.05, BUY)
- Microsoft Corporation (MSFT: \$315.75, BUY)
- Navitas Semiconductor Corporation (NVTX: \$6.95, BUY)
- Nikon (7731 JP: ¥1,577, BUY)
- Nova Ltd (NVMi: \$112.44, BUY)
- NVIDIA Corporation (NVDA: \$434.99, BUY)
- NXP Semiconductors NV (NXPI: \$199.92, BUY)
- ON Semiconductor Corporation (ON: \$92.95, BUY)
- Onto Innovation Inc (ONTO: \$127.52, BUY)
- Oracle Corporation (ORCL: \$105.92, BUY)
- Rambus, Inc. (RMBS: \$55.79, BUY)
- Semiconductor Manufacturing International Corporation (981 HK: HK\$20.05, HOLD)
- Shibaura Mechatronics Corp (6590 JP: ¥7,050, BUY)
- Shin-Etsu Chemical (4063 JP: ¥4,343, BUY)
- Siltronic AG (WAF GR: €80.95, BUY)
- SkyWater Technology, Inc. (SKYT: \$6.02, HOLD)
- SMART Global Holdings, Inc. (SGH: \$24.35, BUY)
- Soitec (SOI FP: €157.75, BUY)
- STMicroelectronics N.V. (STMPA FP: €40.99, HOLD)
- SUMCO (3436 JP: ¥1,949, HOLD)
- TAZMO (6266 JP: ¥2,923, BUY)
- Tencent Holdings Ltd. (700 HK: HK\$306.20, BUY)
- Teradyne Inc (TER: \$100.46, BUY)
- Tesla, Inc. (TSLA: \$250.22, HOLD)
- Texas Instruments Incorporated (TXN: \$159.01, BUY)
- Tokyo Electron (8035 JP: ¥20,440, BUY)
- Tokyo Seimitsu (7729 JP: ¥7,490, BUY)
- TOWA (6315 JP: ¥4,155, BUY)
- Tower Semiconductor Ltd (TSEM: \$24.56, HOLD)
- Ushio (6925 JP: ¥1,817, BUY)
- Wolfspeed, Inc. (WOLF: \$38.10, HOLD)

Distribution of Ratings

			IB Serv./Past12 Mos.		JIL Mkt Serv./Past12 Mos.	
	Count	Percent	Count	Percent	Count	Percent
BUY	1854	58.17%	309	16.67%	108	5.83%
HOLD	1179	36.99%	111	9.41%	15	1.27%
UNDERPERFORM	154	4.83%	5	3.25%	3	1.95%

Other important disclosures

Other Important Disclosures

Jefferies does business and seeks to do business with companies covered in its research reports, and expects to receive or intends to seek compensation for investment banking services among other activities from such companies. As a result, investors should be aware that Jefferies may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision.

Jefferies Equity Research refers to research reports produced by analysts employed by one of the following Jefferies Group LLC ("Jefferies") group companies:

United States: Jefferies LLC which is an SEC registered broker-dealer and a member of FINRA (and distributed by Jefferies Research Services, LLC, an SEC registered Investment Adviser, to clients paying separately for such research).

Canada: You are advised that Jefferies LLC operates as a dealer in your jurisdiction under an exemption from the dealer registration requirements contained in National Instrument 31-103 Registration Requirements, Exemptions and Ongoing Registrant Obligations and, as such, Jefferies LLC is not required to be and is not a registered dealer or adviser in your jurisdiction. You are advised that Jefferies LLC prepared this research report and it was not prepared in accordance with Canadian disclosure requirements relating to research reports in Canada.

United Kingdom: Jefferies International Limited, which is authorized and regulated by the Financial Conduct Authority; registered in England and Wales No. 1978621; registered office: 100 Bishopsgate, London EC2N 4JL; telephone +44 (0)20 7029 8000; facsimile +44 (0)20 7029 8010.

Germany: Jefferies GmbH, which is authorized and regulated by the Bundesanstalt fuer Finanzdienstleistungsaufsicht, BaFin-ID: 10150151; registered office: Bockenheimer Landstr. 24, 60232 Frankfurt a.M., Germany; telephone: +49 (0) 69 719 1870

Hong Kong: Jefferies Hong Kong Limited, which is licensed by the Securities and Futures Commission of Hong Kong with CE number ATS546; located at Level 26, Two International Finance Center, 8 Finance Street, Central, Hong Kong; telephone: +852 3743 8000.

Singapore: Jefferies Singapore Limited, which is licensed by the Monetary Authority of Singapore; located at 80 Raffles Place #15-20, UOB Plaza 2, Singapore 048624, telephone: +65 6551 3950.

Japan: Jefferies (Japan) Limited, Tokyo Branch, which is a securities company registered by the Financial Services Agency of Japan and is a member of the Japan Securities Dealers Association; located at Tokyo Midtown Hibiya 30F Hibiya Mitsui Tower, 1-1-2 Yurakucho, Chiyoda-ku, Tokyo 100-0006; telephone +813 5251 6100; facsimile +813 5251 6101.

India: Jefferies India Private Limited (CIN - U74140MH2007PTC200509), licensed by the Securities and Exchange Board of India for: Stock Broker (NSE & BSE) INZ000243033, Research Analyst INH000000701 and Merchant Banker INM000011443, located at Level 16, Express Towers, Nariman Point, Mumbai 400 021, India; Tel +91 22 4356 6000. Compliance Officer name: Sanjay Pai, Tel No: +91 22 42246150, Email: spai@jefferies.com, Grievance officer name: Sanjay Pai, Tel no. +91 22 42246150, Email: compliance_india@jefferies.com. Registration granted by SEBI and certification from NISM in no way guarantee performance of the intermediary or provide any assurance of returns to investors.

Australia: Jefferies (Australia) Pty Limited (ACN 623 059 898), which holds an Australian financial services license (AFSL 504712) and is located at Level 22, 60 Martin Place, Sydney NSW 2000; telephone +61 2 9364 2800.

Dubai: Jefferies International Limited, Dubai branch, which is licensed by the Dubai Financial Services Authority (DFSA Reference Number F007325); registered office Unit L31-06, L31-07, Level 31, ICD Brookfield Pace, DIFC, PO Box 121208, Dubai, UAE.

This report was prepared by personnel who are associated with Jefferies (Jefferies International Limited, Jefferies GmbH, Jefferies Hong Kong Limited, Jefferies Singapore Limited, Jefferies (Japan) Limited, Tokyo Branch, Jefferies India Private Limited), and Jefferies (Australia) Pty Ltd; or by personnel who are associated with both Jefferies LLC and Jefferies Research Services LLC ("JRS"). Jefferies LLC is a US registered broker-dealer and is affiliated with JRS, which is a US registered investment adviser. JRS does not create tailored or personalized research and all research provided by JRS is impersonal. If you are paying separately for this research, it is being provided to you by JRS. Otherwise, it is being provided by Jefferies LLC. Jefferies LLC, JRS, and their affiliates are collectively referred to below as "Jefferies". Jefferies may seek to do business with companies covered in this research report. As a result, investors should be aware that Jefferies may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only one of many factors in making their investment decisions. Specific conflict of interest and other disclosures that are required by FINRA and other rules are set forth in this disclosure section.

If you are receiving this report from a non-US Jefferies entity, please note the following: Unless prohibited by the provisions of Regulation S of the U.S. Securities Act of 1933, as amended, this material is distributed in the United States by Jefferies LLC, which accepts responsibility for its contents in accordance with the provisions of Rule 15a-6 under the US Securities Exchange Act of 1934, as amended. Transactions by or on behalf of any US person may only be effected through Jefferies LLC. In the United Kingdom and European Economic Area this report is issued and/or approved for distribution by Jefferies International Limited ("JIL") and/or Jefferies GmbH and is intended for use only by persons who have, or have been assessed as having, suitable professional experience and expertise, or by persons to whom it can be otherwise lawfully distributed. Jefferies LLC, JIL, Jefferies GmbH and their affiliates, may make a market or provide liquidity in the financial instruments referred to in this report; and where they do make a market, such activity is disclosed specifically in this report under "company specific disclosures".

For Canadian investors, this material is intended for use only by professional or institutional investors. None of the investments or investment services mentioned or described herein is available to other persons or to anyone in Canada who is not a "permitted client" as defined by National Instrument 31-103 Registration Requirements, Exemptions and Ongoing Registrant Obligations. This research report is a general discussion of the merits and risks of a security or securities only, and is not in any way meant to be tailored to the needs and circumstances of any recipient. The information contained herein is not, and under no circumstances is to be construed as, an offer to sell securities described herein, or solicitation of an offer to buy securities described herein, in Canada or any province or territory thereof. Any offer or sale of the securities described herein in Canada will be made only under an exemption from the requirements to file a prospectus with the relevant Canadian securities regulators, if applicable, and only by a dealer properly registered under applicable securities laws or,

alternatively, pursuant to an exemption from the dealer registration requirement in the relevant province or territory of Canada in which such offer or sale is made. The information contained herein is under no circumstances to be construed as investment advice in any province or territory of Canada and is not tailored to the needs of the recipient. To the extent that the information contained herein references securities of an issuer incorporated, formed or created under the laws of Canada or a province or territory of Canada, any trades in such securities must be conducted through a dealer registered in Canada. No securities commission or similar regulatory authority in Canada has reviewed or in any way passed judgment upon this research report, the information contained herein or the merits of the securities described herein, and any representation to the contrary is an offence.

In Singapore, Jefferies Singapore Limited ("JSL") is regulated by the Monetary Authority of Singapore. For investors in the Republic of Singapore, where this material is prepared and issued by a Jefferies affiliate outside of Singapore, it is distributed by JSL pursuant to Regulation 32C of the Financial Advisers Regulations. The material contained in this document is intended solely for accredited, expert or institutional investors, as defined under the Securities and Futures Act 2001 (Singapore). If there are any matters arising from, or in connection with this material, please contact JSL, located at 80 Raffles Place #15-20, UOB Plaza 2, Singapore 048624, telephone: +65 6551 3950. In Dubai, this material is issued and distributed by Jefferies International Limited, Dubai branch, and is intended solely for Professional Clients and should not be distributed to, or relied upon by, Retail Clients (as defined by DFSA). A distribution of ratings in percentage terms in each sector covered is available upon request from your sales representative. In Japan, this material is issued and distributed by Jefferies (Japan) Limited to institutional investors only. In Hong Kong, this report is issued and approved by Jefferies Hong Kong Limited and is intended for use only by professional investors as defined in the Hong Kong Securities and Futures Ordinance and its subsidiary legislation. In the Republic of China (Taiwan), this report should not be distributed. The research in relation to this report is conducted outside the People's Republic of China ("PRC"). This report does not constitute an offer to sell or the solicitation of an offer to buy any securities in the PRC. PRC investors shall have the relevant qualifications to invest in such securities and shall be responsible for obtaining all relevant approvals, licenses, verifications and/or registrations from the relevant governmental authorities themselves. In India, this report is made available by Jefferies India Private Limited. In Australia, this report is issued and/or approved for distribution by, or on behalf of, Jefferies (Australia) Securities Pty Ltd (ACN 610 977 074), which holds an Australian financial services license (AFSL 487263). It is directed solely at wholesale clients within the meaning of the Corporations Act 2001 (Cth) of Australia (the "Corporations Act"), in connection with their consideration of any investment or investment service that is the subject of this report. This report may contain general financial product advice. Where this report refers to a particular financial product, you should obtain a copy of the relevant product disclosure statement or offer document before making any decision in relation to the product. Recipients of this document in any other jurisdictions should inform themselves about and observe any applicable legal requirements in relation to the receipt of this document.

This report is not an offer or solicitation of an offer to buy or sell any security or derivative instrument, or to make any investment. Any opinion or estimate constitutes the preparer's best judgment as of the date of preparation, and is subject to change without notice. Jefferies assumes no obligation to maintain or update this report based on subsequent information and events. Jefferies, and their respective officers, directors, and employees, may have long or short positions in, or may buy or sell any of the securities, derivative instruments or other investments mentioned or described herein, either as agent or as principal for their own account. This material is provided solely for informational purposes and is not tailored to any recipient, and is not based on, and does not take into account, the particular investment objectives, portfolio holdings, strategy, financial situation, or needs of any recipient. As such, any advice or recommendation in this report may not be suitable for a particular recipient. Jefferies assumes recipients of this report are capable of evaluating the information contained herein and of exercising independent judgment. A recipient of this report should not make any investment decision without first considering whether any advice or recommendation in this report is suitable for the recipient based on the recipient's particular circumstances and, if appropriate or otherwise needed, seeking professional advice, including tax advice. Jefferies does not perform any suitability or other analysis to check whether an investment decision made by the recipient based on this report is consistent with a recipient's investment objectives, portfolio holdings, strategy, financial situation, or needs.

By providing this report, neither JRS nor any other Jefferies entity accepts any authority, discretion, or control over the management of the recipient's assets. Any action taken by the recipient of this report, based on the information in the report, is at the recipient's sole judgment and risk. The recipient must perform his or her own independent review of any prospective investment. If the recipient uses the services of Jefferies LLC (or other affiliated broker-dealers), in connection with a purchase or sale of a security that is a subject of these materials, such broker-dealer may act as principal for its own accounts or as agent for another person. Only JRS is registered with the SEC as an investment adviser; and therefore neither Jefferies LLC nor any other Jefferies affiliate has any fiduciary duty in connection with distribution of these reports.

The price and value of the investments referred to herein and the income from them may fluctuate. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur. Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments.

This report may contain forward looking statements that may be affected by inaccurate assumptions or by known or unknown risks, uncertainties, and other important factors. As a result, the actual results, events, performance or achievements of the financial product may be materially different from those expressed or implied in such statements.

This report has been prepared independently of any issuer of securities mentioned herein and not as agent of any issuer of securities. No Equity Research personnel have authority whatsoever to make any representations or warranty on behalf of the issuer(s). Any comments or statements made herein are those of the Jefferies entity producing this report and may differ from the views of other Jefferies entities.

This report may contain information obtained from third parties, including ratings from credit ratings agencies such as Standard & Poor's. Reproduction and distribution of third party content in any form is prohibited except with the prior written permission of the related third party. Jefferies does not guarantee the accuracy, completeness, timeliness or availability of any information, including ratings, and is not responsible for any errors or omissions (negligent or otherwise), regardless of the cause, or for the results obtained from the use of such content. Third-party content providers give no express or implied warranties, including, but not limited to, any warranties of merchantability or fitness for a particular purpose or use. Neither Jefferies nor any third-party content provider shall be liable for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including lost income or profits and opportunity costs) in connection with any use of their content, including ratings. Credit ratings are statements of opinions

and are not statements of fact or recommendations to purchase, hold or sell securities. They do not address the suitability of securities or the suitability of securities for investment purposes, and should not be relied on as investment advice.

Jefferies research reports are disseminated and available electronically, and, in some cases, also in printed form. Electronic research is simultaneously made available to all clients. This report or any portion hereof may not be copied, reprinted, sold, or redistributed or disclosed by the recipient or any third party, by content scraping or extraction, automated processing, or any other form or means, without the prior written consent of Jefferies. Any unauthorized use is prohibited. Neither Jefferies nor any of its respective directors, officers or employees, is responsible for guaranteeing the financial success of any investment, or accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this report or its contents. Nothing herein shall be construed to waive any liability Jefferies has under applicable U.S. federal or state securities laws.

For Important Disclosure information relating to JRS, please see https://adviserinfo.sec.gov/IAPD/Content/Common/crd_iapd_Brochure.aspx?BRCHR_VRSN_ID=483878 and <https://adviserinfo.sec.gov/Firm/292142> or visit our website at <https://javatar.bluematrix.com/sellside/Disclosures.action>, or www.jefferies.com, or call 1.888.JEfferies.

© 2023 Jefferies