

US Semiconductors and Semi Equipment

The Chartbook: Our Latest Thoughts

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UBS Semis and Semi Equipment - Primary Stock Coverage

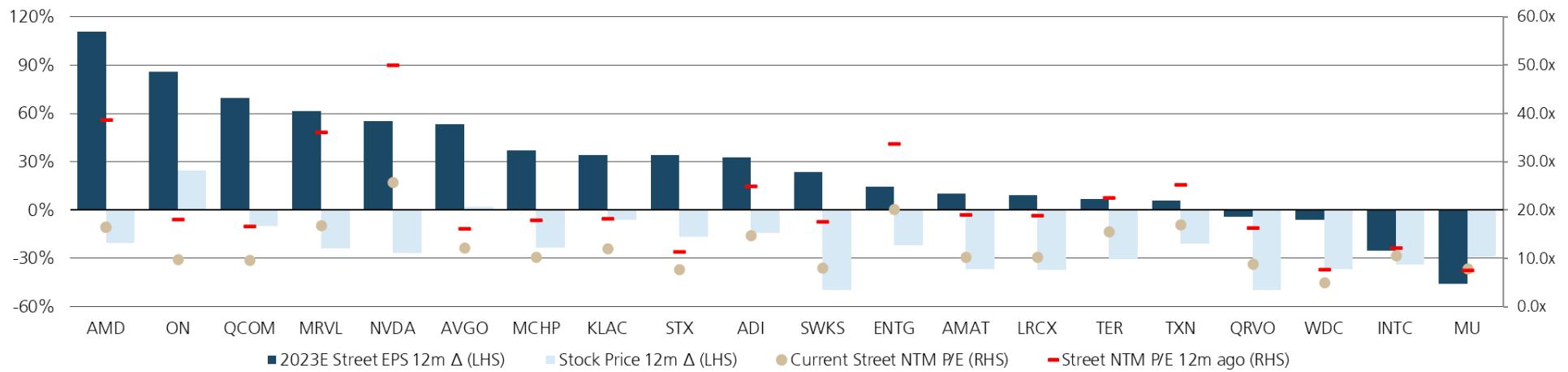
Rating	Ticker	Company	Analyst	Mkt Cap, \$MM	Current Price	UBS Price Target	Upside / Downside	2022E			2023E			% Buy Rating	Short Int	12m Stock Price Δ	Street EPS 12mo Ago	2023 Street EPS Δ (Current vs 1Y Ago)
								UBS EPS	Street EPS	Delta to Street	UBS EPS	Street EPS	Delta to Street					
Buy	NVDA	Nvidia	Timothy Arcuri	\$378,250	\$151	\$280	85%	\$5.50	\$5.42	2%	\$6.83	\$6.43	6%	82%	1%	-27%	\$4.14	55%
Buy	MRVL	Marvell	Timothy Arcuri	\$37,192	\$44	\$80	83%	\$2.38	\$2.33	2%	\$3.14	\$2.94	7%	88%	2%	-24%	\$1.82	61%
Buy	MCHP	Microchip	Timothy Arcuri	\$31,135	\$56	\$100	78%	\$5.35	\$5.19	3%	\$5.72	\$5.53	3%	69%	3%	-23%	\$4.03	37%
Buy	MU	Micron Technology	Timothy Arcuri	\$64,063	\$57	\$90	57%	\$7.36	\$7.86	(6%)	\$7.56	\$7.18	5%	83%	3%	-29%	\$13.23	-46%
Buy	TER	Teradyne	Timothy Arcuri	\$14,096	\$88	\$135	53%	\$4.80	\$4.80	(0%)	\$8.17	\$6.51	25%	57%	2%	-30%	\$6.10	7%
Neutral	AMD	Advanced Micro Devices	Timothy Arcuri	\$122,105	\$75	\$110	46%	\$4.34	\$4.31	1%	\$4.76	\$4.79	(1%)	68%	3%	-20%	\$2.28	111%
Buy	ADI	Analog Devices	Timothy Arcuri	\$75,216	\$145	\$210	45%	\$9.96	\$9.76	2%	\$10.27	\$10.12	1%	78%	2%	-14%	\$7.62	33%
Buy	AVGO	Broadcom	Timothy Arcuri	\$194,886	\$483	\$690	43%	\$38.42	\$38.71	(1%)	\$39.51	\$41.04	(4%)	88%	1%	2%	\$26.80	53%
Neutral	ON	On Semiconductor	Timothy Arcuri	\$20,687	\$48	\$68	43%	\$4.86	\$4.88	(0%)	\$4.93	\$4.87	1%	76%	4%	25%	\$2.62	86%
Buy	STX	Seagate	Timothy Arcuri	\$15,368	\$72	\$100	40%	\$8.83	\$8.60	3%	\$9.51	\$9.24	3%	46%	5%	-16%	\$6.90	34%
Neutral	SWKS	Skyworks Solutions	Timothy Arcuri	\$15,373	\$96	\$133	39%	\$11.45	\$11.29	1%	\$12.61	\$12.64	(0%)	52%	2%	-50%	\$10.22	24%
Neutral	INTC	Intel	Timothy Arcuri	\$151,252	\$37	\$51	38%	\$3.58	\$3.46	4%	\$3.73	\$3.50	7%	26%	2%	-34%	\$4.67	-25%
Neutral	QRVO	Qorvo	Timothy Arcuri	\$10,384	\$98	\$135	38%	\$11.19	\$10.97	2%	\$12.88	\$12.38	4%	43%	3%	-50%	\$12.91	-4%
Neutral	ENTG	Entegris	Timothy Arcuri	\$12,531	\$92	\$125	36%	\$4.35	\$4.28	2%	\$5.10	\$4.91	4%	92%	5%	-22%	\$4.28	14%
Buy	LRCX	Lam Research	Timothy Arcuri	\$54,333	\$392	\$510	30%	\$30.37	\$33.74	(10%)	\$37.82	\$38.28	(1%)	64%	2%	-37%	\$35.05	9%
Neutral	WDC	Western Digital	Timothy Arcuri	\$13,707	\$44	\$55	26%	\$8.85	\$7.98	11%	\$9.25	\$8.73	6%	64%	2%	-37%	\$9.30	-6%
Neutral	QCOM	Qualcomm	Timothy Arcuri	\$142,307	\$127	\$155	22%	\$12.53	\$13.10	(4%)	\$12.00	\$13.32	(10%)	68%	2%	-10%	\$7.86	69%
Neutral	KLAC	KLA Corporation	Timothy Arcuri	\$43,726	\$293	\$345	18%	\$23.10	\$22.78	1%	\$22.25	\$23.90	(7%)	74%	2%	-6%	\$17.80	34%
Neutral	TXN	Texas Instruments	Timothy Arcuri	\$139,067	\$151	\$175	16%	\$9.41	\$8.94	5%	\$8.90	\$8.83	1%	33%	2%	-21%	\$8.34	6%
Neutral	AMAT	Applied Materials	Timothy Arcuri	\$75,303	\$87	\$100	16%	\$7.97	\$7.71	3%	\$7.99	\$8.75	(9%)	71%	1%	-37%	\$7.94	10%

Source: Factset, UBS estimates

Prices as of 07/06/2022

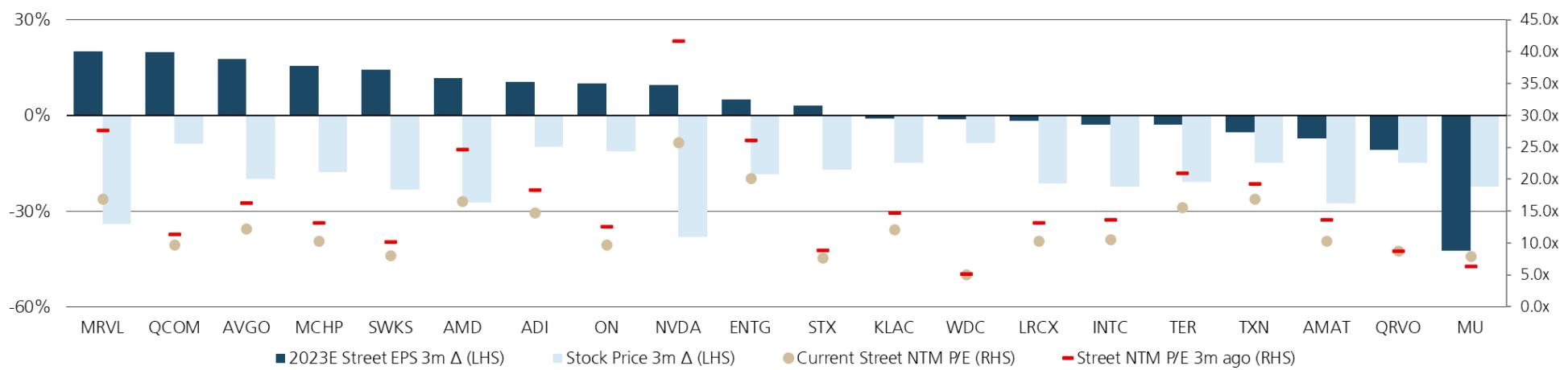
Primary Stock Coverage: Street Estimates Change

Stock Coverage – 12M Change



Source: Factset

Stock Coverage – 3M Change



Source: Factset

Primary Stock Coverage: Summary Thesis and Risks - Part 1

Company	Analyst	Market Cap (Units: \$M)	Rating	Current Stock Price	UBS Target Price	Upside/Downside	Thesis/Risks	
Nvidia	Timothy Arcuri	\$378,250	Buy	\$151	\$280	85%	Our thesis	We view NVDA as a core holding for any growth portfolio. We think NVDA is best positioned to address the broadest set of workloads in the competition as NVDA's GPUs combined with their software horsepower are still very much the most dominant spot amid the proliferation of heterogeneous compute architectures in the cloud. AI workloads continue to rapidly broaden into mainstream verticals of the global economy and this creates a large wedge of opportunity as compute demand for these workloads significantly outstrips supply, creating a very long runway for the data center business. On top of all of these, we believe that the Omniverse platform, spurred by the multi-year secular catalysts of Metaverse, will usher in the next wave of significant TAM expansion given its very broad application spectrum. Gaming represents near-term risk, but the stock is reflecting much of this at current levels.
							Risks to our thesis	Gaming's seasonal and channel headwinds could be worse than we are expecting down the road as it eventually sets up for what are likely to be a few sub-seasonal quarters as the gaming channel becomes more balanced. AMD is catching up with NVDA on the GPU architecture race and there could be a big risk of migration of gamers from NVDA's GPUs to AMD's, while INTC's new discrete GPUs will also intensify the competition. In addition, China's crackdown on cryptocurrency mining will significantly decrease the customer base as well as the TAM in that market. Lastly, the Omniverse platform may not be able to grow its installed base of customers as soon and fast as we are expecting.
Marvell	Timothy Arcuri	\$37,192	Buy	\$44	\$80	83%	Our thesis	Post IPHI and Innovium acquisition, MRVL is now one of the better cloud stories in the market with relatively little competition for its merchant products and very unique custom ASIC capabilities amid a flurry of activity from hyperscalers. Beyond near and even medium term demand strength from cloud5G, the longer-term product roadmap is starting to benefit from 5nm R&D investments that mgmt undertook during the CAVM deal as new cloud wins add visibility out into 2024/2025 after 5G will have largely played out. In this timeframe, the auto segment should also be a much larger revenue contributor as cars become computers on wheels and MRVL is the standard for auto Ethernet. The company raised its long-term revenue growth rate from 14% mid-pt to 17.5% midpt, one of - if not the - most ambitious growth targets for any company in the broader semis universe. MRVL has also been one of the most constrained on the supply side, meaning that more substrate and wafer availability could open some upside for the model and unless data center weakens materially, the backlog seems to offer more protection on the downside than many peers across semis.
							Risks to our thesis	The company has built through M&A and stock compensation relative to EBIT is one of the highest in all of semis. Also, the custom ASIC business can be risky unless MRVL chooses the right partners and projects to pursue. Lastly, the stock may not be able to escape the inevitable downcycle that we see starting to materialize in '23E especially if data center demand were to materially weaken.
Microchip	Timothy Arcuri	\$31,135	Buy	\$56	\$100	78%	Our thesis	We have very much entered the inventory build phase of the cycle and lead times are beginning to come down for MCHP's core products (MCUs), but inventories are well below norm and demand remains relatively strong even as supply is improving. MCHP benefited less than some peers in terms of pricing on the upside and its consistent MCU share gains have staying power while the stock trades at a material discount to TXN. We also like the flexible manufacturing model and strong growth in capital return – which has historically led to multiple expansion.
							Risks to our thesis	Lead times could compress faster than we expect, and stock reaction to lead time compression & supply/demand in C23 remains a risk. Furthermore, Analog remains linked to macro.
Micron Technology	Timothy Arcuri	\$64,063	Buy	\$57	\$90	57%	Our thesis	We are structural bulls on Memory and on MU in particular as DRAM demand remains levered to markets such as Cloud Computing, 5G, Autos all of which have a long runway of growth. Investors most often focus on the supply side in memory because it can be tracked more easily via reported capex from the chip companies and supply growth should be very limited in '23 given rapid pullback in capex across the industry, combined with technology hiccups at Samsung. Returns in NAND should remain far below DRAM for a long time, and we like that MU remains under-levered to NAND as it represents only ~20-25% of revenue. Having said that, MU is also a clear technology leader in NAND as well. MU's technology leadership and supply constraints across the industry should drive sustained gross margin and prevent a big correction in DRAM pricing in '23 even as consumer demand softens. As fundamentals and cycles prove to be more durable, there is a significant re-rating potential.
							Risks to our thesis	DRAM pricing decline may last longer than we are estimating based on supply and demand balance. Supply constraints and inventory/demand correction may also cap Q/Q bit growth in C2H:22E. In addition, MU looks challenged to grow DRAM bits in F2023 given the significant near-term pullback in its shipments. Also, NAND remains a drag on margins until MU can build more scale.
Teradyne	Timothy Arcuri	\$14,096	Buy	\$88	\$135	53%	Our thesis	TER is one of the few stocks in the sector that has seen material cuts to EPS estimates, largely due to this being a down year for AAPL. The company is not immune to a cyclical correction, but this creates a low base off which to grow as AAPL turns back "on" over 2023 and 2024. Additionally, chipmakers are also splitting what would have been previously done in a single chip up into multiple chips - very positive for a capacity/unit driven story like TER. The slowdown in Moore's Law is causing the industry to have to spend more on test and the rise of AI and 5G is driving a big inflection in demand for compute (a dynamic we have written about extensively in the past) and this compute must be tested. We are bullish on Teradyne's share gain opportunity in these markets as it has historically had a weak position in testing x86 compute (AMD/INTC) but a big piece of this new compute will be met by new non x86 architectures for which Teradyne seems well positioned to capture. The Industrial Automation business has been more of a mixed bag as Teradyne invests aggressively, but it has a strong franchise, the opportunity pool is very deep given the increased penetration of robotics in a host of growing verticals, and the business adds some optionality in terms of valuation.
							Risks to our thesis	We may be over-playing the relationship between front-end WFE and back-end tester demand given some capital intensity inflation due to EUV that is disproportionately benefiting the front-end WFE sector. We also may be over-playing TER's ability to win new ARM-based designs and our work around demand from AAPL and the idea that iPhone related tester demand has already corrected could be off. The sharp recovery in EPS we are expecting in 2023E could happen sooner if AAPL comes back earlier and ARM compute designs become broader much earlier than expected.
Advanced Micro Devices	Timothy Arcuri	\$122,105	Neutral	\$75	\$110	46%	Our thesis	AMD's core business is well positioned to continue gaining share in core CPU markets through at least 2024 in both client and server applications. For server, we see AMD exiting C2022 ~15% share (of the full ~40MM server unit TAM) followed by an incremental ~400bps+ of gain in 2023. The question to us remains one of sustainability beyond that timeframe as we see INTC's new Alder Lake (PC) SKU as being much more competitive part and this could foreshadow a more competitive Sapphire Rapids product in 2023 and Granite Rapids on a more competitive process node in 2024. In the meantime, we see the XLNX deal as being growth dilutive and although XLNX diversifies AMD into other verticals, we do not see XLNX bolstering AMD's Data Center software ecosystem.
							Risks to our thesis	INTC has set a very aggressive path that should close the competitive balance, but it has a lot of balls in the air and execution has been poor. Further, capacity allocation should continue to favor AMD given a long term partnership with TSMC. Additionally, the XLNX deal diversifies the story into Comms, which should further bolster the AMD story and add scale to accelerate development and push into new verticals.



Source: Factset, UBS estimates

Prices as of 07/06/2022

Primary Stock Coverage: Summary Thesis and Risks - Part 2

Company	Analyst	Market Cap (Units: \$M)	Rating	Current Stock Price	UBS Target Price	Upside/Downside	Thesis/Risks
Analog Devices	Timothy Arcuri	\$75,216	Buy	\$145	\$210	45%	Our thesis We see ADI as one of the highest-quality diversified Analog franchises that is levered to multiple growth vectors - Industrial Automation, Electric Vehicles, 5G, Space, Renewables and Healthcare. Capital allocation strategies of the two largest players in Analog are diverging and we see ADI as being best positioned for through cycle performance in the specialized Analog era and this was highlighted by: 1) ADI integrating software on top of its premium product portfolio to build customized solutions in Auto/Industrial/Comms that ultimately sets it on a path to ~40% FCF margins; 2) expanding 300 mm capacity within a balanced manufacturing model that builds in flexibility/resilience in a cycle; 3) consistent capital return.
							Risks to our thesis ADI is subject to macro cycles – particularly exposed to the industrial vertical – and remains supply constrained in the near term.
Broadcom	Timothy Arcuri	\$194,886	Buy	\$483	\$690	43%	Our thesis We see AVGO as the most attractive compounder in semis for income investors and we model the dividend to grow again through F2023E. The company is exposed to fast growing markets with very strong franchise in each of its end markets. It also benefits from scale especially post the VMW deal which will offset some revenue cyclicality at the peak of the chip cycle and result is more stability going forward. Though we are at peak cycle, AVGO should be able to maintain lead times better than nearly every other peer given its strong franchises where there is no replacement product. This should provide downside protection with respect to the cycle. The wireless business comes with the most questions and even there, AVGO should continue to expand content 5-10%/yr for the foreseeable future.
							Risks to our thesis AVGO does not plan to work down lead times much if any which should help its shipments more closely match consumption. To some degree, this is muting growth in F2022 but should also help to mute the inevitable correction on the other side of the cycle. The primary risk for the stock is that it gets caught in the downcycle just like peers and its lead times provide little protection. In addition, the deal with VMWare may not be realized or turn out to be not as accretive as we expect.
ON Semiconductor	Timothy Arcuri	\$20,687	Neutral	\$48	\$68	43%	Our thesis ON's updated financial targets GM 48%-50%, Op. Margin 31%-33% look achievable in context of mix shift to Auto/Industrial, upcoming manufacturing optimizations and more evidence of EV traction. In addition, ON has locked in pricing for C2022 and vast majority of C2023 revenue via LTSA and NCNRs while SiC lends to a ~4x richer ASP mix in autos and remains on track, meaning it is hard to see a large ASP cliff in C2022/C2023. Furthermore, GM floor is now structurally higher as EFK could ultimately bias GMs sustainably higher (we think ~48-50%) in 2024/2025+ time frame. However, we see a flatter trajectory in 2023E as revenue growth/GM improvements tail off, weighing on the multiple in the near term.
							Risks to our thesis Onsemi has raised prices aggressively despite a heavy exposure to commodity Analog. The sustainability of this is an open question as demand softens, although EV ramp could cushion impact. Near term impact of Auto production although EV remains strong.
Seagate	Timothy Arcuri	\$15,368	Buy	\$72	\$100	40%	Our thesis We see the HDD business at a structural inflection yielding more stable supply/demand dynamics and expanding cross cycle margins - much like what we have seen happen in DRAM over the past several years - while near-term cyclical dynamics also skew positive. We expect STX to benefit from structural changes under way in the HDD segment. The ramp of high-capacity nearline applications is mixing demand to cloud and these customers increasingly spend on different cadences depending on their technology initiatives. Additionally, the significant growth in data storage requirements has led these customers to engage in more longer-term supply/pricing arrangements while recent storage-driven blockchain have reduced channel inventory. Lastly, new technologies like HAMR will likely keep alternative solutions like NAND at bay for these high capacity applications for many years to come. Combined with strong opex discipline, this should allow STX to sustain OpM well above prior peak levels from the past few years.
							Risks to our thesis In the near-term, COVID costs are expected to continue throughout F22, there are risks of slowing demand where semiconductor supply concerns (beyond the HDD segment) could ease, cloud customers could potentially see cyclical slowdown, and pent-up demand from enterprise could fade. Longer-term, the downside scenario could be possible based on: (1) lower growth in the mass capacity drives; (2) higher decline in legacy segments; (3) gross margin pressure on lower shipments; and (4) fewer opportunities to reduce opex.
Skyworks Solutions	Timothy Arcuri	\$15,373	Neutral	\$96	\$133	39%	Our thesis Our investment thesis is based on the fact that SWKS is a trusted supplier to AAPL and continues to ride wireless content proliferation across an expanding category of devices. SWKS' iPhone content growth has accelerated over the past 12 months, now growing >20% YY. Beyond this iPhone catalyst, in the Broad Markets IoT business, 5G is catalyzing devices of all sorts to move beyond just WiFi and Bluetooth to also start including more cellular connectivity – which works right to SWKS wheelhouse for that business and the SLAB assets should allow SWKS to expand its connectivity solutions more broadly into the autos segment. However, several of the BM businesses are fabless and supply constraints are more acute for them.
							Risks to our thesis Content gain in the next iPhone series launch may not be as good as we are expecting. The iPhone sell through may fall way short of where the supply chain is tracking to on builds. Over time, AAPL may invest more in building more significant internal RF capabilities – which would weigh on SWKS stock. Lastly, tighter supply and higher logistics costs could last longer and weigh on GM more severely.
Intel	Timothy Arcuri	\$151,252	Neutral	\$37	\$51	38%	Our thesis We remain strong believers that decoupling the product and process groups and roadmaps will enable INTC to accelerate its manufacturing roadmap such that it can "catch" TSMC in terms of process density by its 20a and 18a nodes in 2025/2026. This should also allow it to tap into a very big wedge of foundry opportunity from customers such as QCOM, NVDA, and even AAPL. At the same time, by leveraging foundries to a greater degree, it should help to accelerate the product roadmap. INTC also has the most architecturally diverse array of offering across the compute landscape (GPUs – Ponte Vecchio/Arc, FPGAs, IPUs, and ASIC based offerings). However, even inclusive of government subsidies, we are troubled by the amount of capex the company will be spending to build out its foundry business with very uncertain and long tailed ROI. In the meantime, valuation remains a question mark given how low FCF will be over the next few years during this expansion, while PCs are still nearly 50% of revenue and consumer demand is rapidly weakening.
							Risks to our thesis If we are right about the product roadmap, the stock could conceivably look through this multi-year period where FCF is highly constrained by capex and power higher if PCs were to remain strong. On the other hand, building a foundry business is very challenging and it is to some degree mortgaging the future with this endeavor. Lastly, as NVDA expands into CPU, this could prove even more of a competitive threat by taking existing INTC workloads rather than just capturing incremental workload from INTC. AMD remains a threat as well, though INTC's partnership w/TSMC should start to nullify this threat and ARM might be an even bigger threat than AMD.
Qorvo	Timothy Arcuri	\$10,384	Neutral	\$98	\$135	38%	Our thesis QRVO should continue to benefit from RF content gain and expansion into new verticals, but the business remains lumpy given high exposure to China. IDP is cause for optimism as recent acquisitions have bolstered and diversified its exposure to growth areas like auto/EV charging, power management, IoT, auto connectivity, and new WiFi applications as it leverages its BAW expertise. Overall, operational execution remains strong but we find it hard to get excited from here given the tepid sentiment on smartphone market and supply issues.
							Risks to our thesis We may be overly concerned about QCOM's ability to take content from QRVO on its modem reference designs in China. We also may be under-estimating the remaining content growth for QRVO during the remainder of the 5G cycle. Lastly, we may be under-appreciating the breadth of its capabilities as it increasingly bundles SAW and BAW technologies into advanced solutions.
Entegris	Timothy Arcuri	\$12,531	Neutral	\$92	\$125	36%	Our thesis Much like many of the SFE stocks, ENTG remains positively levered to increasing dollar intensity as more varied chip designs are pushing to the leading edge. At the same time, it is also levered to demand for lagging edge capacity – a trend which helps ENTG and should have legs as large segments like auto and broad industrial applications look to secure capacity on a longer-term basis versus the traditional just-in-time transactional approach. Lastly, even in the inevitable cyclical correction, it is hard to see a significant YY decline in revs given a more recurring aspect to its high purity consumables than most other business models in semis. All of these factors make ENTG unique among the SMID tech/Industrial investment landscape. Lastly, the deal with CMC adds critical and highly complementary semiconductor materials to ENTG's core platform, though it does add a fairly significant amount of debt at a challenging time in the semis cycle.
							Risks to our thesis Secular trends are clear, but the broader debate in our view revolves around cyclical sustainability and therefore the multiple with which to capitalize out-year EPS and CF. While we believe long-term ENTG's competitive positioning continues to strengthen and content expansions would serve as catalysts for above-market growth, valuation versus a strong peer group keeps us on the sidelines. ENTG more often than not is a premium grower and we could see more upside on rev growth given solid execution track record and it could very well spin its capacity into further accretive deals. On the flip side, our profitability ests could face cuts on intensified competition and broad cyclical concerns. The semiconductor industry revenues have historically been correlated to global GDP. From a macro standpoint, a deep recession with demand destruction for ENTG end customers is a potential downside risk.



Source: Factset, UBS estimates

Prices as of 07/06/2022

Primary Stock Coverage: Summary Thesis and Risks - Part 3

Company	Analyst	Market Cap (Units: \$M)	Rating	Current Stock Price	UBS Target Price	Upside/Downside	Thesis/Risks
Lam Research	Timothy Arcuri	\$54,333	Buy	\$392	\$510	30%	Our thesis
							Risks to our thesis
Western Digital	Timothy Arcuri	\$13,707	Neutral	\$44	\$55	26%	Our thesis
							Risks to our thesis
Qualcomm	Timothy Arcuri	\$142,307	Neutral	\$127	\$155	22%	Our thesis
							Risks to our thesis
KLA Corporation	Timothy Arcuri	\$43,726	Neutral	\$293	\$345	18%	Our thesis
							Risks to our thesis
Texas Instruments	Timothy Arcuri	\$139,067	Neutral	\$151	\$175	16%	Our thesis
							Risks to our thesis
Applied Materials	Timothy Arcuri	\$75,303	Neutral	\$87	\$100	16%	Our thesis
							Risks to our thesis



Source: Factset, UBS estimates

Prices as of 07/06/2022

Our Most Popular Research

Top 10 Readership – Past 30 Days

#	Report Title	Report Publication Date	Client Readership
1	Micron Technology Inc "Our Top Pick: New MU-specific & Industry Factors..."	12-Jun-2022	
2	UBS Global M&Global Semiconductors and Semi Equipment "Cutting '22-'23E..."	28-Jun-2022	
3	Advanced Micro Devices Inc "Analyst Day Preview: Focus on Product Roadmap"	07-Jun-2022	
4	Global Semiconductor "SIA Data: April Below Seasonal Driven by Poor Memory..."	06-Jun-2022	
5	Advanced Micro Devices Inc "Analyst Day Highlights: SAM Expansion And Share..."	10-Jun-2022	
6	Micron Technology Inc "FQ3 (May) Preview: Demand And Supply Weakness" (Buy)	27-Jun-2022	
7	KLA Corporation "Analyst Day Highlights: Solid Growth Vectors, But An..."	16-Jun-2022	
8	Global Semiconductor "Taiwan Monthly Sales: May Well Above Seasonal" Arcuri	13-Jun-2022	
9	US Semiconductors "China Smartphone: May Shipments Improves, iPhones..."	20-Jun-2022	
10	KLA Corporation "Analyst Day Preview: Laying A Path to >\$30 EPS by C2026"	13-Jun-2022	

Source: UBS

Top 10 Readership – Past 12 Months

#	Report Title	Report Publication Date	Client Readership
1	NVIDIA Corp "Omniverse Deep Dive: Keying The Next Wave of TAM Expansion" (Buy)	19-Jan-2022	
2	US Semiconductors and Semi Equipment "2022 Outlook; Our Latest Thoughts..."	20-Dec-2021	
3	Initiation of Coverage: US Semiconductors "Peak Analog? And How to..."	12-Oct-2021	
4	Analog Devices Inc "The Specialized Analog Era Is Here. Initiate Buy." (Buy)	12-Oct-2021	
5	Intel Corp. "Downgrade to Neutral, PT to \$58 On Capex Commentary" (Neutral)	22-Oct-2021	
6	US Semiconductors and Semi Equipment "2022 Outlook: The Chartbook"	20-Dec-2021	
7	NVIDIA Corp "UBS Evidence Lab Inside: Raise PT to \$350 And New Web 3.0..."	14-Nov-2021	
8	NVIDIA Corp "As Competition Increases, How Big Is Nvidia's Software Moat?" (Buy)	13-Mar-2022	
9	NVIDIA Corp "From Product To Platform Company; Buy" (Buy) Arcuri	17-Feb-2022	
10	Micron Technology Inc "Investing For the Future Amid A Strong Cycle" (Buy)	01-Jul-2021	

Source: UBS

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Section 1

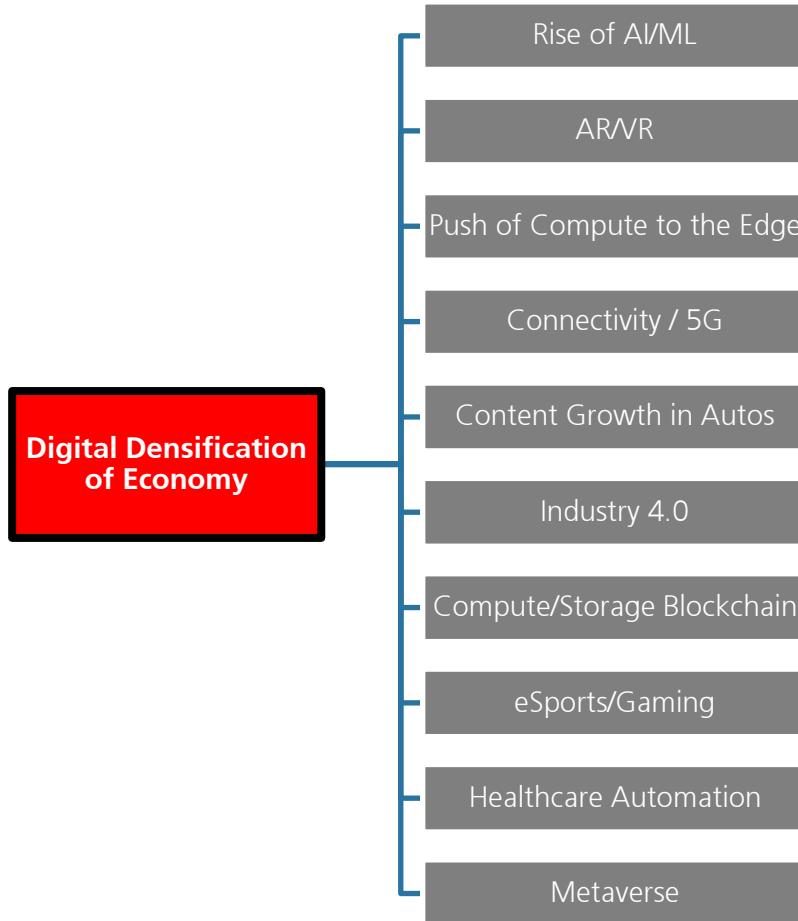
Semiconductors – Big Picture

Key Messages

- A deteriorating consumer has accelerated the downturn – now the ISM is headed <50, consumer confidence is at a 40+yr low, and downstream inventory has grown significantly...
- ...but stocks have already underperformed to a degree that is very similar to prior downturns; we think the group starts to shift to more of an in-line performer as the estimate cutting process starts this Q
 - Too late to be negative, but too early to be positive because estimates will be slow to come down
- During prior recessions, semis revenue declined ~25-30% from peak, a similar number to how much the group has underperformed
 - Valuation is also now slightly – but not significantly – below median on a relative basis...
 - ...semi equipment multiples have held up generally better, but do not see government stimulus as a savior
- HFIs are underweight, but MFs are still slightly overweight and Street estimates for 2H:22 have been cut to sub-seasonal
- The LT backdrop is very positive: semis have become a basic industrial building block (similar to oil) and the digital densification of the global economy should continue to accelerate
- We prefer compute and memory verticals; Buy (NVDA, AVGO, MRVL, MU, LRCX, STX, ADI, MCHP, TER)

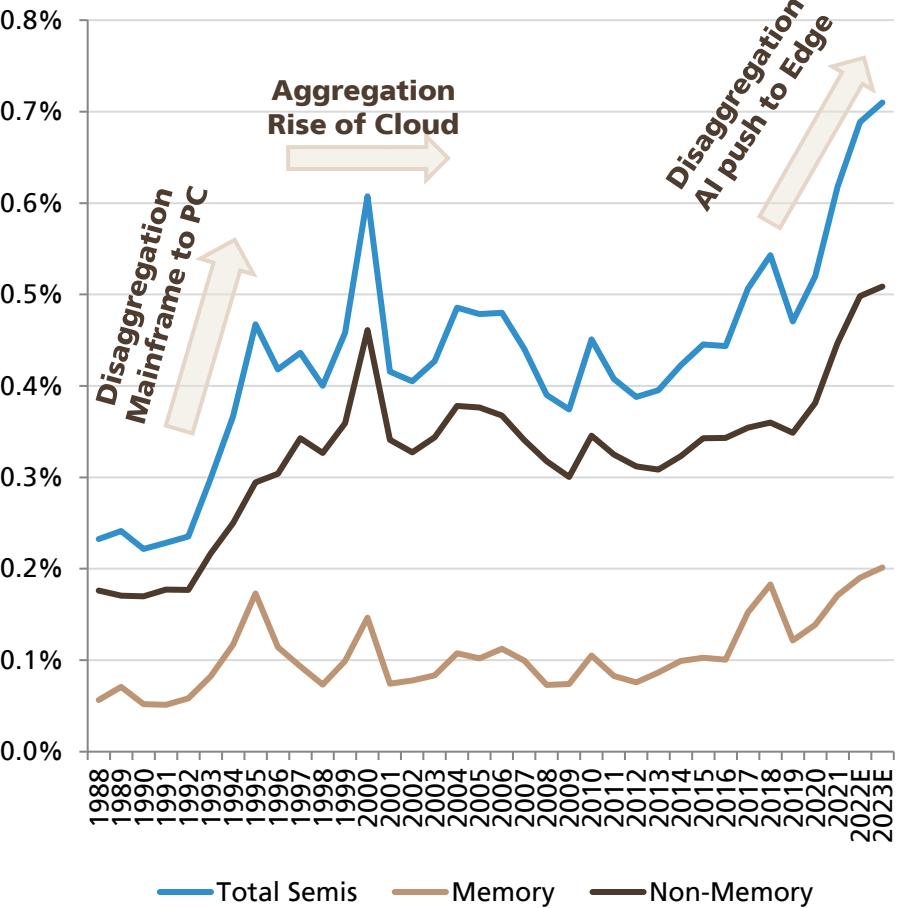
Big Picture: Semis Long-term Secular Drivers

Semis Secular Drivers



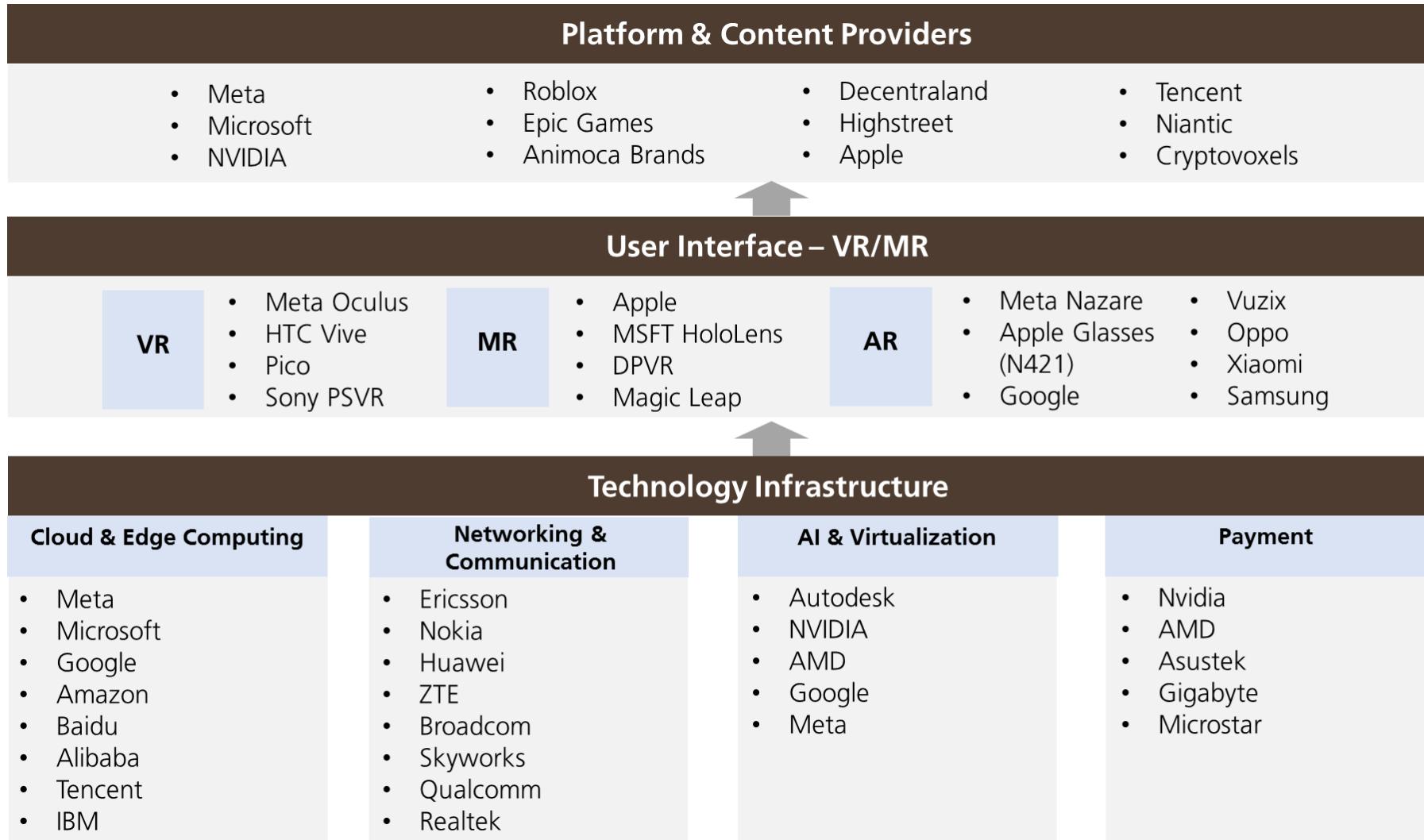
Source: UBS

Semis Revenue as % of Global GDP



Source: Factset, SIA, UBS

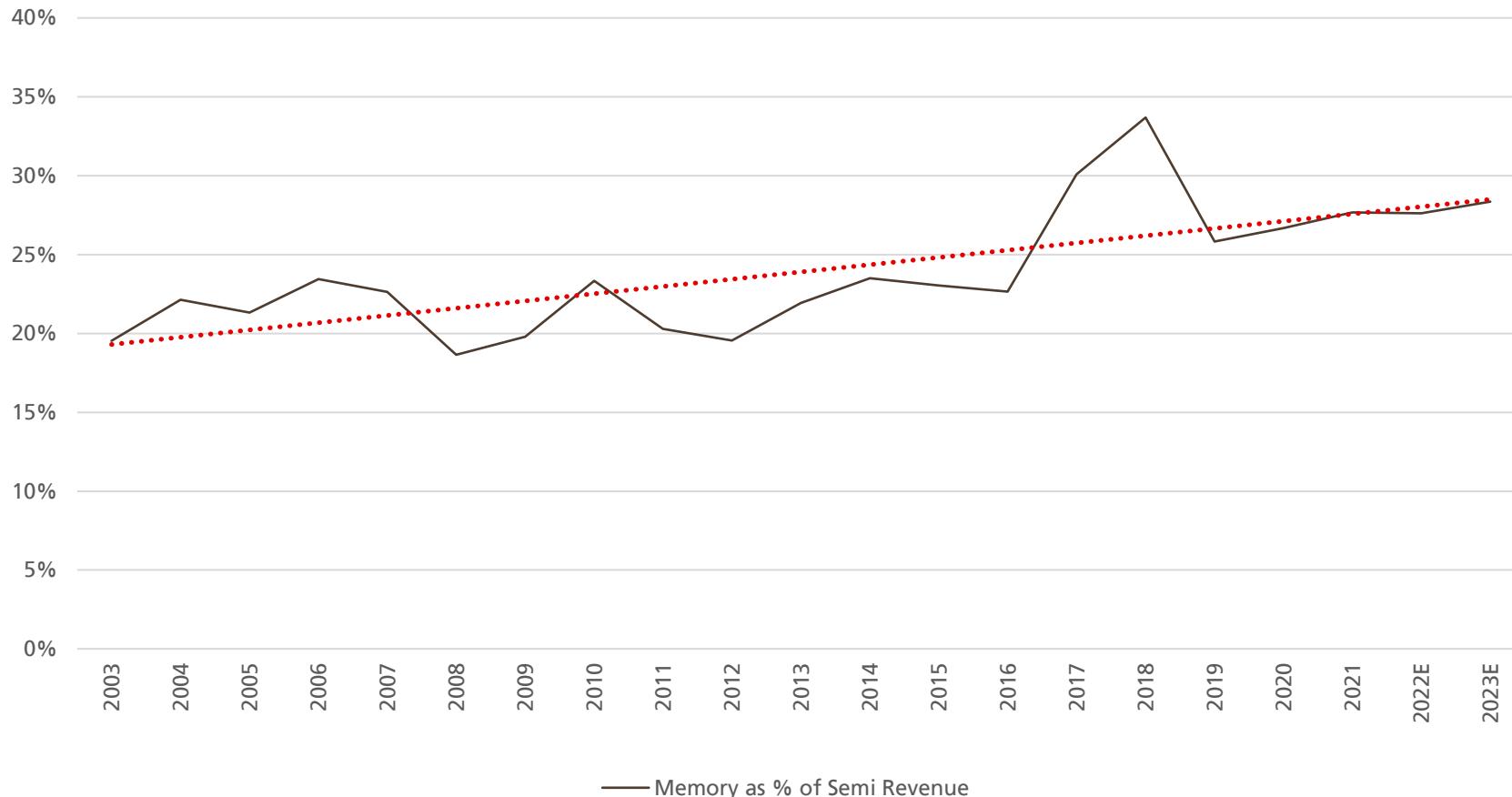
Metaverse Ecosystem



Source: Company data, UBS

Secular Growth in Memory

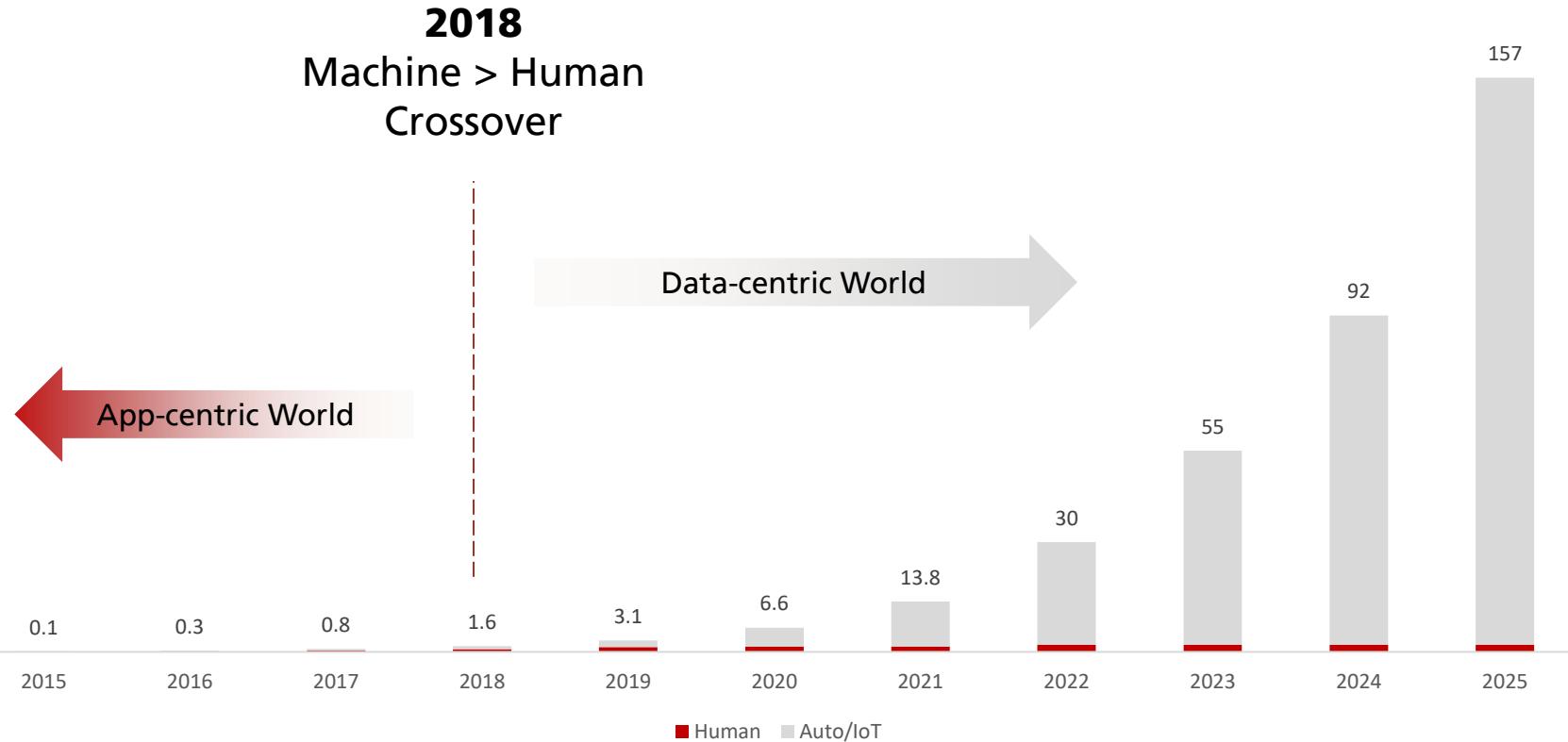
Memory Revs as % of Semi Revs – Premium Growth



Source: Factset, SIA, UBS estimates

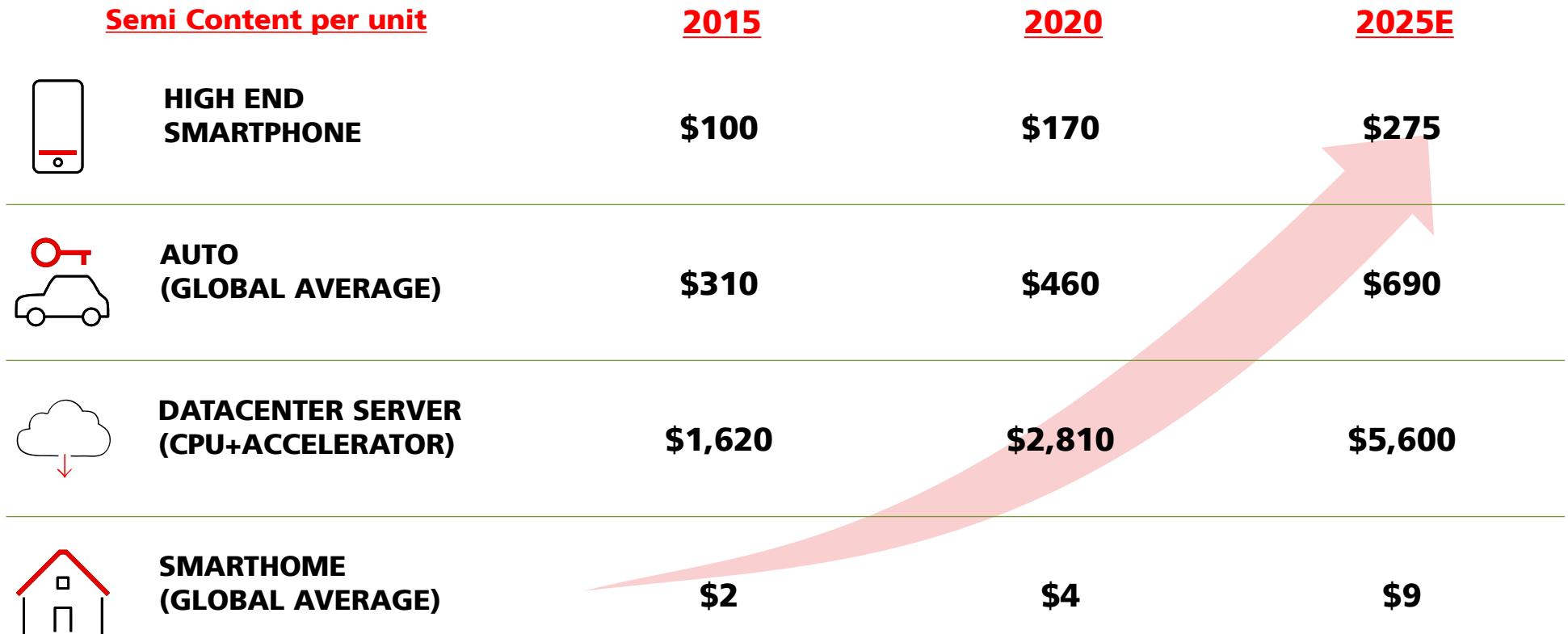
Data has been mostly generated by machine since 2018

Data Generation by Category (ZB)



Source: Applied Materials, Sep 2021

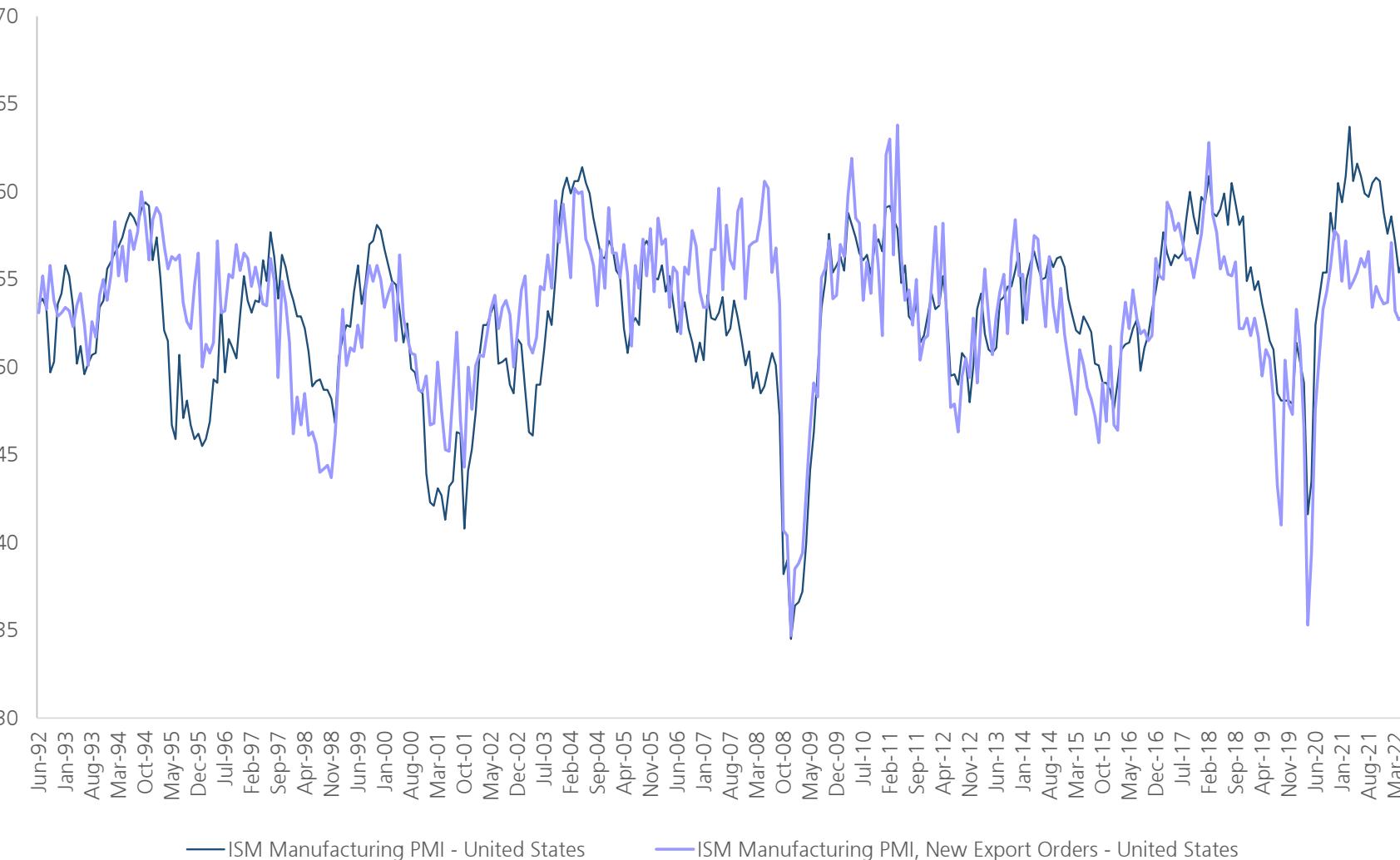
Silicon content growing as everything gets smarter



Source: Applied Materials, Sep 2021

The ISM is headed back to or <50...

ISM Manufacturing Index (USA) and New Orders Component

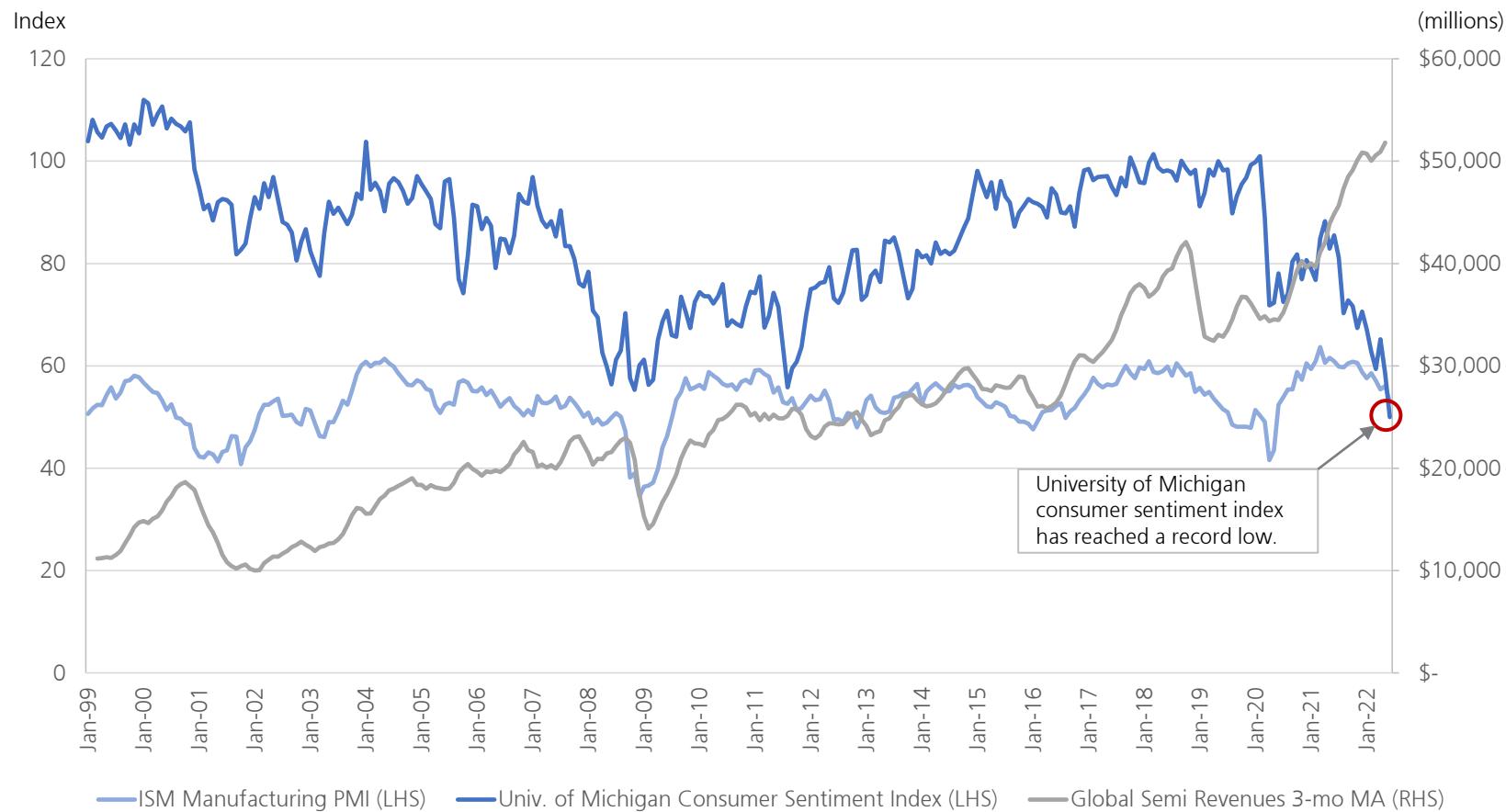


Source: Haver, Factset, UBS



...and consumer confidence is at a 40+yr low

ISM Manufacturing Index vs. University of Michigan Consumer Sentiment Index vs. Global Semiconductor Revenue

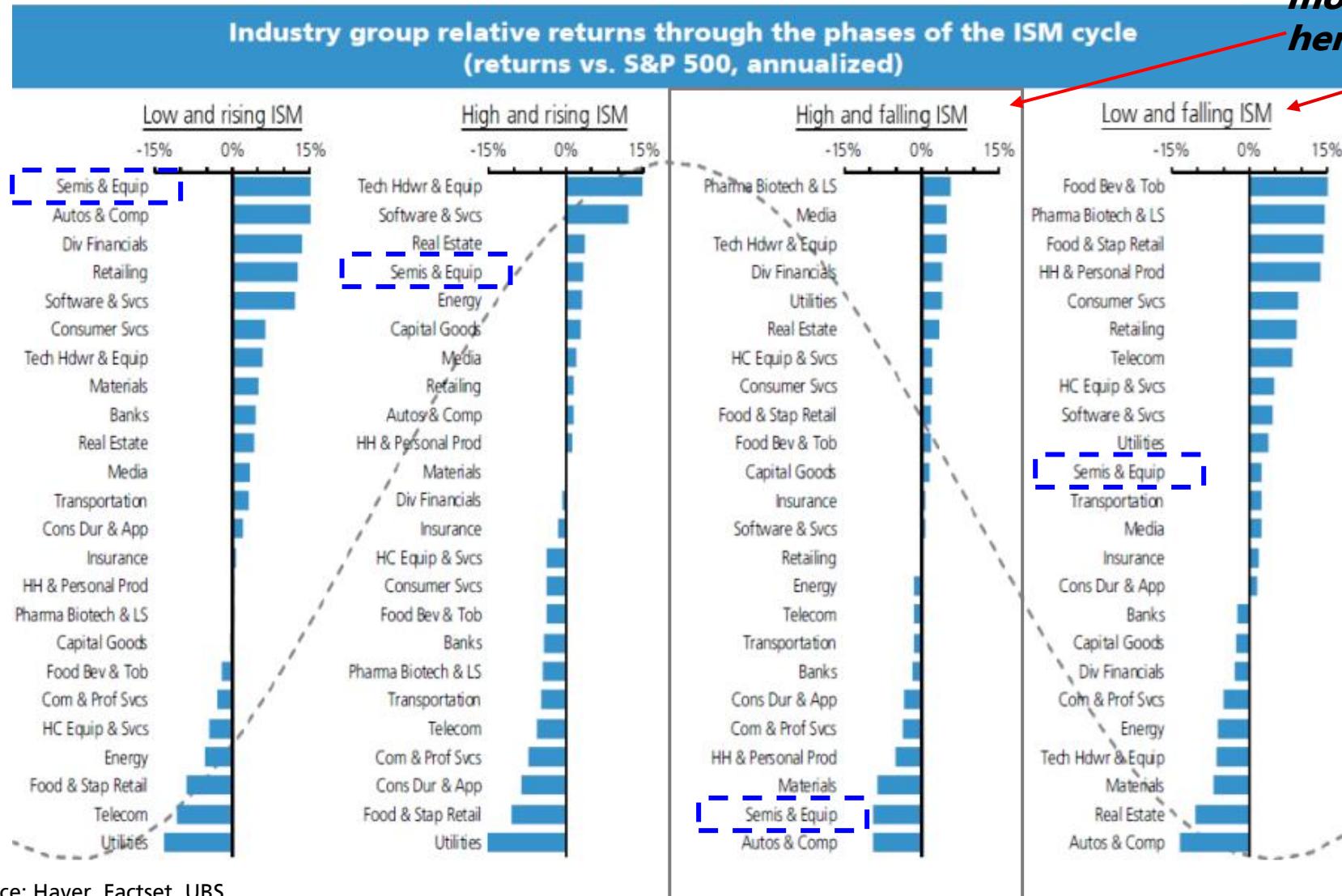


Source: Factset, UBS

...so for stocks, we are transitioning from “bad” to “less bad”

S&P 500 IGs Relative Returns, Annualized (pivot point is 52.5, e.g. low is <52.5, high is >52.5)

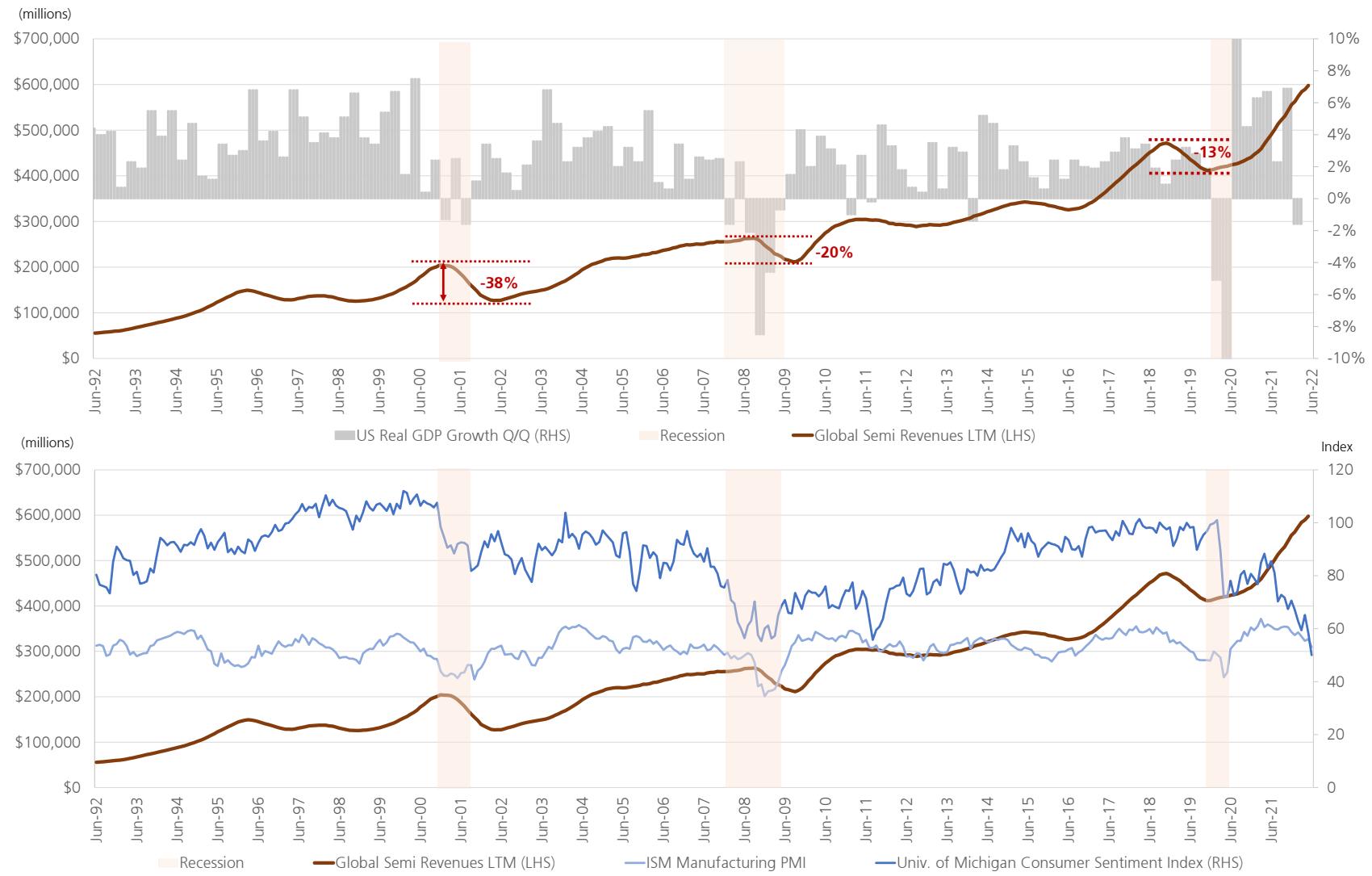
**We are now
moving from
here to here**



Source: Haver, Factset, UBS

How much could semi revenue decline? It came down ~25-30% from peak during prior recessions

Historical trends in global semi revenue relative to GDP growth, consumer sentiment and ISM manufacturing PMI

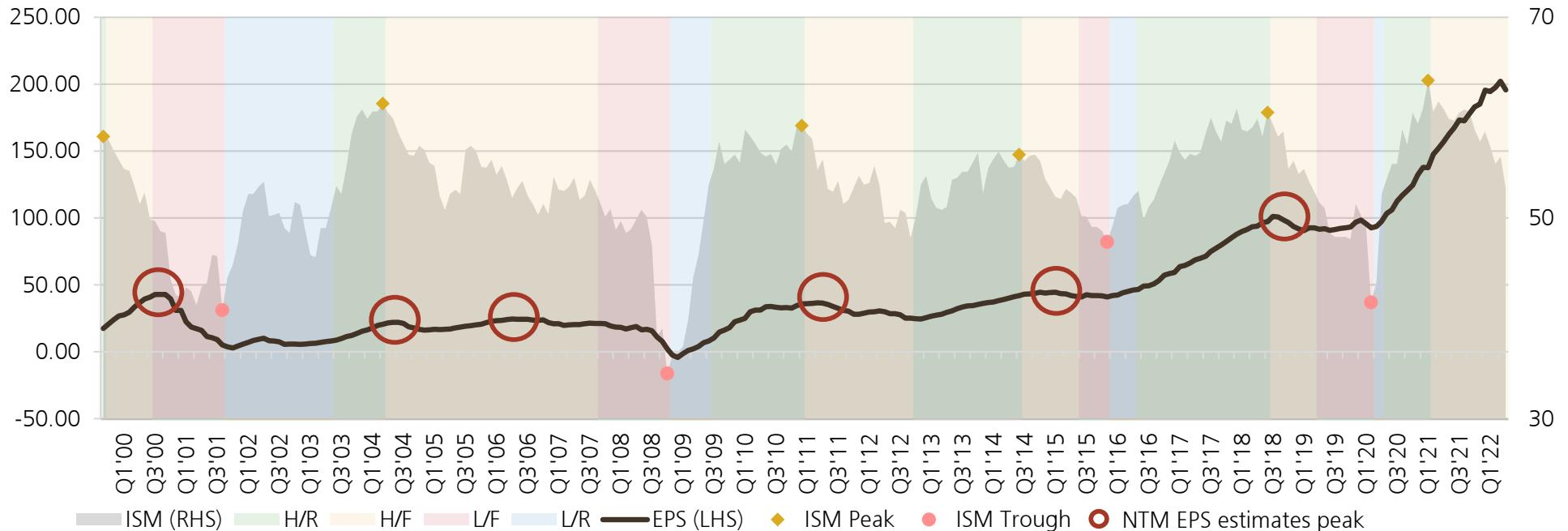


Source: Factset, UBS



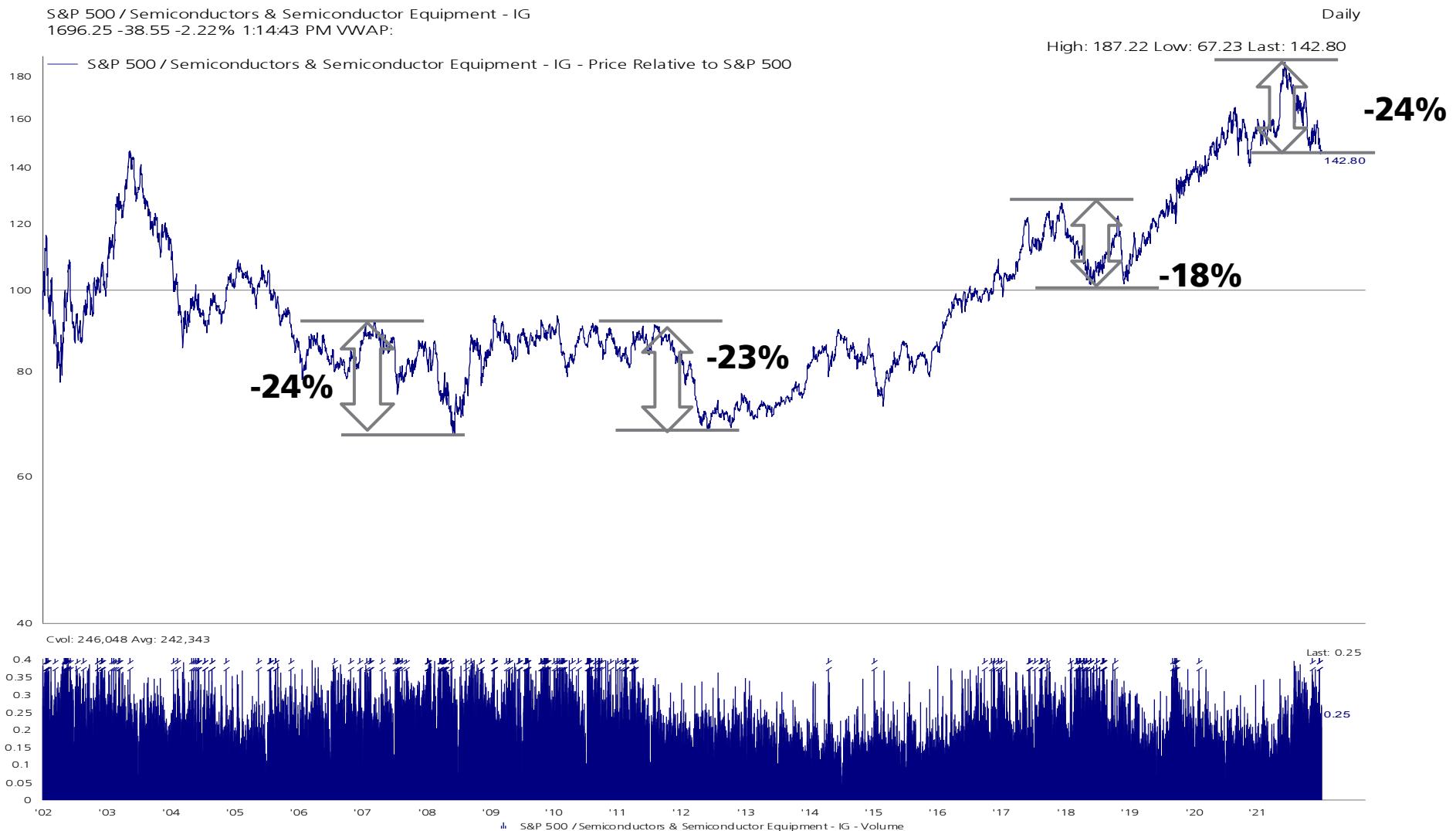
NTM EPS is peaking 6mos after ISM peak, just like in the past

Semis Earnings Peak (SOX) vs. ISM



Underperformance for the group may have already largely played out

S&P500 Semiconductors & Semiconductor Equipment Index Price Relative to S&P500



Source: Factset



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

Smartphone

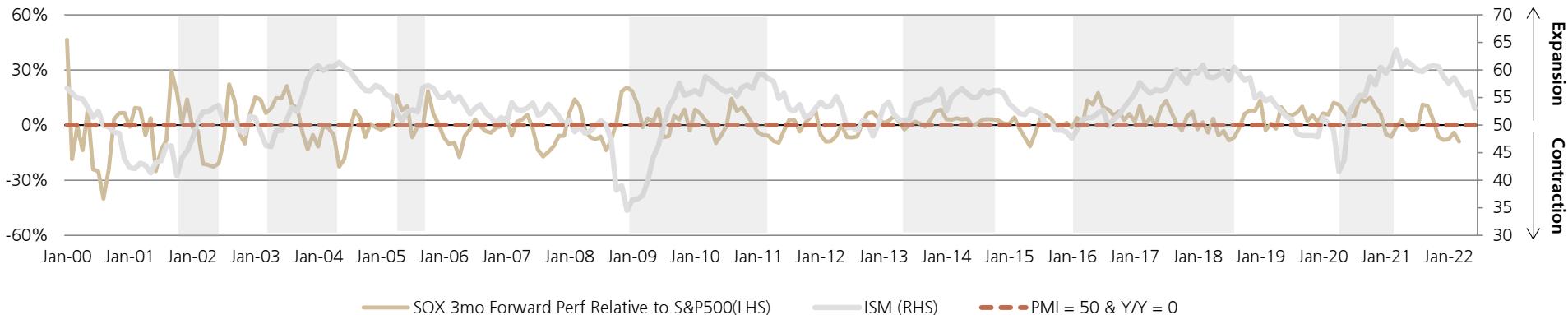
Autos

Semi Cap Equipment

Company Summaries

Semis Relative Performance vs. S&P 500 (3/6M Forward)

Semis Relative Performance – 3M Forward



Source: Factset, UBS estimates

Semis Relative Performance – 6M Forward



Source: Factset, UBS estimates

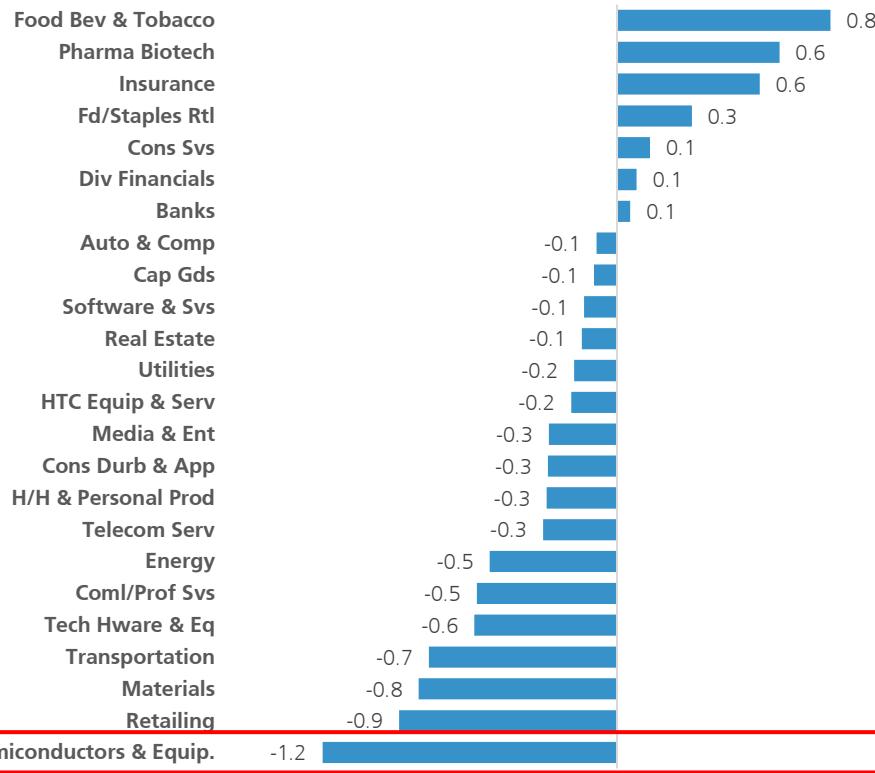
Note: Semi relative performance is calculated by taking SOX's 3m/6m forward performance minus S&P 500's. Shaded area represents a rise in ISM levels.

Controlling inflation is critical for semis

US Industry Groups' Change in Stock Performance Since 1995

US industry groups' change in avg monthly performance (%) with shift from

High inflation, High growth to **High inflation, Medium growth**

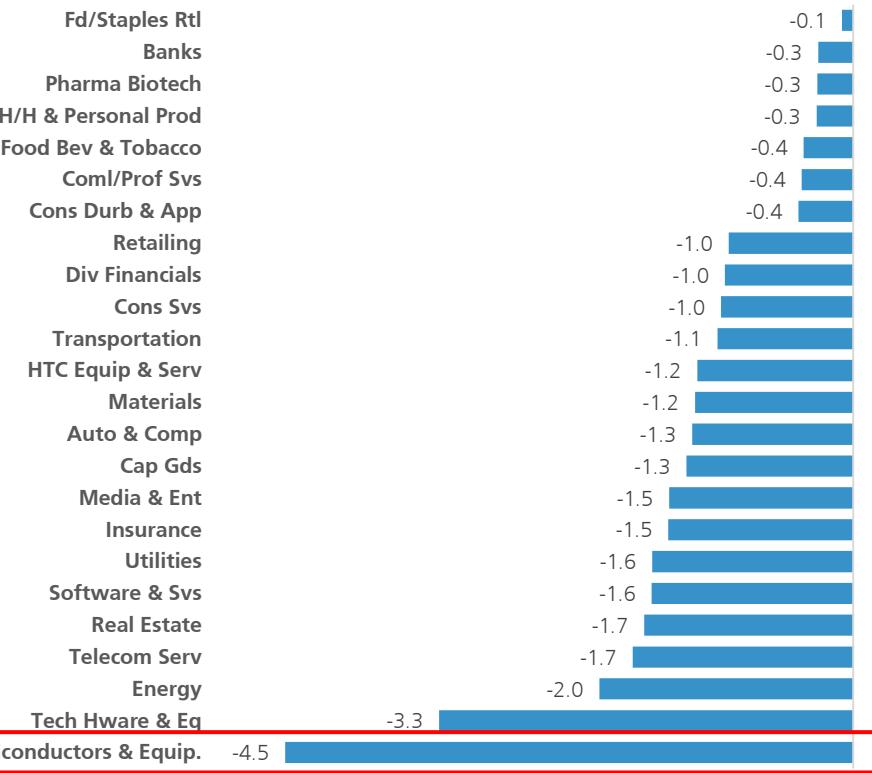


Source: UBS Global Strategy, MSCI, Bloomberg

US Industry Groups' Change in Stock Performance Since 1995

US industry groups' change in avg monthly performance (%) with shift from

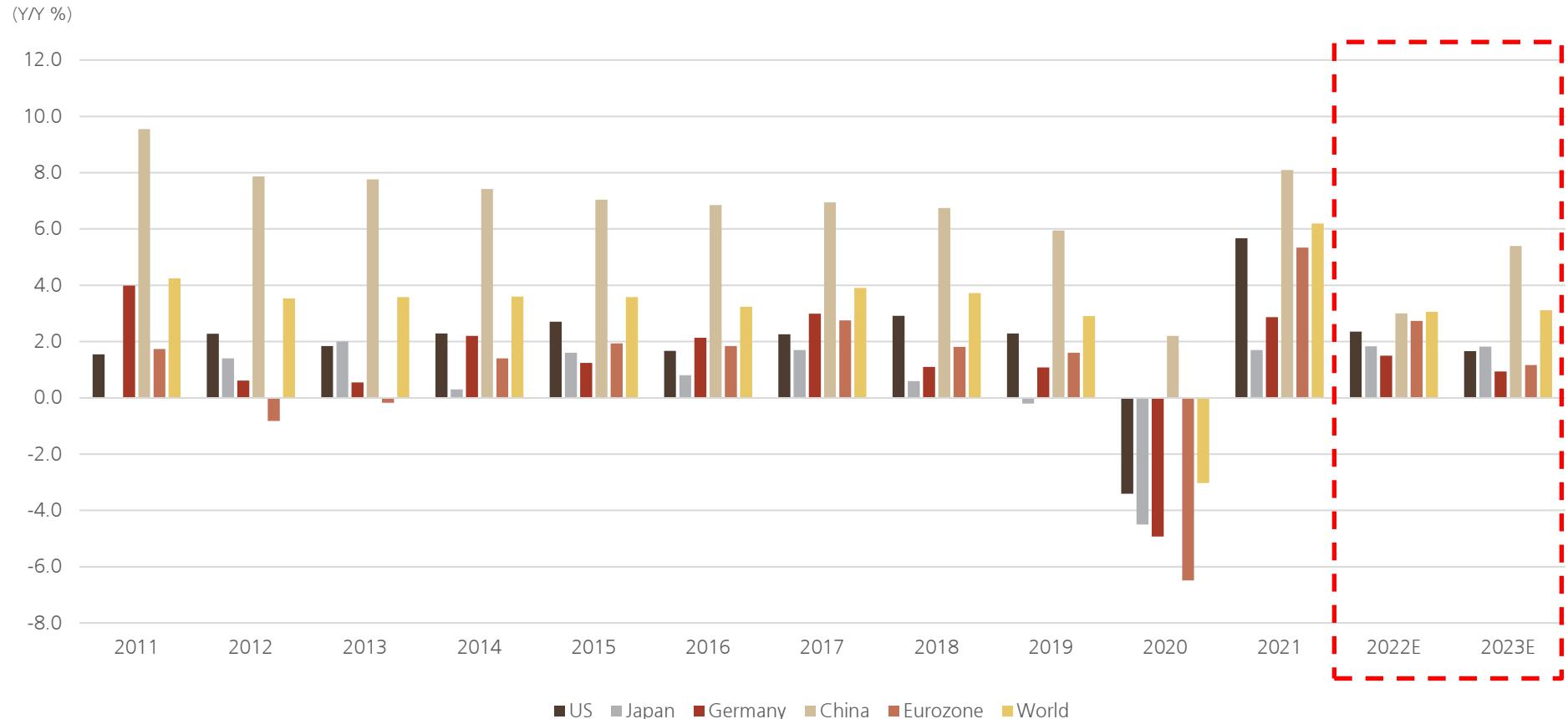
High inflation, High growth to **High inflation, Low growth**



Source: UBS Global Strategy, MSCI, Bloomberg

Global growth is expected to decelerate through '22/23E

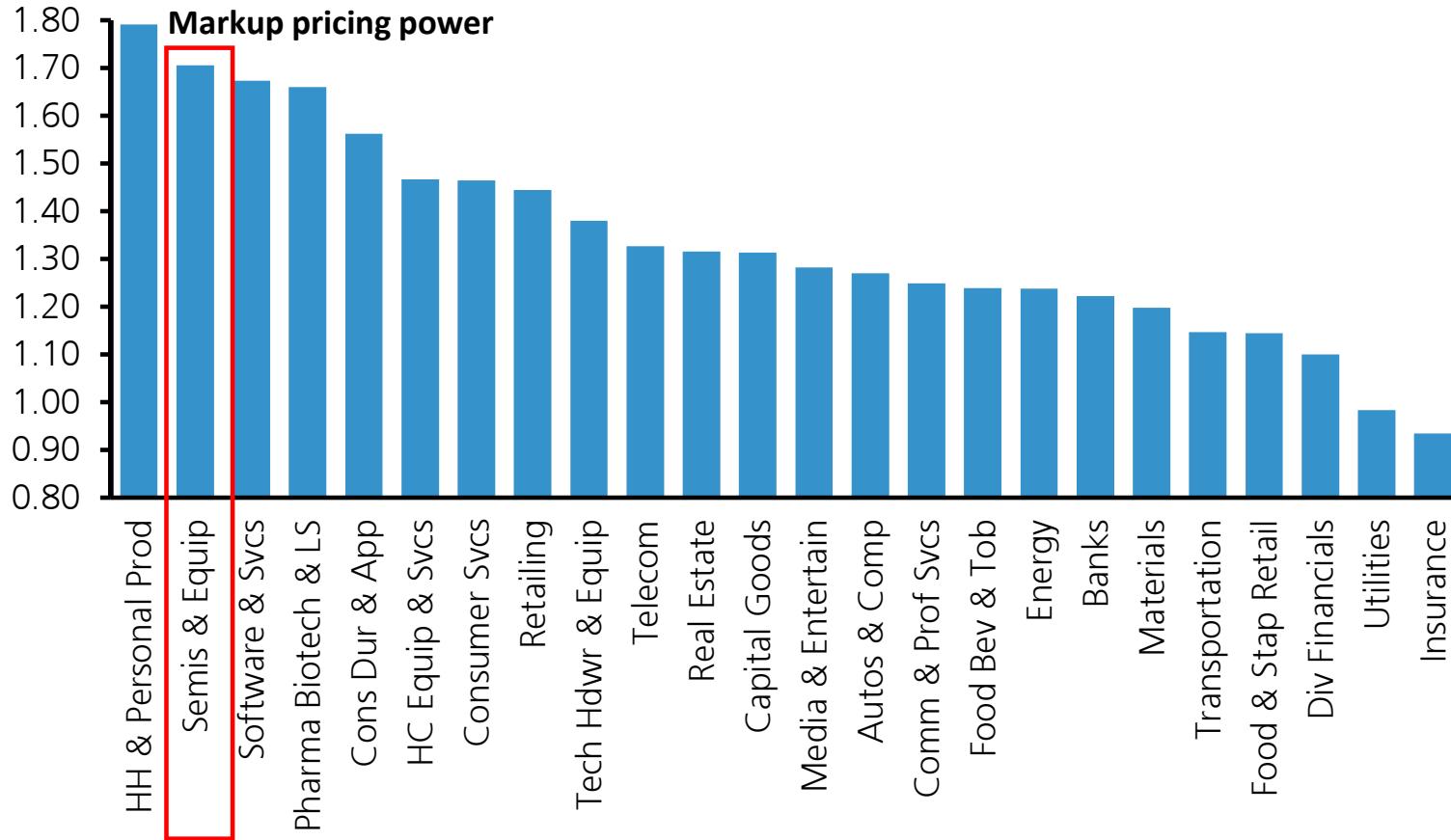
Real GDP Y/Y Growth (%)



Source: Haver, CEIC, National Statistics, UBS estimates

Semis have benefited significantly from pricing...but will it hold during a downturn?

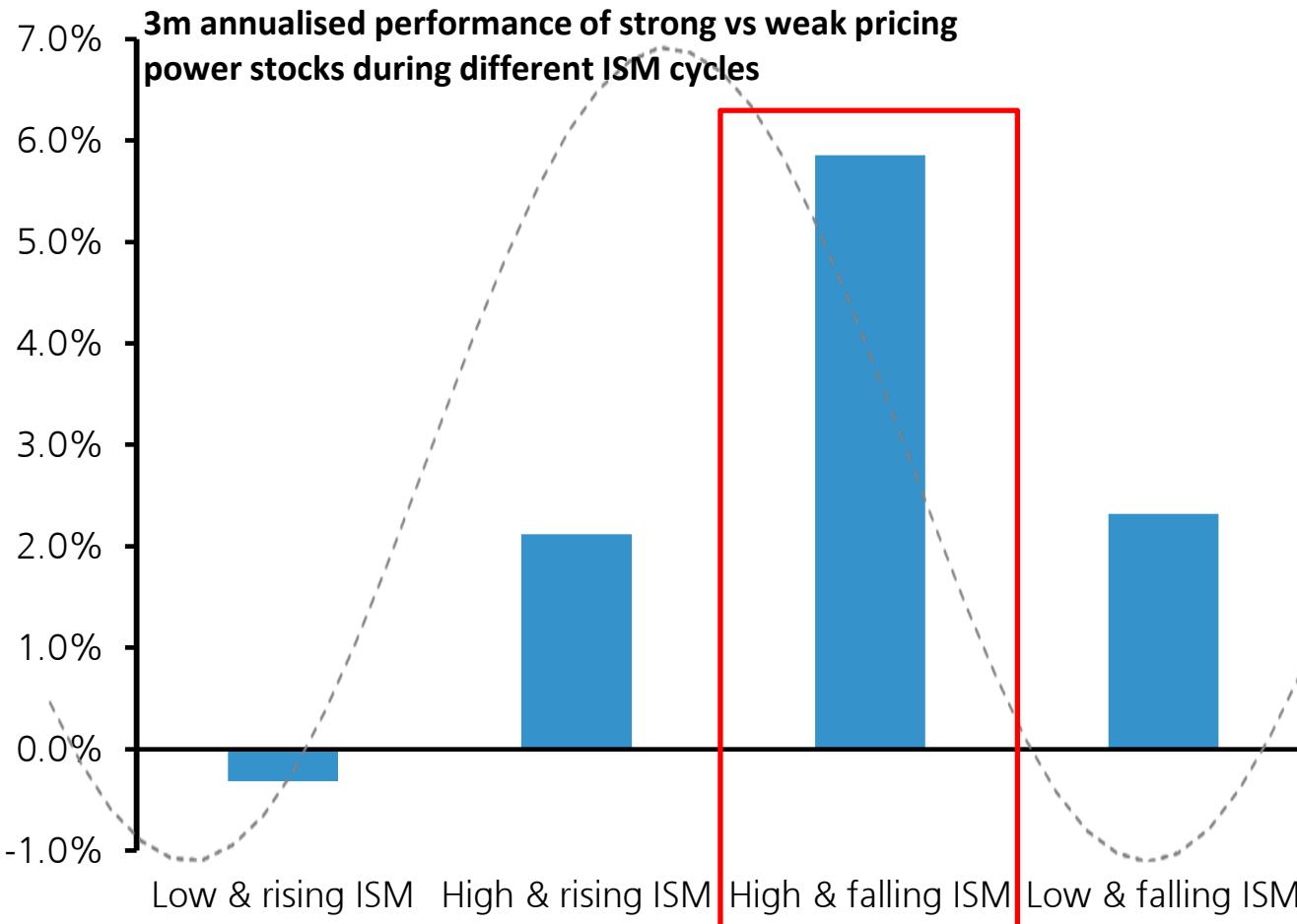
Corporate Markup Pricing Power Across Industry Groups



Source: Factset, UBS

...if so, this provides some ballast on the downside for stocks

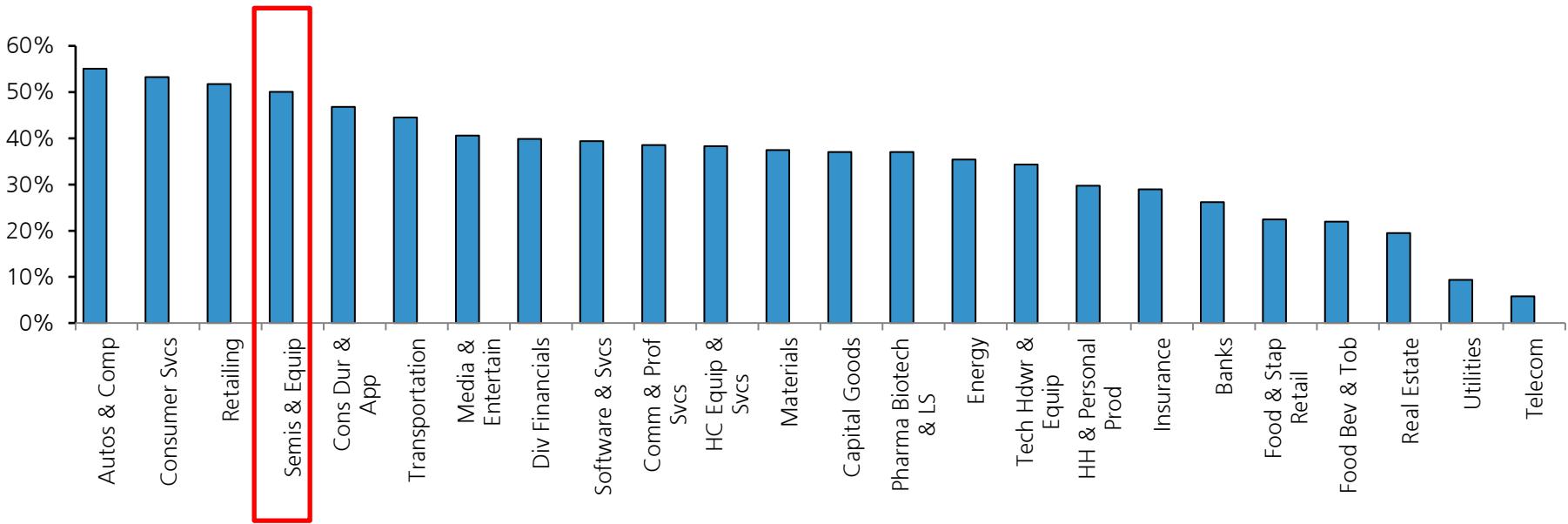
Returns of Strong vs Weak Pricing Power Stocks Around ISM Mfg Cycles



Source: Factset, UBS

Dividend growth has also been strong in semis...

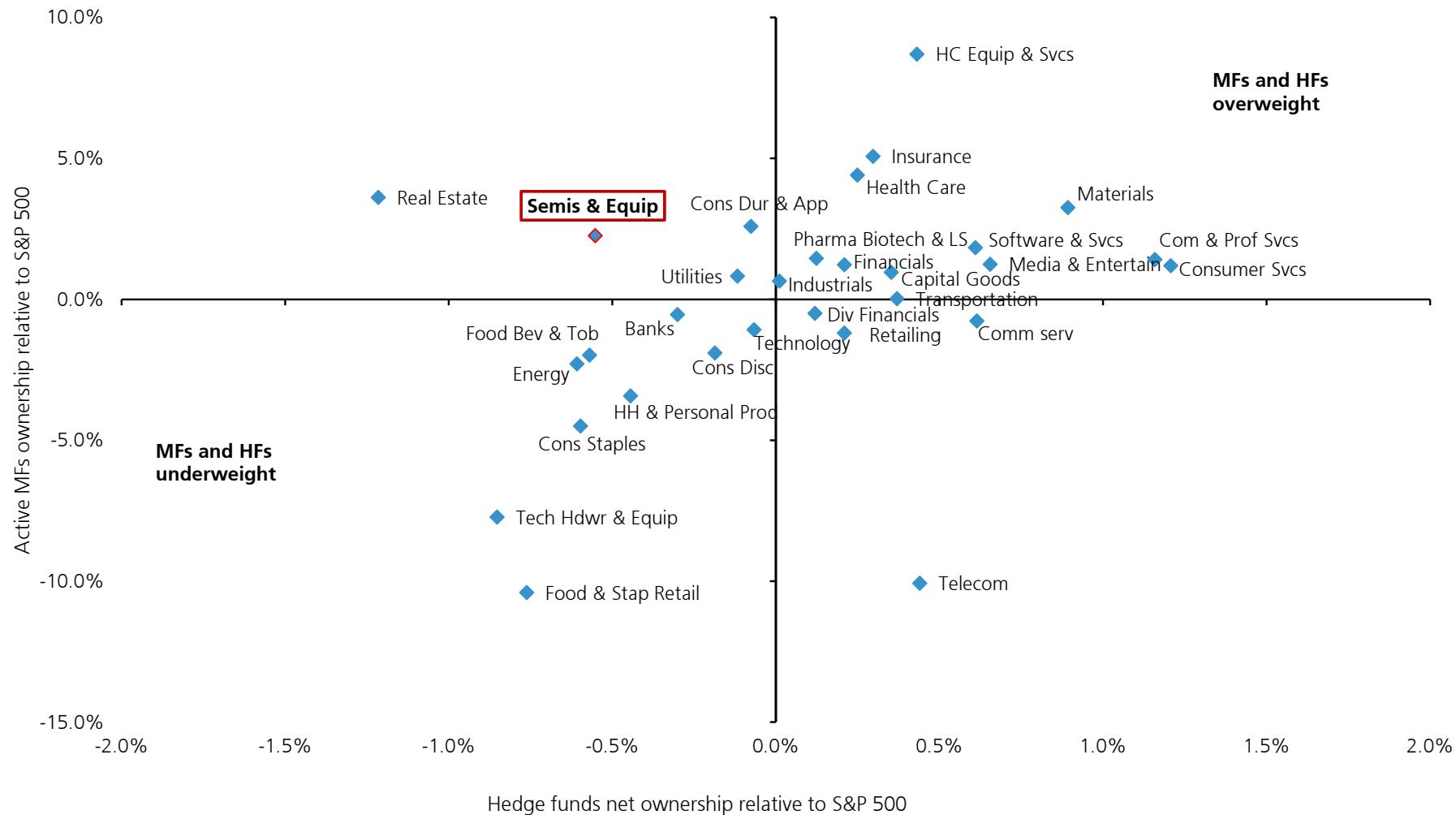
Current Average Probability of Strong Dividend Revisions by Industry Group



Source: Factset, Bloomberg, UBS

MFs overweight semis, HF_s underweight

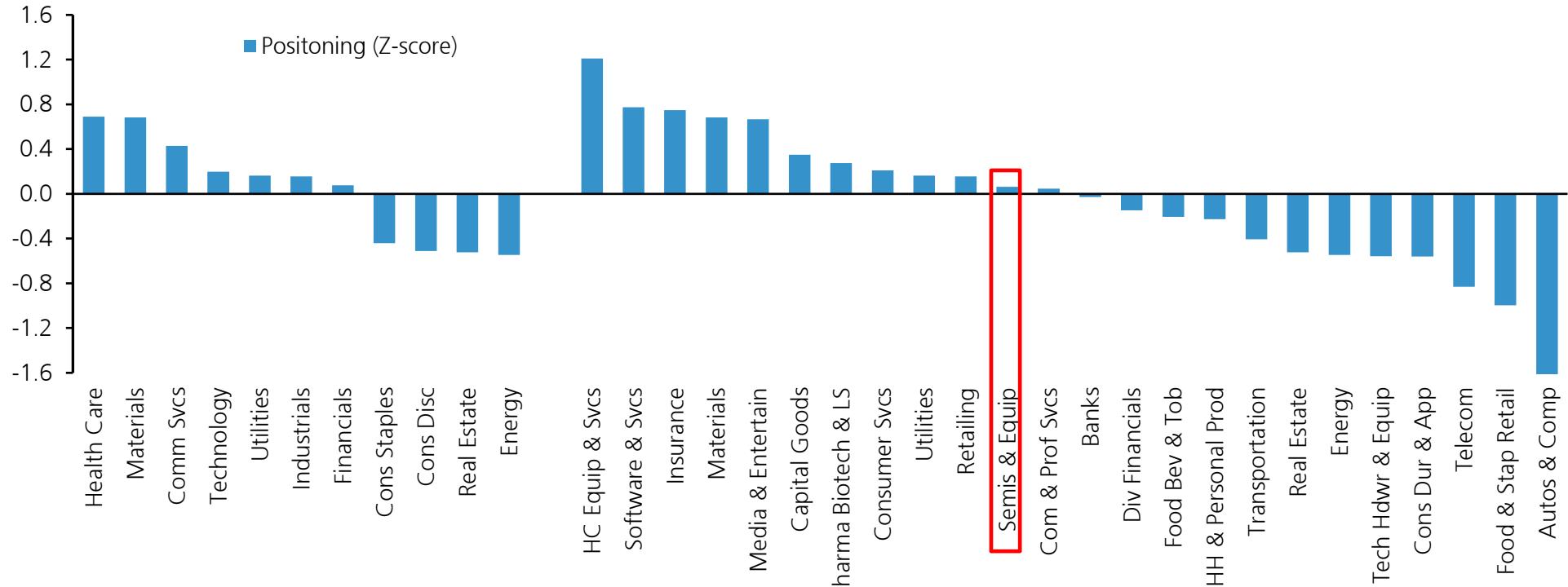
MF vs. HF Ownership Relative to S&P 500



Source: Factset, UBS; Note: Chart excludes Auto and Comps for scaling purposes

But in aggregate, investors are still a touch overweight

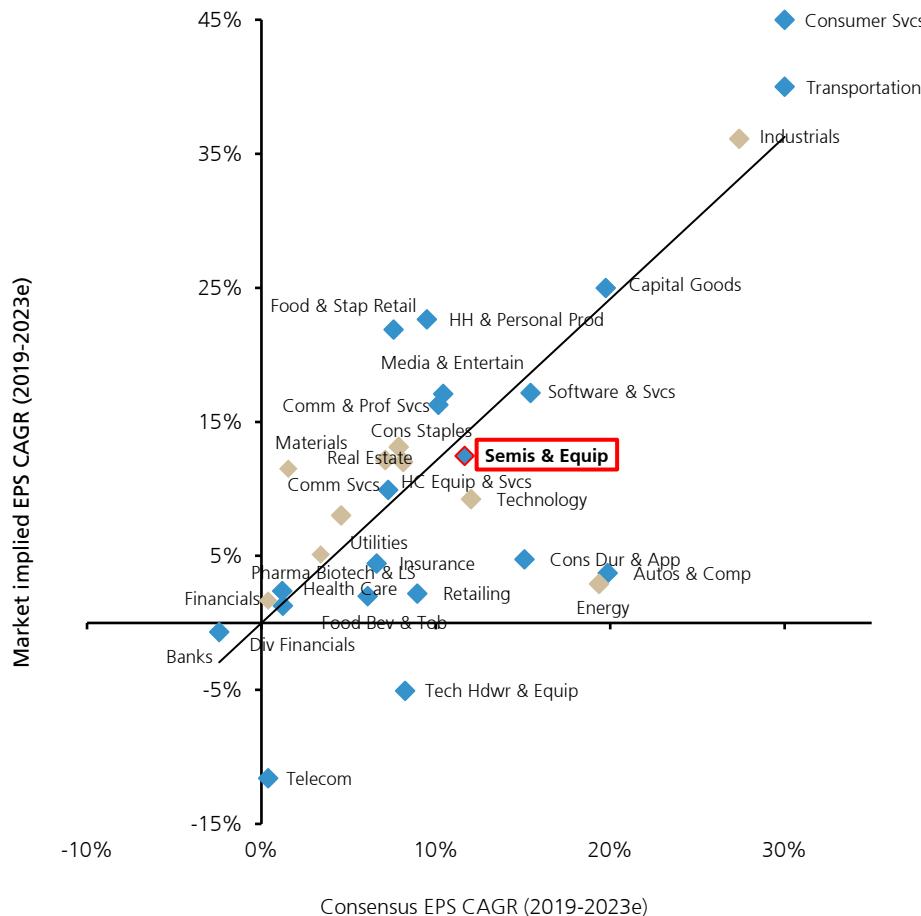
Average of Short Interest, MF Ownership and HF Ownership



Source: Factset, UBS; Note: Z-score represents relative positioning across industries

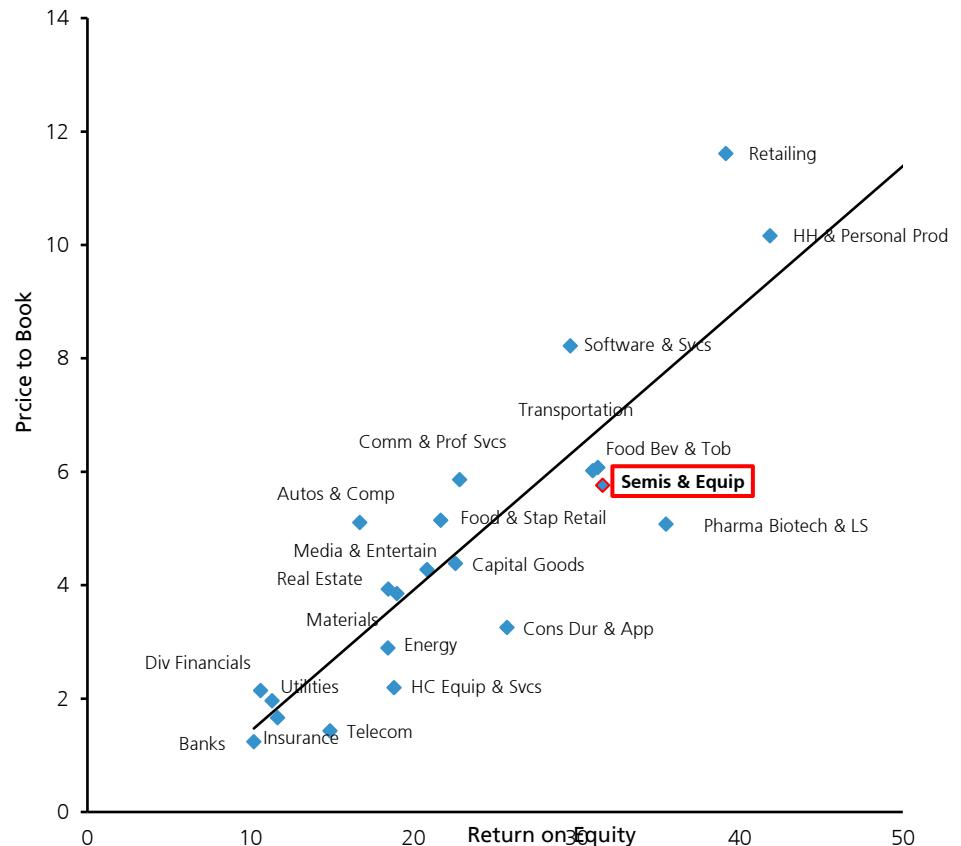
The market is still slightly under-valuing growth in semis

Implied Earnings Growth vs Consensus (2019-2023E CAGR)



Source: Factset, UBS

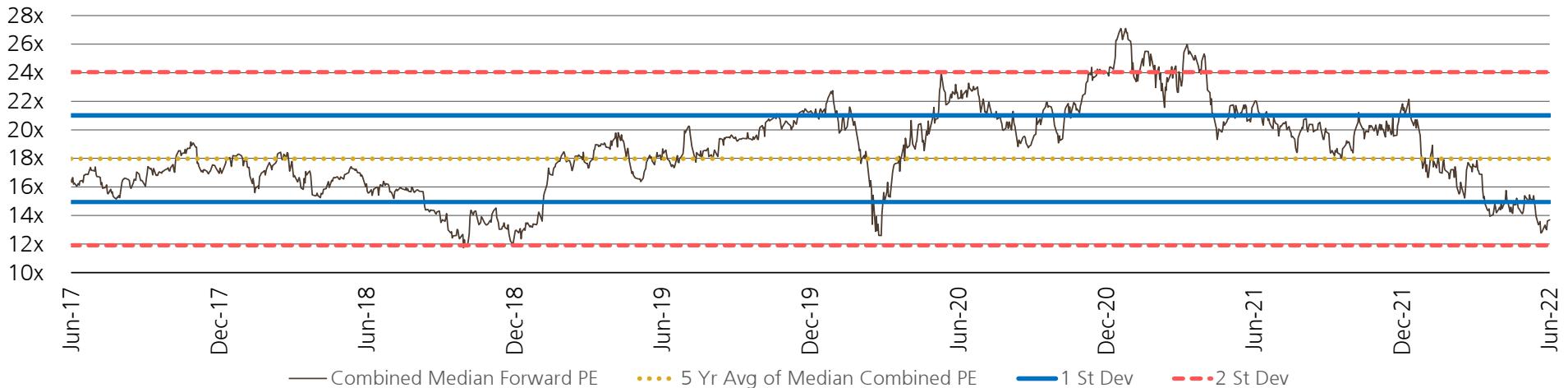
Price-to-Book vs. ROE



Source: Factset, UBS

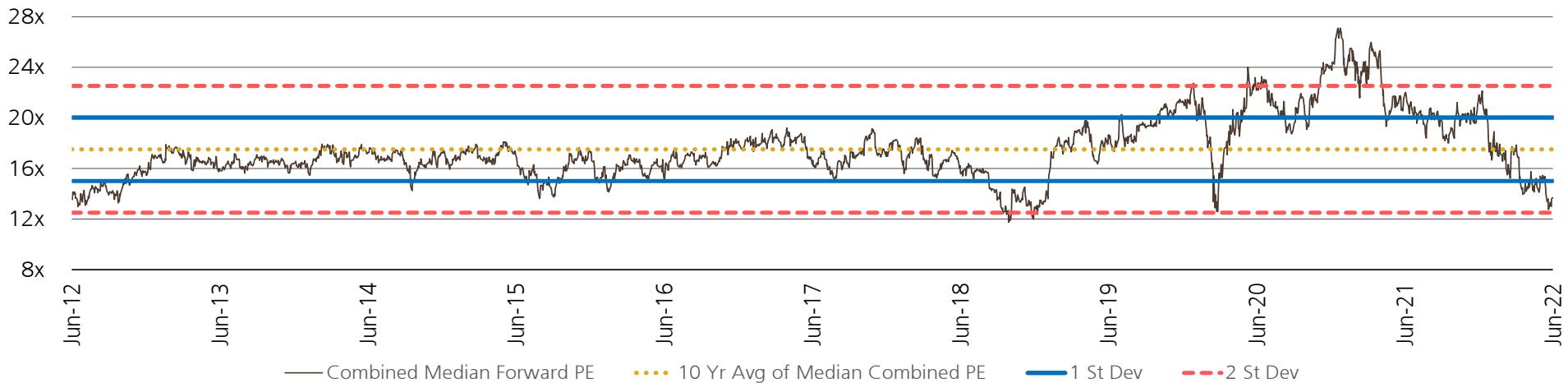
Absolute valuation has compressed, falling even below the 10yr 1 standard deviation...

Combined Semiconductor/Semi Equipment Forward P/E – 5 yr



Source: Factset

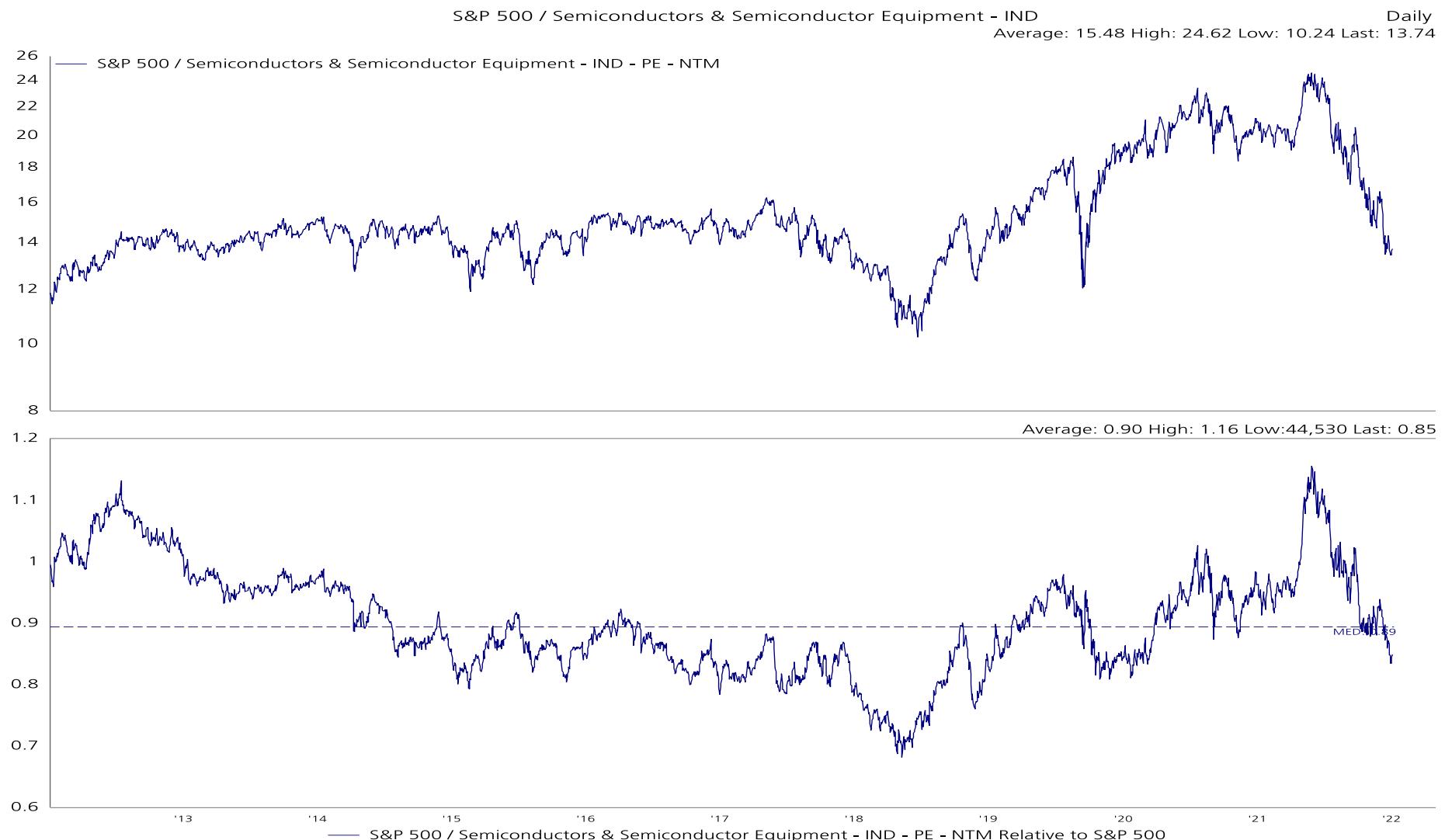
Combined Semiconductor/Semi Equipment Forward P/E – 10 yr



Source: Factset

...and the group is now trading a touch below the 10yr median versus the market

S&P 500 Semiconductors & Semiconductor Equipment Index NTM PE and NTM PE Relative to S&P500 (6/29/12 – 6/29/22)



Source: Factset



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

Smartphone

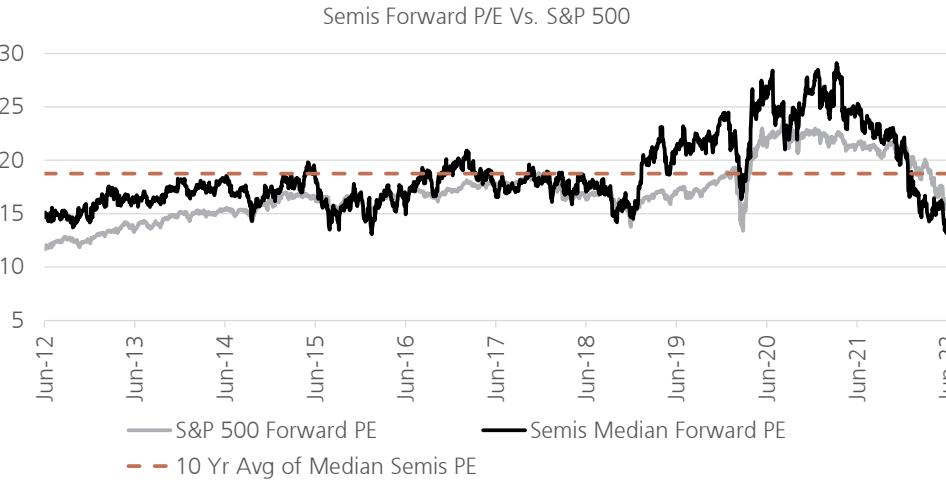
Autos

Semi Cap Equipment

Company Summaries

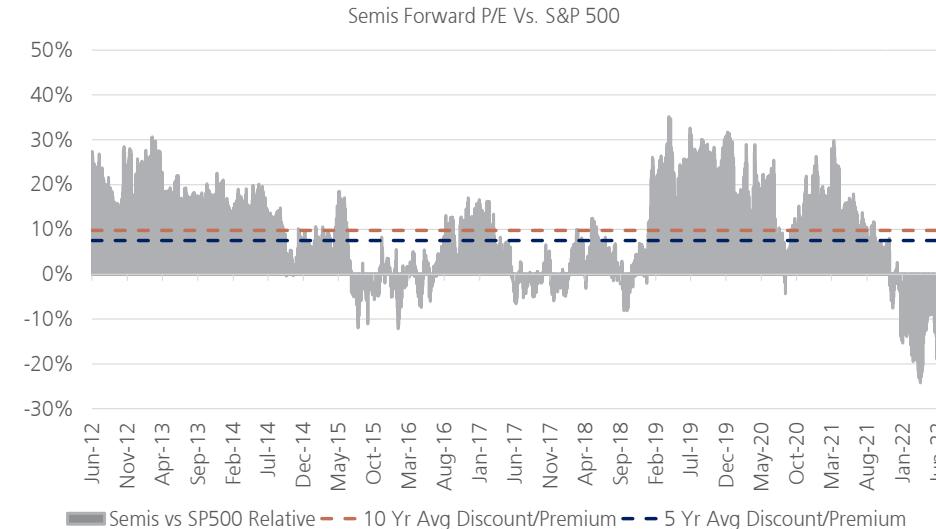
... multiple compression has been bigger in semi components...

Semiconductors Forward P/E – 10-yr Benchmark



Source: Factset

Relative Semiconductor Valuations vs S&P500 – 10-year



Source: Factset



Semis in Big Picture

Semis Industry Forecasts

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PC

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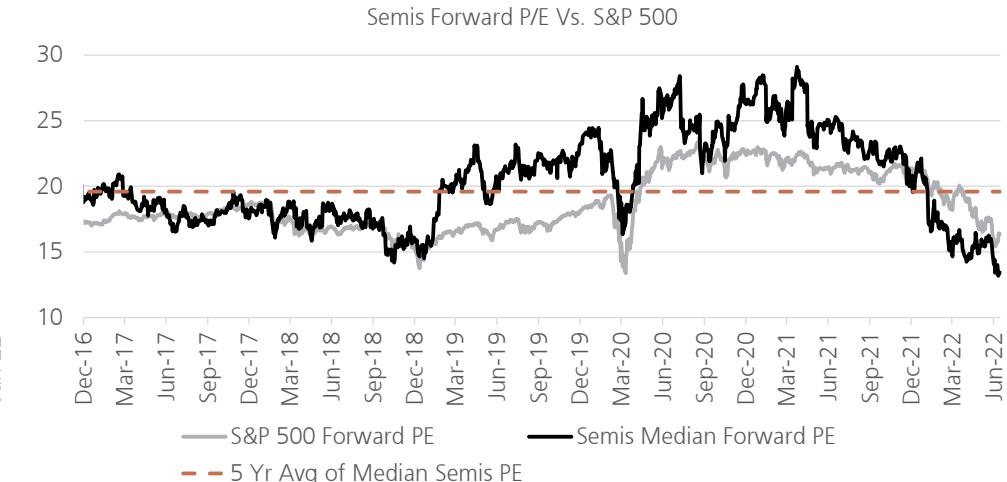
Smartphone

Autos

Semi Cap Equipment

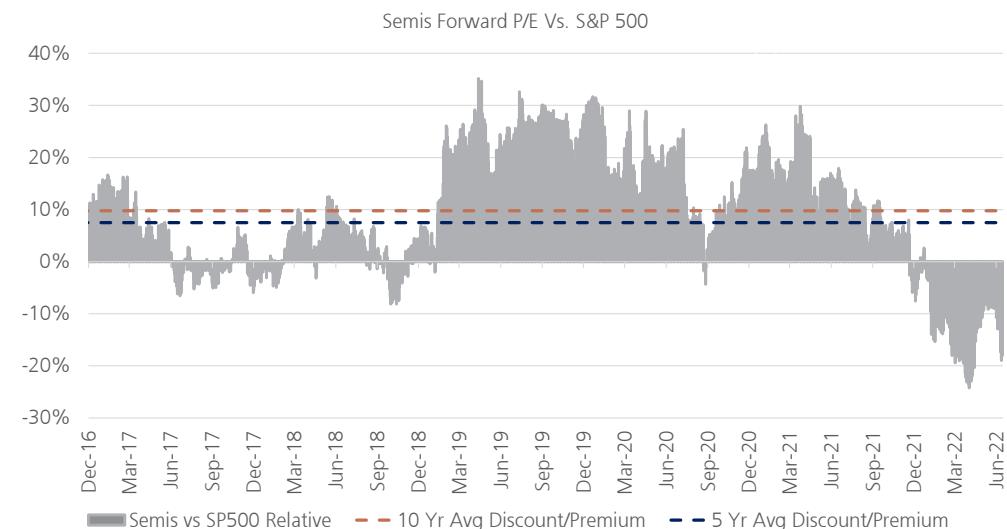
Company Summaries

Semiconductors Forward P/E – 5-yr Benchmark



Source: Factset

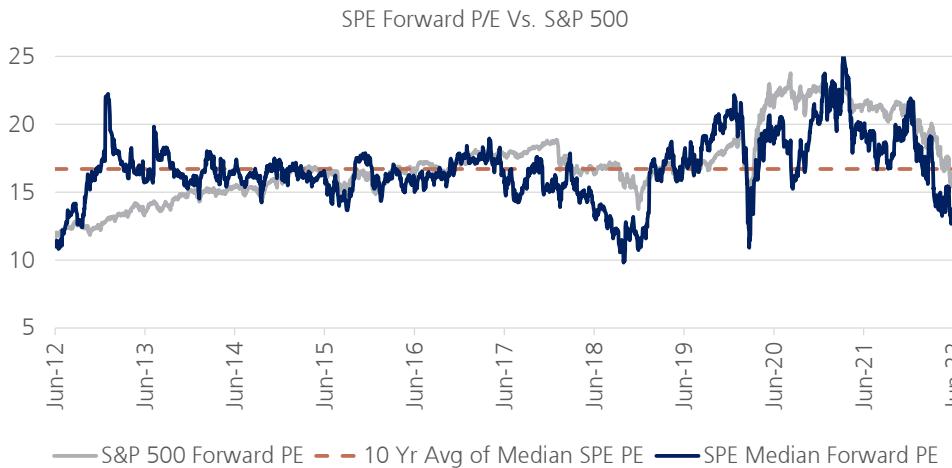
Relative Semiconductor Valuations vs S&P500 – 5-year



Source: Factset

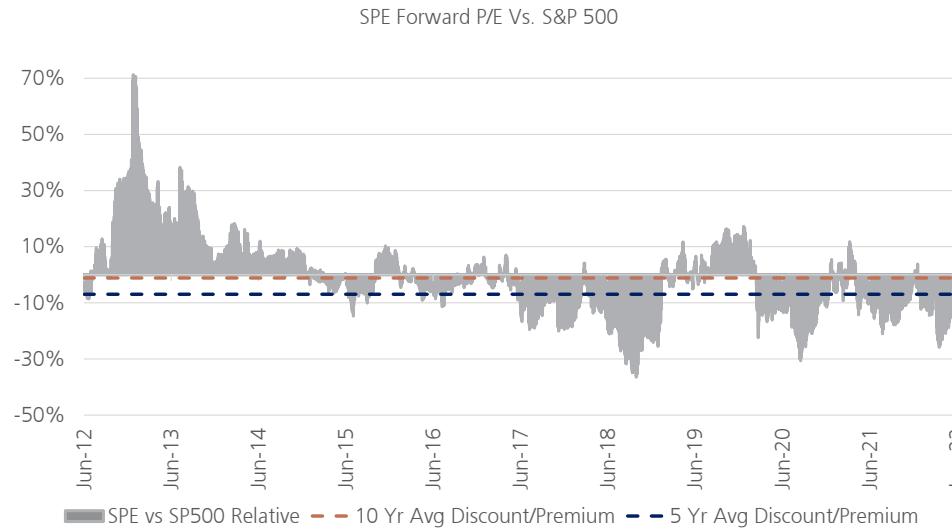
...and SPE multiples have held up relatively better (maybe due to a perception that government stimulus will backstop a downturn)

Semi Equipment Forward P/E – 10-yr Benchmark



Source: Factset

Relative Semi Equipment Valuations vs S&P500



Source: Factset



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

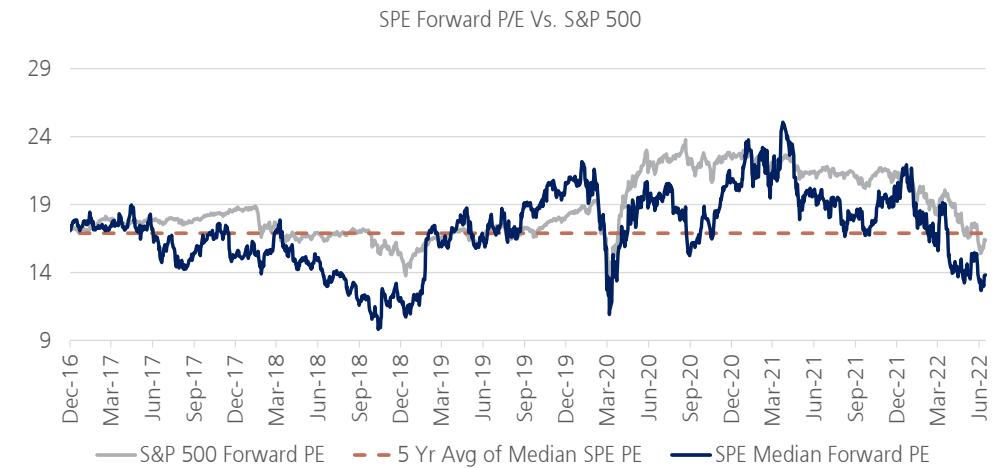
Smartphone

Autos

Semi Cap Equipment

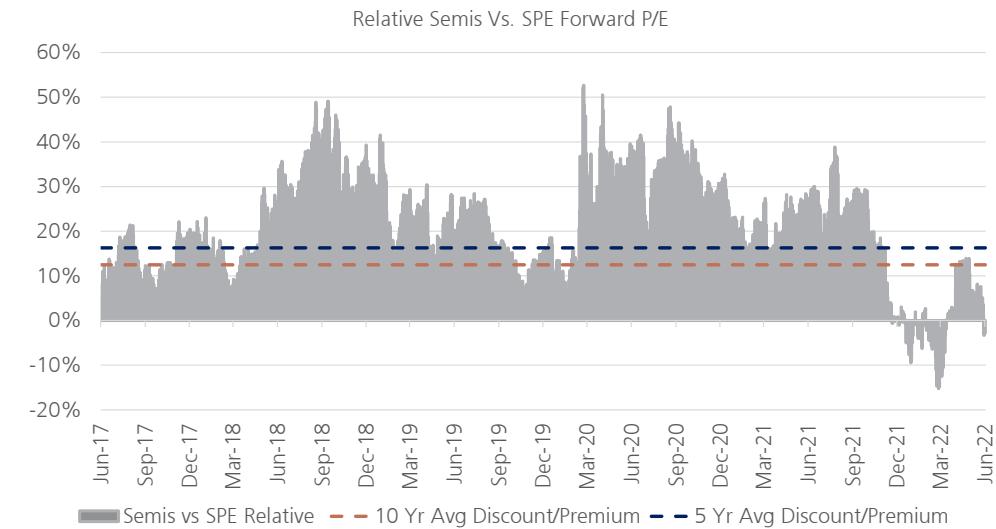
Company Summaries

Semi Equipment Forward P/E – 5-yr Benchmark



Source: Factset

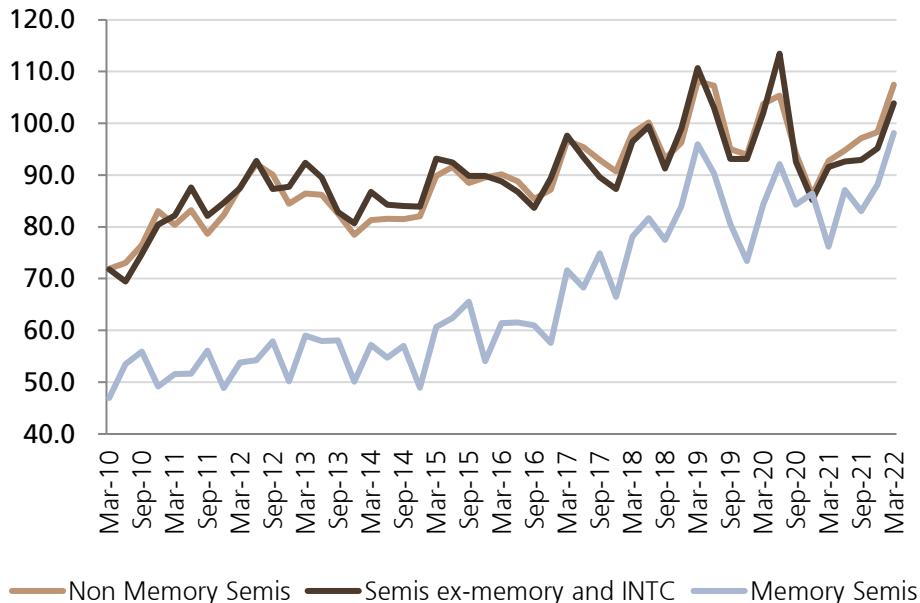
Relative Semiconductor Valuations vs Semi Equipment



Source: Factset

Inventory: downstream has successfully built inventory and is now above “normal” levels (memory being the highest)

Upstream (components)

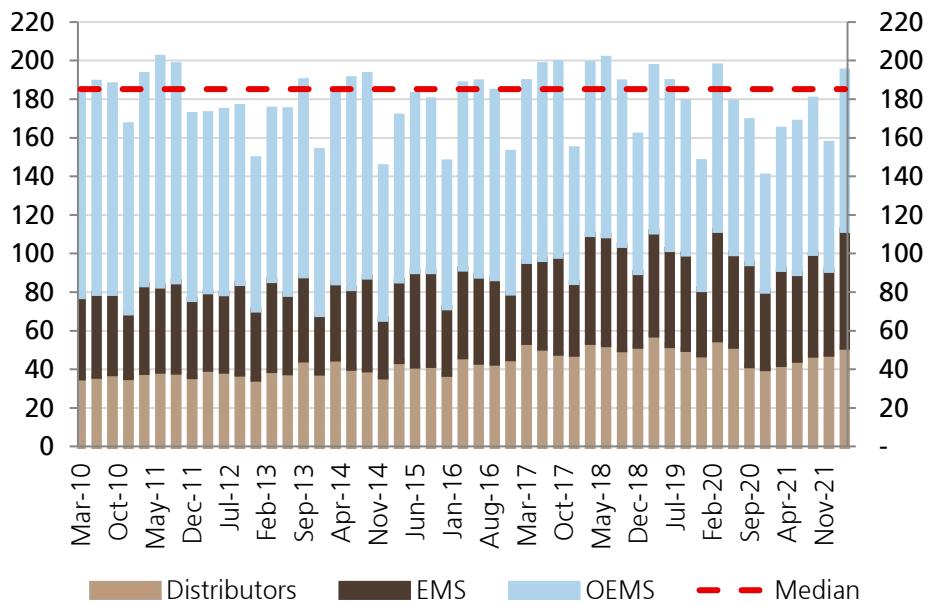


Source: Company reports

Non-memory Semis includes: Anadigics, Altera, AMD, ADI, Atmel, Austriamicrosystems, AVGO, Broadcom, Cavium, Cirrus, CSR, Cypress, Diodes, Fairchild, Freescale, Infineon, Intersil, IRF, Invensense, Lattice, Linear Technology, LSI, Netlogic, Magnachip, Marvell, Maxim, Mediatek, Melexis, Microchip, Mstar, Novatek, NXP, Nvidia, Omnivision, ON Semi, PMC Sierra, Qualcomm, Realtek, Renesas, RFMD, Triquint, Qorvo, Richtek, Rohm, Skyworks, Spreadtrum, STM, Texas Instruments, Xilinx.

Memory includes: Elpida, Hynix, Inotera, Micron, Nanya, Sandisk, Samsung, WDC

Downstream



Source: Company reports

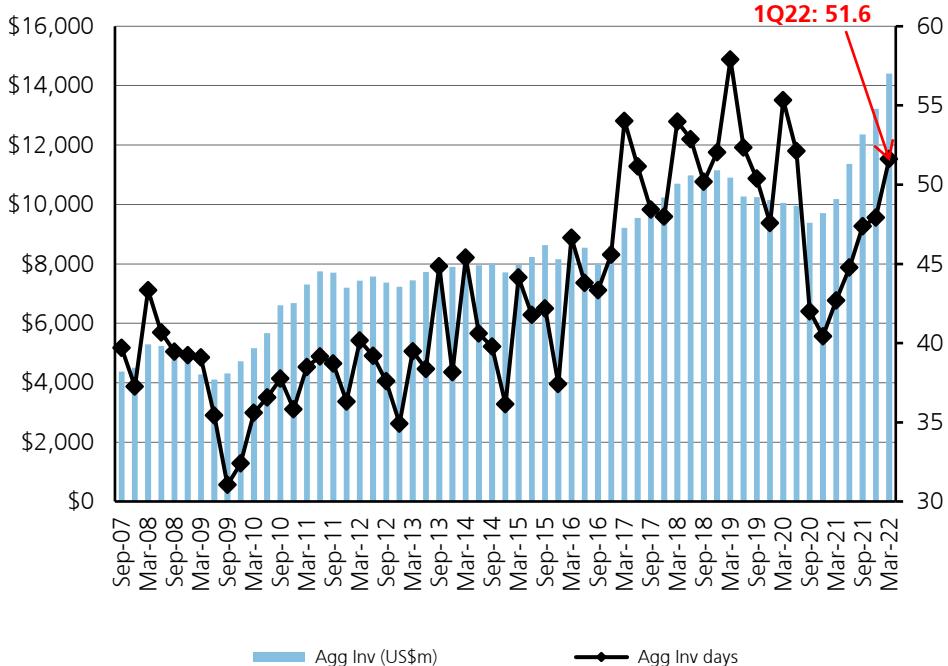
Distributors include: Arrow, Avnet, Digital China, WPG Holdings, Ingram Micro, Synnex, Edom, New Horizons, Yosun.

EMS/ODM includes: Compal, Inventec, Pegatron, Quanta, Wistron, Flextronics, Jabil, Sanmina, Hon Hai, Celestica

OEM includes Apple, Coolpad, HTC, LG, Motorola, RIMM, Samsung, Sony Ericsson, TCL, Alcatel, Arris, Brocade, Cisco, Ericsson, Juniper, JDS Uniphase, Nokia, Riverbed, ZTE, Acer, Asustek, Dell, HPQ, HPE, IBM, Lenovo, Nidec, Positivo, Seagate, WDC, Konka, Nikon, Nintendo, Skyworth, Sony, TCL Multimedia, Haier, Hisense, BorgWarner, Continental, Denso, ABB, Emerson, GE, Honeywell, Jonson Controls, Legrand, Siemens, Toshiba.

Inventory Details: Distributor and OEM

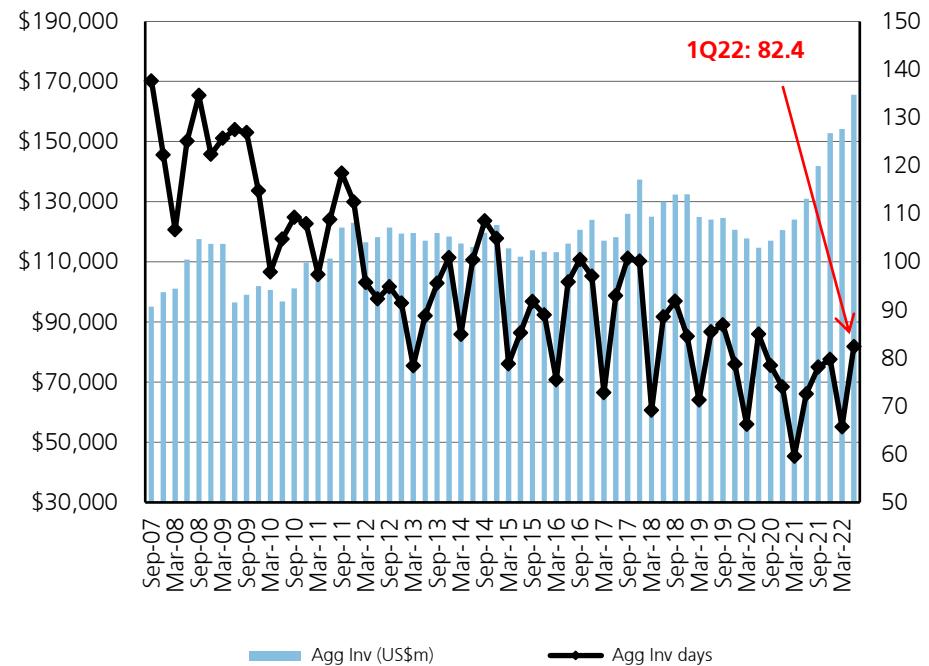
Distributor Days of Inventory



Source: Company reports, UBS

Includes: Arrow, Avnet, Digital China, WPG Holdings, Ingram Micro, Synnex, Edom, New Horizons, Yosun

OEM Inventory Days

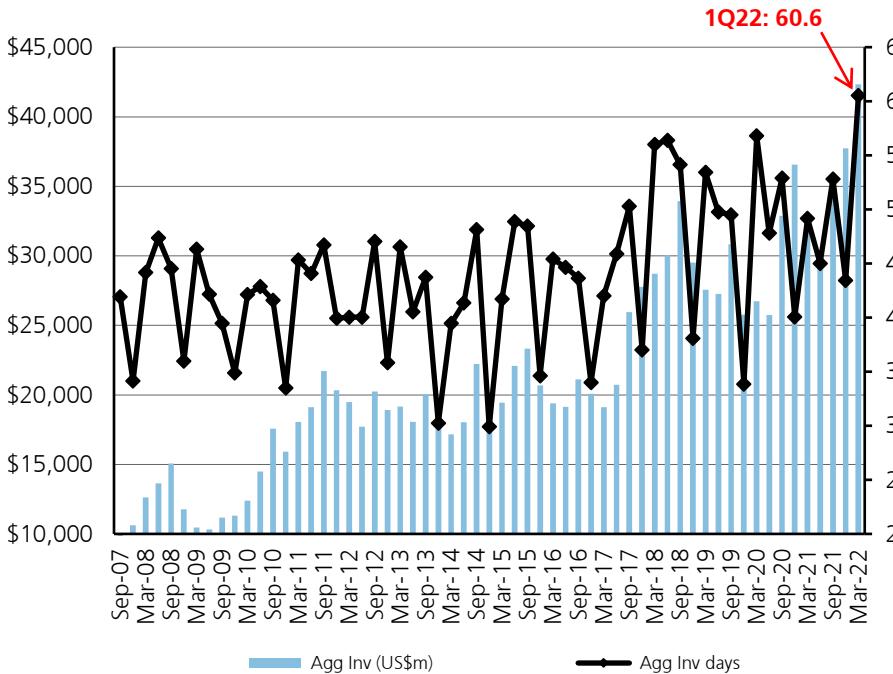


Source: Company reports, UBS

Includes: Apple, Coolpad, HTC, LG Electronics, Motorola, Blackberry, Samsung Electronics, Sony Ericsson, TCL Comms, Alcatel, Arris, Brocade, Cisco, Ericsson, Juniper, JDSU, Nokia, Riverbed, ZTE, Acer, Asustek, DELL, HPQ, HPE, IBM, Lenovo, Nidec, Positivo, STX, WDC, Konka, Nikon, Nintendo, Skyworth, Sony, TCL Multimedia, Haier, Hisense, BorgWarner, Continental, Denso, ABB, Emerson, GE, Honeywell, Johnson Controls, Legrand, Siemens, Toshiba

Inventory Details: EMS and Memory

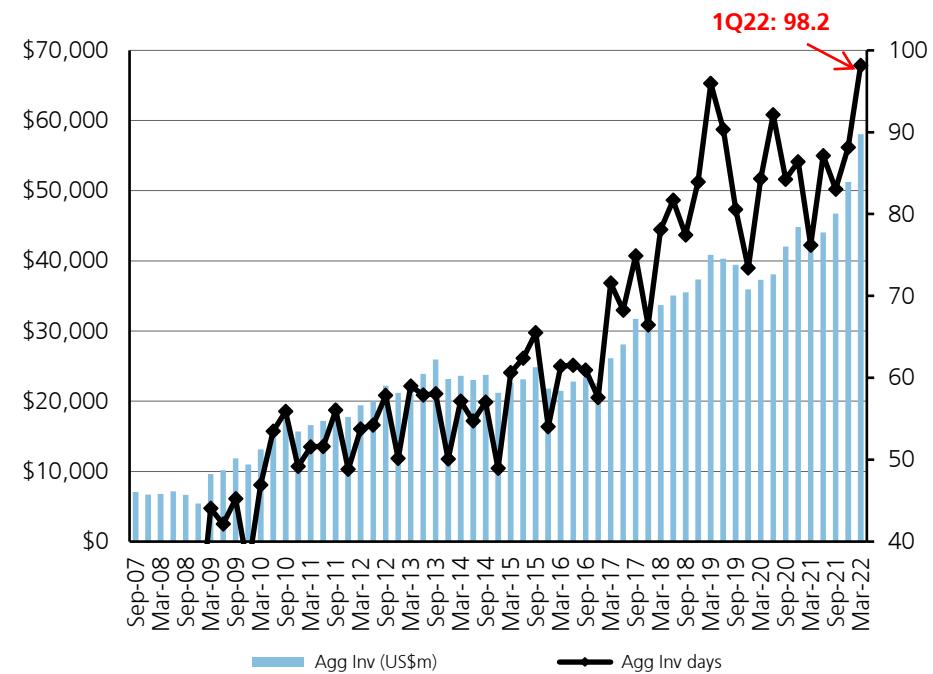
EMS Inventory Days



Source: Company reports, UBS

Includes: Flextronics, Jabil, Sanmina, Hon Hai, Celestica

Memory Inventory Days

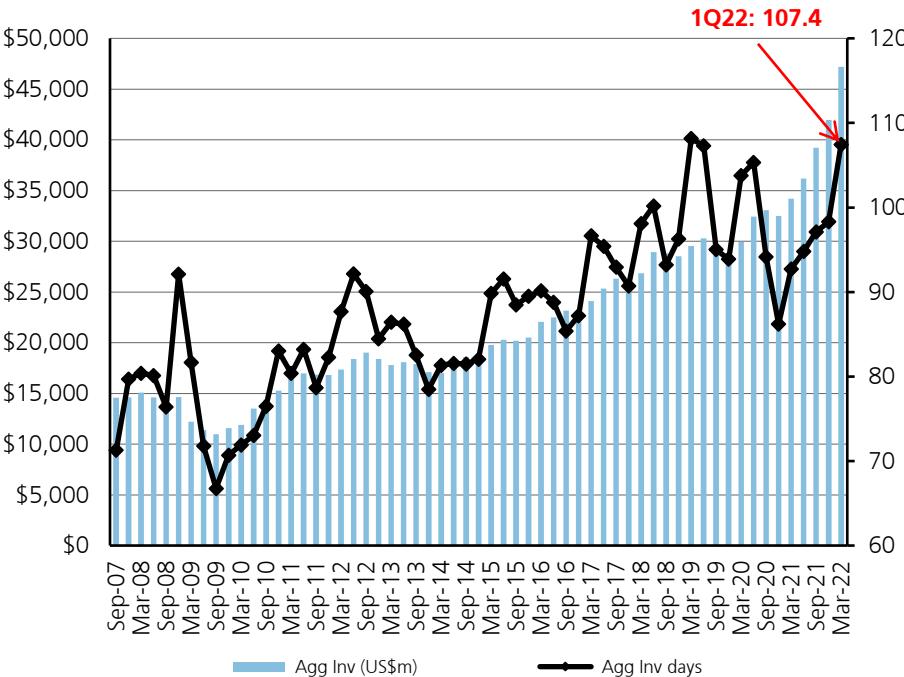


Source: Company reports, UBS

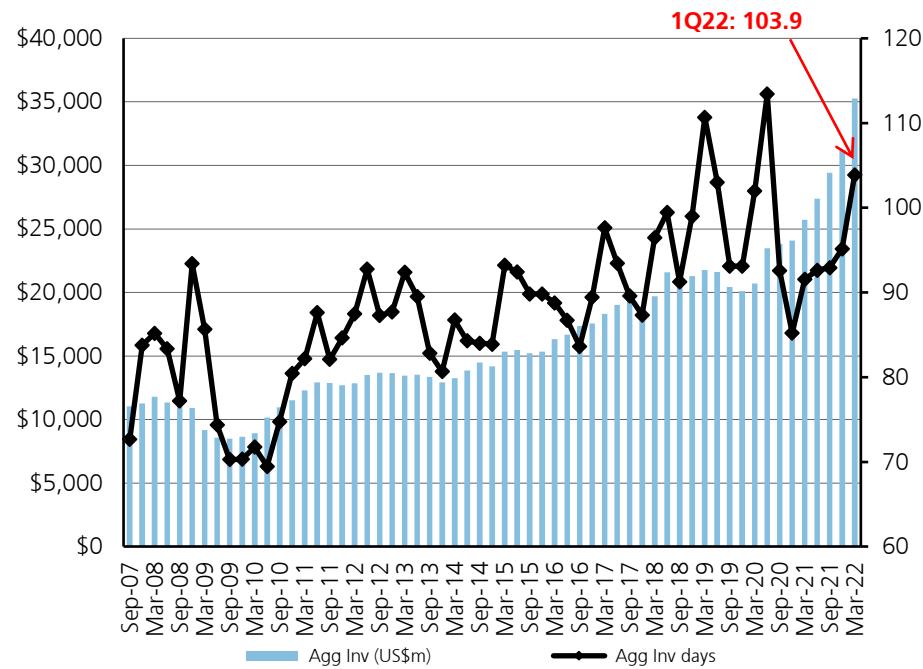
Includes: Hynix, Micron, Nanya

Inventory Details: Semis ex-Memory

Semis ex-Memory Inventory Days



Semis ex-Memory and INTC Days of Inventory

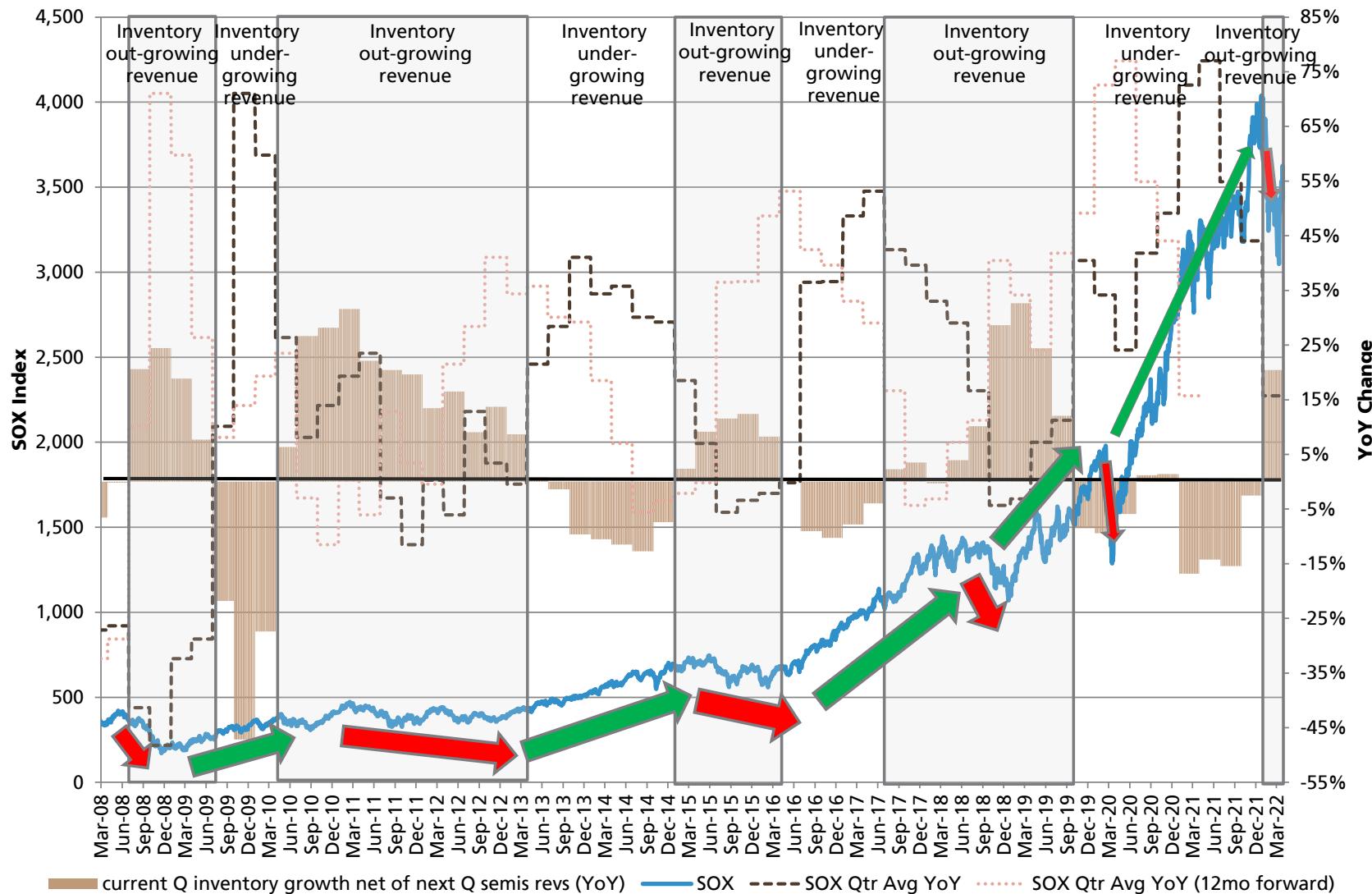


Source: Company reports, UBS

Includes: Anadigics, Altera, AMD, ADI, Atmel, Austriamicrosystems, AVGO, Broadcom, Cavium, Cirrus, CSR, Cypress, Diodes, Fairchild, Freescale, Infineon, Intel, Intersil, IRF, Invensense, Lattice, Linear Technology, LSI, Netlogic, Magnachip, Marvell, Maxim, Mediatek, Melexis, Microchip, Mstar, Novatek, NXP, Nvidia, Omnivision, ON Semi, PMC Sierra, Qualcomm, Realtek, Renesas, RFMD, Triquint, Qorvo, Richtek, Rohm, Skyworks, Spreadtrum, STM, Texas Instruments, Xilinx

Inventory growth is now substantially outpacing revenue growth - a poor backdrop for stocks

Inventory Y/Y growth now faster than semis Y/Y revenue growth on a 1Q lag basis

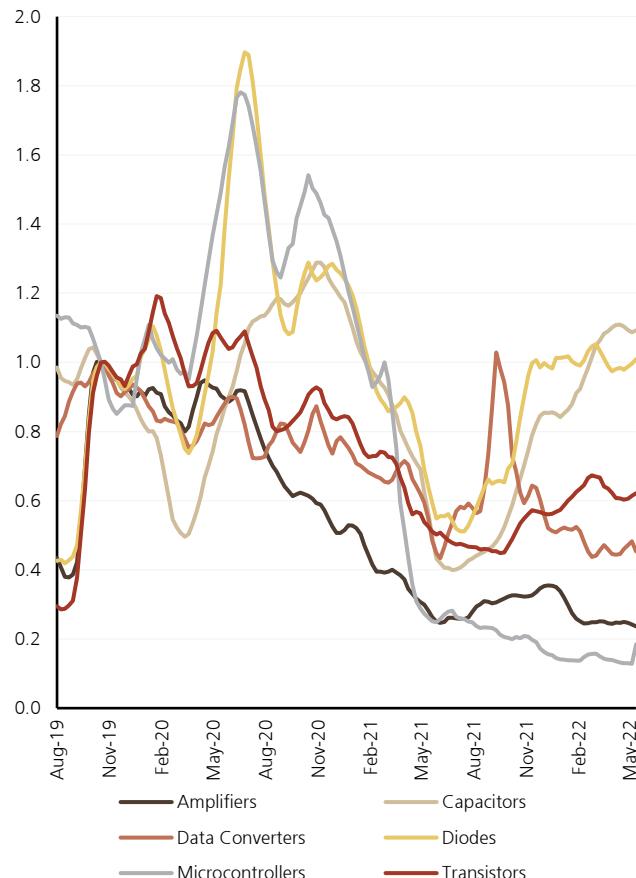


Source: Company data, UBS estimates, SIA



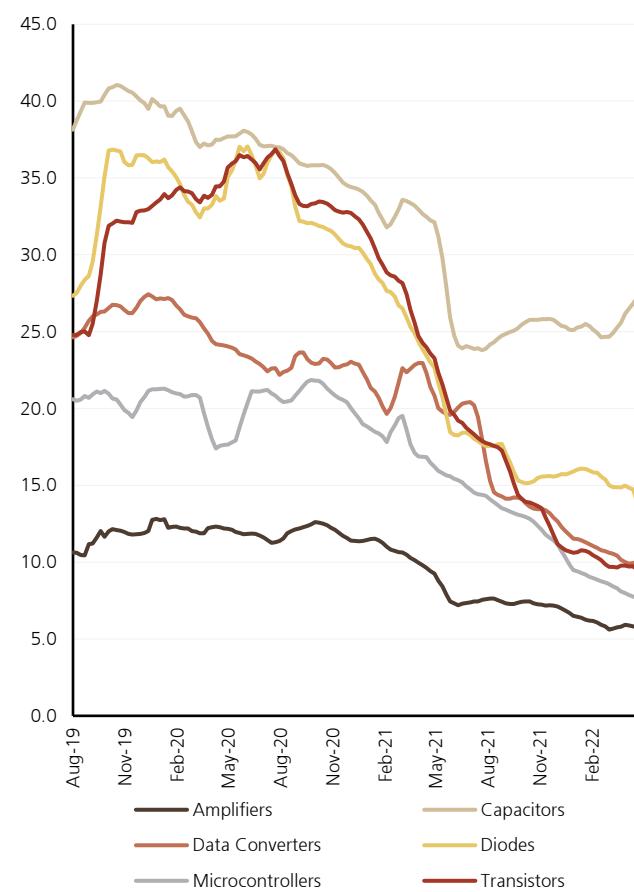
Supply/product availability still low, but has started to improve for most products

Normalized Unit Inventories



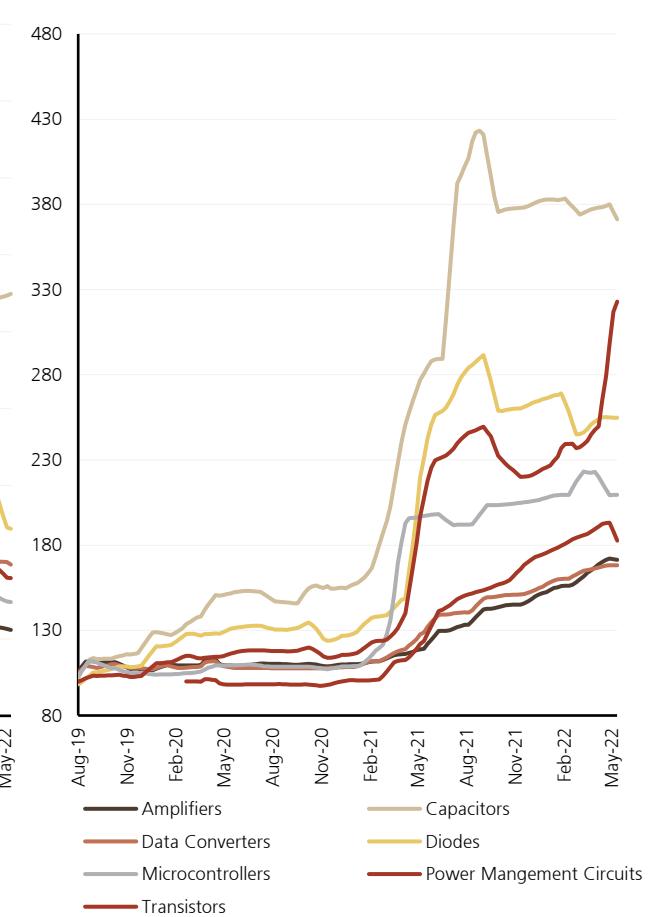
Source: Company data, UBS Evidence Lab,
Datastream, UBS

Products in Stock (%)



Source: Company data, UBS Evidence Lab,
Datastream, UBS

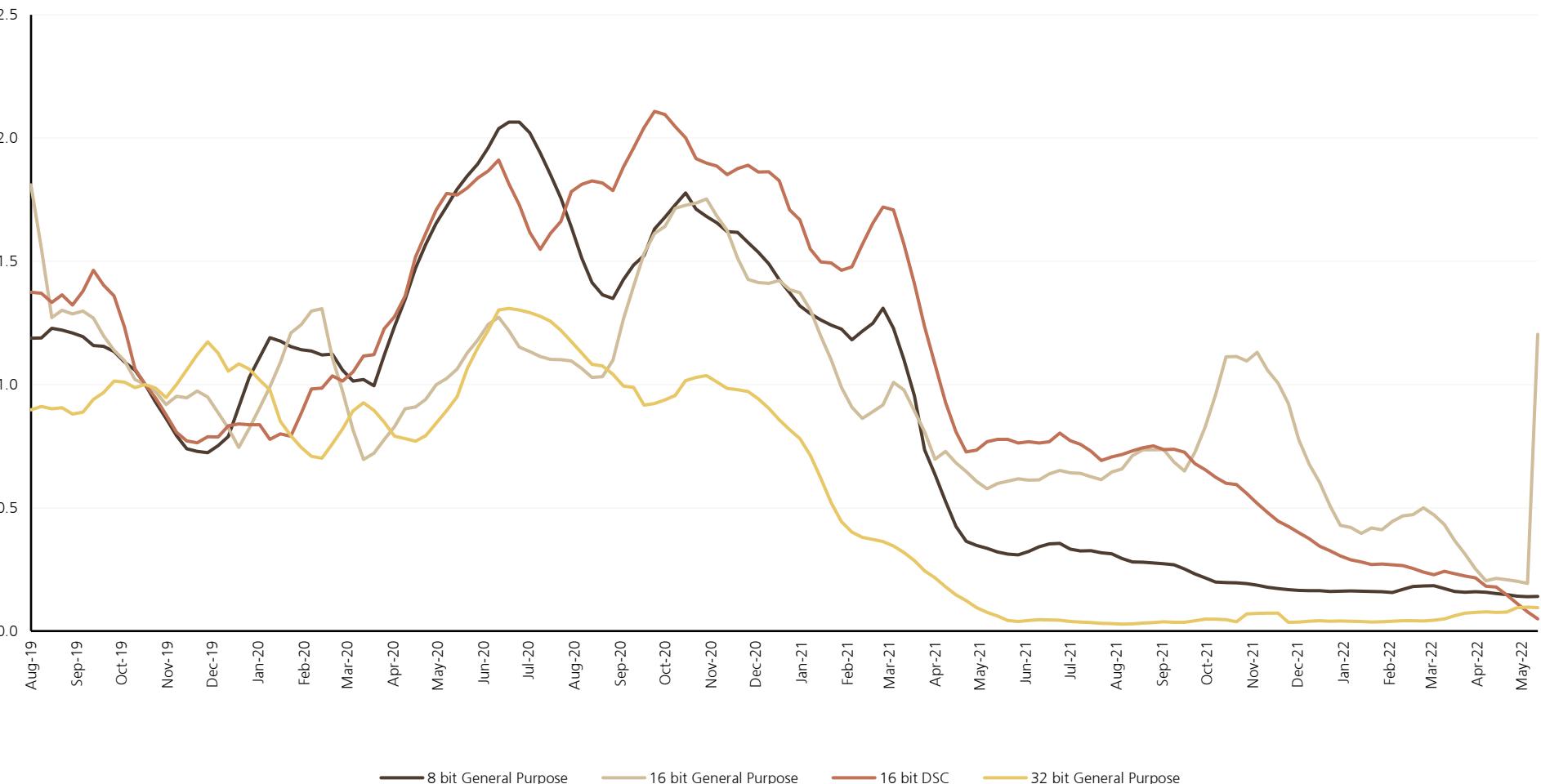
Like-for-like Pricing



Source: Company data, UBS Evidence Lab,
Datastream, UBS

Supply/product availability details: MCU

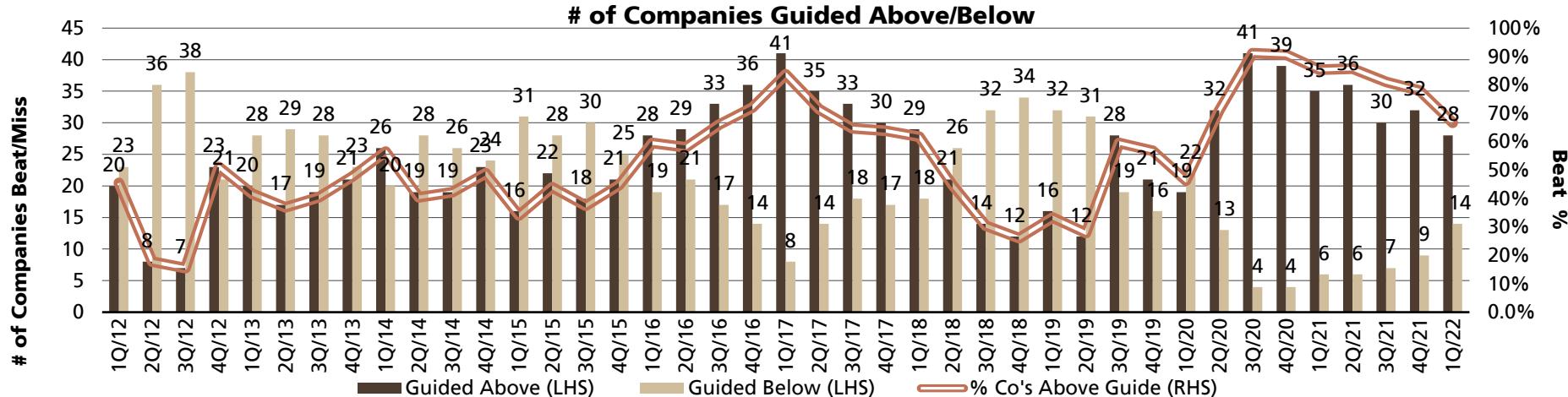
Normalized Unit Inventory: 4-Comp Set Comparison within Microcontrollers



Source: UBS Evidence Lab

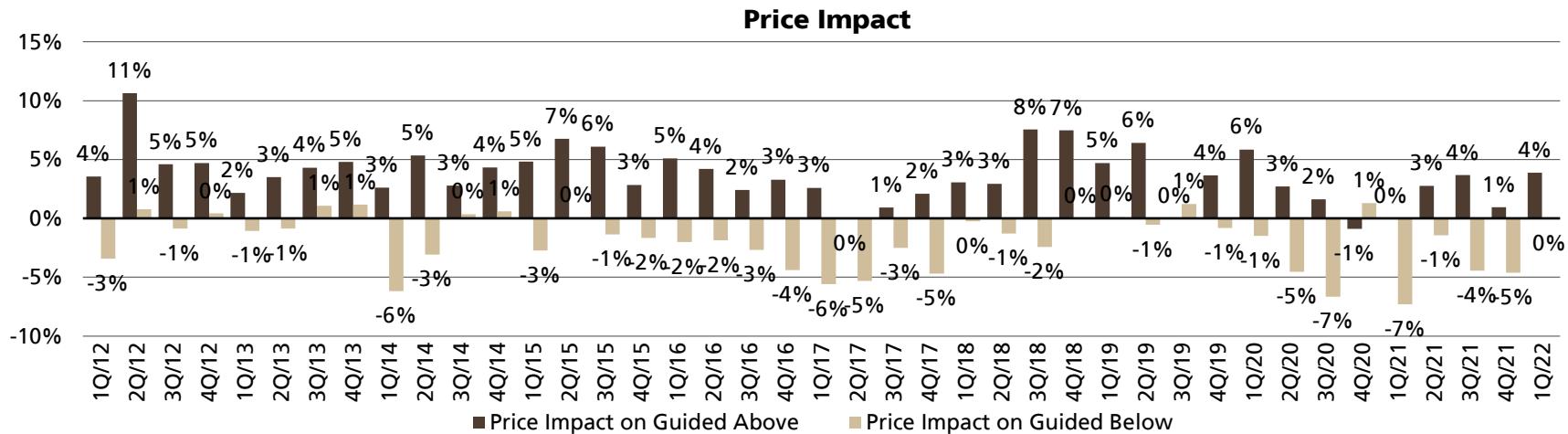
Stock reaction to earnings – the market is starting to want to see cuts

Semis Company Guidance Tracker



Source: Company data, Factset, UBS

Price Impact on Guidance



Source: Company data, Factset, UBS

Note: Price impact is based on T+1 post earnings



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

Smartphone

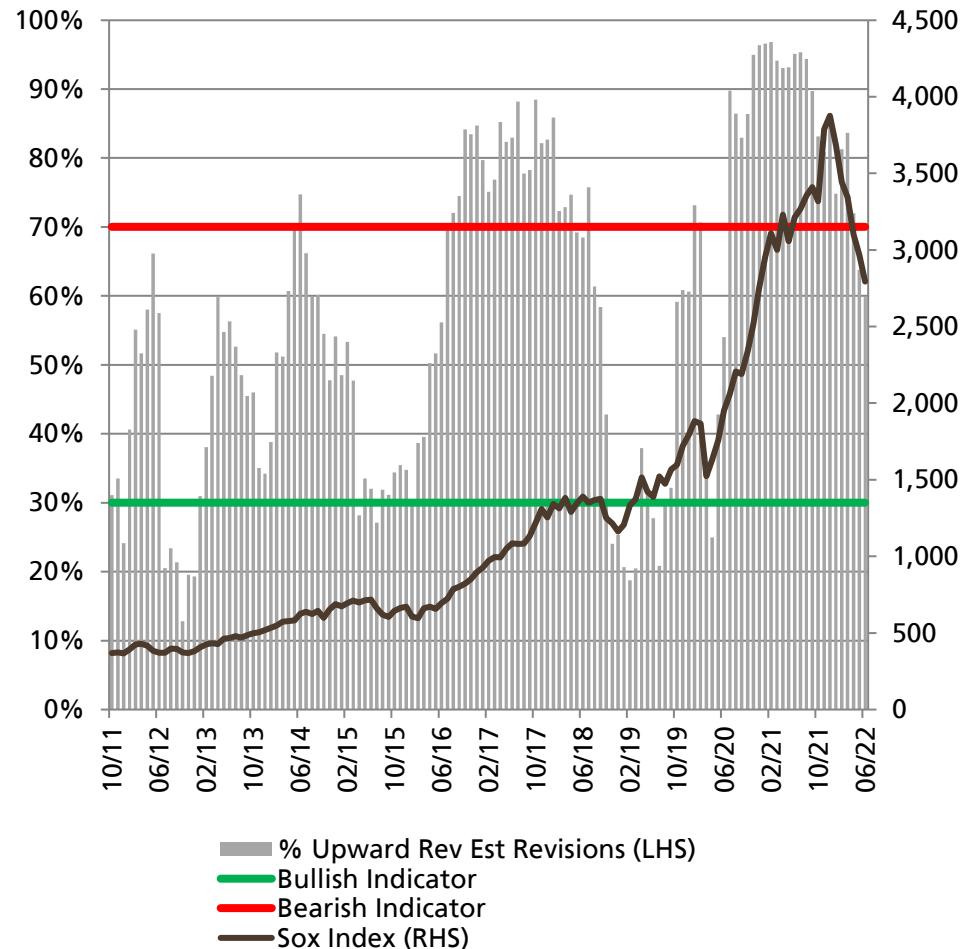
Autos

Semi Cap Equipment

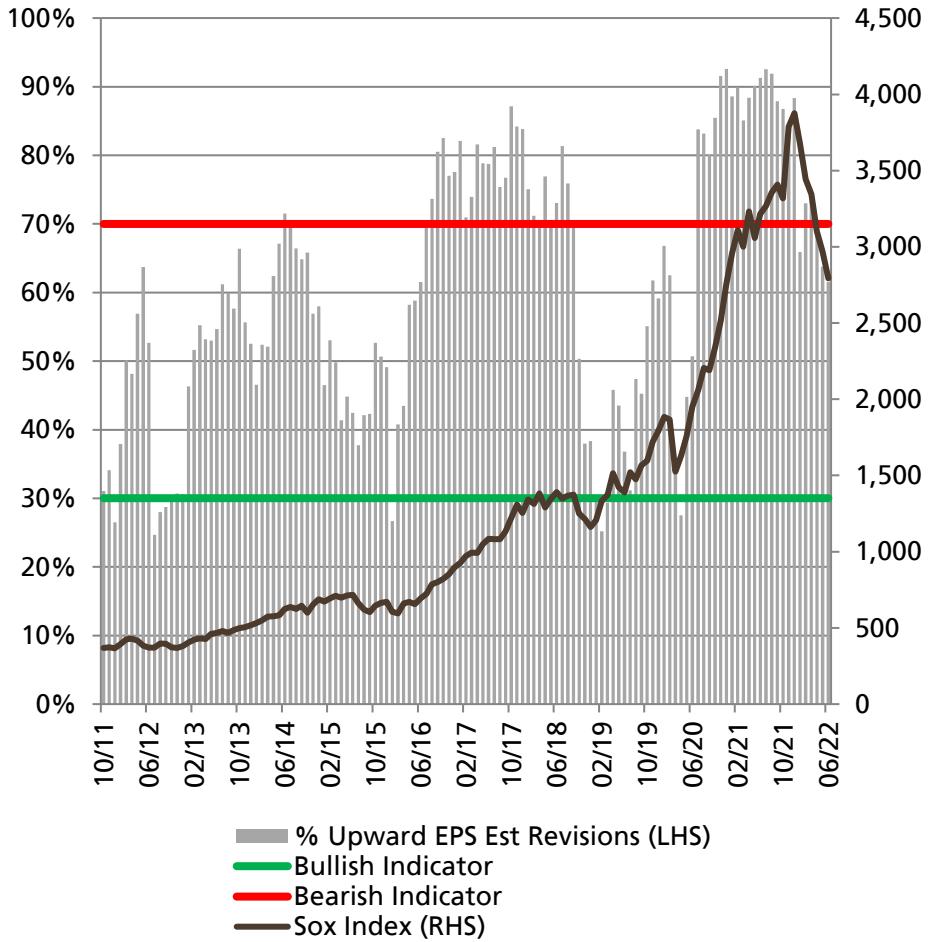
Company Summaries

Monthly estimate revisions are slowing significantly

Upward Revenue Revisions vs. SOX



Upward EPS Revisions vs. SOX



Source: Factset, UBS estimates

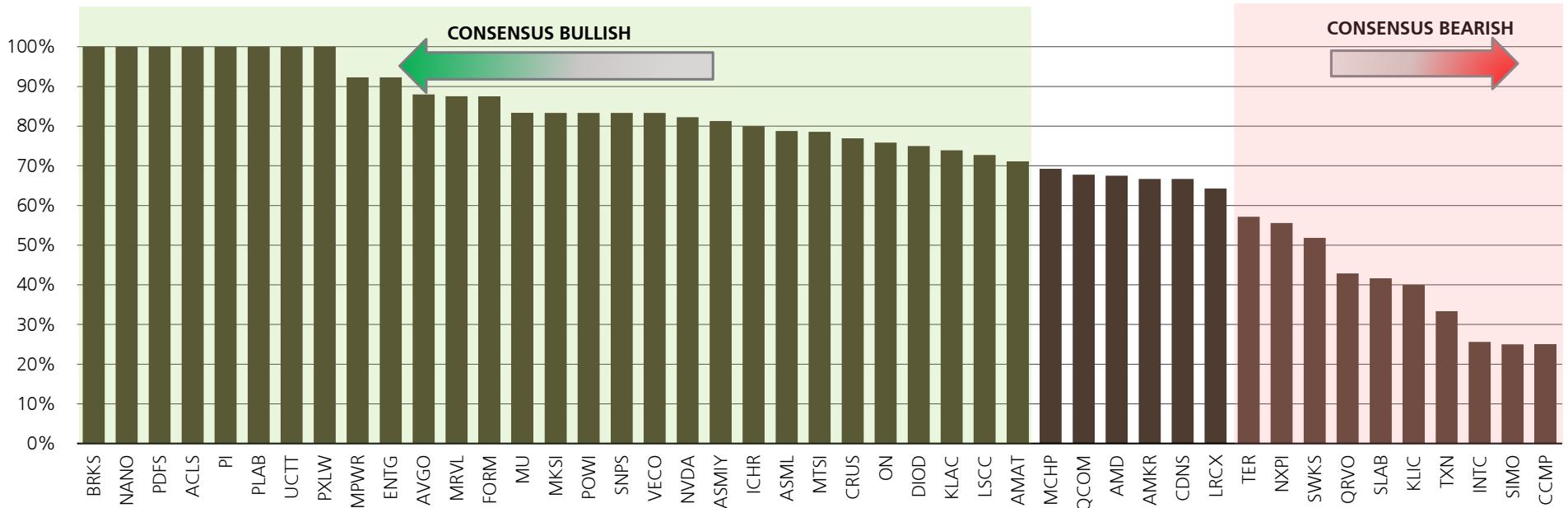


*as of 6/29/22

Source: Factset, UBS estimates

Sell side ratings skew

Semis Sell Side Ratings



Source: Factset

- Notable consensus bullish: ENTG, AVGO, MRVL, MU
- Notable consensus bearish: INTC, TXN, SWKS, QRVO, TER

Stock Performance: Semis vs. Market

Ticker	Broad Markets	Absolute Performance						Relative to S&P500 Semis & SemiCap Sector						Relative to S&P 500												
		1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year				
SP50	S&P 500	1.51%	(8.10%)	(16.48%)	(20.16%)	(19.82%)	(10.93%)	27.00%	2.16%	6.74%	12.15%	15.04%	14.21%	7.39%	(5.98%)	(0.72%)	(0.13%)	(5.87%)	(9.26%)	(8.87%)	(8.95%)	(8.84%)				
NDX	NASDAQ-100 Index	0.79%	(8.23%)	(22.35%)	(29.42%)	(28.69%)	(19.88%)	18.16%	1.44%	6.61%	6.28%	5.78%	5.34%	(1.55%)	(14.82%)	(0.72%)	(0.14%)	1.27%	5.01%	5.18%	4.98%	1.20%	(3.29%)			
DJIAK	DJ Industrial Average	1.37%	(6.82%)	(11.47%)	(14.98%)	(14.84%)	(9.73%)	23.71%	2.02%	8.01%	17.16%	20.23%	19.19%	8.59%	(9.27%)	(2.16%)	(6.74%)	(12.15%)	(15.04%)	(14.21%)	(7.39%)	5.98%	(3.29%)			
99900778	S&P 500 / Semiconductors & Semiconductor	(0.65%)	(14.84%)	(28.63%)	(35.20%)	(34.03%)	(18.33%)	32.98%	(0.28%)	(15.19%)	(33.82%)	(20.49%)	37.47%	0.38%	(0.36%)	3.11%	1.38%	0.98%	(2.17%)	4.49%	(1.78%)	(7.09%)	(13.66%)	(13.23%)	(9.56%)	10.47%
SOX	S&P 500 / Semiconductor	(0.28%)	(15.25%)	(25.52%)	(38.05%)	(20.49%)	37.47%																			
<i>Average Median</i>		0.55%	(10.64%)	(20.89%)	(26.71%)	(26.08%)	(15.87%)	27.86%	1.50%	5.25%	9.68%	10.61%	9.93%	3.07%	(6.40%)	(1.20%)	(3.17%)	(5.51%)	(8.20%)	(7.83%)	(6.18%)	1.08%				
<i>Median</i>		0.79%	(8.23%)	(22.35%)	(29.42%)	(28.69%)	(18.33%)	27.00%	1.73%	6.67%	9.22%	10.41%	9.78%	2.92%	(7.63%)	(1.25%)	(3.44%)	(7.45%)	(11.46%)	(11.05%)	(8.17%)	1.34%				
Ticker	S&P 500 Sectors	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year				
		(1.16%)	(13.69%)	(1.45%)	35.15%	36.59%	42.88%	108.23%	(0.51%)	1.14%	27.18%	70.35%	70.62%	61.20%	75.25%	(2.67%)	(5.60%)	15.03%	55.31%	56.41%	53.81%	81.23%				
99900477	S&P 500 / Consumer Staples -SEC	2.17%	(3.99%)	(5.03%)	(6.43%)	(7.18%)	3.80%	27.51%	2.82%	10.84%	23.60%	28.77%	26.85%	22.13%	(5.47%)	0.67%	4.11%	11.45%	13.72%	12.64%	14.74%	0.51%				
99900821	S&P 500 / Utilities -SEC	5.69%	(7.49%)	(5.31%)	(1.95%)	(3.10%)	7.60%	25.61%	6.34%	7.34%	23.32%	33.25%	30.93%	25.93%	(7.37%)	4.19%	0.60%	11.17%	18.20%	16.72%	18.53%	(1.39%)				
99900565	S&P 500 / Health Care -SEC	3.94%	(4.68%)	(7.19%)	(9.26%)	(9.59%)	1.21%	30.68%	4.59%	10.15%	21.44%	25.94%	24.45%	19.53%	(2.30%)	2.43%	3.42%	9.29%	10.90%	10.23%	12.14%	3.68%				
86099965	S&P 500 / Real Estate - SEC	3.98%	(8.05%)	(13.90%)	(19.73%)	(20.66%)	(7.96%)	23.01%	4.63%	6.79%	14.73%	15.47%	13.37%	10.37%	(9.97%)	2.47%	0.05%	2.58%	0.43%	(0.84%)	2.97%	(3.99%)				
99900037	S&P 500 / Materials -SEC	(0.69%)	(13.77%)	(15.44%)	(16.64%)	(17.08%)	(8.45%)	37.61%	(0.04%)	1.06%	13.19%	18.57%	16.96%	9.87%	4.62%	(2.20%)	(5.67%)	1.04%	3.52%	2.74%	2.48%	10.60%				
99900125	S&P 500 / Industrials -SEC	0.97%	(7.97%)	(15.59%)	(17.03%)	(17.21%)	(13.96%)	32.45%	1.62%	6.86%	13.04%	18.17%	16.82%	4.37%	(0.53%)	(0.54%)	0.12%	0.89%	3.12%	2.61%	(3.03%)	5.45%				
SP50	S&P 500	1.51%	(8.10%)	(16.48%)	(20.16%)	(19.82%)	(10.93%)	27.00%	2.16%	6.74%	12.15%	15.04%	14.21%	7.39%	(5.98%)	(2.67%)	(5.60%)	15.03%	55.31%	56.41%	53.81%	81.23%				
99900621	S&P 500 / Financials -SEC	1.66%	(10.00%)	(18.98%)	(18.62%)	(18.25%)	(12.85%)	41.39%	2.31%	4.83%	9.66%	16.58%	15.78%	5.47%	8.41%	0.15%	(1.90%)	(2.50%)	1.54%	1.57%	(1.92%)	14.39%				
99900701	S&P 500 / Information Technology -SEC	0.84%	(8.99%)	(20.28%)	(27.22%)	(26.42%)	(12.82%)	25.91%	1.49%	5.85%	8.35%	7.98%	7.61%	5.51%	(7.08%)	(0.67%)	(0.89%)	(3.81%)	(7.06%)	(6.60%)	(1.88%)	(1.10%)				
99900793	S&P 500 / Communication Services -SEC	1.14%	(6.12%)	(20.79%)	(30.53%)	(29.54%)	(29.24%)	8.33%	1.79%	8.72%	7.84%	4.67%	4.49%	(10.91%)	(24.65%)	(0.37%)	1.98%	(4.31%)	(10.37%)	(9.72%)	(18.31%)	(18.67%)				
99900285	S&P 500 / Consumer Discretionary -SEC	(0.06%)	(8.82%)	(26.62%)	(32.41%)	(32.05%)	(23.34%)	7.31%	0.59%	6.01%	2.01%	2.80%	1.99%	(5.02%)	(25.67%)	(1.57%)	(0.73%)	(10.14%)	(12.25%)	(12.23%)	(12.41%)	(19.69%)				
<i>Average Median</i>		1.67%	(8.47%)	(13.92%)	(13.74%)	(13.69%)	(5.34%)	32.92%	2.32%	6.36%	14.71%	21.47%	20.34%	12.99%	(0.06%)	0.17%	(0.41%)	2.79%	7.01%	6.68%	6.10%	6.46%				
<i>Median</i>		1.33%	(8.07%)	(15.51%)	(17.83%)	(17.73%)	(9.69%)	27.26%	1.98%	6.76%	13.12%	17.37%	16.30%	8.63%	(5.73%)	(0.37%)	0.05%	1.04%	3.12%	2.61%	2.48%	0.51%				
Ticker	S&P 500 Info Tech Industries	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year				
		(1.41%)	(8.03%)	(11.66%)	(21.15%)	(20.88%)	(24.45%)	(0.30%)	2.06%	6.81%	16.97%	14.05%	13.15%	(6.12%)	(33.28%)	(0.10%)	0.07%	4.82%	(1.00%)	(1.06%)	(13.52%)	(27.30%)				
99900790	S&P 500 / IT Services -IND	0.63%	(9.21%)	(15.83%)	(28.63%)	(28.48%)	(17.95%)	33.91%	1.28%	5.63%	12.80%	6.57%	5.55%	0.37%	0.93%	(0.88%)	(1.11%)	0.65%	(8.47%)	(8.66%)	(7.02%)	6.91%				
99900765	S&P 500 / Electronic Equipment, Instrume	1.51%	(8.10%)	(16.48%)	(20.16%)	(19.82%)	(10.93%)	27.00%	2.16%	6.74%	12.15%	15.04%	14.21%	7.39%	(5.98%)	(2.67%)	(5.60%)	15.03%	55.31%	56.41%	53.81%	81.23%				
SP50	S&P 500	1.51%	(8.10%)	(16.48%)	(20.16%)	(19.82%)	(10.93%)	27.00%	2.16%	6.74%	12.15%	15.04%	14.21%	7.39%	(5.98%)	(2.67%)	(5.60%)	15.03%	55.31%	56.41%	53.81%	81.23%				
99900725	S&P 500 / Software -IND	1.45%	(6.32%)	(17.76%)	(27.22%)	(26.30%)	(11.85%)	21.48%	2.10%	8.51%	10.87%	7.98%	7.73%	6.48%	(11.50%)	(0.06%)	1.77%	(1.28%)	(7.07%)	(6.48%)	(0.92%)	(5.52%)				
99900753	S&P 500 / Technology Hardware, Storage	1.12%	(8.46%)	(21.50%)	(23.23%)	(22.51%)	(1.45%)	55.79%	1.77%	6.38%	7.13%	11.97%	11.52%	19.78%	22.81%	(0.39%)	(0.36%)	(5.02%)	(3.07%)	(2.69%)	12.39%	28.79%				
99900741	S&P 500 / Communications Equipment -IN	(1.25%)	(6.20%)	(21.74%)	(30.97%)	(30.85%)	(14.45%)	4.36%	(0.59%)	8.64%	4.23%	3.18%	3.87%	(28.62%)	(2.75%)	1.90%	(5.26%)	(10.81%)	(11.03%)	(3.52%)	(22.64%)					
99900178	S&P 500 / Semiconductors & Semiconductor	(0.65%)	(14.84%)	(28.63%)	(35.20%)	(34.03%)	(18.33%)	32.98%																		
<i>Average Median</i>		0.60%	(8.74%)	-19.08	(26.65%)	(26.13%)	(13.79%)	25.03%	1.46%	7.12%	11.14	9.97%	9.22%	5.29%	(9.27%)	(1.05%)	(0.75%)	-3.04	(7.58%)	(7.36%)	(3.33%)	(2.30%)				
<i>Median</i>		1.12%	(8.10%)	-17.76	(27.22%)	(26.30%)	(14.45%)	27.00%	1.92%	6.77%	11.51	9.97%	9.62%	5.17%	(8.74%)	(0.63%)	(0.15%)	-3.15	(7.77%)	(7.57%)	(5.27%)	0.23%				

Source: Factset, UBS estimates

Stock Performance: Semis (Sorted by 3mo)

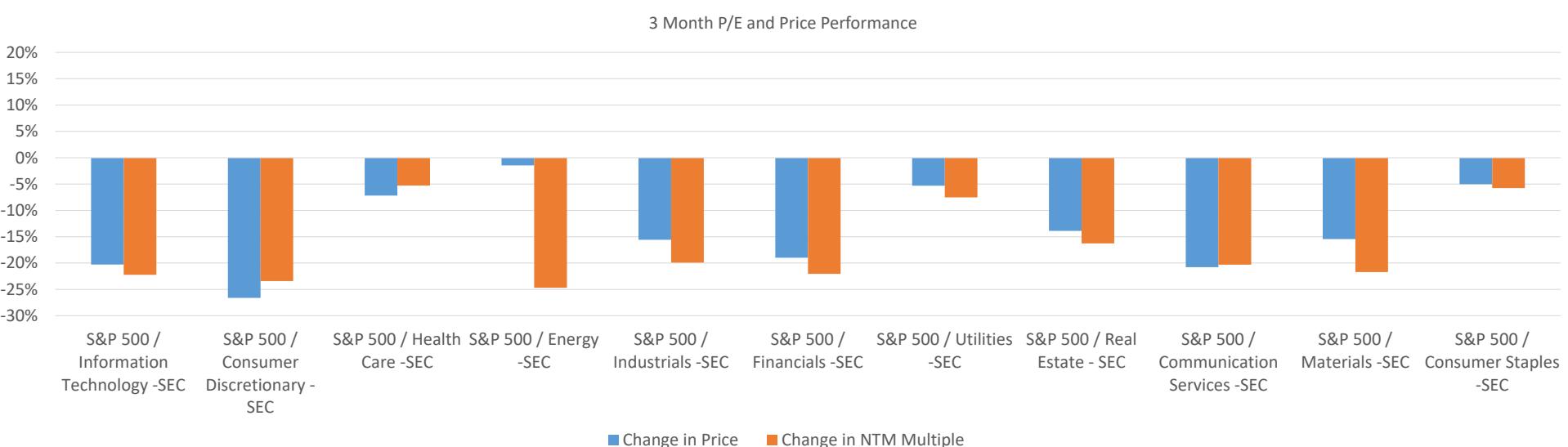
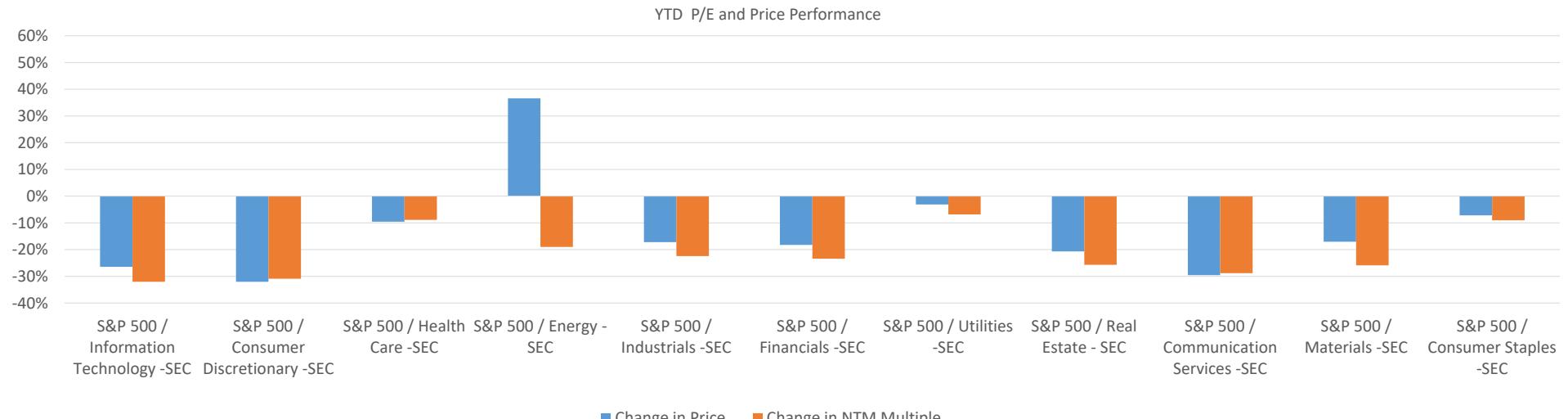
Ticker	Semiconductors/Semi Eqpt	Absolute Performance							Relative to S&P500 Semis & SemiCap Sector							Relative to S&P 500								
		1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year		
SIMO	Silicon Motion Technology Corporation S	0.29%	(8.96%)	24.32%	(13.76%)	(13.76%)	31.77%	66.19%	9.69%	9.86%	54.19%	24.64%	55.33%	45.18%	2.50%	(2.24%)	40.17%	5.98%	5.98%	43.22%	43.42%			
PLAB	Photronics, Inc.	(11.06%)	(16.29%)	9.11%	(4.03%)	(4.03%)	38.73%	65.13%	(1.66%)	2.53%	38.98%	34.37%	62.28%	44.12%	(8.85%)	(9.56%)	24.96%	15.71%	15.71%	50.18%	42.36%			
CCMP	CMC Materials, Inc.	(3.86%)	(3.38%)	(5.67%)	(9.92%)	(9.92%)	16.10%	29.45%	5.54%	15.44%	24.20%	28.49%	39.66%	8.44%	(1.65%)	3.34%	10.19%	9.82%	9.82%	27.55%	6.69%			
CDNS	Cadence Design Systems, Inc.	(5.06%)	(2.34%)	(9.65%)	(19.70%)	(19.70%)	9.28%	54.16%	4.34%	16.49%	20.21%	18.70%	32.84%	33.14%	(2.85%)	4.39%	6.20%	0.04%	0.04%	20.73%	31.39%			
SNPS	Synopsys, Inc.	(5.12%)	(4.93%)	(10.08%)	(18.26%)	(18.26%)	8.70%	52.99%	4.28%	13.89%	19.79%	20.15%	20.15%	32.26%	31.97%	(2.91%)	1.79%	5.78%	1.49%	1.49%	20.15%	30.22%		
PI	Impinj, Inc.	(2.11%)	18.12%	(12.94%)	(38.41%)	(38.41%)	103.92%	7.28%	36.94%	16.93%	(0.01%)	(0.01%)	33.08%	82.91%	0.09%	24.85%	2.91%	(18.67%)	(18.67%)	20.97%	81.15%			
ADI	Analog Devices, Inc.	(4.53%)	(13.27%)	(13.58%)	(18.69%)	(18.69%)	(15.52%)	18.73%	4.87%	5.56%	16.29%	19.71%	8.03%	(2.29%)	(2.32%)	(6.54%)	2.27%	1.05%	1.05%	(4.07%)	(4.04%)			
SLAB	Silicon Laboratories Inc.	(11.50%)	(13.44%)	(13.74%)	(37.80%)	(37.80%)	(15.42%)	31.00%	(2.11%)	5.39%	16.13%	0.60%	0.60%	8.13%	9.98%	(9.30%)	(6.71%)	2.11%	(18.06%)	(18.06%)	(3.97%)	8.23%		
QCOM	Qualcomm Incorporated	(1.25%)	(11.78%)	(15.96%)	(32.45%)	(32.45%)	(12.27%)	37.59%	8.14%	7.05%	13.91%	5.95%	11.29%	16.58%	0.95%	(5.05%)	(0.11%)	(12.71%)	(12.71%)	(0.82%)	14.82%			
MX	Magnachip Semiconductor Corp.	(7.10%)	(29.34%)	(15.98%)	(33.29%)	(33.29%)	(41.24%)	35.83%	2.29%	(10.52%)	18.39%	5.12%	(17.69%)	14.81%	(4.90%)	(22.62%)	(0.13%)	(13.55%)	(13.55%)	(29.79%)	13.06%			
BRKS	Azenta, Inc.	(4.60%)	(5.39%)	(16.51%)	(31.27%)	(31.27%)	(24.53%)	63.03%	4.80%	13.43%	13.36%	7.14%	(0.98%)	42.02%	(2.39%)	1.33%	(0.66%)	(11.53%)	(11.53%)	(13.08%)	(40.26%)			
CRUS	Cirrus Logic, Inc.	(4.10%)	(14.22%)	(17.04%)	(24.30%)	(24.30%)	(17.22%)	15.70%	5.30%	4.60%	12.83%	14.10%	6.34%	(5.32%)	(1.89%)	(7.50%)	(1.19%)	(4.56%)	(4.56%)	(5.77%)	(7.07%)			
FORM	FormFactor, Inc.	(13.20%)	(15.17%)	(17.44%)	(24.80%)	(24.80%)	(6.45%)	17.26%	(3.80%)	3.65%	12.43%	13.60%	17.11%	(3.76%)	(10.99%)	(8.45%)	(1.58%)	(5.06%)	(5.06%)	5.00%	(5.51%)			
KLAC	KLA Corporation	(12.74%)	(17.01%)	(17.77%)	(31.12%)	(31.12%)	(4.97%)	53.38%	(3.34%)	1.81%	12.10%	7.28%	18.59%	32.37%	(10.53%)	(10.28%)	(1.92%)	(11.38%)	(11.38%)	6.48%	30.61%			
AEIS	Advanced Energy Industries, Inc.	(6.21%)	(13.14%)	(18.34%)	(23.84%)	(23.84%)	(37.52%)	5.33%	3.19%	5.68%	11.52%	14.56%	(13.97%)	(15.68%)	(4.00%)	(6.41%)	(2.49%)	(4.10%)	(26.07%)	(17.44%)				
TXN	Texas Instruments Incorporated	(4.75%)	(14.84%)	(18.42%)	(21.19%)	(21.19%)	(22.17%)	19.02%	4.65%	3.99%	11.45%	17.22%	1.39%	(1.99%)	(2.54%)	(8.11%)	(2.57%)	(1.45%)	(1.45%)	(10.72%)	(3.75%)			
NXPI	NXP Semiconductors NV	(8.30%)	(20.85%)	(19.74%)	(35.86%)	(35.86%)	(27.63%)	30.54%	1.09%	(2.03%)	10.13%	2.54%	2.54%	(4.07%)	9.53%	(6.10%)	(14.12%)	(3.89%)	(16.12%)	(16.18%)	7.77%			
MPWR	Monolithic Power Systems, Inc.	(12.98%)	(18.58%)	(21.28%)	(26.02%)	(26.02%)	(1.41%)	54.94%	(3.59%)	0.24%	8.59%	12.38%	22.14%	33.92%	(10.78%)	(11.86%)	(5.43%)	(6.28%)	(10.04%)	32.17%				
ON	ON Semiconductor Corporation	(11.57%)	(20.97%)	(21.45%)	(31.04%)	(31.04%)	(23.56%)	145.88%	(2.17%)	(2.15%)	8.42%	7.37%	7.37%	47.11%	124.87%	(9.36%)	(14.24%)	(5.60%)	(11.30%)	(35.01%)	123.11%			
NVMI	Nova Ltd.	(12.94%)	(21.87%)	(22.08%)	(43.01%)	(43.01%)	(16.93%)	74.88%	(3.54%)	(3.05%)	7.79%	(4.61%)	(4.61%)	6.63%	53.87%	(10.73%)	(15.14%)	(6.23%)	(23.27%)	(23.27%)	(5.48%)	52.12%		
SMTC	Semtech Corporation	(9.37%)	(19.28%)	(23.33%)	(41.56%)	(41.56%)	(23.64%)	1.80%	0.03%	(0.45%)	6.54%	(3.16%)	(3.16%)	(0.09%)	(19.21%)	(7.16%)	(12.55%)	(7.48%)	(21.82%)	(21.82%)	(12.19%)	(20.97%)		
LSCC	Lattice Semiconductor Corporation	(12.94%)	(12.40%)	(23.33%)	(41.24%)	(41.24%)	(18.12%)	61.14%	(3.54%)	6.42%	6.54%	(2.84%)	5.44%	40.13%	(10.73%)	(5.67%)	(7.48%)	(21.50%)	(21.50%)	(6.67%)	38.37%			
PDFS	PDF Solutions, Inc.	(1.14%)	(13.29%)	(23.66%)	(34.73%)	(34.73%)	(14.39%)	8.02%	8.26%	5.53%	6.21%	3.68%	3.68%	37.94%	(13.00%)	1.07%	(6.56%)	(7.81%)	(14.99%)	(14.99%)	25.84%	(14.75%)		
POWI	Power Integrations, Inc.	(7.75%)	(16.36%)	(23.72%)	(24.51%)	(24.51%)	(15.05%)	21.05%	1.65%	2.46%	6.15%	13.89%	13.89%	8.51%	0.04%	(5.54%)	(9.64%)	(7.87%)	(4.77%)	(3.60%)	(1.72%)			
AVGO	Broadcom Inc.	(6.14%)	(16.70%)	(23.79%)	(28.19%)	(28.19%)	(1.75%)	52.80%	3.26%	2.13%	6.08%	10.21%	25.30%	31.78%	(3.93%)	(9.97%)	(7.94%)	(8.45%)	(8.45%)	(13.20%)	30.03%			
QRVO	Qorvo, Inc.	(5.52%)	(15.62%)	(23.90%)	(40.87%)	(40.87%)	(52.13%)	(14.59%)	3.88%	3.20%	5.97%	(2.47%)	(2.47%)	(28.58%)	(35.60%)	(3.31%)	(8.89%)	(8.05%)	(21.13%)	(21.13%)	(40.68%)	(37.35%)		
MCHP	Microchip Technology Incorporated	(7.30%)	(21.08%)	(24.08%)	(35.49%)	(35.49%)	(23.95%)	8.92%	2.10%	(2.26%)	5.79%	2.91%	2.91%	(0.40%)	(12.09%)	(5.09%)	(14.35%)	(8.23%)	(15.75%)	(15.75%)	(12.50%)	(13.85%)		
MTSI	MACOM Technology Solutions Holdings, Inc.	(10.89%)	(18.62%)	(24.21%)	(43.46%)	(43.46%)	(29.36%)	28.51%	(1.49%)	0.20%	5.66%	(5.06%)	(5.81%)	7.49%	(8.68%)	(11.89%)	(8.36%)	(23.72%)	(23.72%)	(19.71%)	5.74%			
INTC	Intel Corporation	(5.88%)	(17.62%)	(24.46%)	(29.44%)	(29.44%)	(35.12%)	(38.21%)	3.52%	1.21%	5.40%	8.97%	8.97%	(11.56%)	(59.22%)	(3.67%)	(10.89%)	(8.61%)	(9.70%)	(23.67%)	(60.98%)			
LRCX	Lam Research Corporation	(12.30%)	(21.94%)	(24.86%)	(45.10%)	(45.10%)	(37.63%)	24.36%	(2.90%)	(3.11%)	5.01%	(6.69%)	(6.69%)	(14.08%)	3.35%	(10.09%)	(15.21%)	(9.01%)	(25.36%)	(25.36%)	(26.18%)	1.59%		
TER	Teradyne, Inc.	(11.66%)	(19.54%)	(26.27%)	(47.53%)	(47.53%)	(33.68%)	3.49%	(2.26%)	(0.72%)	3.60%	(9.13%)	(9.13%)	(10.13%)	(17.53%)	(9.45%)	(12.82%)	(10.42%)	(27.79%)	(27.79%)	(22.23%)	(19.28%)		
NANO	Onto Innovation, Inc.	(15.01%)	(21.89%)	(26.52%)	(38.42%)	(38.42%)	(13.42%)	90.35%	(5.61%)	(3.07%)	3.35%	(0.01%)	10.14%	69.34%	(12.80%)	(15.16%)	(16.67%)	(18.68%)	(18.68%)	(1.97%)	67.58%			
DIOD	Diodes Incorporated	(8.21%)	(19.31%)	(27.33%)	(44.50%)	(44.50%)	(22.99%)	24.72%	1.19%	(0.49%)	2.54%	(6.09%)	(6.09%)	0.56%	3.70%	(6.00%)	(12.59%)	(11.48%)	(24.75%)	(24.75%)	(11.54%)	1.95%		
ENTG	Entegris, Inc.	(14.94%)	(19.53%)	(29.37%)	(36.22%)	(36.22%)	(25.42%)	51.36%	(5.54%)	(0.71%)	0.50%	2.18%	2.18%	(1.86%)	30.35%	(12.73%)	(12.80%)	(13.52%)	(16.48%)	(16.48%)	(13.97%)	28.59%		
MU	Micron Technology, Inc.	(8.20%)	(27.06%)	(29.57%)	(42.40%)	(42.40%)	(33.03%)	7.95%	1.20%	(8.23%)	0.29%	(4.00%)	(4.00%)	(9.48%)	(13.07%)	(5.99%)	(20.33%)	(13.72%)	(22.66%)	(22.66%)	(21.58%)	(14.82%)		
SWKS	Skyworks Solutions, Inc.	(7.05%)	(15.06%)	(30.99%)	(41.27%)	(41.27%)	(51.79%)	(27.60%)	2.35%	3.77%	(1.12%)	(2.86%)	(2.86%)	(28.24%)	(48.61%)	(4.84%)	(8.33%)	(15.14%)	(21.53%)	(21.53%)	(40.34%)	(30.37%)		
MKSI	MKS Instruments, Inc.	(9.05%)	(20.79%)	(31.79%)	(44.70%)	(44.70%)	(43.60%)	(13.43%)	0.34%	(1.97%)	(1.92%)	(6.29%)	(6.29%)	(20.04%)	(34.44%)	(6.85%)	(14.06%)	(15.94%)	(24.96%)	(24.96%)	(32.15%)	(36.20%)		
AMD	Advanced Micro Devices, Inc.	(15.40%)	(27.22%)	(31.91%)	(48.80%)	(48.80%)	(21.05%)	40.11%	(6.00%)	(8.39%)	(2.04%)	(10.40%)	(10.40%)	2.51%	19.10%	(13.19%)	(20.49%)	(16.06%)	(29.06%)	(29.06%)	(9.60%)	17.34%		
VECO	Veeco Instruments Inc.	(9.65%)	(15.75%)	(32.00%)	(36.49%)	(36.49%)	(23.10%)	38.65%	(0.25%)	3.07%	(2.14%)	1.91%	1.91%	0.46%	17.64%	(7.44%)	(9.02%)	(16.15%)	(16.75%)	(16.75%)	(11.65%)	15.88%		
AMAT	Applied Materials, Inc.	(11.39%)	(24.63%)	(32.29%)	(45.18%)	(45.18%)	(37.46%)	44.55%	(1.99%)	(5.81%)	(2.42%)	(6.77%)	(6.77%)	(13.91%)	23.54%	(9.18%)	(17.90%)	(16.44%)	(25.44%)	(25.44%)	(26.01%)	21.78%		
ASML	ASML Holding NV ADR	(12.70%)	(20.19%)	(32.63%)	(43.50%)	(43.50%)	(33.78%)	22.37%	(3.30%)	(1.37%)	2.76%	(5.10%)	(5.10%)	(10.23%)	1.36%	(10.49%)	(13.47%)	(16.78%)	(23.76%)	(23.76%)	(22.33%)	(0.40%)		
ACLS	Axcelis Technologies, Inc.	(17.61%)	(21.68%)	(32.98%)	(35.69%)	(35.69%)	(20.45%)	76.48%	(8.21%)	(2.85%)	(3.12%)	2.71%	2.71%	44.00%	55.47%	(15.40%)	(14.95%)	(17.13%)	(15.95%)	(15.95%)	31.90%	53.71%		
UCTT	Ultra Clean Holdings, Inc.	(11.29%)	(16.69%)	(33.32%)	(52.96%)	(52.96%)	(48.80%)	19.03%	(1.89%)	2.14%	(3.45%)	(14.55%)	(14.55%)	(25.24%)	(1.98%)	(9.08%)	(9.96%)	(17.47%)	(33.21%)	(33.21%)	(37.35%)	(3.74%)		
ICHR	Ichor Holdings, Ltd.	(19.06%)	(24.63%)	(34.62%)	(51.66%)	(51.66%)	(58.14%)	(15.27%)	(9.66%)	(5.80%)	(4.75%)	(13.26%)	(13.26%)	(34.58%)	(36.28%)	(16.85%)	(17.90%)	(18.77%)	(31.92%)	(31.92%)	(46.69%)	(38.04%)		
ASMIY	ASM International N.V. Sponsored ADR	(13.68%)	(26.93%)	(37																				

Stock Performance: Semis (Sorted by 6mo)

Ticker	Semiconductors/Semi Eqpt	Absolute Performance							Relative to S&P500 Semis & SemiCap Sector							Relative to S&P 500							
		1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	
PLAB	Photronics, Inc.	(11.06%)	(16.29%)	9.11%	(4.03%)	(4.03%)	38.73%	65.13%	(1.66%)	2.53%	38.98%	34.37%	34.37%	62.28%	44.12%	(8.85%)	(9.56%)	24.96%	15.71%	15.71%	50.18%	42.36%	
CCMP	CMC Materials, Inc.	(3.86%)	(3.38%)	(5.67%)	(9.92%)	(9.92%)	16.10%	29.45%	5.54%	15.44%	24.20%	28.49%	28.49%	39.66%	8.44%	(1.65%)	3.34%	10.19%	9.82%	9.82%	27.55%	6.69%	
SIMO	Silicon Motion Technology Corporation S	0.29%	(8.96%)	24.32%	(13.76%)	(13.76%)	31.77%	66.19%	9.69%	9.86%	54.19%	24.64%	24.64%	55.33%	45.18%	2.50%	(2.24%)	40.17%	5.98%	5.98%	43.22%	43.42%	
SNPS	Synopsys, Inc.	(5.12%)	(4.93%)	(10.08%)	(18.26%)	(18.26%)	8.70%	52.99%	4.28%	13.89%	19.79%	20.15%	20.15%	32.26%	31.97%	(2.91%)	1.79%	5.78%	1.49%	1.49%	20.15%	30.22%	
ADI	Analog Devices, Inc.	(4.53%)	(13.27%)	(13.58%)	(18.69%)	(18.69%)	(15.52%)	18.73%	4.87%	5.56%	16.29%	19.71%	19.71%	8.03%	(2.29%)	(2.32%)	(6.54%)	2.27%	1.05%	1.05%	(4.07%)	(4.04%)	
CDNS	Cadence Design Systems, Inc.	(5.06%)	(2.34%)	(9.65%)	(19.70%)	(19.70%)	9.28%	54.16%	4.34%	16.49%	20.21%	18.70%	18.70%	32.84%	33.14%	(2.85%)	4.39%	6.20%	0.04%	0.04%	20.73%	31.39%	
TXN	Texas Instruments Incorporated	(4.75%)	(14.84%)	(18.42%)	(21.19%)	(21.19%)	(22.17%)	19.02%	4.65%	3.99%	11.45%	17.22%	17.22%	1.39%	(1.99%)	(2.54%)	(8.11%)	(2.57%)	(1.45%)	(1.45%)	(10.72%)	(3.75%)	
AEIS	Advanced Energy Industries, Inc.	(6.21%)	(13.14%)	(18.34%)	(23.84%)	(23.84%)	(37.52%)	5.33%	3.19%	5.68%	11.52%	14.56%	14.56%	(13.97%)	(15.68%)	(4.00%)	(6.41%)	(4.29%)	(4.10%)	(4.10%)	(26.07%)	(17.44%)	
CRUS	Cirrus Logic, Inc.	(4.10%)	(14.22%)	(17.04%)	(24.30%)	(24.30%)	(17.22%)	15.70%	5.30%	4.60%	12.83%	14.10%	14.10%	6.34%	(5.32%)	(1.89%)	(7.50%)	(1.19%)	(4.56%)	(4.56%)	(5.77%)	(7.07%)	
POWI	Power Integrations, Inc.	(7.75%)	(16.36%)	(23.72%)	(24.51%)	(24.51%)	(15.05%)	21.05%	1.65%	2.46%	6.15%	13.89%	13.89%	8.51%	0.04%	(5.54%)	(9.64%)	(7.87%)	(4.77%)	(4.77%)	(3.60%)	(1.72%)	
FORM	FormFactor, Inc.	(13.20%)	(15.17%)	(17.44%)	(24.80%)	(24.80%)	(6.45%)	17.26%	(3.80%)	3.65%	12.43%	13.60%	13.60%	17.11%	(3.76%)	(10.99%)	(8.45%)	(1.58%)	(5.06%)	(5.06%)	(5.06%)	(5.51%)	
MMPWR	Monolithic Power Systems, Inc.	(12.98%)	(18.58%)	(21.28%)	(26.02%)	(26.02%)	(1.41%)	54.94%	(3.59%)	0.24%	8.59%	12.38%	12.38%	22.14%	33.92%	(10.78%)	(11.86%)	(5.43%)	(6.28%)	(6.28%)	10.04%	32.17%	
AVGO	Broadcom Inc.	(6.14%)	(16.70%)	(23.79%)	(28.19%)	(28.19%)	1.75%	52.80%	3.26%	2.13%	6.08%	10.21%	10.21%	25.30%	31.78%	(3.93%)	(9.97%)	(7.94%)	(8.45%)	(8.45%)	13.20%	30.03%	
INTC	Intel Corporation	(5.88%)	(17.62%)	(24.46%)	(29.44%)	(29.44%)	(35.12%)	(38.21%)	3.52%	1.21%	5.40%	8.97%	8.97%	(11.56%)	(59.22%)	(3.67%)	(10.89%)	(8.61%)	(9.70%)	(9.70%)	(23.67%)	(60.98%)	
ON	ON Semiconductor Corporation	(11.57%)	(20.97%)	(21.45%)	(31.04%)	(31.04%)	23.56%	145.88%	(2.17%)	(2.15%)	8.42%	7.37%	7.37%	47.11%	124.87%	(9.36%)	(14.24%)	(5.60%)	(11.30%)	(11.30%)	35.01%	123.11%	
KLAC	KLA Corporation	(12.74%)	(17.01%)	(17.77%)	(31.12%)	(31.12%)	(4.97%)	53.38%	(3.34%)	1.81%	12.10%	7.28%	7.28%	18.59%	32.37%	(10.53%)	(10.28%)	(1.92%)	(11.38%)	(11.38%)	6.48%	30.61%	
BRKS	Azenta, Inc.	(4.60%)	(5.39%)	(16.51%)	(31.27%)	(31.27%)	(24.53%)	63.03%	4.80%	13.43%	13.36%	7.14%	7.14%	(0.98%)	42.02%	(2.39%)	1.33%	(0.66%)	(1.53%)	(1.53%)	(13.08%)	40.26%	
QCOM	Qualcomm Incorporated	(1.25%)	(11.78%)	(15.96%)	(32.45%)	(32.45%)	(12.27%)	37.59%	8.14%	7.05%	13.91%	5.95%	5.95%	11.29%	16.58%	0.95%	(5.05%)	(0.11%)	(12.71%)	(12.71%)	(0.82%)	14.82%	
MX	Magnachip Semiconductor Corp.	(7.10%)	(29.34%)	(15.98%)	(33.29%)	(33.29%)	(41.24%)	35.83%	2.29%	(10.52%)	13.89%	5.12%	5.12%	(17.69%)	14.81%	(4.90%)	(22.62%)	(0.13%)	(13.55%)	(13.55%)	(29.79%)	13.06%	
PDFS	PDF Solutions, Inc.	(1.14%)	(13.29%)	(23.66%)	(34.73%)	(34.73%)	14.39%	8.02%	8.26%	5.53%	6.21%	3.68%	3.68%	37.94%	(13.00%)	1.07%	(6.56%)	(7.81%)	(14.99%)	(14.99%)	25.84%	(14.75%)	
MCHP	Microchip Technology Incorporated	(7.30%)	(21.08%)	(24.08%)	(35.49%)	(35.49%)	(23.95%)	8.92%	2.10%	(2.26%)	5.79%	2.91%	2.91%	(0.40%)	(12.09%)	(5.09%)	(14.35%)	(8.23%)	(15.75%)	(15.75%)	(12.50%)	(13.85%)	
ACLS	Axcelis Technologies, Inc.	(17.61%)	(21.68%)	(32.98%)	(35.69%)	(35.69%)	(20.45%)	76.48%	(8.21%)	(2.85%)	(3.12%)	2.71%	2.71%	44.00%	55.47%	(15.40%)	(14.95%)	(17.13%)	(15.95%)	(15.95%)	31.90%	53.71%	
NXPI	NXP Semiconductors NV	(8.30%)	(20.85%)	(19.74%)	(35.86%)	(35.86%)	(27.63%)	30.54%	1.09%	(2.03%)	10.13%	2.54%	2.54%	(4.07%)	9.53%	(6.10%)	(14.12%)	(3.89%)	(16.12%)	(16.12%)	(16.18%)	7.77%	
ENTG	Entegris, Inc.	(14.94%)	(19.53%)	(29.37%)	(36.22%)	(36.22%)	(25.42%)	51.36%	2.18%	(5.54%)	(0.71%)	0.50%	2.18%	2.18%	(1.86%)	30.35%	(12.73%)	(12.80%)	(13.52%)	(16.48%)	(16.48%)	(13.97%)	28.59%
VECO	Veeco Instruments Inc.	(9.65%)	(15.75%)	(32.00%)	(36.49%)	(36.49%)	(23.10%)	38.65%	(0.25%)	3.07%	(2.14%)	1.91%	1.91%	0.46%	17.64%	(7.44%)	(9.02%)	(16.15%)	(16.75%)	(16.75%)	(11.65%)	15.88%	
SLAB	Silicon Laboratories Inc.	(11.50%)	(13.44%)	(13.74%)	(37.80%)	(37.80%)	(15.42%)	31.00%	(2.11%)	5.39%	16.13%	0.60%	0.60%	8.13%	9.98%	(9.30%)	(6.71%)	2.11%	(18.06%)	(18.06%)	(3.97%)	8.23%	
PI	Impinj, Inc.	(2.11%)	18.12%	(12.94%)	(38.41%)	(38.41%)	9.52%	103.92%	7.28%	36.94%	16.93%	(0.01%)	(0.01%)	33.08%	82.91%	0.09%	24.85%	2.91%	(18.67%)	(18.67%)	20.97%	81.15%	
NANO	Onto Innovation, Inc.	(15.01%)	(21.89%)	(26.52%)	(38.42%)	(38.42%)	(13.42%)	90.35%	(5.61%)	(3.07%)	3.35%	(0.01%)	(0.01%)	10.14%	69.34%	(12.80%)	(15.16%)	(10.67%)	(18.68%)	(18.68%)	(1.97%)	67.58%	
QRVO	Qorvo, Inc.	(5.52%)	(15.62%)	(23.90%)	(40.87%)	(40.87%)	(52.13%)	(14.59%)	3.88%	3.20%	5.97%	(2.47%)	(2.47%)	(28.58%)	(35.60%)	(3.31%)	(8.89%)	(8.05%)	(21.13%)	(21.13%)	(40.68%)	(37.35%)	
LSCC	Lattice Semiconductor Corporation	(12.94%)	(12.40%)	(23.33%)	(41.24%)	(41.24%)	(18.12%)	61.14%	(3.54%)	6.42%	6.54%	(2.84%)	(2.84%)	5.44%	(40.13%)	(10.73%)	(5.67%)	(7.48%)	(21.50%)	(21.50%)	(6.67%)	38.37%	
SWKS	Skyworks Solutions, Inc.	(7.05%)	(15.06%)	(30.99%)	(41.27%)	(41.27%)	(51.79%)	(27.60%)	2.35%	3.77%	(1.12%)	(2.86%)	(2.86%)	(28.24%)	(48.61%)	(4.84%)	(8.33%)	(15.14%)	(21.53%)	(21.53%)	(40.34%)	(50.37%)	
SMTC	Semtech Corporation	(9.37%)	(19.28%)	(23.33%)	(41.56%)	(41.56%)	(23.64%)	1.80%	0.03%	(0.45%)	6.54%	(3.16%)	(3.16%)	(0.09%)	(19.21%)	(7.16%)	(12.55%)	(7.48%)	(21.82%)	(21.82%)	(12.19%)	20.97%	
MU	Micron Technology, Inc.	(8.20%)	(27.06%)	(29.57%)	(42.40%)	(42.40%)	(33.03%)	7.95%	1.20%	(8.23%)	0.29%	(4.00%)	(4.00%)	(9.48%)	(13.07%)	(5.99%)	(20.33%)	(13.72%)	(22.66%)	(22.66%)	(21.58%)	(14.82%)	
NVMI	Nova Ltd.	(12.94%)	(21.87%)	(22.08%)	(43.01%)	(43.01%)	(16.93%)	74.88%	(3.54%)	(3.05%)	7.79%	(4.61%)	(4.61%)	6.63%	53.87%	(10.73%)	(15.14%)	(6.23%)	(23.27%)	(23.27%)	(5.48%)	52.12%	
MTSI	MACOM Technology Solutions Holdings, Inc.	(10.89%)	(18.62%)	(24.21%)	(43.46%)	(43.46%)	(29.36%)	28.51%	(1.49%)	0.20%	5.66%	(5.06%)	(5.06%)	(5.81%)	7.49%	(8.68%)	(11.89%)	(8.36%)	(23.72%)	(23.72%)	(17.91%)	5.74%	
ASML	ASML Holding NV ADR	(12.70%)	(20.19%)	(32.63%)	(43.50%)	(43.50%)	(33.78%)	22.37%	(3.30%)	(1.37%)	(2.76%)	(5.10%)	(5.10%)	(10.23%)	1.36%	(10.49%)	(13.47%)	(16.78%)	(23.76%)	(23.76%)	(22.33%)	(0.40%)	
DIOD	Diodes Incorporated	(8.21%)	(19.31%)	(27.33%)	(44.50%)	(44.50%)	(22.99%)	24.72%	1.19%	(0.49%)	2.54%	(6.09%)	(6.09%)	0.56%	3.70%	(6.00%)	(12.59%)	(11.48%)	(24.75%)	(24.75%)	(11.54%)	1.95%	
MKSI	MKS Instruments, Inc.	(9.05%)	(20.79%)	(31.79%)	(44.70%)	(44.70%)	(43.60%)	(13.43%)	0.34%	(1.97%)	(1.92%)	(6.29%)	(6.29%)	(20.04%)	(34.44%)	(6.85%)	(14.06%)	(15.94%)	(24.96%)	(24.96%)	(32.15%)	(36.20%)	
LRCX	Lam Research Corporation	(12.30%)	(21.94%)	(24.86%)	(45.10%)	(45.10%)	(37.63%)	24.35%	(2.90%)	(3.11%)	5.01%	(6.69%)	(6.69%)	(14.08%)	3.35%	(10.09%)	(15.21%)	(9.01%)	(25.36%)	(25.36%)	(26.18%)	1.59%	
AMAT	Applied Materials, Inc.	(11.39%)	(24.63%)	(32.29%)	(45.18%)	(45.18%)	(37.46%)	44.55%	(1.99%)	(5.81%)	(2.42%)	(6.77%)	(6.77%)	(13.91%)	23.54%	(9.18%)	(17.90%)	(16.44%)	(25.44%)	(25.44%)	(26.01%)	21.78%	
TER	Teradyne, Inc.	(11.66%)	(19.54%)	(26.27%)	(47.53%)	(47.53%)	(33.68%)	3.49%	(2.26%)	(0.72%)	3.60%	(9.13%)	(9.13%)	(10.13%)	(17.53%)	(9.45%)	(12.82%)	(10.42%)	(27.79%)	(27.79%)	(22.23%)	(19.28%)	
AMD	Advanced Micro Devices, Inc.	(15.40%)	(27.22%)	(31.91%)	(48.80%)	(48.80%)	(21.05%)	40.11%	(6.00%)	(8.39%)	(2.04%)	(10.40%)	(10.40%)	2.51%	19.10%	(13.19%)	(20.49%)	(16.06%)	(29.06%)	(29.06%)	(9.60%)	17.34%	
ASMY	ASM International N.V. Sponsored ADR	(13.68%)	(26.93%)	(37.54%)	(49.16%)	(49.16%)	(29.19%)	44.87%	(4.29%)	(8.11%)	(7.67%)	(10.76%)	(10.76%)	(5.64%)	23.85%	(11.48%)	(20.20%)	(16.99%)	(29.42%)	(29.42%)	(17.74%)	22.10%	
NVDA	NVIDIA Corporation	(15.20%)	(20.73%)	(45.63%)	(50.62%)	(50.62%)	(28.15%)	52.39%	(5.80%)	(1.90%)	(15.76%)	(12.22%)	(12.22%)	(4.59%)	31.38%	(12.99%)	(14.00%)	(29.78%)	(30.88%)	(30.88%)	(16.70%)	29.62%	
MRVL	Marvell Technology, Inc.	(11.76%)	(26.69%)	(40.13%)	(51.37%)	(51.37%)	(25.86%)	23.80%	(2.36%)	(7.87%)	(10.26%)	(12.96%)	(12.96%)	(2.3									

Breakdown of Stock Performance: S&P 500 Sectors (YTD, 3mo)

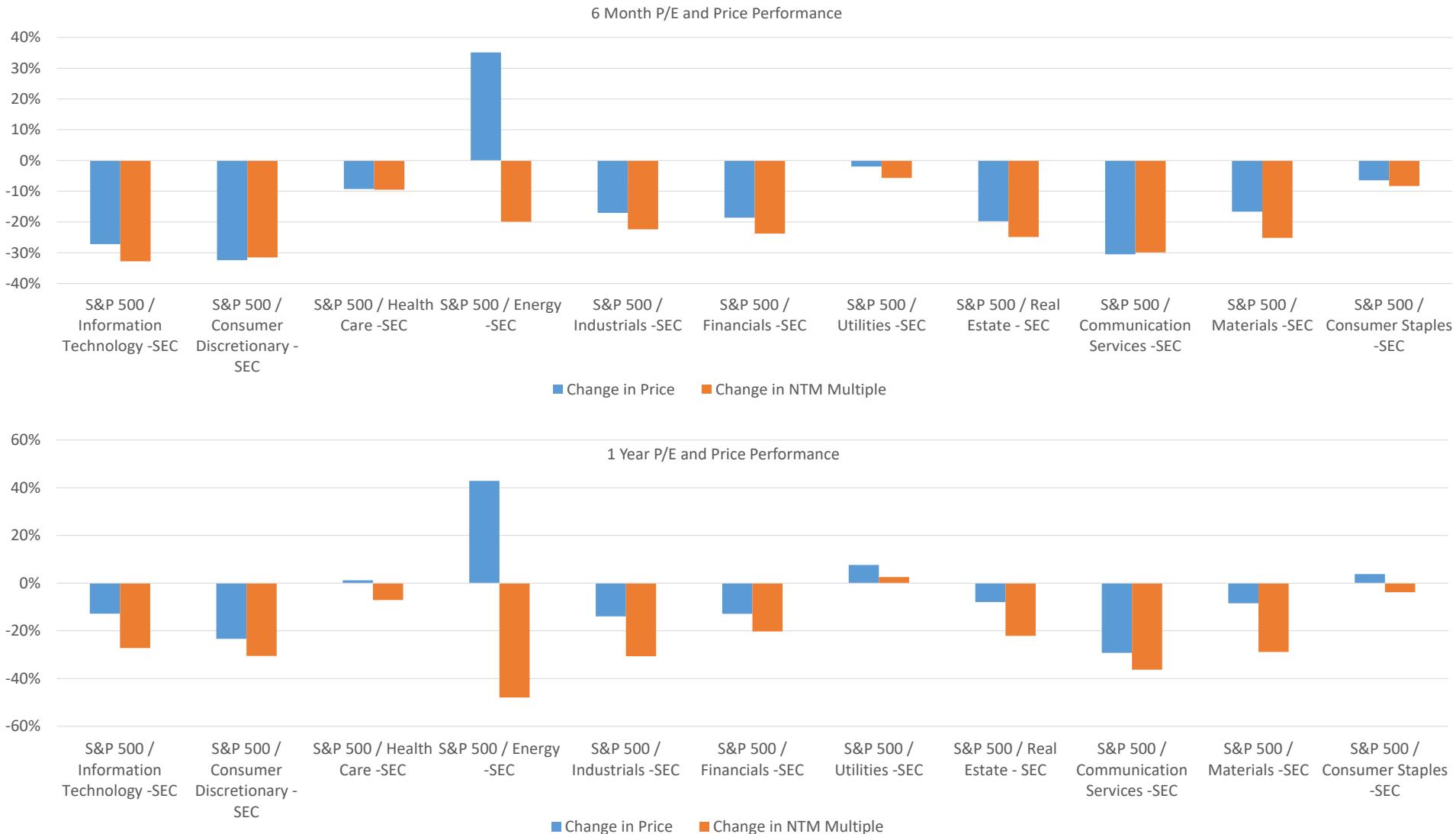
S&P 500 Industry Sector Performance vs NTM P/E multiple change



Source: Factset, UBS estimates

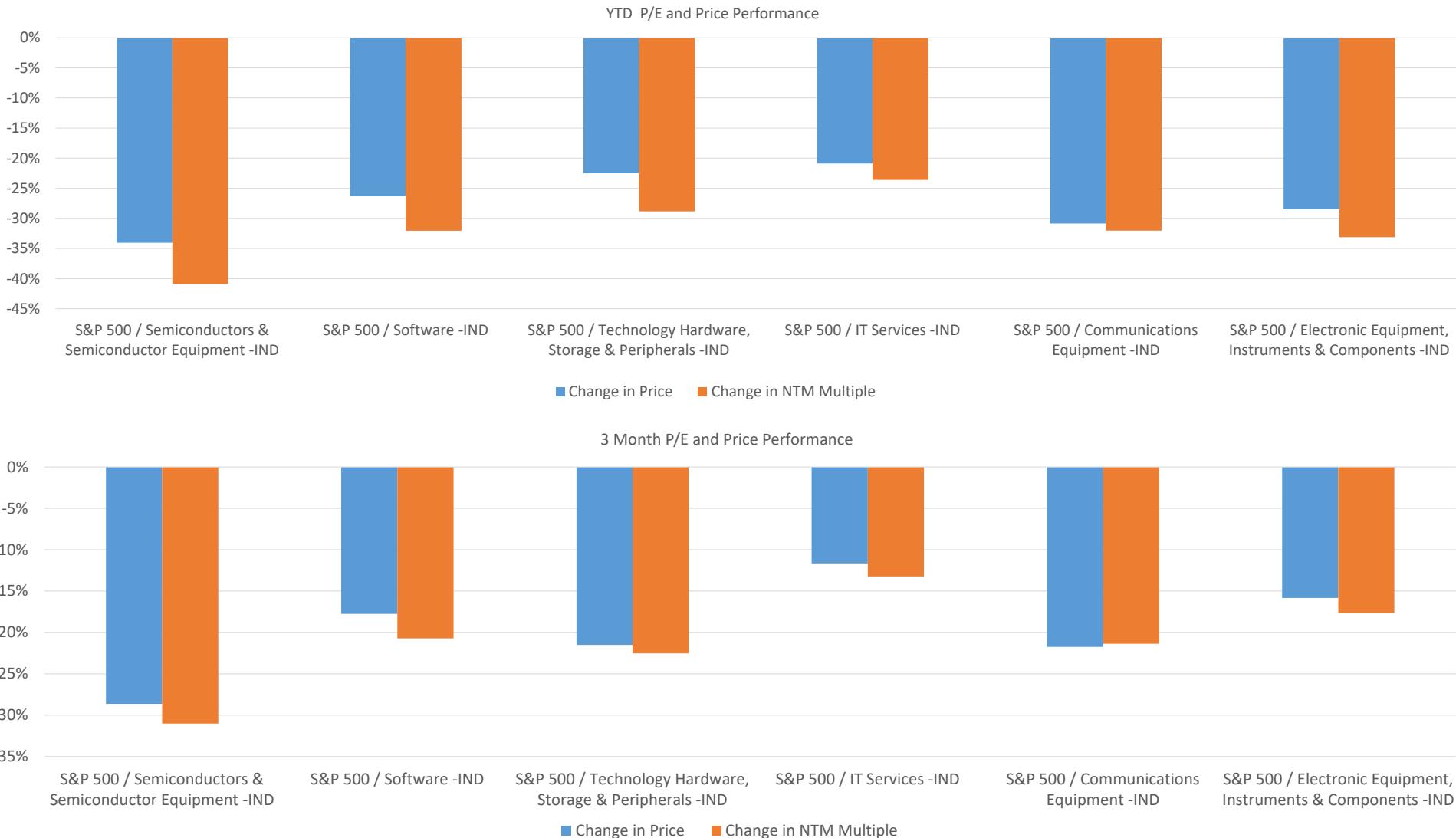
Breakdown of Stock Performance: S&P 500 Sectors (6mo, 12mo)

S&P 500 Industry Sector Performance vs NTM P/E multiple change

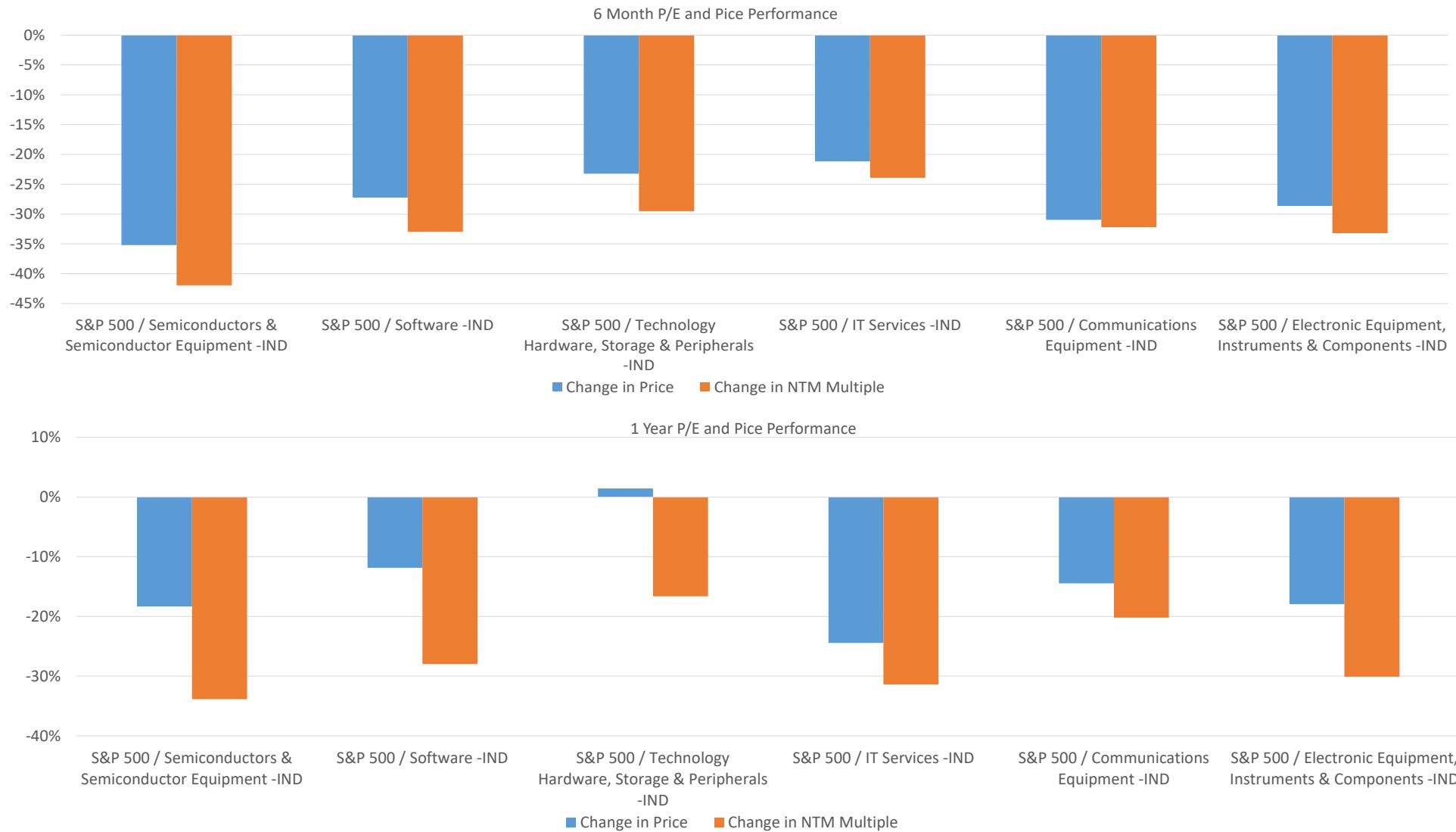


Source: Factset, UBS estimates

Breakdown of Stock Performance: S&P Tech Sectors (YTD, 3mo)

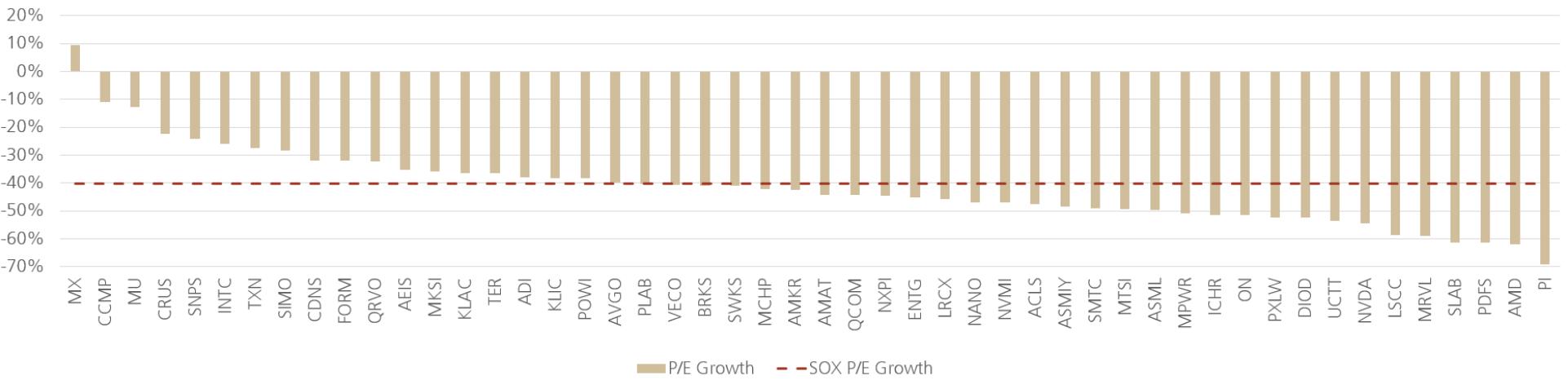
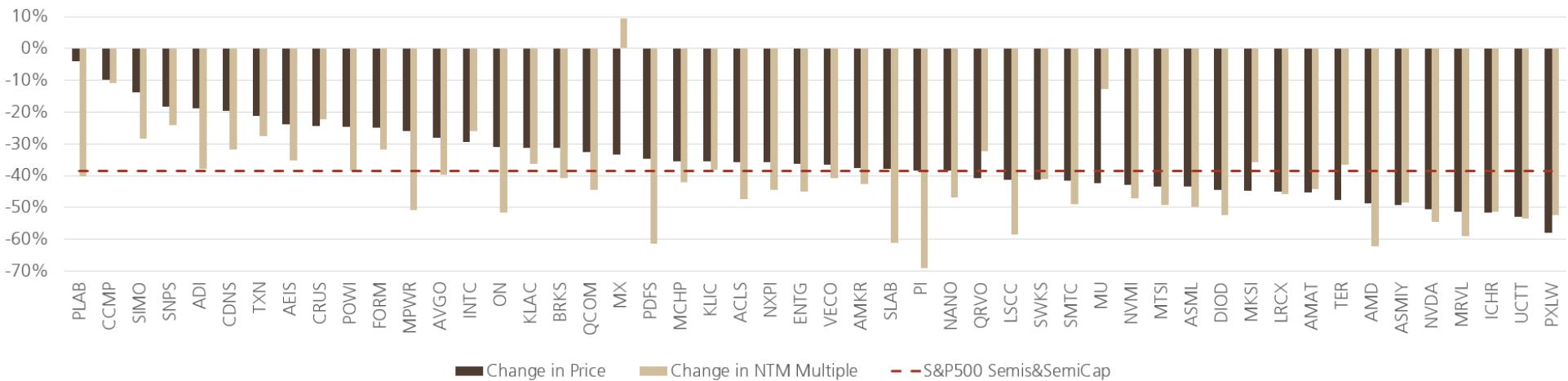


Breakdown of Stock Performance: S&P Tech Sectors (6mo, 12mo)

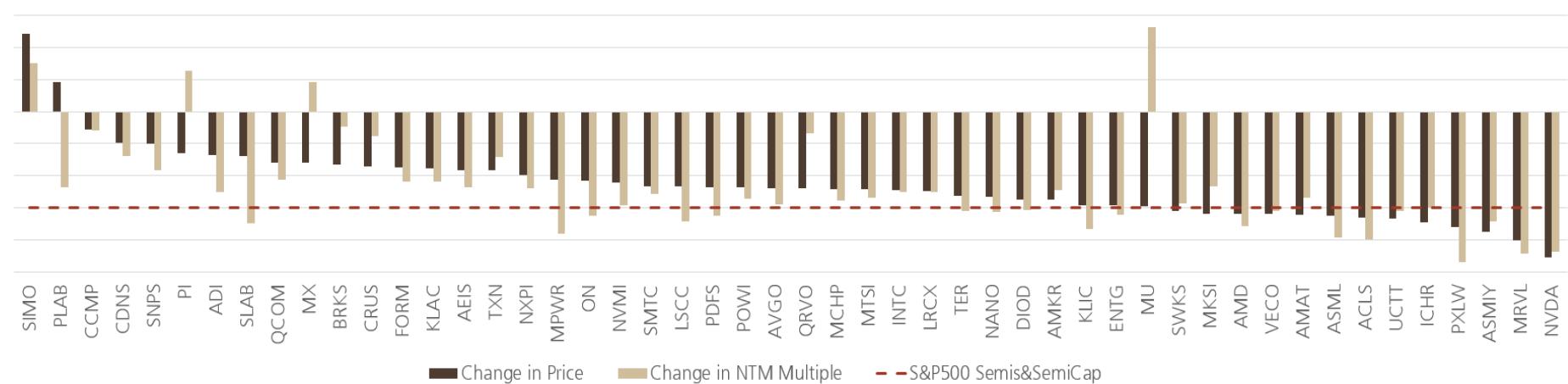


Source: Factset, UBS estimates

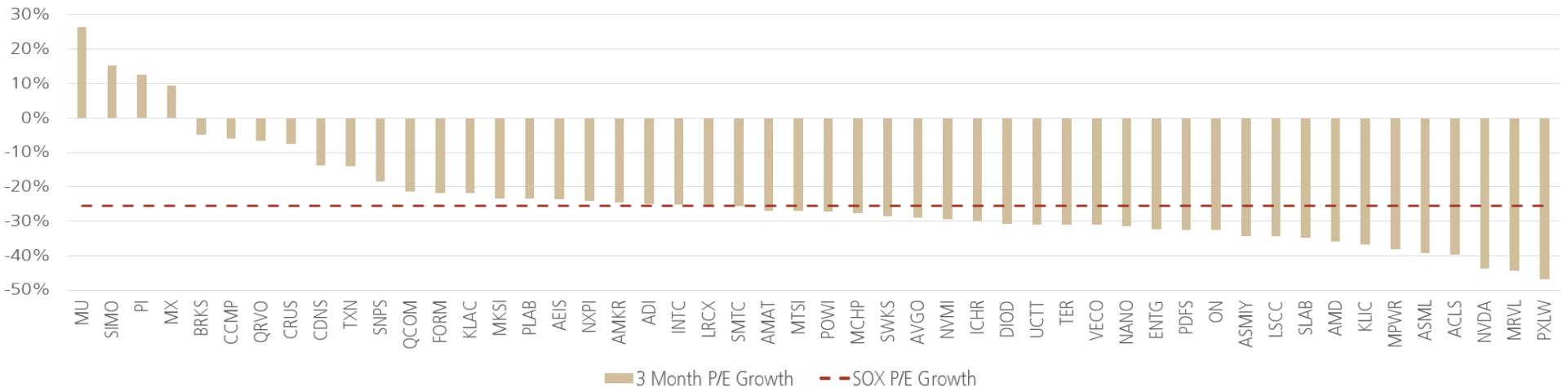
Breakdown of Stock Performance: Semis (YTD)



Breakdown of Stock Performance: Semis (3mo)

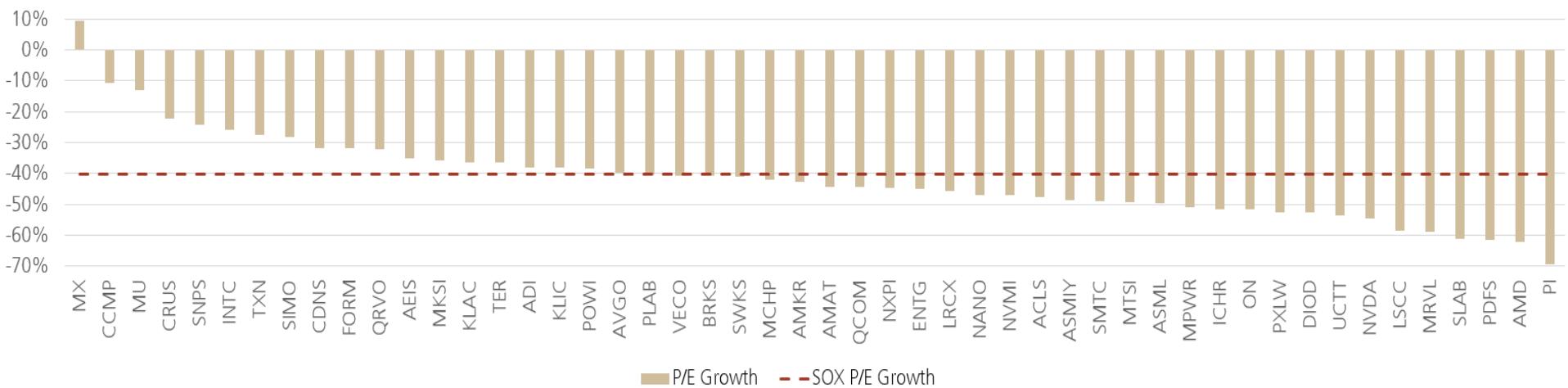
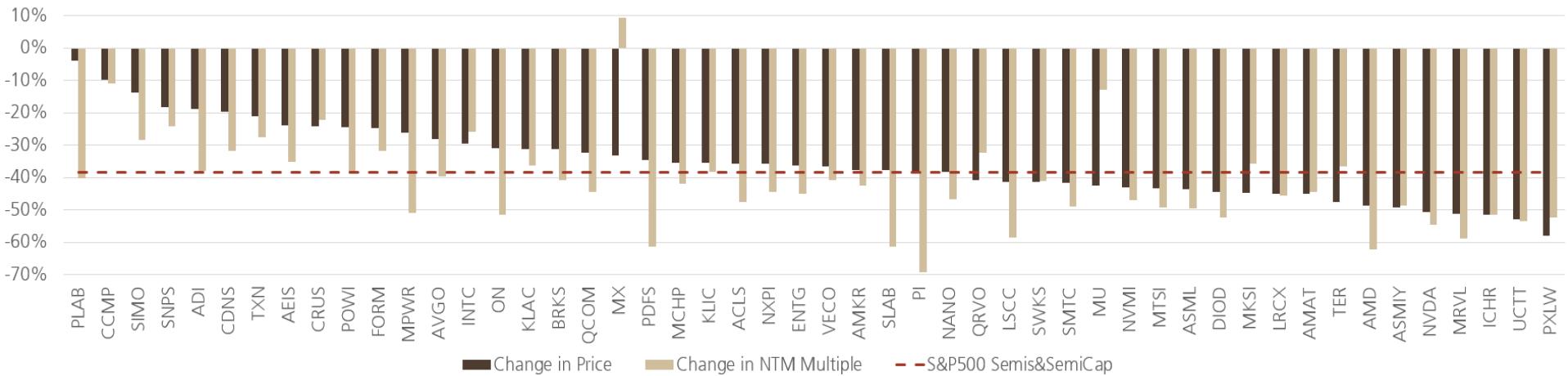


Source: Factset

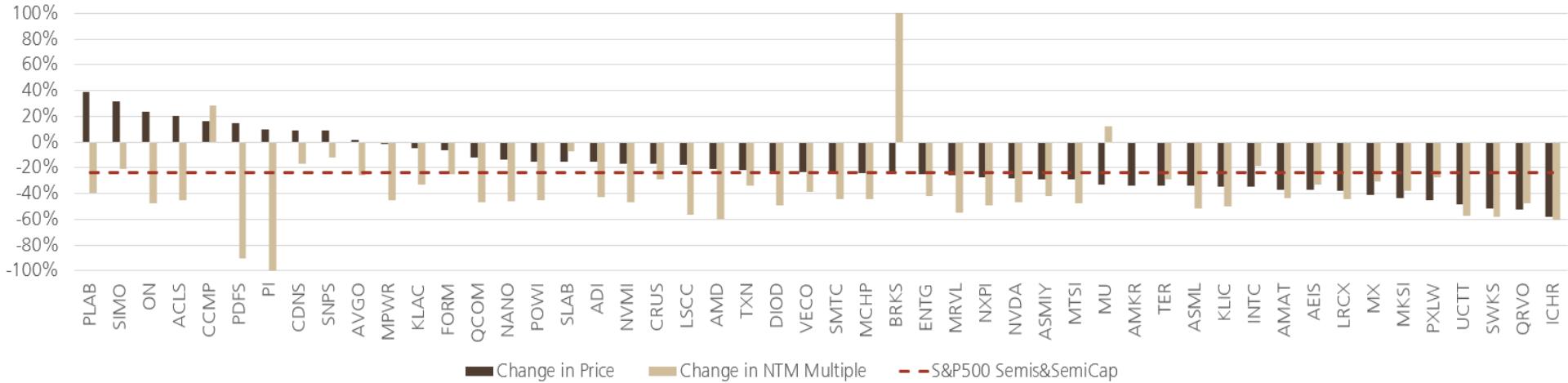


Source: Factset

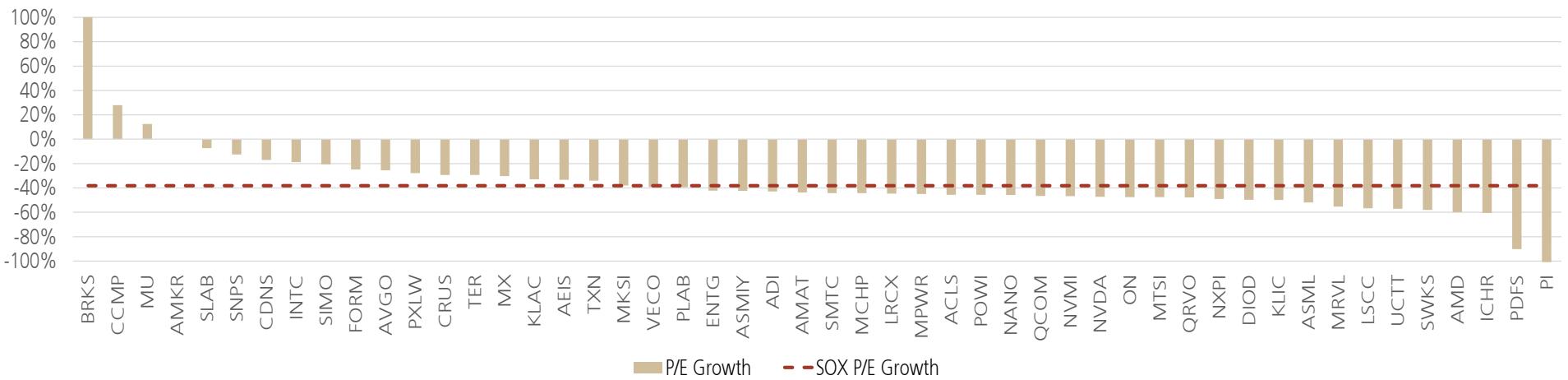
Breakdown of Stock Performance: Semis (6mo)



Breakdown of Stock Performance: Semis (12mo)

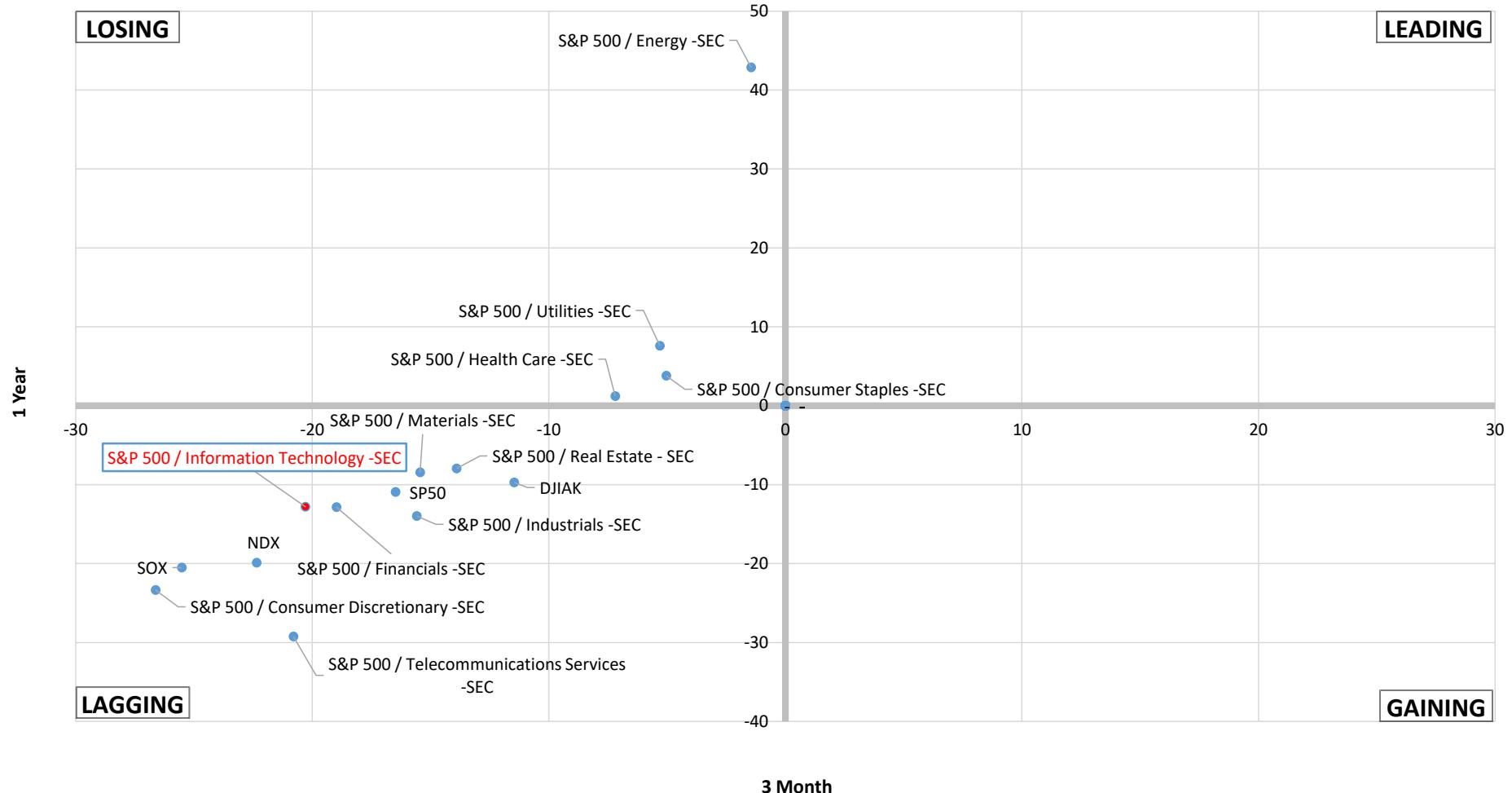


Source: Factset



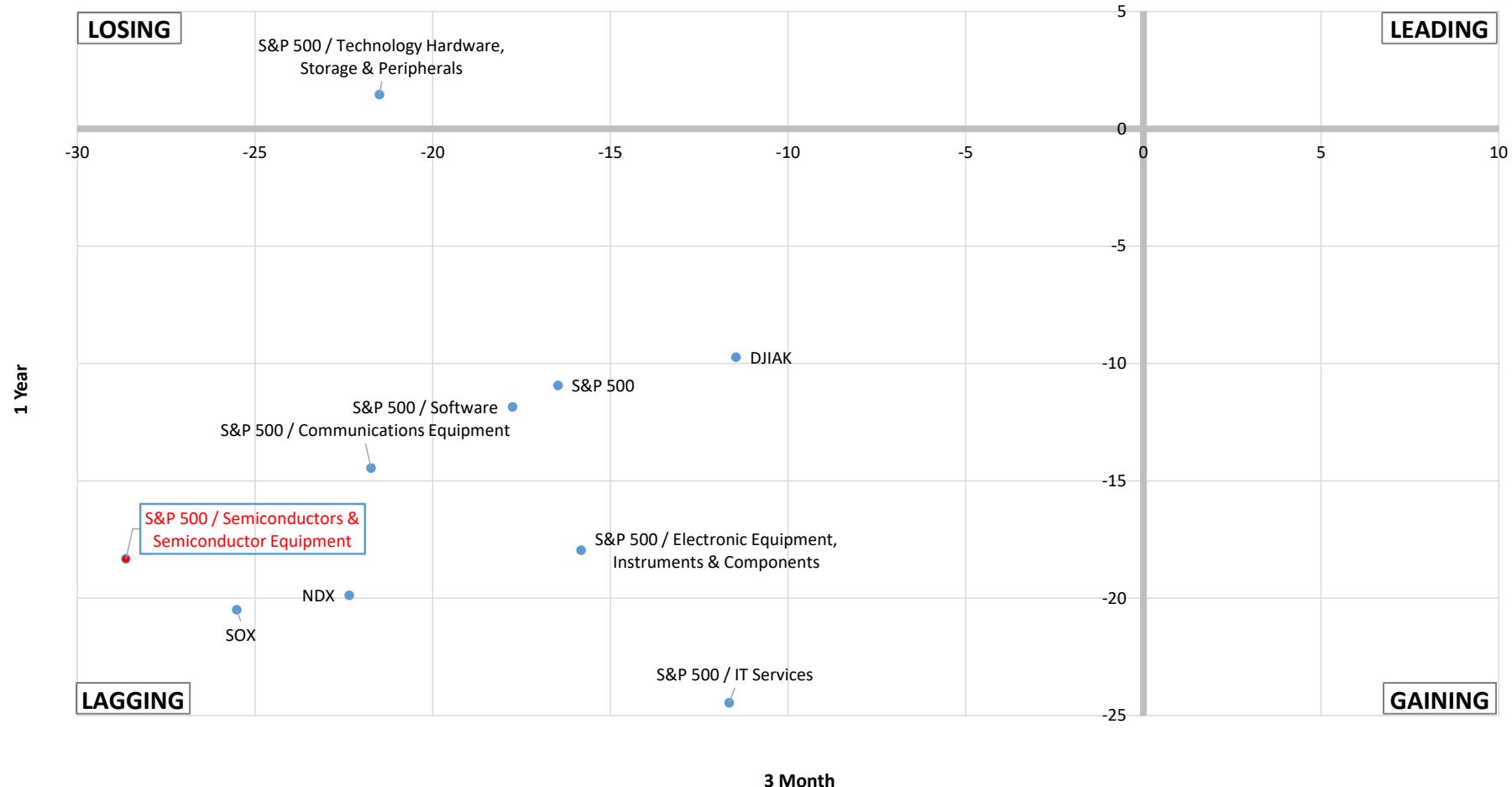
Source: Factset

Stock Performance Momentum: S&P 500 Sectors (12mo vs 3mo)



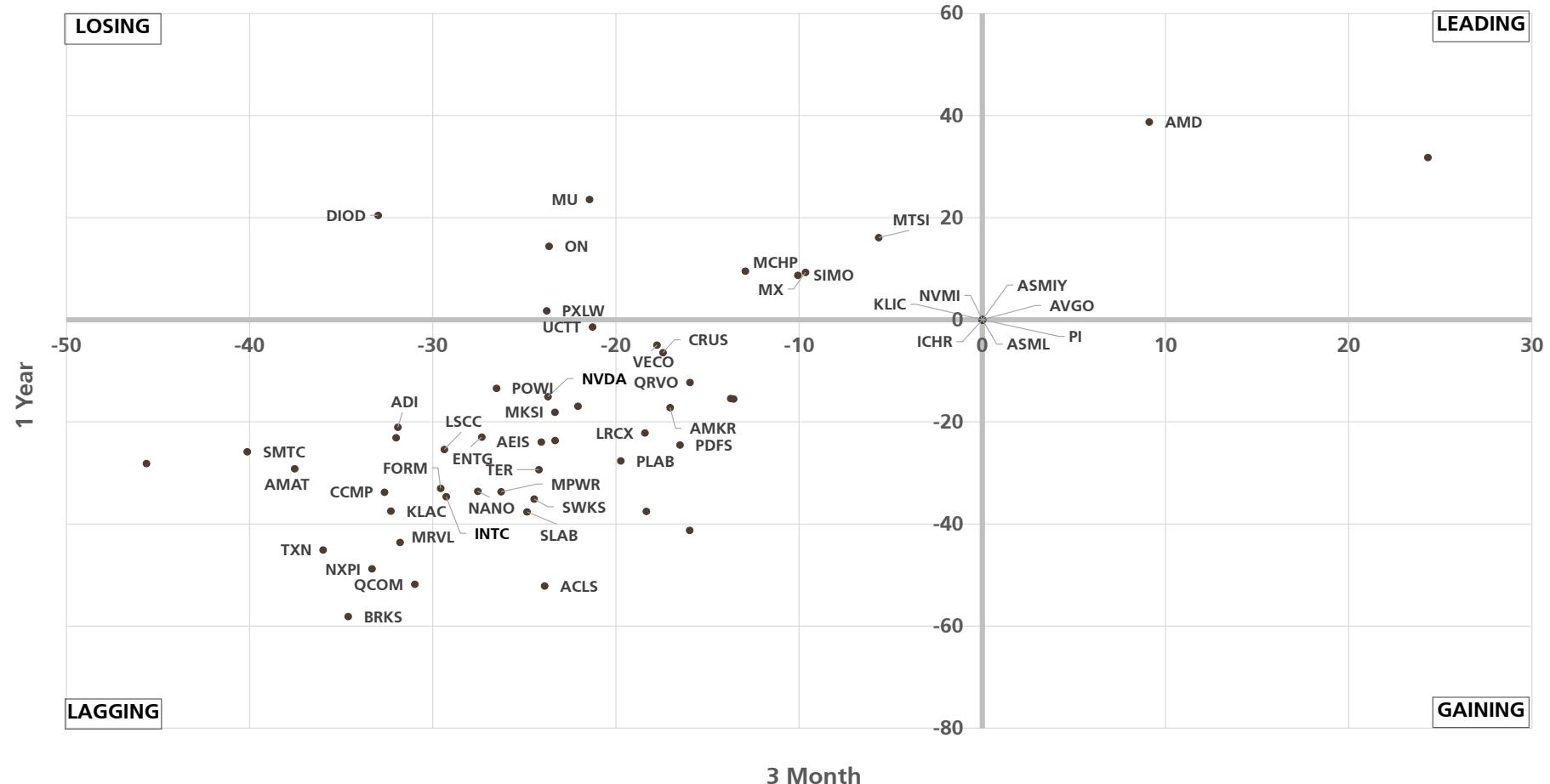
Source: Factset

Stock Performance Momentum: S&P Tech Sectors (12mo vs 3mo)



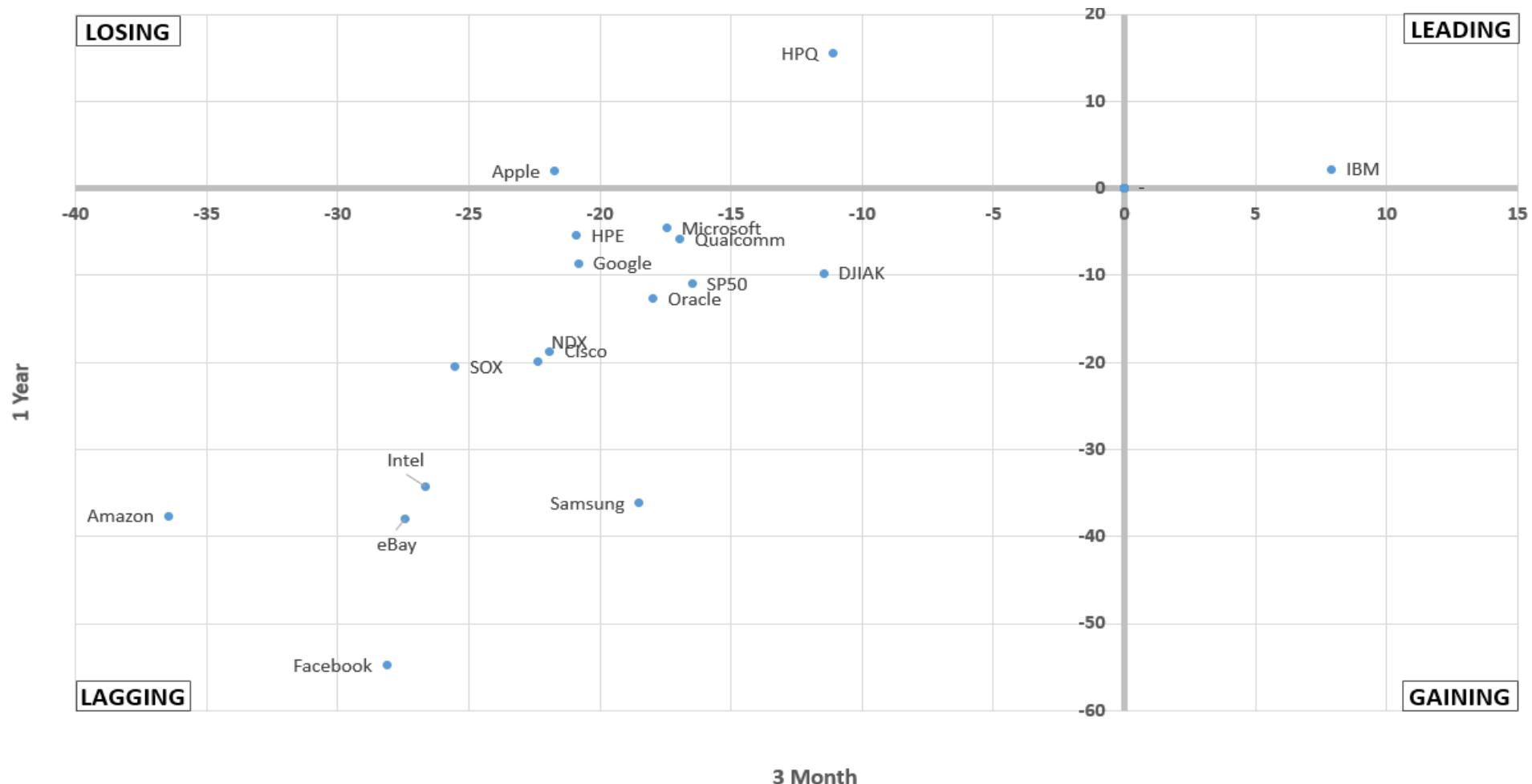
Source: Factset

Stock Performance Momentum: Semis (12mo vs 3mo)



Source: Factset

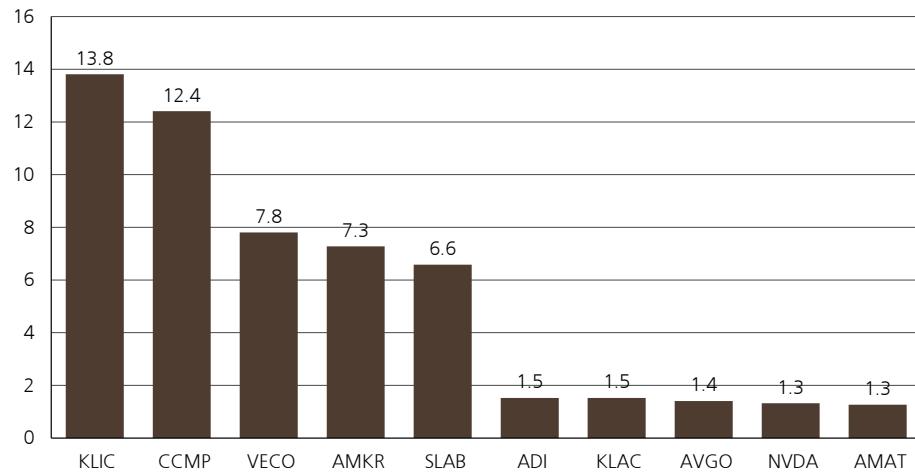
Stock Performance Momentum: Large Cap Tech (12mo vs 3mo)



Source: Factset

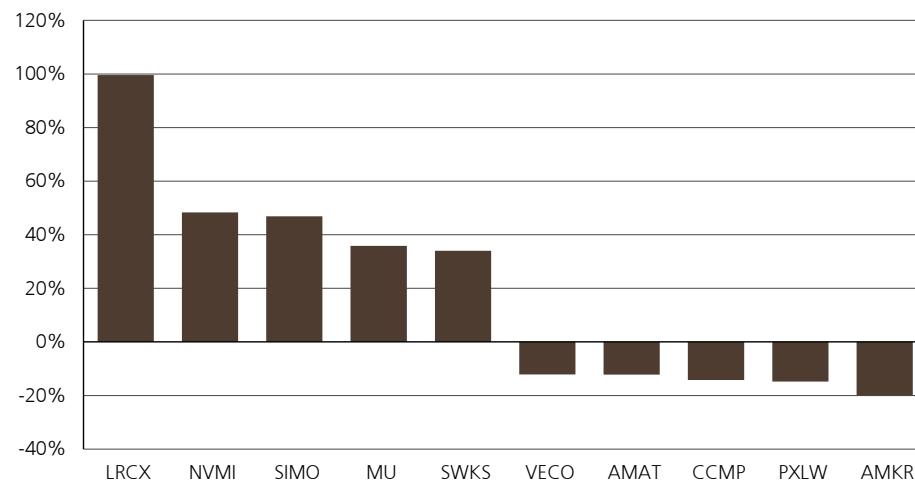
Short Interest Highlights

Semiconductor & Semi Eqpt Short Interest - Top/Bottom 5 % Float



Source: Factset

Top/Bottom 5 Short Interest Change – Last 4 Weeks



Source: Factset



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

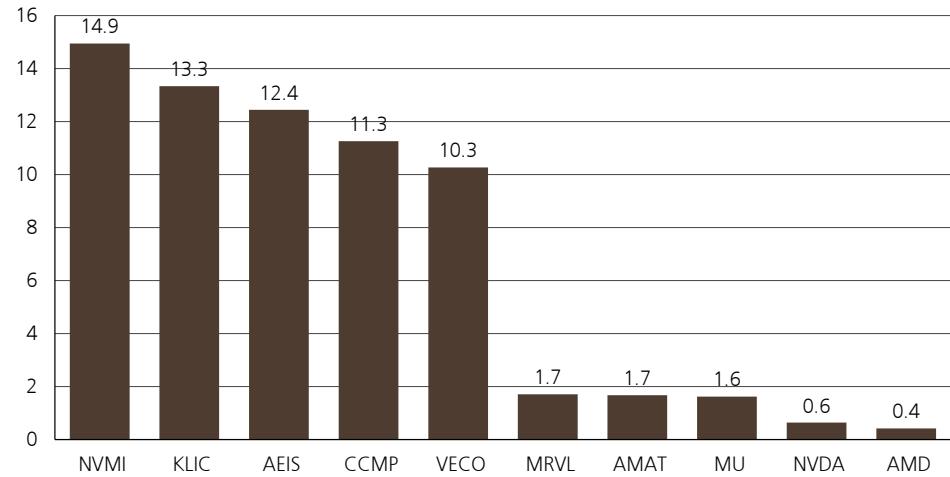
Smartphone

Autos

Semi Cap Equipment

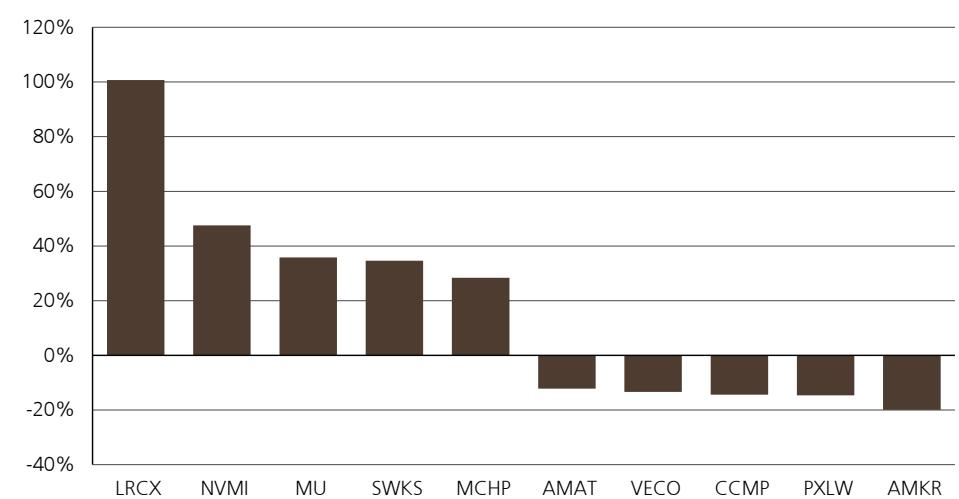
Company Summaries

Semiconductor & Semi Eqpt Short Interest – Top/Bottom 5 Days to Cover



Source: Factset

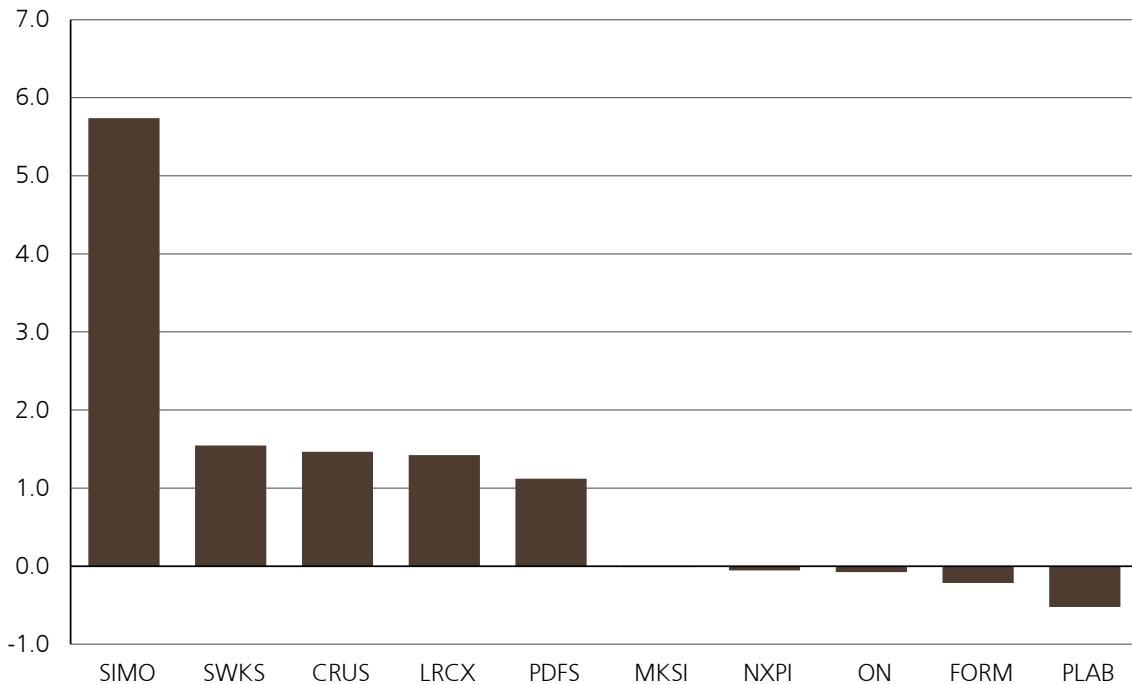
Top/Bottom 5 Short Interest % Float Change – Last 4 Weeks



Source: Factset

Short Interest Highlights (continued)

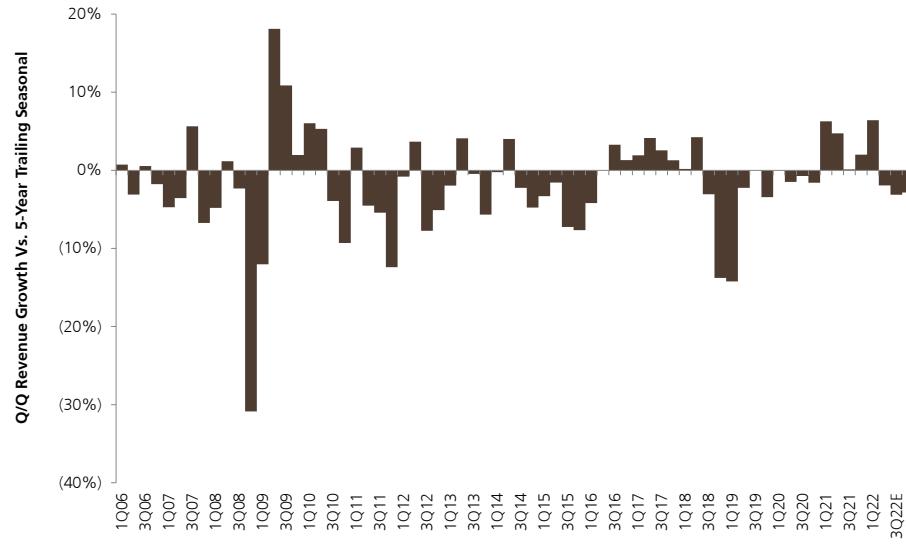
Top/Bottom 5 Short Interest Days to Cover – Last 4 Weeks



Source: Factset

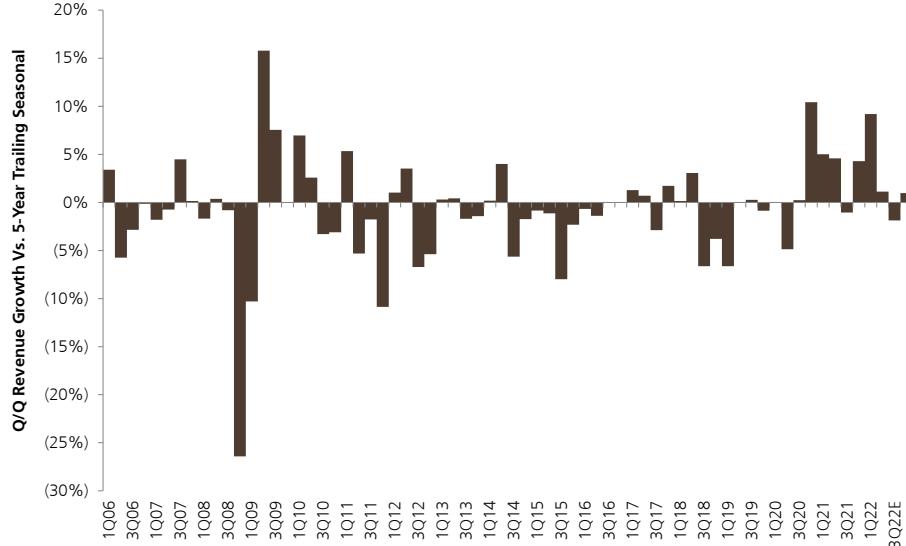
Street estimates are already sub-seasonal for 2H:22

Historical Rev Q/Q vs 5-Year Seasonality (incl Memory)



Source: Factset

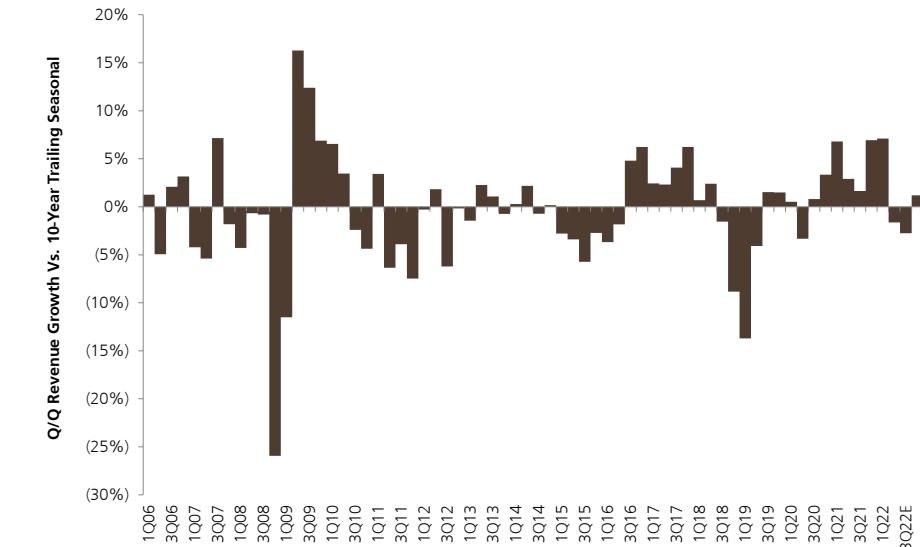
Historical Rev Q/Q vs 5-Year Seasonality (excl Memory)



Source: Factset

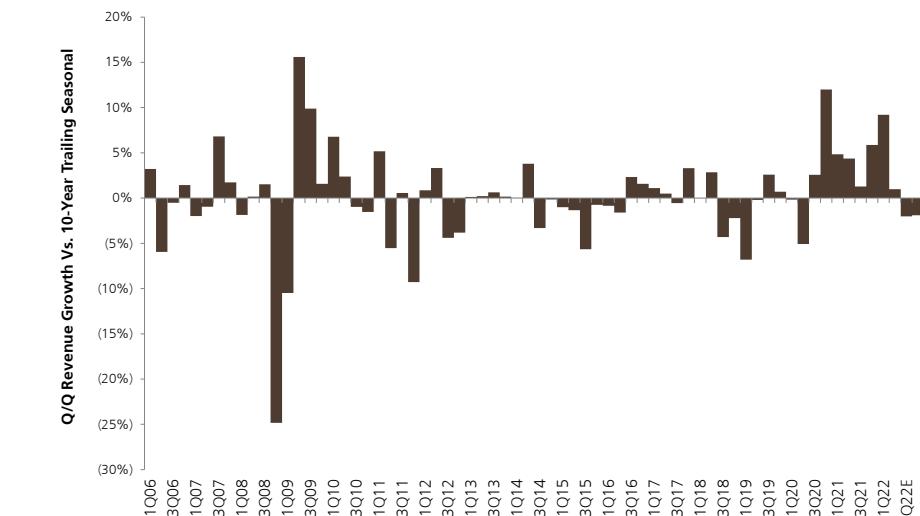


Historical Rev Q/Q vs 10-Year Seasonality (incl Memory)



Source: Factset

Historical Rev Q/Q vs 10-Year Seasonality (excl Memory)

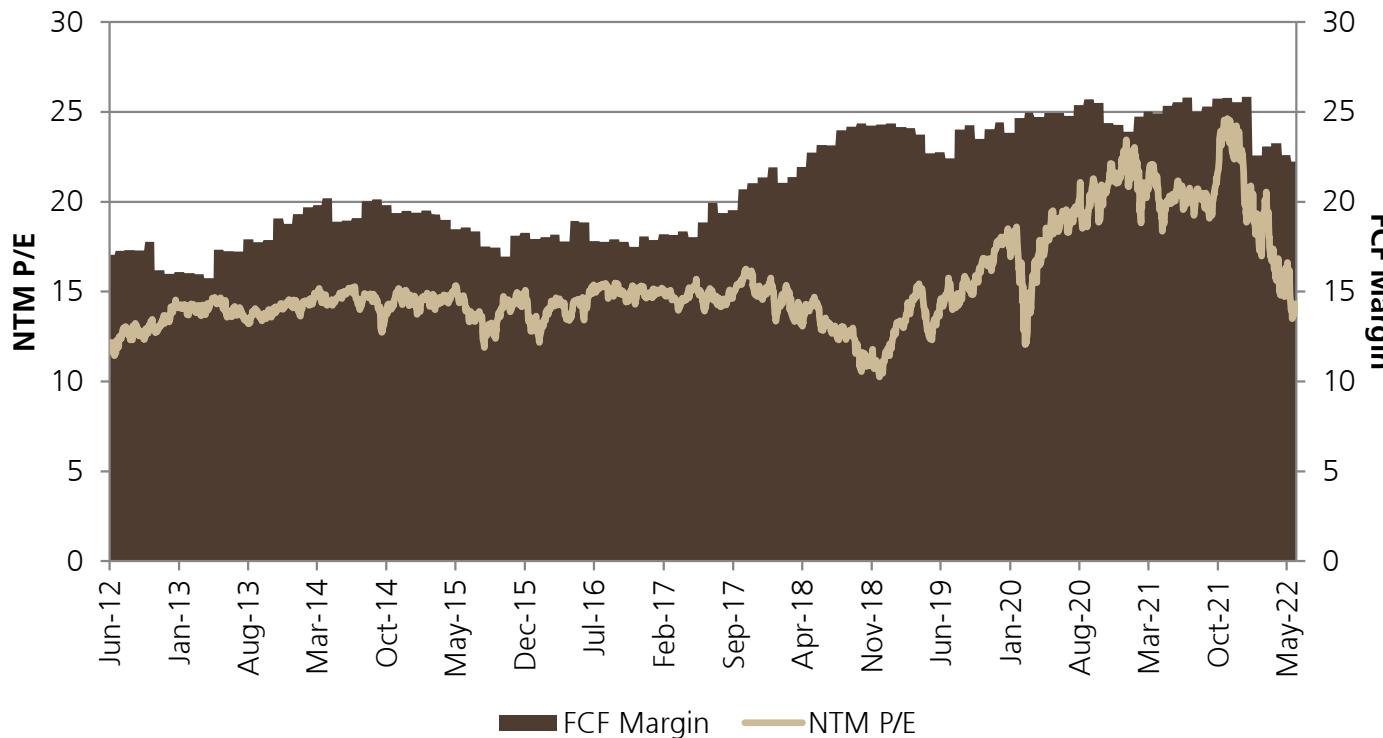


Source: Factset



FCF margins have come down recently due to supply chain disruptions, but still much higher than in the past

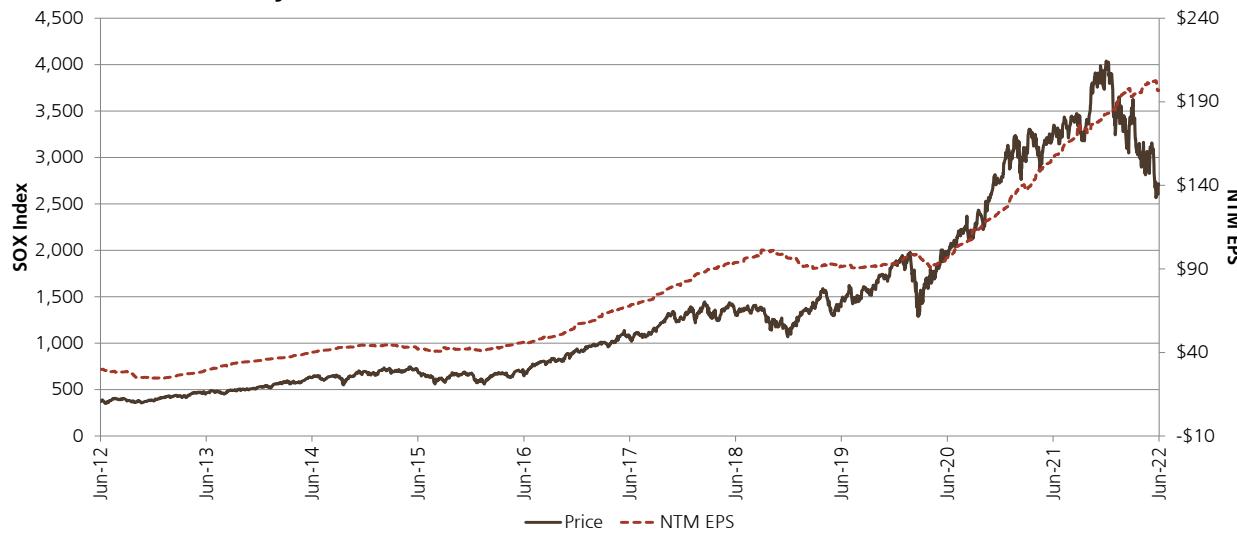
S&P 500 Semiconductors and Semi Equipment Industry Group – FCF Margin vs P/E



Source: Factset

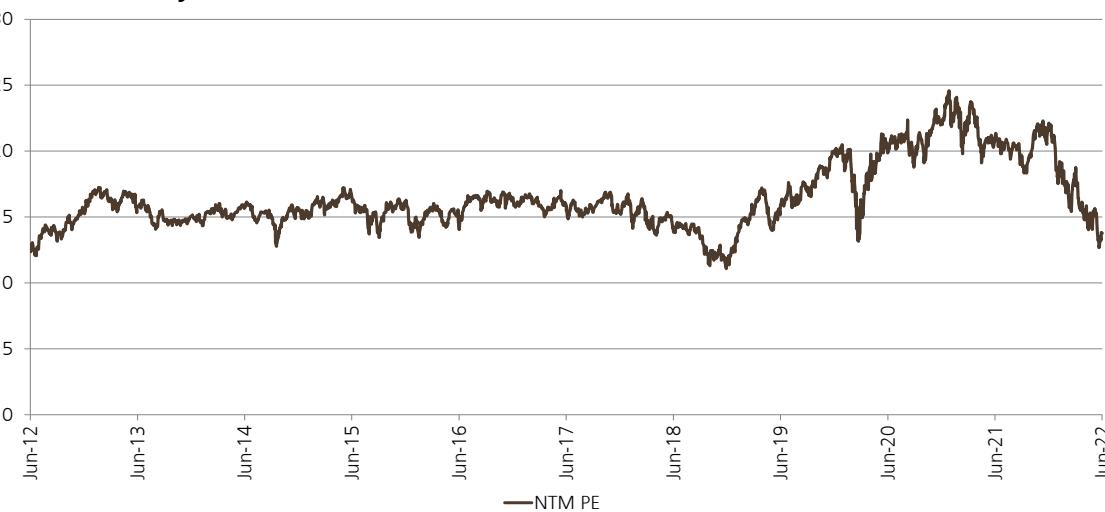
SOX Index: P/E and NTM EPS (10 Year)

SOX v NTM EPS (10yr)



Source: Factset

SOX NTM P/E (10yr)

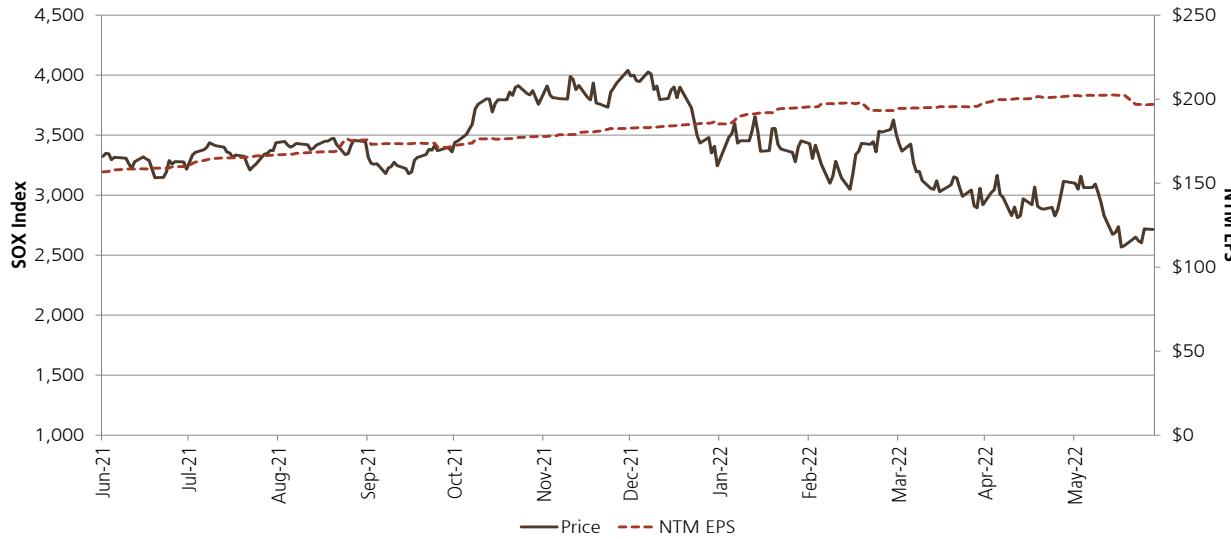


Source: Factset



SOX Index: P/E and NTM EPS (12mo)

SOX v NTM EPS (1yr)



Source: Factset

SOX NTM PE (1yr)



Source: Factset



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

Smartphone

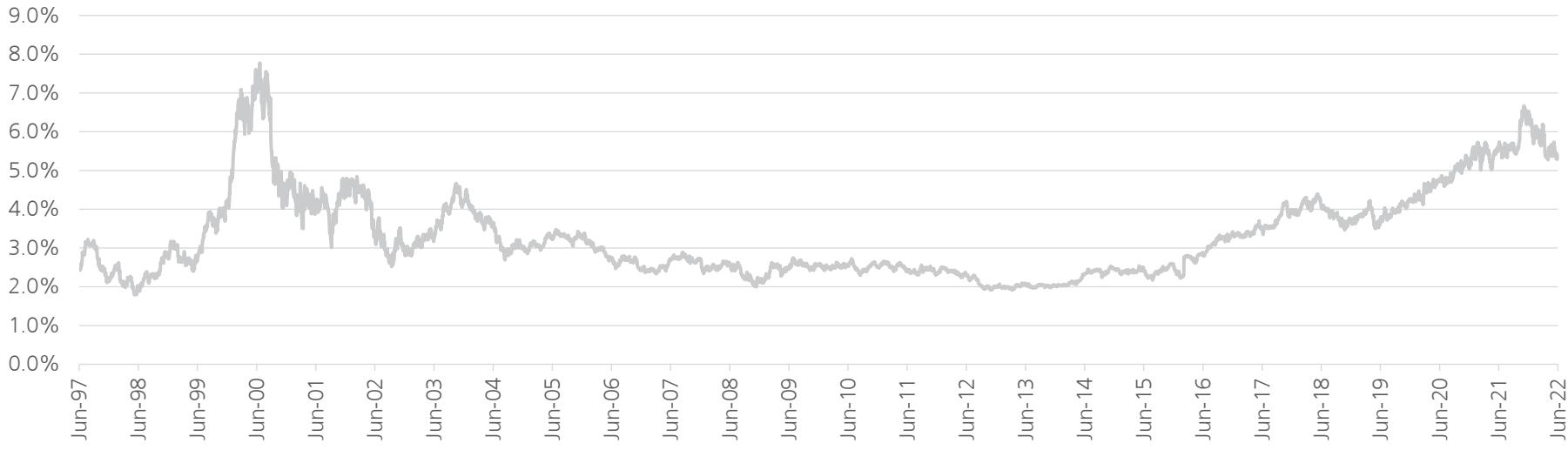
Autos

Semi Cap Equipment

Company Summaries

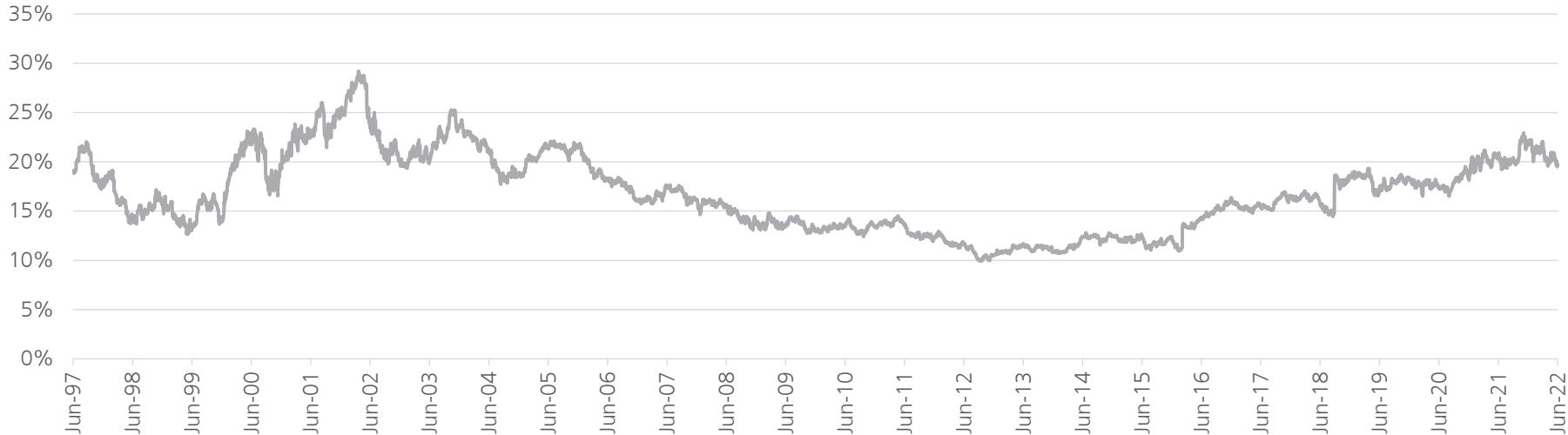
Semis' weighting among key indices has nearly doubled in 5yrs, adding risk to being underweight

Semis % of S&P 500 Market Cap



Source: Factset

Semis % of S&P Info Tech Market Cap



Source: Factset



Comp Tables: S&P 500 & Tech Sector

S&P Industry Sector Valuations

Company	Price	Market Cap (\$m)	EV/Sales		EV/EBITDA		Price/Earnings		Revenue Growth		
			2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	
S&P 500 / Communication Services -SEC	\$188.47	\$2,866,983	3.0x	2.8x	9.0x	8.3x	16.1x	13.8x	8%	7%	
S&P 500 / Consumer Discretionary -SEC	\$1,094.58	\$3,414,255	2.0x	1.9x	13.6x	11.6x	26.9x	19.7x	13%	10%	
S&P 500 / Consumer Staples -SEC	\$746.82	\$2,219,309	1.6x	1.5x	14.1x	13.4x	20.5x	19.1x	7%	4%	
S&P 500 / Energy -SEC	\$577.42	\$1,468,478	1.2x	1.3x	5.1x	5.7x	8.4x	9.6x	42%	-6%	
S&P 500 / Financials -SEC	\$531.41	\$3,512,236	3.1x	2.8x	NM	NM	12.0x	10.5x	3%	7%	
S&P 500 / Health Care -SEC	\$1,486.34	\$4,805,147	2.3x	2.3x	12.2x	12.3x	15.7x	15.7x	7%	3%	
S&P 500 / Industrials -SEC	\$740.94	\$2,498,771	2.1x	1.9x	11.9x	10.4x	17.4x	14.6x	12%	6%	
S&P 500 / Information Technology -SEC	\$2,248.29	\$8,659,483	5.2x	4.8x	14.4x	13.2x	20.1x	18.1x	11%	8%	
S&P 500 / Materials -SEC	\$472.37	\$844,525	2.0x	2.0x	8.2x	8.5x	12.3x	13.0x	14%	-1%	
S&P 500 / Real Estate - SEC	\$257.65	\$939,811	9.2x	8.7x	19.6x	18.5x	18.5x	17.5x	16%	6%	
S&P 500 / Utilities -SEC	\$352.42	\$978,961	4.6x	4.4x	12.9x	11.8x	20.1x	18.7x	9%	4%	
Industry Sectors			Mean	3.3x	3.1x	12.1x	11.4x	17.1x	15.5x	13%	
			Median	2.3x	2.3x	12.5x	11.7x	17.4x	15.7x	11%	

Source: Factset

S&P Tech Sector Valuations

Company	Price	Market Cap (\$m)	EV/Sales		EV/EBITDA		Price/Earnings		Revenue Growth		
			2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	
S&P 500 / Communications Equipment -IND	\$451.37	\$254,014	3.5x	3.3x	9.9x	9.5x	14.3x	13.3x	4%	6%	
S&P 500 / Electronic Equipment, Instruments & Components -IND	\$265.64	\$195,259	2.5x	2.4x	12.2x	11.4x	17.7x	16.1x	13%	6%	
S&P 500 / IT Services -IND	\$518.28	\$1,416,808	4.9x	4.5x	15.3x	13.7x	21.9x	19.0x	6%	9%	
S&P 500 / Semiconductors & Semiconductor Equipment -IND	\$1,734.80	\$1,711,487	4.6x	4.2x	10.4x	9.6x	14.6x	13.3x	19%	8%	
S&P 500 / Software -IND	\$4,143.28	\$2,870,838	8.1x	7.1x	17.5x	15.4x	25.8x	22.4x	16%	14%	
S&P 500 / Technology Hardware, Storage & Peripherals -IND	\$6,116.78	\$2,211,077	4.5x	4.3x	15.8x	15.3x	20.4x	19.1x	7%	4%	
IT Sectors			Mean	4.7x	4.3x	13.5x	12.5x	19.1x	17.2x	11%	
			Median	4.5x	4.3x	13.8x	12.5x	19.1x	17.6x	10%	

Source: Factset

Comp Tables: Semiconductor Sub-Sectors (Comms + AAPL Supply Chain)

MPU/Communications/Wireless Semiconductor Comp Table

Company	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash (% of MC) Current		Gross Margin		ROE		Revenue Growth	
	(lc)	Cap (\$m)	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E		
Advanced Micro Dev.	80.78	\$126,383	3.6x	3.2x	nm	10.6x	15.2x	13.3x	18.7x	17.0x	0.0%	0.0%	4.9%	5.6%	nm	29.8%	3%	53.4%	54.6%	12.9%	13.0%	63%	14%	
ams AG	9.17	\$2,521	0.8x	0.9x	4.5x	4.1x	14.8x	25.6x	7.6x	6.6x	0.0%	0.1%	11.8%	6.8%	18.9%	21.1%	-75%	32.0%	33.3%	8.9%	10.0%	-12%	-3%	
Broadcom	498.45	\$198,036	7.1x	6.8x	9.3x	9.2x	9.4x	9.2x	12.2x	11.5x	3.6%	4.1%	8.6%	9.3%	nm	-16%	75.4%	75.8%	79.0%	108.9%	20%	4%		
Intel	38	\$152,479	2.0x	2.0x	5.3x	5.1x	79.1x	60.5x	10.9x	10.5x	3.9%	4.0%	1.3%	1.6%	37.9%	38.3%	2%	51.5%	52.2%	13.0%	13.0%	2%	3%	
Marvell Technology	45.32	\$37,668	6.9x	5.7x	nm	nm	22.2x	17.4x	19.6x	14.7x	0.5%	0.5%	5.0%	6.4%	nm	nm	-12%	65.2%	65.8%	12.3%	15.4%	41%	20%	
MediaTek	651	\$35,620	1.5x	1.4x	5.7x	5.6x	6.3x	7.5x	8.3x	8.2x	12.0%	12.1%	13.2%	11.1%	26.9%	25.4%	24%	49.3%	48.1%	28.9%	29.1%	8%	8%	
NVIDIA	159.82	\$388,550	11.6x	10.0x	22.7x	19.6x	33.0x	25.3x	29.0x	24.3x	0.2%	0.2%	3.0%	3.9%	51.3%	50.8%	2%	67.3%	68.0%	41.8%	38.9%	29%	17%	
Qorvo	99	\$10,158	2.6x	2.4x	nm	nm	10.1x	8.8x	8.8x	7.9x	0.0%	0.0%	11.6%	13.2%	nm	-11%	51.3%	51.8%	25.8%	25.8%	2%	8%		
Qualcomm	131.60	\$145,858	3.3x	3.2x	8.4x	8.4x	10.8x	9.5x	10.4x	10.8x	2.2%	2.4%	7.9%	9.9%	28.8%	28.8%	-3%	58.6%	58.1%	73.4%	51.1%	38%	5%	
Skyworks Solutions	96	\$15,106	3.1x	2.9x	5.4x	5.3x	7.0x	7.0x	8.3x	7.6x	2.3%	2.3%	10.5%	16.2%	28.8%	28.8%	-11%	51.3%	53.1%	35.9%	33.7%	4%	5%	
Texas Instruments	154.16	\$140,884	7.1x	6.9x	12.4x	11.9x	16.0x	17.2x	16.1x	17.1x	3.1%	3.5%	4.4%	4.0%	57.3%	58.1%	1%	68.2%	66.7%	59.3%	48.3%	11%	2%	
TSMC	498	\$429,049	5.8x	5.1x	8.5x	7.3x	76.3x	31.9x	14.5x	13.1x	2.6%	2.9%	1.3%	3.0%	68.9%	69.9%	4%	56.0%	54.2%	32.3%	29.2%	24%	15%	
UMC	41.85	\$17,204	1.6x	1.7x	3.0x	3.5x	13.7x	8.2x	6.8x	9.6x	8.3%	13.6%	5.8%	9.7%	51.6%	47.4%	28%	43.5%	38.2%	25.4%	18.8%	15%	-8%	
Processor/Wireless/Comms Serr		Mean	4.2x	3.9x	8.5x	8.3x	23.5x	18.6x	13.1x	12.2x	3.0%	3.3%	6.8%	7.8%	39.7%	38.5%	-4%	55.3%	55.0%	33.4%	32.5%	18%	7%	
Processor/Wireless/Comms Serr		Median	3.2x	3.0x	8.4x	7.9x	15.0x	13.3x	11.5x	11.2x	2.3%	2.4%	6.1%	6.8%	33.4%	29.8%	2%	52.4%	53.6%	27.3%	27.4%	13%	5%	

Source: Factset, UBS estimates

Apple Supply Chain Comp Table

Company	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash (% of MC) Current		Gross Margin		ROE		Revenue Growth	
	(lc)	Cap (\$m)	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E		
ams AG	9.17	\$2,521	0.8x	0.9x	4.5x	4.1x	14.8x	25.6x	7.6x	6.6x	0.0%	0.1%	11.8%	6.8%	18.9%	21.1%	-75%	32.0%	33.3%	8.9%	10.0%	-12%	-3%	
Broadcom	498.45	\$198,036	7.1x	6.8x	9.3x	9.2x	9.4x	9.2x	12.2x	11.5x	3.6%	4.1%	8.6%	9.3%	nm	nm	-16%	75.4%	75.8%	79.0%	108.9%	20%	4%	
Qualcomm	131.60	\$145,858	3.3x	3.2x	8.4x	8.4x	10.8x	9.5x	10.4x	10.8x	2.2%	2.4%	7.9%	9.9%	28.8%	28.8%	-3%	58.6%	58.1%	73.4%	51.1%	38%	5%	
Skyworks Solutions	96	\$15,106	3.1x	2.9x	5.4x	5.3x	7.0x	7.0x	8.3x	7.6x	2.3%	2.3%	10.5%	16.2%	28.8%	28.8%	-11%	51.3%	53.1%	35.9%	33.7%	4%	5%	
Qorvo	98.55	\$10,158	2.6x	2.4x	nm	nm	10.1x	8.8x	8.8x	7.9x	0.0%	0.0%	11.6%	13.2%	nm	nm	-11%	51.3%	51.8%	25.8%	25.8%	2%	8%	
Catchr	168	\$4,119	nm	nm	nm	nm	1.6x	1.6x	nm	nm	nm	nm	8.4%	8.0%	nm	90%	32.3%	32.5%	nm	nm	nm	nm		
Foxconn Technology	53.10	\$2,488	0.2x	0.2x	2.7x	2.4x	3.2x	2.5x	11.5x	10.4x	4.0%	4.9%	7.7%	9.7%	nm	nm	126%	nm	nm	nm	nm	-7%	4%	
Zhen Ding Technology	105	\$3,399	0.8x	0.7x	4.2x	3.6x	nm	nm	8.7x	7.9x	5.2%	5.9%	-4.6%	-0.3%	19.5%	20.6%	8%	20.4%	20.7%	12.9%	14.3%	5%	10%	
Largan	1710.00	\$7,646	2.7x	2.7x	5.1x	5.0x	7.9x	7.3x	12.8x	14.3x	4.1%	3.9%	6.8%	7.4%	53.4%	54.5%	55%	56.2%	57.3%	11.9%	10.2%	-11%	1%	
Goertek	34.24	\$17,003	1.1x	0.9x	14.4x	12.2x	73.5x	23.8x	22.1x	18.2x	0.9%	1.1%	1.4%	4.2%	7.9%	7.3%	0%	14.6%	14.5%	15.9%	17.4%	24%	26%	
Luxshare	34.10	\$34,613	1.7x	1.4x	14.7x	12.6x	372.9x	45.4x	20.7x	16.7x	0.5%	0.6%	0.3%	2.4%	11.3%	11.2%	-4%	13.1%	13.6%	24.8%	24.0%	16%	18%	
AAC	19	\$2,868	1.2x	1.0x	6.0x	5.8x	36.8x	18.2x	16.4x	15.6x	1.8%	1.7%	3.5%	7.0%	19.4%	17.1%	-23%	22.5%	22.7%	3.7%	3.7%	12%	17%	
Apple suppliers		Mean	2.2x	2.1x	7.6x	7.0x	47.0x	14.5x	12.7x	11.6x	2.2%	2.3%	6.2%	7.8%	23.8%	23.8%	11%	39.9%	40.3%	28.3%	29.0%	8%	8%	
Apple suppliers		Median	2.0x	1.8x	6.0x	5.8x	10.4x	9.2x	11.9x	11.2x	2.2%	2.0%	7.7%	7.7%	19.5%	21.1%	-3%	41.5%	41.8%	19.4%	19.4%	8%	5%	

Source: Factset, UBS estimates

Comp Tables: Semiconductor Sub-Sectors (Analog + Memory + Semiconductor Equipment)

Analog Semis Comp Table

Company	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash (% of MC) Current		Gross Margin		ROE		Revenue Growth		
	(lc)	Cap (\$m)	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	
Analog Devices	148.49	\$76,552	6.3x	6.0x	12.6x	11.8x	17.7x	15.2x	15.6x	14.5x	2.1%	2.3%	5.5%	6.4%	50.0%	50.8%	-6%	-14%	42.4%	42.3%	18.9%	17.4%	23%	8%	
Infinion	24.34	\$32,712	2.6x	2.4x	8.1x	7.5x	28.4x	21.8x	13.6x	12.7x	2.2%	2.3%	4.0%	5.2%	31.5%	31.3%	-14%	-14%	42.4%	42.3%	18.9%	17.4%	23%	8%	
Microchip Technology	59.45	\$32,189	5.3x	5.0x	11.6x	10.6x	14.8x	13.6x	11.1x	10.4x	2.0%	2.4%	8.5%	9.2%	45.6%	47.1%	-23%	-23%	66.6%	67.6%	43.5%	41.3%	18%	6%	
Meloxis	71.00	\$2,936	3.4x	3.3x	11.0x	11.5x	19.5x	18.0x	15.9x	17.6x	4.7%	4.5%	5.0%	5.4%	31.3%	28.5%	3%	3%	43.6%	42.6%	38.0%	30.5%	14%	5%	
NXP	154.22	\$39,390	3.7x	3.5x	9.1x	8.9x	18.7x	14.8x	10.9x	10.5x	2.1%	2.3%	6.6%	8.4%	40.9%	39.8%	-20%	-20%	57.5%	58.0%	51.7%	45.0%	19%	5%	
ON Semi	52.81	\$22,212	3.1x	2.9x	7.7x	7.6x	14.2x	11.9x	10.4x	10.4x	0.0%	0.0%	7.7%	9.2%	39.8%	38.6%	-8%	-8%	49.1%	49.6%	32.4%	25.0%	20%	4%	
Renesas Electronics	1331.00	\$18,294	2.1x	2.0x	4.7x	4.7x	11.3x	8.6x	5.6x	5.8x	0.0%	0.0%	10.6%	13.9%	44.2%	43.5%	-22%	-22%	54.7%	55.3%	33.7%	26.7%	26%	1%	
Rohm	10300.00	\$7,572	1.5x	1.4x	5.4x	5.0x	74.1x	19.8x	15.8x	15.5x	1.9%	2.0%	0.9%	0.9%	3.5%	27.8%	28.7%	42%	42%	35.3%	36.1%	7.5%	7.3%	0%	4%
STMicroelectronics	31.43	\$29,368	1.9x	1.9x	5.4x	5.3x	47.0x	16.8x	10.2x	11.9x	0.7%	0.7%	2.1%	5.9%	36.1%	35.4%	3%	3%	46.7%	46.3%	24.7%	17.6%	20%	2%	
TE Connectivity	114.92	\$36,370	2.5x	2.4x	10.8x	10.1x	19.7x	17.0x	15.4x	14.0x	1.8%	1.9%	5.7%	6.6%	23.5%	23.6%	-9%	-9%	33.4%	33.9%	21.3%	20.8%	6%	6%	
Texas Instruments	154.16	\$140,884	7.1x	7.0x	12.4x	11.9x	22.6x	24.7x	16.8x	17.2x	3.1%	3.6%	4.4%	4.0%	56.8%	58.5%	1%	1%	68.2%	66.7%	51.9%	45.7%	11%	2%	
Analog Semis			Mean	3.6x	3.4x	9.0x	8.6x	26.2x	16.6x	12.9x	12.8x	1.9%	2.0%	5.6%	7.1%	38.9%	38.7%	-5%	-5%	51.8%	51.9%	30.6%	26.5%	19%	4%
			Median	3.1	2.9	9.1	8.9	19.5	16.8	13.6	12.7	2.0%	2.3%	5.5%	6.4%	39.8%	38.6%	-8%	-8%	49.1%	49.6%	32.4%	25.0%	19%	5%

Source: Factset, UBS estimates

Memory Comp Table

Company	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash (% of MC) Current		Gross Margin		ROE		Revenue Growth		
	(lc)	Cap (\$m)	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	
SK Hynix	95300.00	\$52,673	1.3x	1.2x	2.3x	2.3x	10.2x	8.0x	5.3x	4.9x	1.9%	2.1%	10.9%	14.0%	55.7%	50.8%	-8%	-8%	43.9%	42.2%	17.9%	16.5%	27%	11%	
Nanya Tech	58.90	\$5,960	1.1x	0.9x	2.2x	2.0x	7.8x	15.0x	8.3x	7.8x	5.7%	5.9%	6.3%	3.3%	47.0%	46.4%	53%	53%	41.2%	42.4%	11.6%	11.6%	-11%	13%	
Micron Technology	57.86	\$62,556	1.8x	1.5x	3.3x	2.8x	10.4x	8.0x	6.2x	4.6x	0.8%	0.9%	9.4%	12.3%	53.8%	55.6%	7%	7%	48.6%	50.4%	19.4%	21.8%	14%	16%	
Samsung Electronics	59,400	\$266,508	0.9x	0.8x	3.1x	2.9x	10.0x	8.5x	8.5x	8.4x	3.7%	4.8%	7.5%	8.9%	29.4%	28.6%	38%	38%	40.7%	40.4%	12.1%	11.1%	8%	7%	
Memory Semis			Mean	1.3x	1.1x	2.7x	2.5x	9.6x	9.9x	7.1x	6.4x	3.0%	3.4%	8.5%	9.6%	46.5%	45.4%	23%	23%	43.6%	43.9%	15.2%	15.3%	9%	12%
			Median	1.2x	1.0x	2.7x	2.5x	10.1x	8.3x	7.2x	6.3x	2.8%	3.5%	8.5%	10.6%	50.4%	48.6%	22%	22%	42.6%	42.3%	15.0%	14.0%	11%	12%

Source: Factset, UBS estimates

Semiconductor Equipment Comp Table

Company	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash (% of MC) Current		Gross Margin		ROE		Revenue Growth	
	(lc)	Cap (\$m)	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E
Advantest	7630.00	\$10,995	2.9x	2.7x	8.7x	7.8x	17.5x	13.3x	13.6x	12.2x	2.0%	2.3%	5.3%	7.0%	33.3%	34.4%	-5%	-5%	57.7%	57.8%	30.4%	28.3%	9%	7%
Applied Materials	95.02	\$79,983	3.4x	3.2x	10.7x	10.4x	10.9x	10.6x	12.2x	11.4x	1.2%	1.5%	7.4%	8.8%	31.7%	30.9%	0%	0%	47.0%	48.2%	58.3%	70.5%	10%	3%
ASM International	245.95	\$12,403	5.0x	4.4x	15.2x	13.2x	25.6x	19.6x	19.7x	17.4x	1.2%	1.3%	3.7%	4.8%	32.7%	33.5%	5%	5%	47.7%	48.3%	22.5%	22.3%	21%	12%
ASM Pacific Tech	69.20	\$3,595	1.3x	1.2x	5.9x	5.6x	7.8x	9.0x	9.5x	9.0x	5.5%	5.8%	12.5%	10.9%	21.1%	21.1%	2%	2%	40.3%	40.3%	18.2%	17.5%	2%	6%
ASML	472.85	\$198,140	8.5x	7.1x	24.1x	18.4x	40.5x	26.7x	29.8x	22.7x	0.9%	1.0%	2.5%	3.7%	35.3%	38.3%	0%	0%	52.3%	53.5%	56.4%	53.2%	12%	17%
Disco	33,700	\$8,731	4.1x	4.2x	10.6x	10.9x	18.5x	15.4x	18.3x	18.9x	2.6%	3.1%	4.9%	5.8%	38.6%	38.6%	12%	12%	60.9%	62.1%	20.8%	18.6%	-1%	-4%
Eugene Tech	31050.00	\$545	1.5x	1.4x	6.7x	7.4x	7.3x	5.0x	11.6x	12.2x	0.9%	1.3%	10.9%	15.7%	22.5%	19.2%	23%	23%	49.8%	45.3%	17.8%	14.8%	3%	6%
Jusung Engineering	17,150	\$648	1.7x	1.5x	5.7x	5.0x	9.0x	8.2x	8.4x	7.4x	0.6%	0.6%	10.4%	11.4%	29.9%	29.7%	36%	36%	51.7%	49.4%	21.5%	19.9%	nm	15%
KLA Corp	330.09	\$47,840	5.2x	5.1x	11.9x	12.4x	16.3x	14.7x	14.7x	14.6x	1.3%	1.3%	6.4%	7.1%	43.4%	41.1%	-3%	-3%	63.4%	64.6%	94.5%	94.3%	30%	2%
LAM Research Corp.	438	\$59,238	3.4x	3.2x	10.7x	10.0x	14.2x	12.0x	13.2x	12.1x	1.5%	1.6%	7.3%	8.6%	32.2%	32.3%	0%	0%	46.0%	47.1%	79.1%	85.5%	5%	6%
Nikon	1643.00	\$4,501	0.7x	0.6x	5.0x	4.8x	29.4x	13.0x	14.2x	13.6x	2.5%	2.7%	2.1%	4.8%	13.0%	13.0%	59%	59%	42.4%	41.5%	7.0%	7.0%	0%	4%
Screen	9,870	\$3,597	0.9x	0.8x	4.5x	4.0x	8.6x	8.6x	8.7x	8.0x	3.0%	3.2%	9.2%	9.1%	18.8%	19.9%	31%	31%	34.2%	34.9%	18.9%	17.3%	2%	6%
Teradyne	95.23	\$14,458	4.4x	3.2x	14.2x	8.9x	29.0x	14.9x	19.9x	11.7x	0.5%	0.7%	3.7%	7.1%	31.2%	35.5%	7%	7%	60.5%	59.5%	34.9%	49.4%	-6%	41%
Tokyo Electron	47,550	\$53,080	3.1x	3.0x	9.6x	9.1x	21.7x	14.7x	15.0x	14.4x	3.4%	3.6%	4.4%	6.4%	32.7%	32.7%	6%	6%	46.2%	46.4%	32.1%	28.7%	7%	3%
VAT Group</td																								

Section 2

Semiconductor and SPE Industry Forecasts

Key Messages

- Semiconductor revenue declined Q/Q in CQ1:22 for the first time in 6Qs due to the weak performance in memory; we have begun cutting estimates for semis revenue, now up ~15% Y/Y this year versus ~18% prior w/current 2023 forecast up ~6%
 - Memory revenue out-grew overall semis in '20 and '21, and we expect it to grow in-line to better in '22 and '23
 - Semis now >70bps of global GDP and have out-grown GDP by ~50% over the past 7yrs
- WFE grew ~44% in '21 led by NAND and foundry/logic – domestic China WFE is now ~20% of total WFE and we still have yet to see much if any effect from subsidies in US/EUR
 - We have been cutting WFE estimates, but still see ~12% growth this year before a decline in '23 and likely '24
 - In a “hard landing” recessionary scenario, WFE could retrench to ~\$65-70B but versus our forecast, this would entail big cuts to foundry/logic (TSMC, INTC, etc..)
- Our base case implies WFE intensity will come down slightly from ~15.6% in '21 to ~15.2% in '22 before going back to ~14% in '23 – a level which we still think is close to – but still slightly above – “normalized”
 - WFE intensity in foundry/logic is much higher than historical median versus memory where intensity remains restrained and well below median levels despite memory revenue growing faster than the overall industry – this supports our bull secular view
- SEE [SECTION 8](#) FOR MORE DETAILED QUARTERLY WFE & WFE INTENSITY FORECASTS

Semiconductor/Semi Equipment Waterfall

Figures are \$B	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E
Global GDP	60,436.7	66,162.7	73,479.9	75,172.8	77,331.9	79,468.9	75,233.6	76,417.3	81,326.7	86,343.5	87,607.8	84,705.4	89,946.6	92,696.0	95,578.8
GDP, Y/Y	-5.1%	9.5%	11.1%	2.3%	2.9%	2.8%	-5.3%	1.6%	6.4%	6.2%	1.5%	-3.2%	6.2%	3.1%	3.1%
US GDP	14,478.1	15,049.0	15,599.7	16,254.0	16,843.2	17,550.7	18,206.0	18,695.1	19,479.6	20,527.2	21,372.6	20,893.7	22,993.5	24,888.7	25,854.2
Y/Y	-2.0%	3.9%	3.7%	4.2%	3.6%	4.2%	3.7%	2.7%	4.2%	5.4%	4.1%	-2.2%	10.0%	8.2%	3.9%
% of Global GDP	24.0%	22.7%	21.2%	21.6%	21.8%	22.1%	24.2%	24.5%	24.0%	23.8%	24.4%	24.7%	25.6%	26.8%	27.1%
Semiconductor Revenue	226.3	298.3	299.5	291.6	305.6	335.8	335.2	338.9	412.1	468.8	412.1	440.4	555.9	638.2	678.7
Y/Y	-9.0%	31.8%	0.4%	-2.7%	4.8%	9.9%	-0.2%	1.1%	21.6%	13.8%	-12.1%	6.9%	26.2%	14.8%	6.3%
% of Global GDP	0.4%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.6%	0.7%	0.7%	0.7%
% of US GDP	1.6%	2.0%	1.9%	1.8%	1.8%	1.9%	1.8%	1.8%	2.1%	2.3%	1.9%	2.1%	2.4%	2.6%	2.6%
Memory Semis Revenue	44.8	69.6	60.7	57.0	66.1	78.9	77.2	76.8	123.6	158.0	106.4	117.5	153.8	176.2	192.4
Y/Y	-3.3%	55.4%	-12.7%	-6.2%	16.0%	19.4%	-2.2%	-0.6%	61.1%	27.8%	-32.6%	10.4%	30.9%	14.5%	9.2%
% of Total Semis Revenue	19.8%	23.3%	20.3%	19.5%	21.6%	23.5%	23.0%	22.7%	30.0%	33.7%	25.8%	26.7%	27.7%	27.6%	28.4%
DRAM Revenue	22.4	39.2	29.4	26.1	34.2	46.9	45.0	123.9	72.6	99.3	62.5	64.3	93.0	103.0	123.7
Y/Y	-6.7%	74.9%	-25.1%	-11.1%	31.2%	36.8%	-4.0%	175.5%	-41.4%	36.9%	-37.1%	3.0%	44.5%	10.8%	20.1%
% of Memory Semis Revenue	50.0%	56.3%	48.3%	45.8%	51.8%	59.4%	58.2%	161.4%	58.7%	62.9%	58.7%	54.8%	60.4%	58.4%	64.3%
% of Total Semis Revenue	9.9%	13.1%	9.8%	9.0%	11.2%	14.0%	13.4%	36.6%	17.6%	21.2%	15.2%	14.6%	16.7%	16.1%	18.2%
NAND Revenue	14.8	21.7	24.4	25.4	27.4	111.6	28.8	32.0	47.1	54.2	40.2	49.4	56.0	68.0	63.7
Y/Y	20.8%	46.5%	12.3%	4.1%	7.7%	307.8%	-74.2%	11.0%	47.2%	15.1%	-25.9%	22.9%	13.3%	21.6%	-6.4%
% of Memory Semis Revenue	33.1%	31.2%	40.2%	44.6%	41.4%	141.5%	37.4%	41.7%	38.1%	34.3%	37.8%	42.0%	36.4%	38.6%	33.1%
% of Total Semis Revenue	6.6%	7.3%	8.2%	8.7%	9.0%	33.2%	8.6%	9.4%	11.4%	9.8%	11.2%	10.1%	10.7%	9.4%	10.7%
IC Revenue	190.3	249.9	246.1	238.2	251.8	277.3	274.5	276.7	343.0	393.3	333.2	361.2	463.0	542.5	581.1
Y/Y	-8.8%	31.3%	-1.5%	-3.2%	5.7%	10.1%	-1.0%	0.8%	24.0%	14.7%	-15.3%	8.4%	28.2%	17.2%	7.1%
% of Total Semis Revenue	84.1%	83.8%	82.2%	81.7%	82.4%	82.6%	81.9%	81.6%	83.2%	83.9%	80.8%	82.0%	83.3%	85.0%	85.6%
Figures are \$B	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E	2023E
Semiconductor Capital Spending	25.9	56.5	66.6	58.7	57.8	64.6	64.7	70.4	92.1	106.8	102.0	117.6	162.6	193.2	188.4
Y/Y	-41.2%	118.5%	17.9%	-11.9%	-1.5%	11.6%	0.2%	8.8%	30.8%	16.0%	-4.5%	15.3%	38.3%	18.9%	-2.5%
Total Capex Intensity	11.4%	18.9%	22.3%	20.1%	18.9%	19.2%	19.3%	20.8%	22.3%	22.8%	24.8%	26.7%	29.2%	30.3%	27.8%
WFE	12.9	31.6	36.4	29.6	27.5	32.0	33.3	35.3	47.2	53.9	50.9	60.0	86.5	97.3	95.5
Y/Y	-47.8%	145.2%	15.2%	-18.5%	-7.3%	16.3%	4.1%	6.1%	33.6%	14.2%	-5.5%	17.9%	44.2%	12.4%	-1.8%
% of Total Semis Capex	49.8%	55.9%	54.6%	50.5%	47.5%	49.5%	51.4%	50.1%	51.2%	50.4%	49.9%	51.0%	53.2%	50.3%	50.7%
Total WFE Intensity	5.7%	10.6%	12.1%	10.2%	9.0%	9.5%	9.9%	10.4%	11.4%	11.5%	12.4%	13.6%	15.6%	15.2%	14.1%
Memory WFE	4.5	13.5	12.5	7.1	9.3	12.7	16.0	17.0	26.4	34.4	22.9	29.1	43.3	37.4	32.3
Y/Y	-57.0%	197.4%	-6.8%	-43.6%	31.7%	36.4%	25.9%	6.0%	55.5%	30.1%	-33.5%	27.1%	48.9%	-13.6%	-13.7%
% of WFE	35.1%	42.6%	34.5%	23.9%	33.9%	39.8%	48.2%	48.1%	56.0%	63.8%	44.9%	48.4%	50.0%	38.4%	33.8%
Memory WFE Intensity	10.1%	19.3%	20.7%	12.4%	14.1%	16.1%	20.7%	22.1%	21.4%	21.7%	21.5%	24.7%	28.1%	21.2%	16.8%
NAND WFE	1.5	4.6	7.3	4.4	5.2	6.4	7.2	10.9	17.3	18.8	12.6	15.9	20.6	17.8	16.8
Y/Y	-61.2%	211.2%	60.6%	-40.6%	19.8%	23.0%	12.9%	50.3%	59.0%	8.7%	-33.0%	25.8%	29.7%	-13.6%	-5.6%
% of Memory WFE	32.4%	33.9%	58.3%	61.4%	55.9%	50.4%	45.2%	64.1%	65.5%	54.7%	55.1%	54.6%	47.5%	47.5%	51.9%
% of Total WFE	11.4%	14.4%	20.1%	14.7%	19.0%	20.1%	21.8%	30.8%	36.7%	34.9%	24.8%	26.4%	23.8%	18.3%	17.5%
NAND WFE Intensity	9.9%	21.0%	30.0%	17.1%	19.0%	5.7%	25.1%	34.0%	36.7%	34.7%	31.4%	32.1%	36.7%	26.1%	26.3%
DRAM WFE	2.9	8.9	5.2	2.7	4.1	6.3	8.8	6.0	9.1	15.6	10.3	13.2	22.7	19.6	15.5
Y/Y	-51.4%	202.2%	-41.3%	-47.7%	50.5%	53.5%	39.2%	-32.2%	52.9%	70.9%	-34.1%	28.8%	72.0%	-13.7%	-20.9%
% of Memory WFE	65.1%	66.1%	41.7%	38.6%	44.1%	49.6%	54.8%	35.1%	34.5%	45.3%	44.9%	45.4%	52.5%	52.5%	48.1%
% of Total WFE	22.9%	28.2%	14.4%	9.2%	15.0%	19.7%	26.4%	16.9%	19.3%	28.9%	20.1%	22.0%	26.2%	20.2%	16.2%
DRAM WFE Intensity	13.1%	22.7%	17.8%	10.5%	12.0%	13.5%	19.5%	4.8%	12.5%	15.7%	16.4%	20.5%	24.4%	19.0%	12.5%
Non-memory WFE	8.4	18.1	23.8	22.6	18.1	19.2	17.2	18.3	20.8	19.5	28.0	31.0	43.3	59.9	63.3
Y/Y	-41.0%	117.0%	31.5%	-5.4%	-19.6%	6.0%	-10.4%	6.3%	13.2%	-6.0%	43.3%	10.7%	39.7%	38.5%	5.6%
% of WFE	64.9%	57.4%	65.5%	76.1%	66.1%	60.2%	51.8%	51.9%	44.0%	36.2%	54.9%	51.6%	50.0%	61.6%	66.2%
Non-Memory WFE Intensity	4.6%	7.9%	10.0%	9.6%	7.6%	7.5%	6.7%	7.0%	7.2%	6.3%	9.1%	9.6%	10.8%	13.0%	13.0%

Source: SIA, SEMI, UBS estimates



We model Semis revenue growth of ~15% in '22E, ~6% in '23E

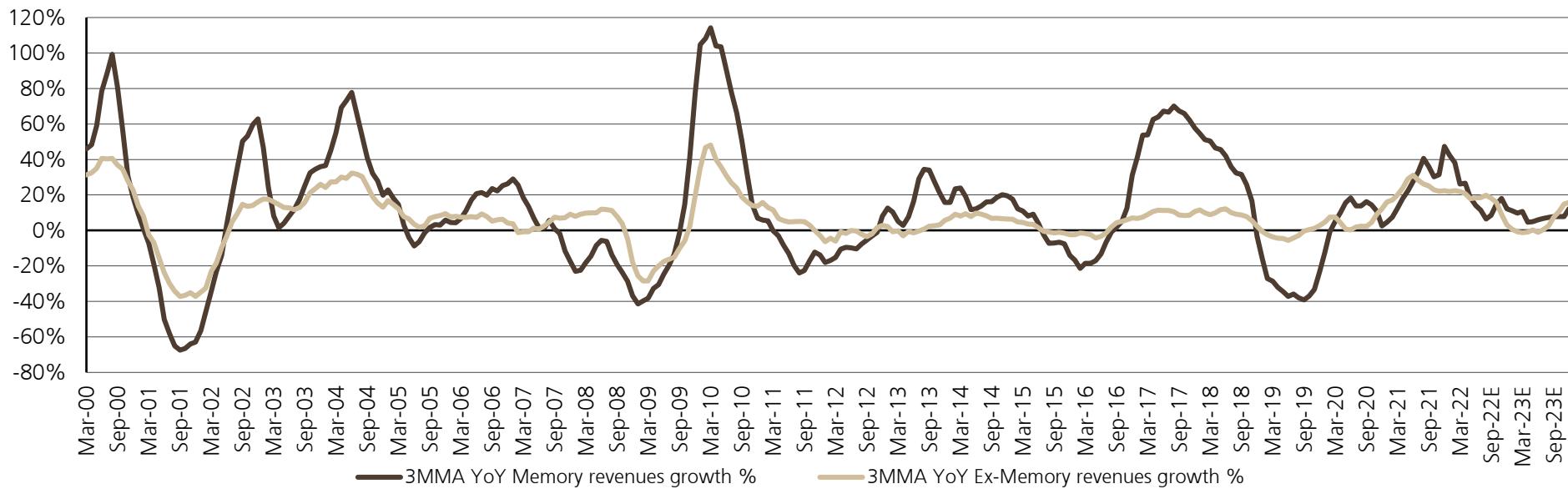
Total Semiconductors Revenue and ASP by Segment

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E
MPU, Sales	41,120,167	44,033,382	43,268,451	43,050,304	44,369,658	46,899,058	47,974,176	51,811,870	57,753,026	63,817,094	68,284,290
MPU, Units	458,121	488,207	494,826	494,091	457,500	428,249	384,220	421,985	498,647	470,944	479,002
MPU, ASPs	89.76	90.19	87.44	87.13	96.98	109.51	124.86	122.78	115.82	135.51	142.56
MCU, Sales	14,658,774	15,310,211	15,478,968	16,258,630	16,437,022	17,068,878	15,807,854	15,483,891	19,622,513	22,958,340	23,876,674
MCU, Units	15,573,737	18,628,168	21,621,573	21,014,318	25,304,047	27,568,461	25,036,268	26,226,091	29,742,488	31,635,192	32,900,599
MCU, ASPs	0.94	0.82	0.72	0.77	0.65	0.62	0.63	0.59	0.66	0.73	0.73
DSP, Sales	2,909,345	2,728,208	2,550,621	2,869,143	3,285,817	3,265,021	2,657,836	2,382,134	2,845,419	2,987,690	3,077,321
DSP, Units	467,389	426,095	446,414	418,648	460,959	443,356	408,847	393,251	446,387	446,423	464,423
DSP, ASPs	6.22	6.40	5.71	6.85	7.13	7.36	6.50	6.06	6.37	6.69	6.63
Analog, Sales	40,116,781	44,365,411	45,227,611	47,847,781	53,072,260	58,785,389	53,903,091	55,657,641	74,105,380	82,998,026	86,317,947
Analog, Units	104,250,628	115,559,563	123,013,755	131,673,767	153,446,553	174,988,735	163,706,568	173,199,980	214,862,107	229,186,247	238,353,697
Analog, ASPs	0.38	0.38	0.37	0.36	0.35	0.34	0.33	0.32	0.34	0.36	0.36
CMOS Logic, Sales	85,927,195	91,633,002	90,752,745	89,902,602	102,200,535	109,303,107	106,382,346	118,407,779	154,836,967	193,546,209	207,094,443
CMOS Logic Units	47,676,638	46,412,108	47,071,600	51,985,511	60,659,139	65,527,574	59,020,581	65,241,368	88,128,777	102,954,179	110,160,971
CMOS Logic, ASPs	1.80	1.97	1.93	1.73	1.68	1.67	1.80	1.81	1.76	1.88	1.88
Total IC ex-Memory, Sales	184,732,262	198,070,214	197,278,396	199,928,460	219,365,292	235,321,453	226,725,303	243,743,315	309,163,305	366,307,358	388,650,675
% Growth	1.9%	7.2%	-0.4%	1.3%	9.7%	7.3%	-3.7%	7.5%	26.8%	18.5%	6.1%
Total IC ex-Memory, Units	168,426,513	181,514,141	192,648,168	205,586,335	240,328,198	268,956,375	248,556,484	265,482,675	333,678,406	364,692,949	382,358,693
Total IC ex-Memory, ASP	1.10	1.09	1.02	0.97	0.91	0.87	0.91	0.92	0.93	1.00	1.02
Memory, Sales	67,043,368	78,916,369	77,205,278	76,766,947	123,973,749	157,966,749	106,431,501	117,482,479	153,838,238	176,217,415	192,416,899
% Growth	17.6%	17.7%	-2.2%	-0.6%	61.5%	27.4%	-32.6%	10.4%	30.9%	14.5%	9.2%
Memory Units	33,977,253	37,599,572	37,797,130	41,901,509	43,130,333	41,723,954	42,431,272	44,652,312	50,143,158	55,430,960	65,073,124
Memory, ASP	1.97	2.10	2.04	1.83	2.87	3.79	2.51	2.63	3.07	3.18	2.96
Total IC, Sales	251,775,630	277,302,214	274,483,673	276,695,407	343,010,225	393,288,202	333,156,804	361,225,794	463,001,543	542,524,773	581,067,574
% Growth	5.7%	10.1%	-1.0%	0.8%	24.0%	14.7%	-15.3%	8.4%	28.2%	17.2%	7.1%
Total IC Units	202,403,766	219,275,907	230,445,298	247,487,844	283,458,531	310,680,329	290,987,756	310,134,987	383,821,564	420,123,909	447,431,817
Total IC, ASP	1.24	1.26	1.19	1.12	1.21	1.27	1.14	1.16	1.21	1.29	1.30
Discrete&Opto&Passives Sales	53,808,234	58,544,636	60,684,188	62,193,832	69,074,897	75,490,083	78,944,564	79,163,564	92,890,971	95,677,700	97,591,254
% Growth	0.9%	8.8%	3.7%	2.5%	11.1%	9.3%	4.6%	0.3%	17.3%	3.0%	2.0%
Discrete&Opto&Passives, Units	503,087,891	547,141,084	556,793,220	579,514,912	652,357,666	693,807,604	640,950,125	643,612,663	763,036,425	748,502,398	763,472,446
Discrete&Opto&Passives, ASP	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.13
Total Semiconductor Sales	305,583,864	335,846,850	335,167,861	338,889,239	412,085,122	468,778,285	412,101,368	440,389,358	555,892,514	638,202,473	678,658,828
% Growth	4.8%	9.9%	-0.2%	1.1%	21.6%	13.8%	-12.1%	6.9%	26.2%	14.8%	6.3%
Total Semiconductor, Units	705,491,657	766,416,991	787,238,518	827,002,756	935,816,197	1,004,487,933	931,937,881	953,747,650	1,146,857,989	1,168,626,307	1,210,904,263
Total Semiconductor, ASP	0.43	0.44	0.43	0.41	0.44	0.47	0.44	0.46	0.48	0.55	0.56

Source: SIA, UBS estimates

Y/Y revenue growth is decelerating, but should remain positive through CY22 before a more challenging '23

3MMA Y/Y Memory vs. ex-Memory Revenues Growth Comparison



Source: SIA, UBS estimates

SIA Data – Quarterly Semiconductor Revenue

Quarterly Semiconductor Revenue Relative to 10-Year Seasonality

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	5-yr Avg	5-yr Median	10-yr Avg	10-yr Median
Total Semi Revenue	Q1	-16.3%	+3.7%	+0.6%	-2.3%	-5.1%	-1.9%	-4.9%	-5.5%	-0.4%	-2.3%	-14.7%	-3.5%	3.8%	(0.5%)	-3.4%	-2.3%	-3.7%	-2.9%
	Q2	+20.0%	+6.6%	-1.7%	+4.7%	+6.0%	+4.9%	+1.0%	+1.2%	+5.3%	+6.0%	+0.7%	-1.1%	9.1%		+4.0%	+5.3%	+3.8%	+4.8%
	Q3	+19.9%	+5.6%	+3.7%	+1.8%	+7.9%	+6.5%	+1.5%	+11.6%	+10.5%	+5.9%	+8.9%	+9.8%	8.1%		+8.6%	+8.9%	+7.2%	+8.0%
	Q4	+7.0%	-4.0%	-7.7%	-0.3%	-0.8%	-0.4%	-2.8%	+5.3%	+5.7%	-8.2%	+0.9%	+4.7%	4.9%		+1.6%	+4.7%	+0.9%	+0.3%
Total Memory Revenue	Q1	-10.1%	+8.8%	+1.6%	-0.0%	-2.7%	+4.1%	-3.4%	-8.5%	+7.4%	+2.3%	-24.6%	+3.9%	14.0%	(2.4%)	+0.6%	+3.9%	-0.7%	+1.2%
	Q2	+26.4%	+12.4%	-2.2%	+4.0%	+15.0%	+4.2%	-2.4%	+4.0%	+13.0%	+6.7%	-6.2%	+5.7%	20.0%		+7.8%	+6.7%	+6.4%	+4.9%
	Q3	+27.2%	+0.5%	-10.3%	-5.9%	+8.5%	+12.3%	+0.4%	+17.9%	+18.0%	+9.3%	+5.8%	+3.9%	10.8%		+9.5%	+9.3%	+8.1%	+8.9%
	Q4	+22.4%	-13.1%	-3.3%	+10.4%	-4.6%	-1.9%	-9.3%	+16.8%	+10.2%	-18.8%	+1.9%	-10.2%	(2.7%)		-3.9%	-2.7%	-0.8%	-2.3%
Total IC ex-Memory Revenue	Q1	-15.4%	+1.9%	+0.3%	-4.0%	-4.8%	-4.9%	-5.9%	-5.7%	-3.8%	-4.9%	-11.7%	-5.1%	(0.0%)	1.0%	-5.1%	-4.9%	-5.1%	-4.9%
	Q2	+17.8%	+4.6%	-3.3%	+5.6%	+2.5%	+6.0%	+0.9%	+0.6%	+2.7%	+5.1%	+2.0%	-2.8%	6.7%		+2.7%	+2.7%	+2.9%	+2.6%
	Q3	+17.7%	+6.9%	+8.4%	+3.4%	+8.5%	+4.5%	+2.2%	+10.1%	+7.3%	+3.5%	+10.4%	+10.4%	7.6%		+7.8%	+7.6%	+6.8%	+7.4%
	Q4	+2.2%	-0.9%	-8.6%	-3.2%	+0.8%	+0.5%	-0.1%	+2.2%	+3.9%	-1.6%	+1.4%	+12.7%	9.0%		+5.1%	+3.9%	+2.6%	+1.1%
Total Analog Revenue	Q1	-18.7%	+5.3%	-0.2%	+0.7%	+1.6%	+0.4%	-3.1%	-0.9%	-2.2%	+3.4%	-9.3%	-5.2%	3.9%	4.4%	-1.9%	-2.2%	-1.1%	-0.3%
	Q2	+28.3%	+6.0%	+3.2%	+2.4%	+3.6%	+5.1%	+1.9%	+5.0%	+3.1%	+2.2%	-1.8%	-5.3%	5.7%		+0.8%	+2.2%	+2.2%	+2.7%
	Q3	+14.0%	+4.8%	-2.7%	+1.7%	+4.9%	+7.2%	+2.2%	+9.9%	+6.8%	+1.1%	+6.9%	+18.8%	6.7%		+8.1%	+6.8%	+6.6%	+6.8%
	Q4	+7.0%	-2.3%	-10.3%	-7.5%	-0.8%	-1.0%	-5.0%	+1.1%	+1.5%	-1.6%	-3.0%	+12.2%	7.9%		+3.4%	+1.5%	+0.4%	-0.9%
Total MPU Revenue	Q1	+0.4%	+3.4%	+6.2%	-10.9%	-7.4%	-7.1%	-10.5%	-10.9%	-7.1%	-11.7%	-11.8%	-3.7%	(2.9%)	(5.7%)	-7.4%	-7.1%	-8.4%	-8.9%
	Q2	+13.6%	+4.1%	-8.2%	+3.3%	+1.2%	+8.3%	-3.5%	-1.9%	+0.7%	+10.1%	+3.0%	-4.3%	7.8%		+3.4%	+3.0%	+2.5%	+2.1%
	Q3	+25.1%	+3.6%	+17.4%	+0.5%	+7.4%	+6.7%	+13.4%	+11.2%	+6.0%	+9.9%	+16.8%	-1.2%	2.8%		+6.8%	+6.0%	+7.3%	+7.1%
	Q4	-1.4%	+2.6%	-4.4%	-0.2%	+1.3%	-0.1%	+2.2%	+0.9%	+5.9%	-5.6%	+7.3%	+8.9%	8.4%		+5.0%	+7.3%	+2.9%	+1.7%

Source: SIA, UBS Estimates

SIA Data – Quarterly Semiconductor Units

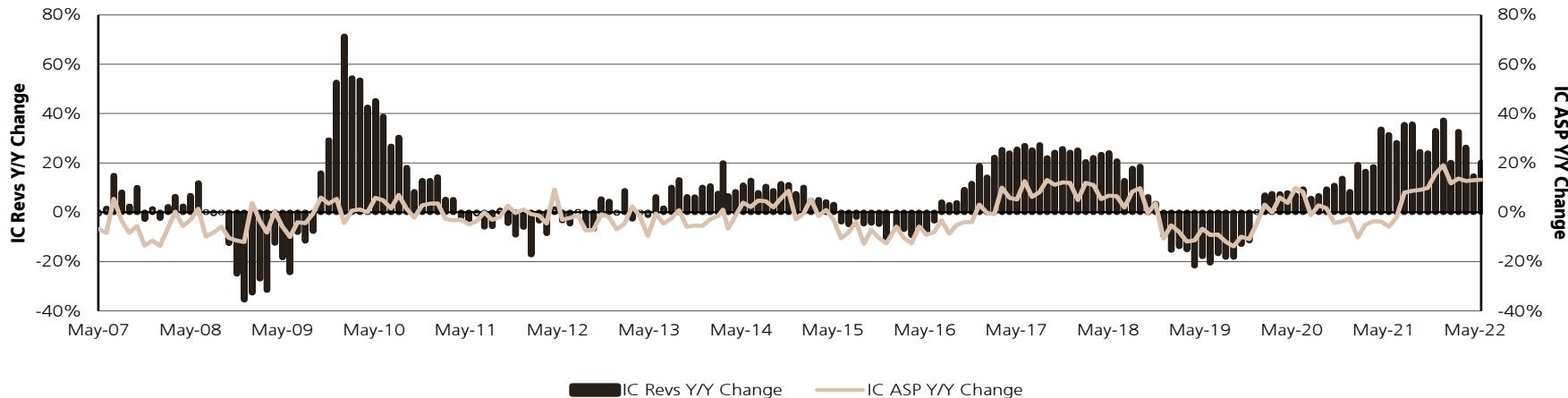
Quarterly Semiconductor Units Relative to 10-Year Seasonality

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	5-yr Avg	5-yr Median	10-yr Avg	10-yr Median	
		Q1	-17.6%	+0.8%	+1.4%	+5.6%	-1.7%	-1.2%	-1.6%	-0.6%	+1.4%	-0.1%	-7.4%	-5.6%	4.9%	(2.0%)	-1.3%	-0.1%	-0.6%	-0.9%
Total Semi Units	Q2	+31.6%	+8.5%	+4.2%	+6.8%	+9.0%	+7.9%	+4.1%	+3.0%	+4.8%	+6.6%	-1.8%	-2.4%	5.3%		+2.5%	+4.8%	+4.3%	+5.0%	
	Q3	+17.7%	+1.9%	-1.2%	+1.2%	+4.3%	+4.9%	+0.8%	+8.2%	+6.0%	+4.7%	+7.3%	+14.0%	1.6%		+6.7%	+6.0%	+5.3%	+4.8%	
	Q4	+3.2%	-5.4%	-10.5%	-4.8%	-2.7%	-3.3%	-3.1%	+0.8%	-2.9%	-7.0%	-1.6%	+5.2%	(1.8%)		-1.7%	-1.8%	-2.1%	-2.8%	
	Q1	-10.0%	-2.4%	+6.9%	+1.7%	-4.7%	+1.3%	-4.5%	+1.1%	-7.2%	-7.3%	-8.2%	-7.6%	2.5%	(1.9%)	-5.6%	-7.3%	-3.3%	-4.6%	
Total Memory Units	Q2	+22.3%	+6.4%	-3.4%	+5.6%	+2.7%	+10.0%	+4.2%	+9.0%	+0.4%	+4.0%	+10.0%	-2.0%	3.0%		+3.1%	+3.0%	+4.7%	+4.1%	
	Q3	+15.1%	+0.0%	-1.0%	-2.8%	+2.5%	+7.1%	+0.0%	+10.6%	+7.9%	+6.8%	+16.8%	+8.1%	(0.0%)		+7.9%	+7.9%	+5.7%	+6.9%	
	Q4	+11.7%	-3.0%	-5.3%	+0.2%	-3.9%	-3.1%	-4.8%	+0.4%	-3.7%	-11.4%	-1.0%	+6.8%	(4.8%)		-2.8%	-3.7%	-2.6%	-3.4%	
	Q1	-22.2%	+4.1%	+0.9%	+2.0%	-0.5%	-2.2%	-1.2%	-4.2%	-0.8%	-0.3%	-10.7%	-7.1%	1.8%	(0.2%)	-3.4%	-0.8%	-2.3%	-1.0%	
Total IC ex-Memory Units	Q2	+28.4%	+9.4%	+3.0%	+6.9%	+13.0%	+5.8%	+7.0%	+5.4%	+6.3%	+9.1%	+1.2%	-0.7%	7.7%		+4.7%	+6.3%	+6.2%	+6.6%	
	Q3	+16.9%	+3.4%	-1.1%	+4.7%	+9.3%	+3.6%	+4.3%	+12.2%	+10.1%	+3.2%	+8.8%	+17.2%	3.5%		+8.6%	+8.8%	+7.7%	+6.7%	
	Q4	+3.6%	-4.8%	-11.1%	-6.2%	-3.7%	-2.9%	-3.9%	+0.4%	-1.3%	-6.8%	-0.4%	+7.9%	2.8%		+0.5%	-0.4%	-1.4%	-2.1%	
	Q1	-23.5%	+4.2%	-0.2%	+0.2%	+0.1%	+0.1%	-0.4%	-4.1%	-1.5%	-0.1%	-11.8%	-9.3%	(0.7%)	(0.3%)	-4.7%	-1.5%	-2.8%	-0.6%	
Total Analog Units	Q2	+34.9%	+10.7%	+5.0%	+7.8%	+14.1%	+5.8%	+10.0%	+5.3%	+6.4%	+9.3%	-0.3%	-2.7%	8.5%		+4.2%	+6.4%	+6.4%	+7.1%	
	Q3	+17.0%	+3.2%	-2.5%	+5.2%	+9.0%	+2.8%	+3.9%	+12.4%	+11.1%	+5.6%	+8.7%	+21.0%	4.5%		+10.2%	+8.7%	+8.4%	+7.1%	
	Q4	+2.9%	-4.4%	-10.8%	-5.5%	-1.7%	-5.3%	-4.4%	+0.5%	-2.2%	-4.6%	+2.3%	+6.9%	2.1%		+0.9%	+2.1%	-1.2%	-2.0%	
	Q1	-5.3%	-3.3%	+0.6%	-16.8%	-7.4%	-6.4%	-6.3%	-13.1%	-11.9%	-12.5%	-13.4%	-0.1%	(5.4%)	(4.5%)	-8.7%	-11.9%	-9.3%	-9.6%	
Total MPU Units	Q2	+7.3%	+6.1%	-7.1%	+2.8%	+1.4%	+10.5%	-3.6%	+6.2%	+1.4%	+5.4%	+2.2%	-6.5%	3.6%		+1.2%	+2.2%	+2.3%	+2.5%	
	Q3	+19.2%	+7.6%	+18.8%	+5.7%	+7.7%	+8.4%	+13.7%	+5.2%	+5.0%	-2.7%	+6.9%	-1.1%	11.4%		+3.9%	+5.0%	+6.0%	+6.3%	
	Q4	+0.6%	-5.2%	-8.0%	-2.0%	-2.2%	-4.3%	+3.6%	-4.4%	+3.6%	-4.7%	+8.7%	+21.3%	7.6%		+7.3%	+7.6%	+2.7%	+0.8%	

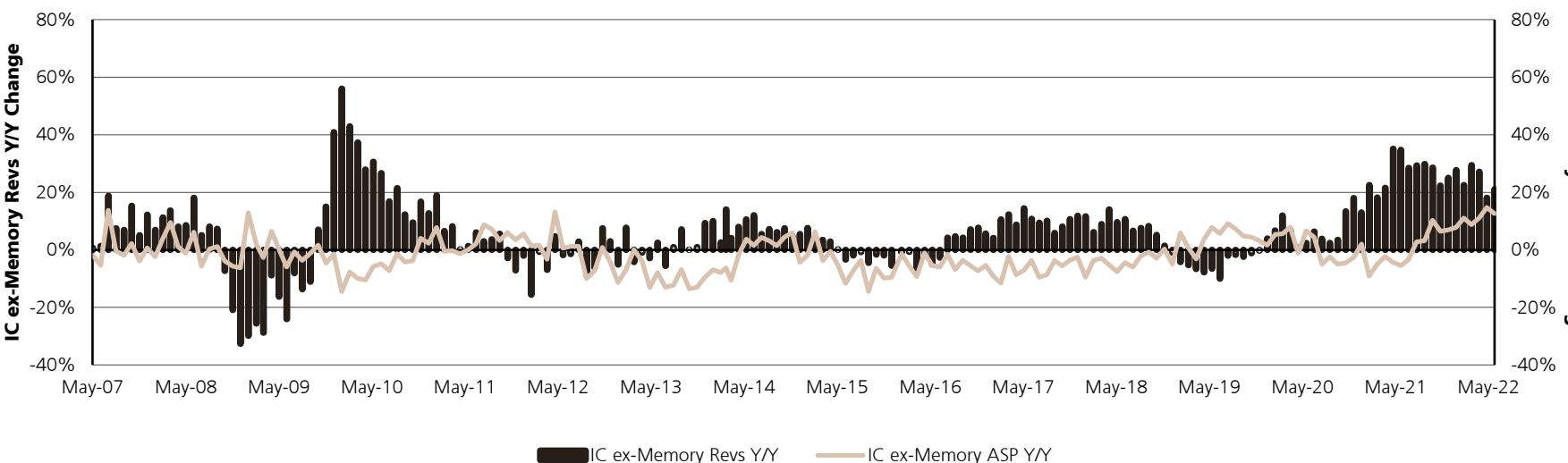
Source: SIA, UBS Estimates

Semis pricing is growing

Total IC (excl. Discretes) Revenue and ASP Y/Y Change

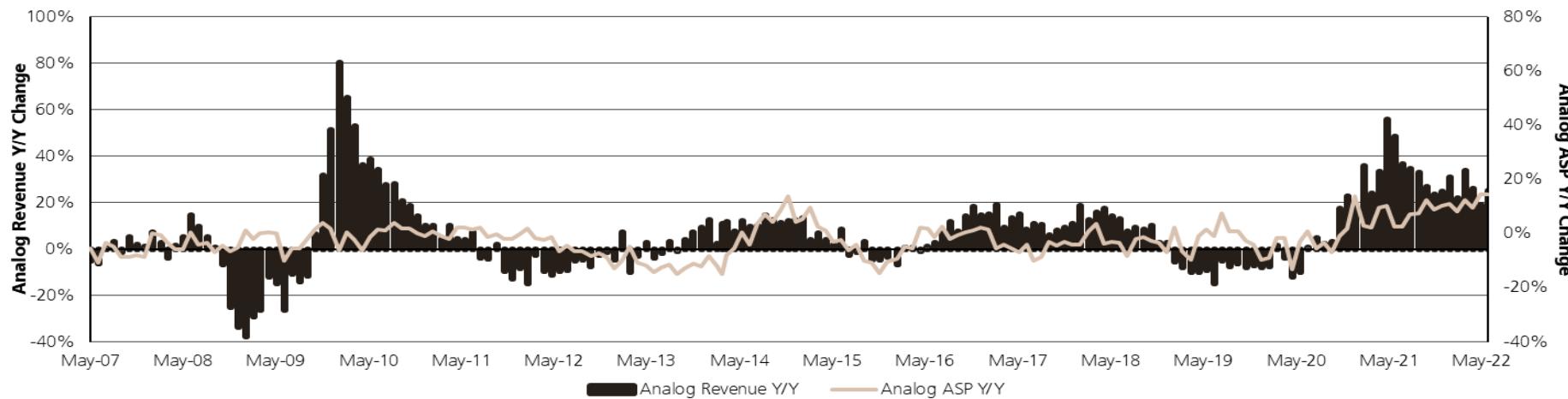


Total IC (excl. Memory) Revenue and ASP Y/Y Change



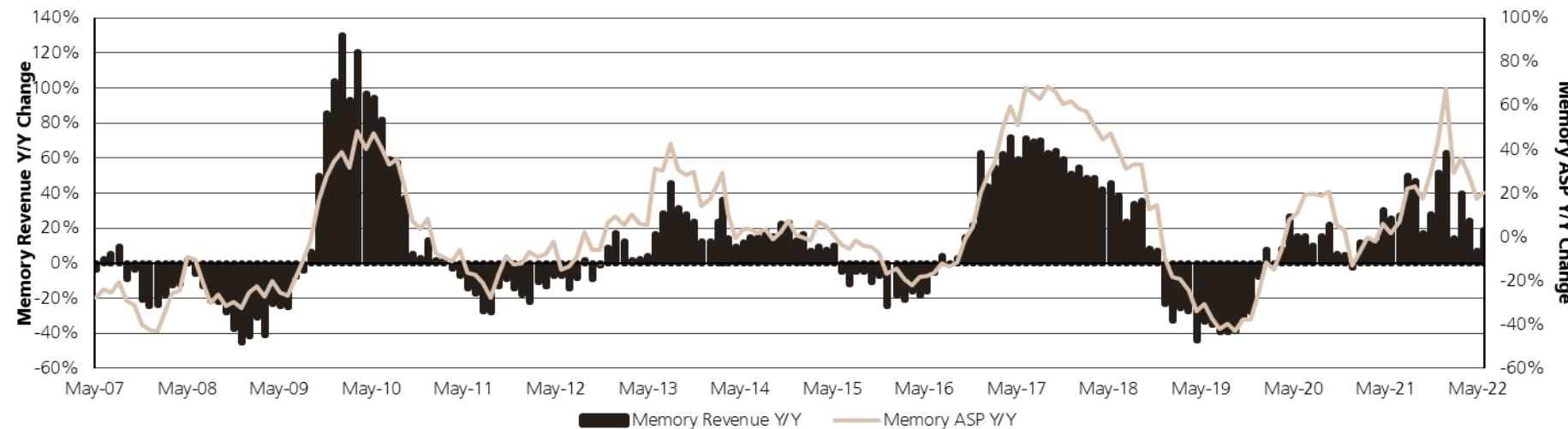
...especially for Analog while Memory pricing has been declining

Analog Revenue and ASP Y/Y Change



Source: SIA, UBS estimates

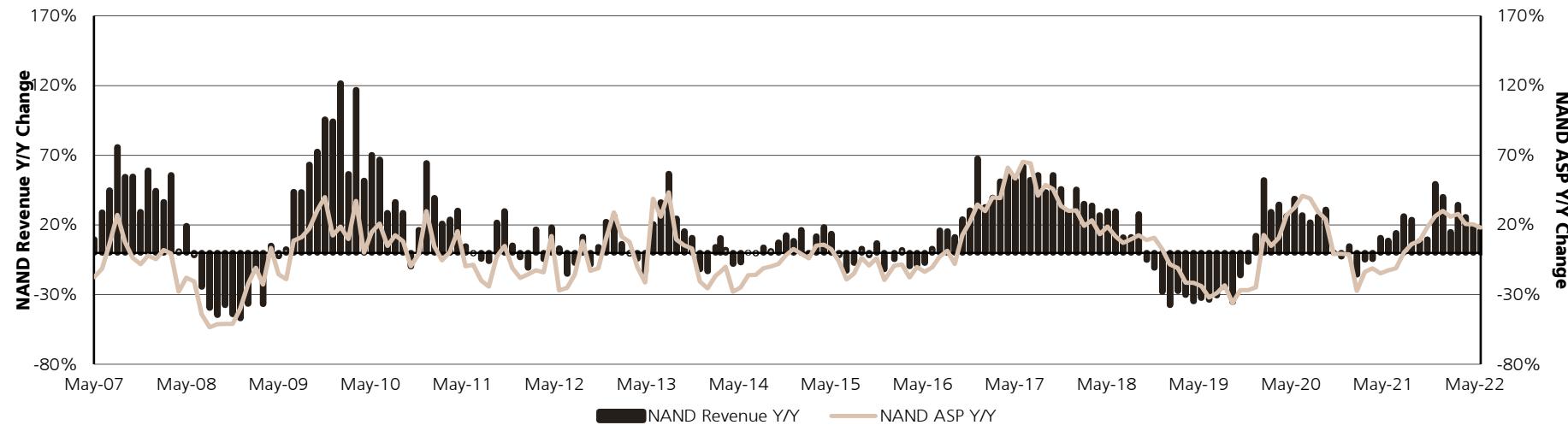
Memory Revenue and ASP Y/Y Change



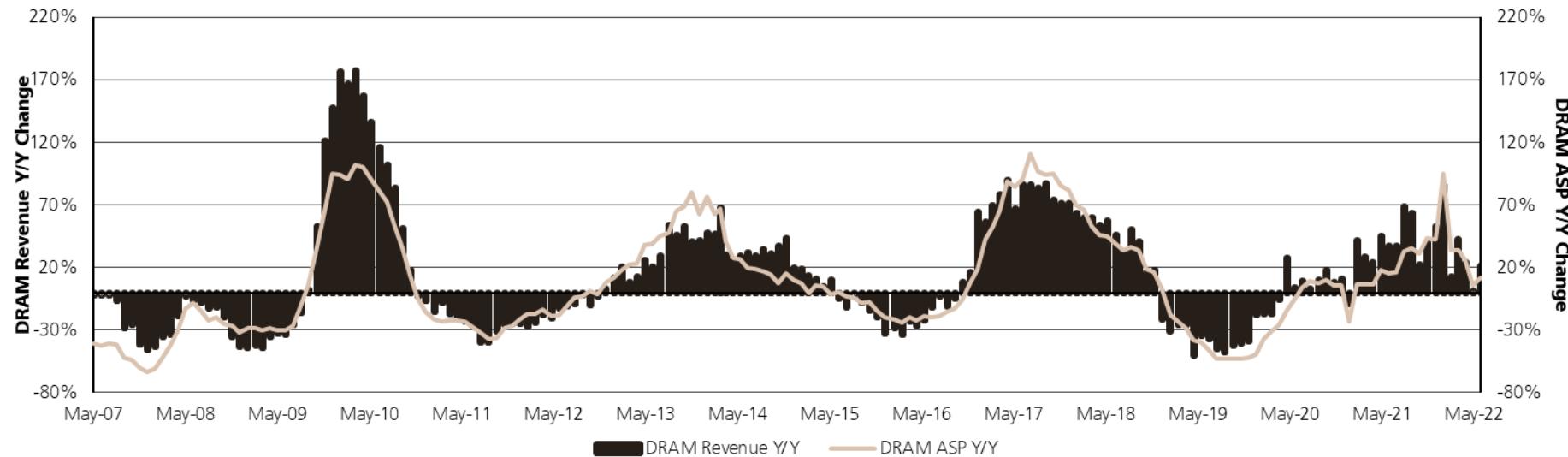
Source: SIA, UBS estimates

Memory Pricing Details

NAND Revenue and ASP Y/Y Change



DRAM Revenue and ASP Y/Y Change



Source: SIA, UBS estimates



Taiwan monthly sales highlight recent supply improvements

Taiwan Sales M/M Growth

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Grand Total	Jan	(2%)	(9%)	(3%)	(20%)	(13%)	(14%)	(18%)	(19%)	(17%)	(24%)	(18%)	(21%)
	Feb	(11%)	(17%)	3%	(21%)	(14%)	(26%)	(18%)	(8%)	(26%)	(29%)	(24%)	(19%)
	Mar	27%	31%	11%	21%	21%	28%	28%	17%	29%	34%	44%	24%
	Apr	(2%)	(2%)	(7%)	(1%)	(2%)	(6%)	(11%)	(11%)	(6%)	(2%)	5%	0%
	May	6%	(0%)	3%	4%	(1%)	(6%)	1%	1%	5%	3%	2%	(3%)
	Jun	2%	(2%)	5%	(1%)	7%	7%	9%	13%	3%	3%	3%	3%
	Jul	(3%)	9%	(2%)	(1%)	(6%)	(4%)	(5%)	(3%)	4%	1%	4%	(0%)
	Aug	8%	(1%)	(2%)	0%	3%	2%	10%	6%	7%	5%	2%	1%
	Sep	10%	(3%)	8%	16%	23%	33%	23%	20%	18%	22%	10%	21%
	Oct	(7%)	18%	3%	(1%)	5%	1%	(2%)	3%	4%	(0%)	6%	(7%)
	Nov	(6%)	(2%)	9%	10%	2%	(3%)	2%	4%	(2%)	(1%)	9%	11%
	Dec	(3%)	(10%)	(3%)	1%	(0%)	(10%)	(7%)	(0%)	(6%)	(6%)	(0%)	7%

Source: UBS, Company filings

Taiwan Sales M/M Growth – Relative to 5 Year Seasonal Average

	2015	2016	2017	2018	2019	2020	2021	2022
Grand Total	Jan	(5%)	(6%)	(5%)	(0%)	(8%)	0%	(2%)
	Feb	(14%)	(3%)	7%	(8%)	(10%)	(3%)	2%
	Mar	6%	6%	(5%)	5%	9%	16%	(6%)
	Apr	(3%)	(8%)	(5%)	0%	5%	12%	5%
	May	(8%)	1%	1%	5%	3%	1%	(6%)
	Jun	5%	6%	8%	(4%)	(5%)	(4%)	(4%)
	Jul	(3%)	(5%)	1%	7%	3%	5%	(0%)
	Aug	(0%)	9%	4%	3%	(1%)	(4%)	(5%)
	Sep	22%	8%	(0%)	(5%)	(2%)	(13%)	3%
	Oct	(2%)	(7%)	2%	3%	(2%)	5%	(9%)
	Nov	(6%)	(1%)	0%	(5%)	(1%)	9%	8%
	Dec	(7%)	(2%)	4%	(2%)	(2%)	5%	11%

Source: UBS, Company filings

Taiwan Monthly Sales (Sector Detail - Monthly)

Taiwan Sales M/M Growth

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Smartphone-related	Jan	(12%)	(18%)	(9%)	(25%)	(15%)	(12%)	(17%)	(23%)	(21%)	(28%)	(27%)	(29%)
	Feb	(16%)	(15%)	(3%)	(26%)	(21%)	(32%)	(25%)	(14%)	(32%)	(33%)	(30%)	(22%) (8%)
	Mar	36%	35%	15%	12%	24%	33%	28%	14%	22%	35%	46%	21% 26%
	Apr	(3%)	(5%)	(5%)	8%	4%	(6%)	(9%)	(3%)	3%	3%	8%	8% (15%)
	May	18%	(1%)	(1%)	8%	(5%)	(11%)	(3%)	(5%)	(1%)	(2%)	2%	(4%) 6%
	Jun	(7%)	14%	2%	(7%)	9%	2%	10%	13%	4%	3%	(1%)	(3%)
	Jul	14%	1%	(1%)	1%	(13%)	(0%)	(3%)	4%	8%	5%	6%	1%
	Aug	11%	(6%)	(5%)	(5%)	5%	3%	7%	2%	3%	2%	3%	(2%)
	Sep	12%	11%	11%	29%	39%	54%	41%	39%	30%	36%	14%	37%
	Oct	5%	13%	8%	(2%)	12%	7%	(0%)	6%	12%	(1%)	12%	(9%)
	Nov	0%	(3%)	19%	12%	4%	(7%)	(4%)	(0%)	(5%)	(3%)	14%	12%
	Dec	(5%)	(1%)	2%	2%	(2%)	(18%)	(12%)	2%	(9%)	(9%)	(3%)	10%
PC-related	Jan	12%	2%	4%	(15%)	(18%)	(27%)	(20%)	(9%)	(12%)	(28%)	(15%)	(20%)
	Feb	(9%)	(21%)	15%	(16%)	(7%)	(17%)	(6%)	(2%)	(17%)	(25%)	(24%)	(18%) (11%)
	Mar	17%	27%	3%	29%	21%	30%	33%	24%	28%	44%	65%	37% 31%
	Apr	(10%)	4%	(14%)	(17%)	(14%)	(18%)	(27%)	(20%)	(17%)	(14%)	3%	(10%) (36%)
	May	8%	3%	8%	4%	7%	3%	10%	10%	11%	6%	6%	(3%) 20%
	Jun	2%	(14%)	19%	8%	9%	23%	21%	19%	6%	8%	7%	11%
	Jul	(16%)	21%	(15%)	(5%)	(4%)	(17%)	(14%)	(9%)	(1%)	(7%)	3%	(1%)
	Aug	17%	1%	(1%)	5%	4%	10%	11%	7%	8%	5%	(1%)	3%
	Sep	14%	(11%)	16%	13%	13%	28%	15%	15%	8%	17%	9%	16%
	Oct	(12%)	24%	(2%)	(7%)	(1%)	(12%)	(7%)	(1%)	5%	(3%)	(4%)	(4%)
	Nov	(20%)	(4%)	1%	11%	1%	3%	10%	3%	(2%)	0%	8%	9%
	Dec	(8%)	(22%)	(7%)	(6%)	(1%)	(1%)	(6%)	(13%)	(7%)	(4%)	(1%)	1%
Foundry-related	Jan	0%	8%	26%	3%	21%	20%	(2%)	(8%)	(11%)	0%	7%	9%
	Feb	0%	(7%)	(3%)	(12%)	(7%)	(25%)	(16%)	(6%)	(17%)	(20%)	(9%)	(14%) (13%)
	Mar	7%	12%	10%	8%	7%	14%	24%	18%	50%	25%	19%	20% 16%
	Apr	4%	(0%)	10%	12%	19%	4%	(9%)	(30%)	(18%)	(3%)	(13%)	(12%) 0%
	May	4%	(1%)	7%	4%	(1%)	(6%)	11%	23%	0%	7%	(2%)	2% 8%
	Jun	4%	(0%)	(1%)	3%	0%	(13%)	10%	14%	(10%)	5%	24%	27%
	Jul	3%	(3%)	10%	(2%)	5%	29%	(6%)	(13%)	5%	1%	(10%)	(13%)
	Aug	1%	3%	2%	3%	5%	(15%)	20%	24%	17%	20%	13%	9%
	Sep	0%	(9%)	(11%)	(0%)	8%	(5%)	(5%)	(4%)	2%	(5%)	3%	9%
	Oct	0%	10%	13%	(6%)	8%	24%	1%	8%	7%	7%	(5%)	(10%)
	Nov	(4%)	(4%)	(10%)	(12%)	(11%)	(20%)	2%	(3%)	(3%)	1%	4%	9%
	Dec	(4%)	(10%)	(15%)	9%	(2%)	(7%)	(14%)	(4%)	(8%)	(4%)	(5%)	5%
Apple Supply Chain-related	Jan	(10%)	(9%)	(7%)	(26%)	(16%)	(17%)	(19%)	(24%)	(22%)	(28%)	(29%)	(29%)
	Feb	(9%)	(16%)	(5%)	(25%)	(20%)	(30%)	(21%)	(13%)	(30%)	(32%)	(31%)	(21%) (8%)
	Mar	26%	35%	10%	12%	19%	27%	26%	14%	22%	33%	50%	21% 21%
	Apr	(3%)	(2%)	(7%)	3%	0%	(3%)	(12%)	(6%)	1%	2%	8%	(5%) (18%)
	May	13%	(3%)	1%	3%	(4%)	(8%)	(3%)	(3%)	1%	1%	2%	(5%) 10%
	Jun	9%	3%	5%	(1%)	11%	6%	10%	14%	3%	1%	(1%)	(3%)
	Jul	(8%)	8%	1%	2%	(9%)	(3%)	(3%)	2%	9%	4%	6%	4%
	Aug	10%	(5%)	(6%)	(3%)	4%	2%	8%	5%	4%	3%	2%	(3%)
	Sep	13%	2%	11%	24%	37%	50%	37%	33%	27%	32%	12%	34%
	Oct	1%	27%	12%	1%	10%	4%	0%	7%	12%	0%	14%	(5%)
	Nov	(10%)	1%	15%	14%	5%	(6%)	(1%)	1%	(3%)	(1%)	13%	11%
	Dec	(2%)	(6%)	(1%)	3%	(1%)	(15%)	(9%)	2%	(8%)	(10%)	(1%)	10%

Source: UBS, Company filings

M/M Relative to 5 Year Seasonal Average

	2015	2016	2017	2018	2019	2020	2021	2022
Smartphone-related	Jan	4%	(1%)	(8%)	(3%)	(10%)	(7%)	(6%)
	Feb	(16%)	(6%)	7%	(8%)	(8%)	5%	18%
	Mar	9%	4%	(8%)	(1%)	11%	19%	(8%) (2%)
	Apr	(6%)	(8%)	(2%)	5%	5%	10%	7% (19%)
	May	(14%)	(1%)	(3%)	2%	3%	7%	(2%) 8%
	Jun	(1%)	6%	10%	(2%)	(5%)	(7%)	(9%)
	Jul	(1%)	(0%)	7%	10%	6%	3%	(3%)
	Aug	2%	9%	1%	1%	(2%)	(0%)	(6%)
	Sep	34%	13%	4%	(10%)	(4%)	(26%)	5%
	Oct	(0%)	(8%)	1%	7%	(9%)	7%	(14%)
	Nov	(14%)	(9%)	(5%)	(6%)	(0%)	18%	9%
	Dec	(17%)	(9%)	7%	(3%)	(1%)	7%	15%
PC-related	Jan	(24%)	(9%)	6%	6%	(10%)	4%	(3%)
	Feb	(10%)	3%	4%	(7%)	(15%)	(11%)	(4%) 7%
	Mar	11%	11%	0%	1%	17%	33%	(1%) (9%)
	Apr	(8%)	(15%)	(2%)	2%	5%	22%	4% (24%)
	May	(3%)	5%	4%	4%	(2%)	(2%)	(12%) 14%
	Jun	19%	12%	3%	(10%)	(8%)	(9%)	(1%)
	Jul	(14%)	(10%)	2%	9%	2%	12%	5%
	Aug	5%	8%	1%	1%	(3%)	(10%)	(4%)
	Sep	19%	3%	(3%)	(9%)	1%	(8%)	3%
	Oct	(12%)	(7%)	5%	10%	(0%)	(1%)	(2%)
	Nov	5%	8%	(3%)	(7%)	(3%)	5%	5%
	Dec	8%	2%	(9%)	(2%)	1%	5%	8%
Foundry-related	Jan	8%	(17%)	(21%)	(18%)	(4%)	7%	11%
	Feb	(19%)	(5%)	6%	(4%)	(6%)	8%	(0%) 1%
	Mar	5%	14%	6%	35%	3%	(7%)	(8%) (11%)
	Apr	(5%)	(18%)	(37%)	(17%)	4%	(2%)	3% (16%)
	May	(9%)	10%	20%	(6%)	1%	(9%)	(6%) 2%
	Jun	(14%)	12%	14%	(13%)	5%	23%	19%
	Jul	26%	(14%)	(20%)	3%	(3%)	(13%)	(9%)
	Aug	(18%)	20%	21%	9%	10%	(0%)	(10%)
	Sep	(2%)	(1%)	(1%)	4%	(4%)	6%	11%
	Oct	19%	(8%)	(1%)	(1%)	(3%)	(14%)	(14%)
	Nov	(12%)	13%	8%	5%	8%	8%	9%
	Dec	(2%)	(9%)	2%	(4%)	3%	3%	11%
Apple Supply Chain-related	Jan	(3%)	(4%)	(7%)	(1%)	(8%)	(7%)	(5%)
	Feb	(15%)	(1%)	8%	(8%)	(9%)	(6%)	4% 18%
	Mar	6%	6%	(5%)	2%	11%	26%	(8%) (7%)
	Apr	(2%)	(10%)	(2%)	5%	6%	12%	6% (20%)
	May	(10%)	(1%)	(0%)	3%	4%	5%	(5%) 11%
	Jun	1%	5%	7%	(5%)	(7%)	(8%)	(8%)
	Jul	(2%)	(3%)	4%	12%	5%	5%	0%
	Aug	2%	10%	3%	1%	(1%)	(2%)	(7%)
	Sep	32%	13%	1%	(9%)	(5%)	(24%)	5%
	Oct	(6%)	(11%)	1%	7%	(6%)	9%	(12%)
	Nov	(11%)	(6%)	(4%)	(6%)	(0%)	15%	9%
	Dec	(13%)	(5%)	7%	(5%)	(4%)	7%	15%

Taiwan Monthly Sales (Sector Detail - Quarterly)

Taiwan Sales Q/Q Growth

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Grand Total	Q1	(10%)	(5%)	(10%)	(20%)	(21%)	(25%)	(21%)	(26%)	(30%)	(32%)	(21%)	(14%)
Smartphone-related	Q1	10%	6%	4%	6%	7%	(2%)	1%	1%	4%	8%	23%	6%
PC-related	Q1	13%	5%	3%	5%	8%	10%	16%	18%	19%	15%	12%	8%
Foundry-related	Q1	(6%)	11%	13%	16%	23%	15%	14%	21%	15%	12%	21%	16%
Apple Supply Chain-related	Q1	(15%)	(17%)	(17%)	(27%)	(27%)	(33%)	(29%)	(35%)	(37%)	(39%)	(32%)	(20%)
Grand Total	Q2	1%	15%	3%	7%	10%	(8%)	(2%)	1%	3%	8%	22%	8%
Smartphone-related	Q3	51%	8%	0%	4%	6%	17%	22%	27%	24%	21%	13%	8%
PC-related	Q4	16%	17%	29%	24%	42%	26%	18%	32%	26%	15%	33%	24%
Foundry-related	Q1	(13%)	8%	(3%)	(14%)	(20%)	(22%)	(15%)	(19%)	(22%)	(30%)	(15%)	(15%)
Apple Supply Chain-related	Q2	2%	8%	3%	(3%)	3%	0%	(1%)	4%	1%	5%	37%	4%
Grand Total	Q3	2%	8%	2%	9%	11%	12%	14%	15%	15%	9%	12%	13%
Smartphone-related	Q4	(23%)	3%	5%	8%	9%	8%	11%	8%	8%	8%	5%	14%
PC-related	Q1	(5%)	(0%)	2%	2%	0%	1%	(9%)	(9%)	(22%)	(2%)	1%	11%
Foundry-related	Q2	14%	4%	21%	17%	21%	(5%)	9%	(7%)	(4%)	10%	1%	3%
Apple Supply Chain-related	Q3	8%	(5%)	9%	4%	12%	1%	15%	15%	10%	19%	13%	11%
Grand Total	Q4	(3%)	(2%)	(7%)	(10%)	6%	(4%)	1%	9%	8%	8%	1%	6%
Smartphone-related	Q1	(17%)	(9%)	(16%)	(28%)	(27%)	(32%)	(27%)	(34%)	(37%)	(39%)	(33%)	(21%)
PC-related	Q2	16%	12%	(0%)	2%	5%	(4%)	(4%)	1%	3%	9%	25%	4%
Foundry-related	Q3	17%	5%	5%	8%	12%	16%	21%	26%	25%	20%	12%	9%
Apple Supply Chain-related	Q4	2%	28%	28%	27%	39%	23%	21%	31%	25%	15%	33%	25%

Source: UBS, Company filings

Q/Q Relative to 5 Year Seasonal Average

	2015	2016	2017	2018	2019	2020	2021	2022
Grand Total	Q1	(11%)	(5%)	(7%)	(7%)	(7%)	5%	12%
Smartphone-related	Q2	(9%)	(3%)	(2%)	2%	6%	20%	(1%)
PC-related	Q3	3%	9%	9%	7%	0%	(3%)	(7%)
Foundry-related	Q4	4%	(1%)	5%	(3%)	(6%)	6%	(0%)
Grand Total	Q1	(12%)	(5%)	(9%)	(7%)	(7%)	3%	14%
Smartphone-related	Q2	(15%)	(8%)	(1%)	1%	7%	22%	2%
PC-related	Q3	3%	15%	17%	9%	2%	(9%)	(13%)
Foundry-related	Q4	1%	(9%)	4%	(3%)	(14%)	9%	(1%)
Grand Total	Q1	(14%)	(5%)	(4%)	(4%)	(10%)	6%	5%
Smartphone-related	Q2	(2%)	(3%)	4%	0%	3%	35%	(5%)
PC-related	Q3	5%	5%	6%	3%	(4%)	(1%)	(0%)
Foundry-related	Q4	7%	4%	(0%)	(0%)	(1%)	(3%)	6%
Grand Total	Q1	1%	(10%)	(8%)	(19%)	6%	9%	19%
Smartphone-related	Q2	(21%)	(3%)	(19%)	(11%)	8%	0%	2%
PC-related	Q3	(4%)	11%	7%	0%	9%	1%	(3%)
Foundry-related	Q4	(1%)	4%	11%	8%	5%	(3%)	0%
Grand Total	Q1	(13%)	(5%)	(8%)	(7%)	(8%)	1%	13%
Smartphone-related	Q2	(11%)	(7%)	1%	3%	9%	24%	(2%)
PC-related	Q3	7%	12%	14%	9%	(0%)	(10%)	(11%)
Foundry-related	Q4	(2%)	(8%)	3%	(3%)	(12%)	10%	(0%)

Source: UBS, Company filings

Taiwan Sales: Quarterly Summary Heat Map

Quarterly Summary Heat Map

	1Q2022		4Q2021		3Q2021		2Q2021		1Q2021	
	QoQ	Above/Below Seasonal	QoQ	Above/Below Seasonal	QoQ	Above/Below Seasonal	QoQ	Above/Below Seasonal	QoQ	Above/Below Seasonal
Smartphones Related	(20.2%)	8.6%	23.7%	3.1%	8.2%	(9.8%)	7.9%	2.6%	(31.8%)	(2.9%)
Apple Related	(21.3%)	12.7%	25.2%	(0.0%)	9.3%	(11.5%)	4.4%	(2.1%)	(32.9%)	0.9%
PC Related	(15.2%)	5.0%	13.8%	5.8%	12.7%	(0.3%)	4.1%	(5.0%)	(15.1%)	6.4%
Foundry	10.9%	19.3%	5.7%	0.3%	11.3%	(3.0%)	3.5%	1.8%	0.6%	9.0%
OSATs	(11.7%)	2.5%	9.5%	3.9%	14.2%	(0.7%)	7.1%	(0.8%)	(12.9%)	1.4%
Fabless	7.3%	14.8%	(2.1%)	1.1%	6.4%	(6.1%)	13.6%	(0.3%)	7.6%	17.9%
Memory	(3.9%)	(1.8%)	(2.3%)	(2.3%)	6.5%	(4.5%)	16.8%	12.8%	4.2%	8.2%
IC Substrates and PCBs	(2.7%)	13.5%	5.2%	2.9%	14.4%	(5.1%)	2.7%	(3.2%)	(7.4%)	10.9%
Distribution/EMS	(3.1%)	11.5%	6.9%	5.9%	5.9%	(10.5%)	10.5%	0.3%	(2.0%)	15.1%
Components (Motherboard)	(1.5%)	9.7%	(16.3%)	(8.8%)	(1.2%)	(24.7%)	21.2%	(3.4%)	(10.6%)	2.3%
Components (Camera)	(28.3%)	3.0%	5.0%	6.8%	41.3%	4.6%	(12.0%)	(33.0%)	(28.8%)	6.4%
Components (display)	(11.4%)	(2.7%)	(9.0%)	(10.5%)	2.6%	(3.6%)	13.4%	4.7%	4.6%	18.6%
Components (Lithium-Ion Battery)	(10.2%)	15.2%	0.6%	(10.2%)	0.4%	(14.7%)	6.2%	(11.0%)	(17.2%)	9.3%
Other components / periphs	(4.2%)	9.8%	3.3%	5.5%	4.1%	(4.4%)	10.7%	(5.5%)	(4.9%)	11.1%
Servers & Data Centre	(18.4%)	10.5%	25.7%	2.8%	4.3%	(9.0%)	4.6%	(6.4%)	(25.2%)	3.8%
EMS/ODM	(24.5%)	9.7%	28.5%	(1.3%)	10.1%	(6.1%)	4.1%	(3.3%)	(32.9%)	1.1%
Total	(14.3%)	11.5%	16.4%	(0.1%)	8.4%	(7.4%)	6.1%	(1.4%)	(21.2%)	5.4%

Source: Company data, UBS estimates. Note: red = below seasonal, green = above seasonal

Taiwan Sales: Apple Supply Chain M/M Performance

Apple Supply Chain M/M Performance

Apple Supply Chain	Company Name	Ticker	May 2022	Above/Below Seasonal			5-YR AVG	Above/Below Seasonal			5-YR AVG	Above/Below Seasonal	
				M/M	5-YR AVG	April 2022		M/M	5-YR AVG	March 2022		March 2022	Above/Below Seasonal M/M
ODM/EMS	Hon Hai Precision	2317.TW	199,110	6.1%	2.3%	(3.7%)	194,586	-7.5%	(4.1%)	3.4%	202,958	-19.5%	11.5%
	Pegatron	4938.TW	51,516	29.3%	24.8%	(4.5%)	41,284	-51.0%	(35.0%)	15.9%	63,560	17.8%	35.8%
	Compal	2324.TW	22,317	62.5%	65.6%	3.1%	13,480	-39.5%	(47.5%)	(8.0%)	25,691	-33.3%	24.6%
	Wistron	3231.TW	11,151	4.1%	8.8%	4.7%	10,253	-19.4%	(27.9%)	(8.5%)	14,229	15.6%	46.8%
	Quanta	2382.TW	27,984	12.1%	19.8%	7.8%	23,355	-38.1%	(39.5%)	(1.4%)	38,601	0.6%	21.6%
	Inventec	2356.TW	3,951	-11.2%	(10.5%)	0.7%	4,416	-15.7%	(17.6%)	(1.9%)	5,357	-7.9%	50.5%
Foundry/OSAT	TSMC	2330.TW	27,856	1.0%	7.6%	6.7%	25,884	18.4%	0.3%	(18.1%)	25,795	-13.8%	17.0%
	ASE	2311.TW	16,140	-0.3%	10.6%	10.9%	14,593	-2.5%	(6.4%)	(3.9%)	15,596	1.1%	18.6%
Display	TPK Holding	3673.TW	7,467	20.0%	9.6%	(10.4%)	6,814	-36.9%	(35.5%)	1.5%	10,557	40.6%	54.9%
	AU Optronics	2409.TW	21,971	0.6%	8.6%	8.1%	20,223	-21.1%	(27.9%)	(6.8%)	28,043	-5.2%	9.3%
	Radiant (ROEC)	6176.TW		0.0%				0.0%					
Metal Castings	Catcher Technology	2474.TW	1,950	68.2%	74.5%	6.3%	1,118	-104.0%	(58.3%)	45.6%	2,683	25.1%	57.6%
	Foxconn Tech	2354.TW	7,350	9.1%	21.3%	12.2%	6,057	-37.1%	(30.9%)	6.1%	8,772	-55.6%	53.6%
Camera Modules	Largan Precision	3008.TW	3,148	-1.0%	0.6%	1.6%	3,128	-18.8%	(16.7%)	2.1%	3,756	9.0%	44.0%
	Genius Electronic Optical	3406.TW	808	-16.1%	(11.2%)	4.8%	911	-22.0%	(26.3%)	(4.3%)	1,236	-9.1%	47.0%
Lithium-Ion Battery	Simplo Technology	6121.TW	7,933	-2.6%	1.0%	3.6%	7,854	-5.1%	(3.7%)	1.5%	8,153	-15.3%	12.7%
	Dynapack International	3211.TW	1,669	53.7%	64.4%	10.7%	1,015	-31.4%	(40.2%)	(8.8%)	1,698	-37.2%	21.6%
Electronic Components	Lite-On Technology	2301.TW	14,564	1.9%	5.8%	3.9%	13,768	-5.0%	(9.1%)	(4.1%)	15,147	-3.9%	30.7%
	Unimicron	3037.TW	12,156	5.8%	8.9%	3.2%	11,157	4.1%	4.5%	0.4%	10,681	-1.7%	11.8%
	Delta Electronics	2308.TW	30,568	9.7%	12.1%	2.4%	27,274	-14.5%	(11.0%)	3.5%	30,648	-12.0%	19.6%
Total AAPL Supply Chain			469,609	16.0%	9.9%	(6.1%)	427,169	-12.7%	(16.8%)	(4.1%)	513,159	-1.0%	19.8%

Source: Company data, UBS estimates. Note: red = below seasonal, green = above seasonal

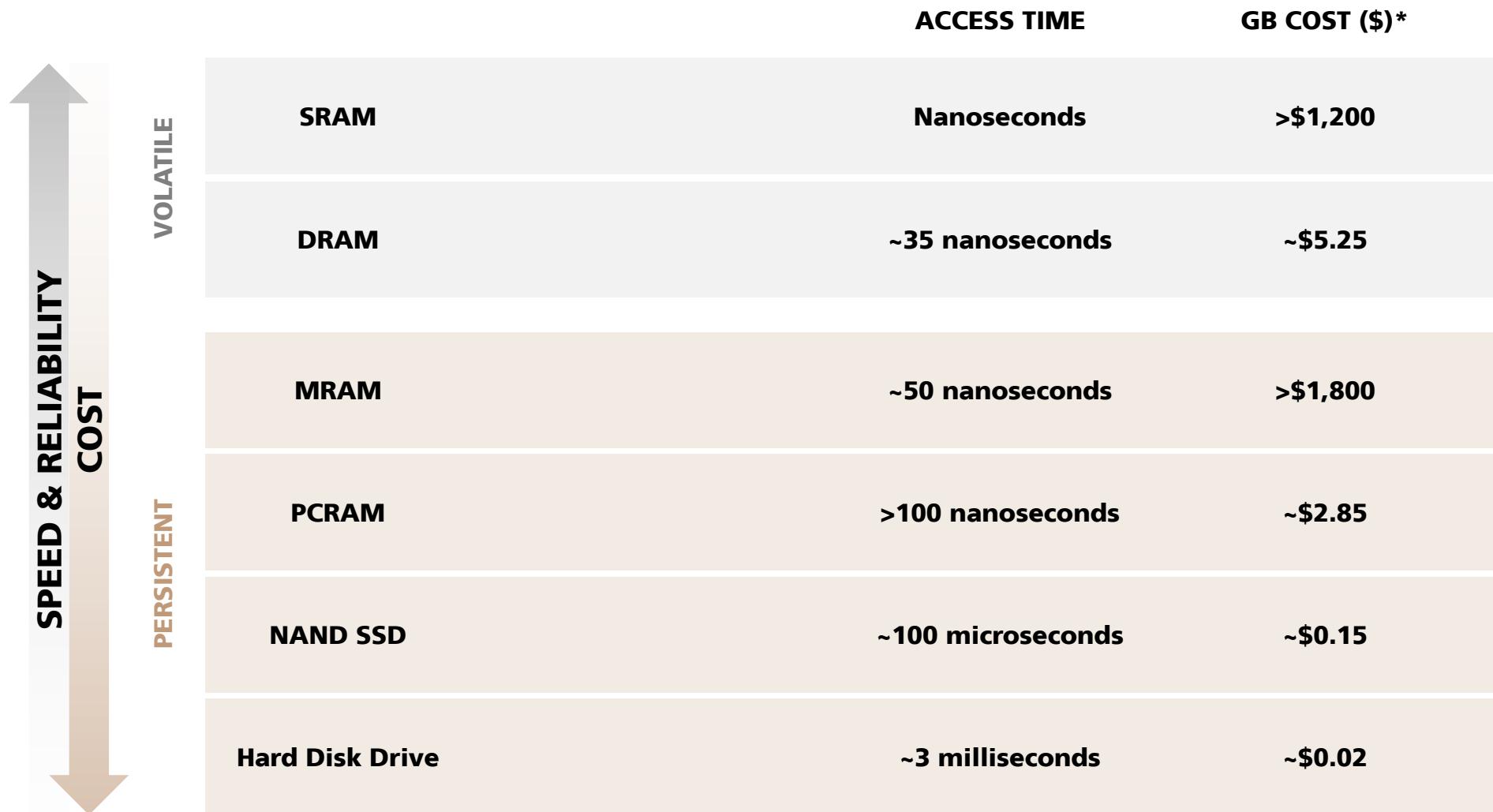
Section 3

Memory

Key Messages

- We are secular bulls on memory demand; memory should continue to out-grow the overall industry – which is itself significantly outgrowing global GDP – as the use of AI pervades every vertical of the global economy
 - Machines are now creating more data than humans, removing a key constraint on memory demand
- DRAM – we believe the shape of cycles is changing with higher lows/higher highs and shorter and shallower cycles. We see it as fundamentally more stable as demand shifts from consumer applications to infrastructure; industry OpM has been >30% since 2014
 - Server demand – we think demand remains strong even as consumer demand softens
 - Sapphire Rapids/Eagle Stream refresh should drive strong DRAM content gains for '23
 - Producer and customer inventories are an overhang
 - Even amid PC inventory correction, we do not see DRAM pricing down much as supply is a big cushion given Samsung 1 beta challenges for '23
 - Profit share among vendors is stable; Samsung mid 40's bit share and ~50% of OP
- NAND – we are less positive as the industry averages ~\$5B/yr in FCF versus ~\$25-30B/yr for DRAM but spends more on WFE
 - The supply side is still structurally disadvantaged and the “process node” approach of US trade restrictions insulates YMTC and allows it to build scale
 - Profit share among vendors is volatile; Samsung mid 30's bit share and ~60% of OP

Memory Market Segmentation

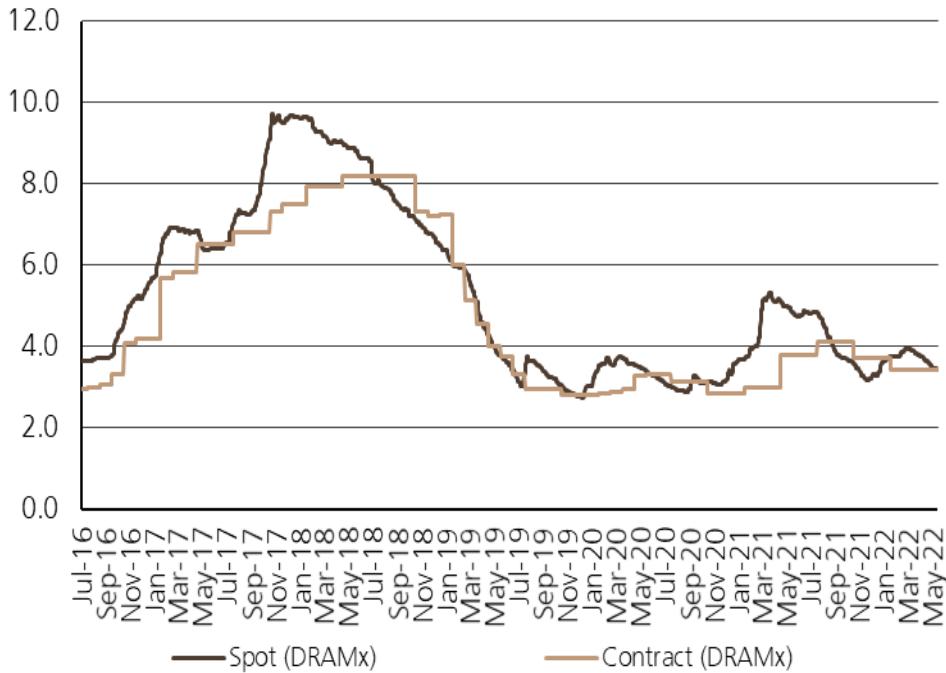


Source: Applied Materials, May 2021

*Note: Cost estimates based on retail devices and pricing

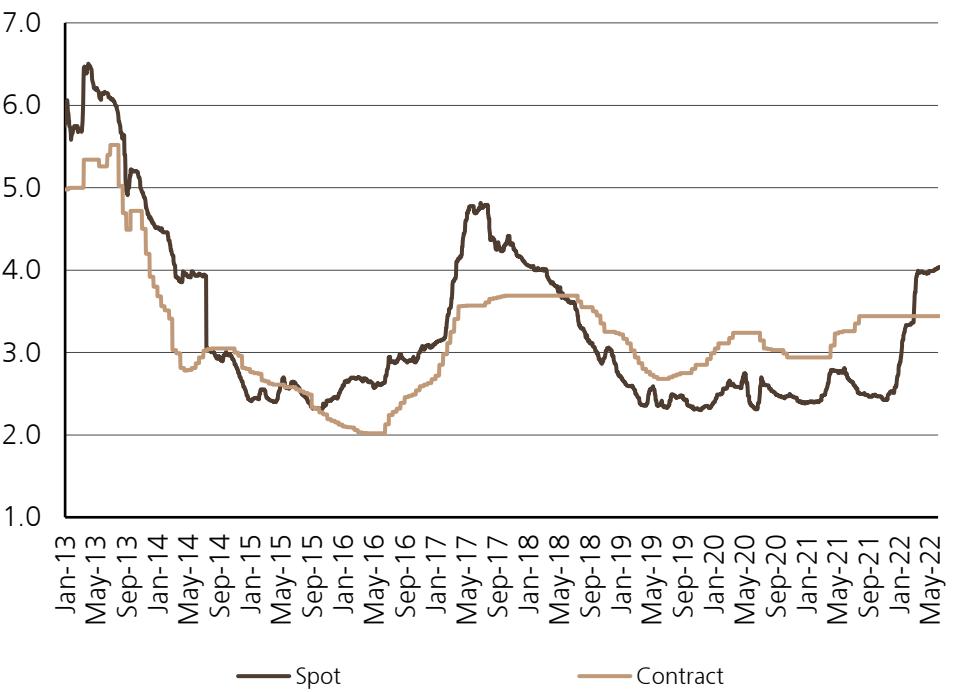
DRAM pricing softening, NAND has remained strong

DRAM Spot vs. Contract Pricing



Source: DRAM eXchange, UBS

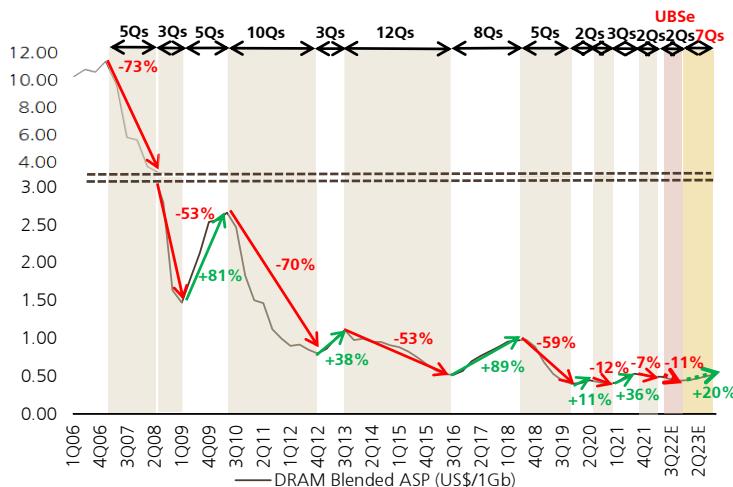
NAND Spot vs. Contract Pricing



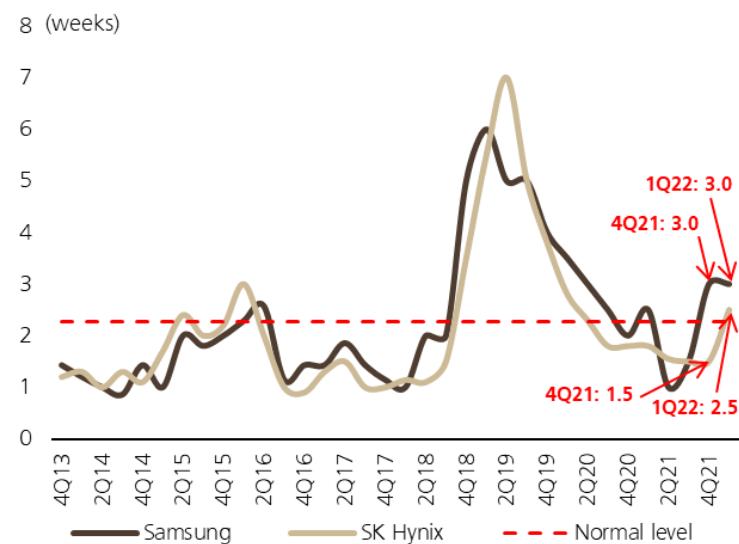
Source: DRAM eXchange, UBS

DRAM KPIs

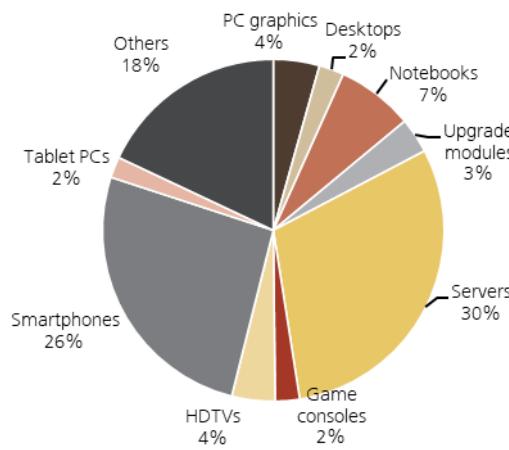
DRAM Cycles in Context



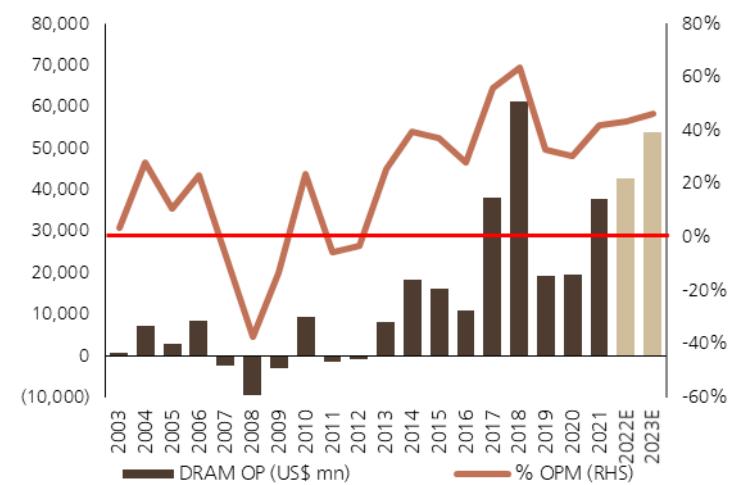
DRAM Finished Wafers and Dies Inventories



DRAM Bit Demand by Applications (2022E)



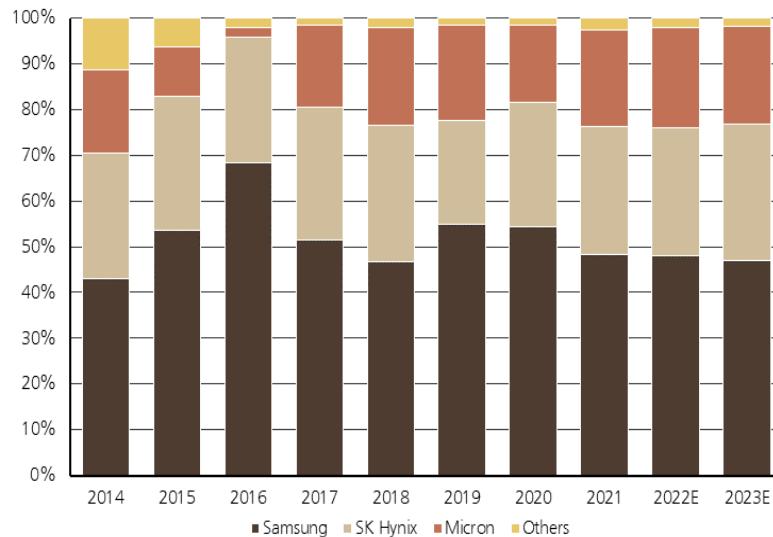
DRAM Industry OP and % OP margin



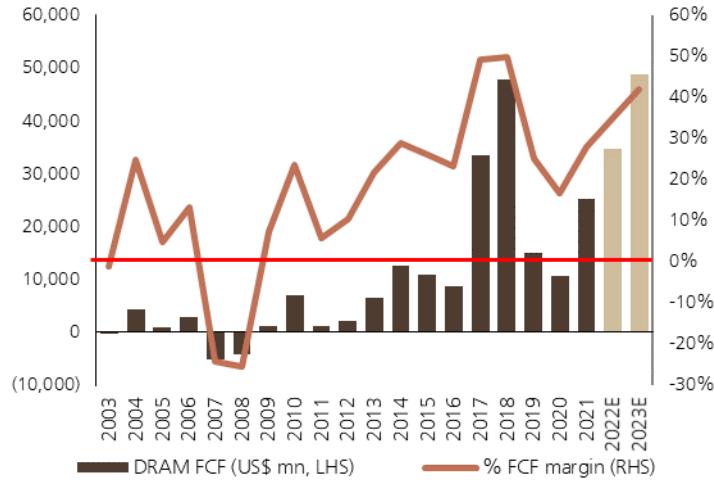
Source: Company data, UBS estimates

DRAM KPIs – Other Key Charts

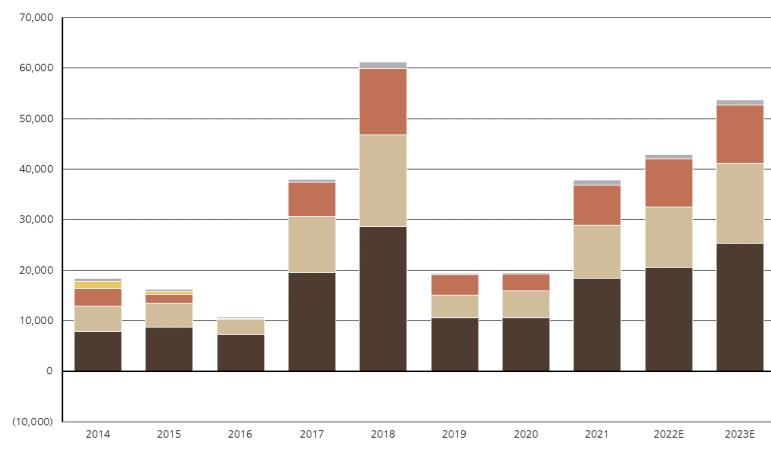
DRAM Producer Share of Industry OP



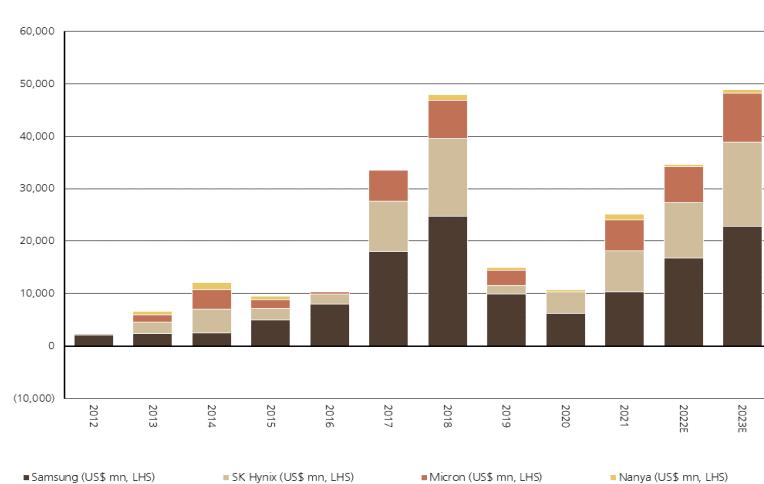
DRAM Industry FCF and % FCF margin



DRAM Producer OP



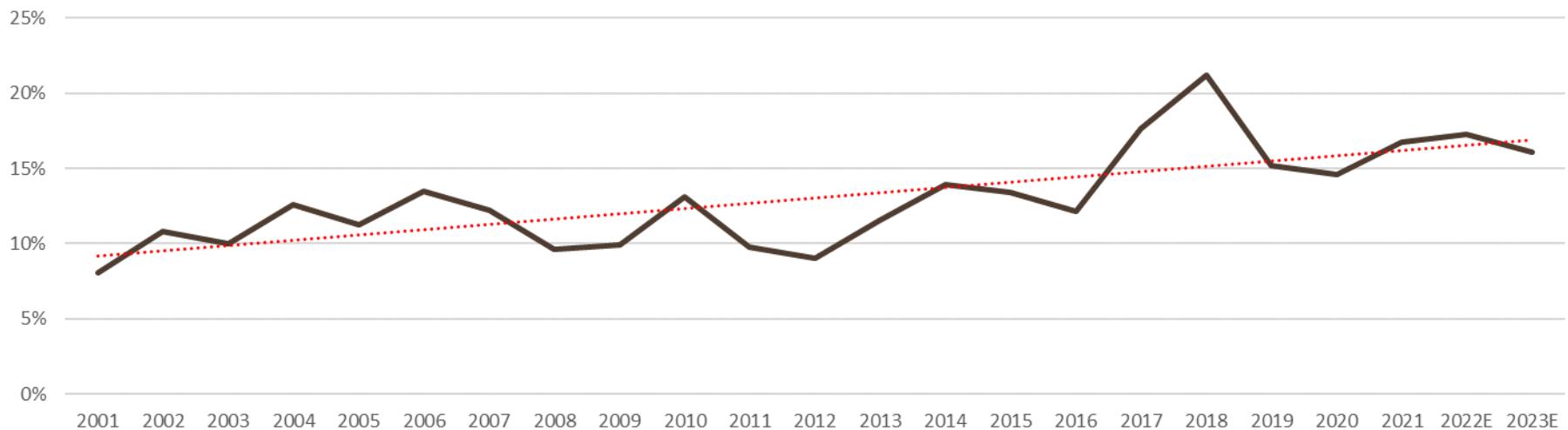
DRAM Producer FCF



Source: Company data, UBS estimates

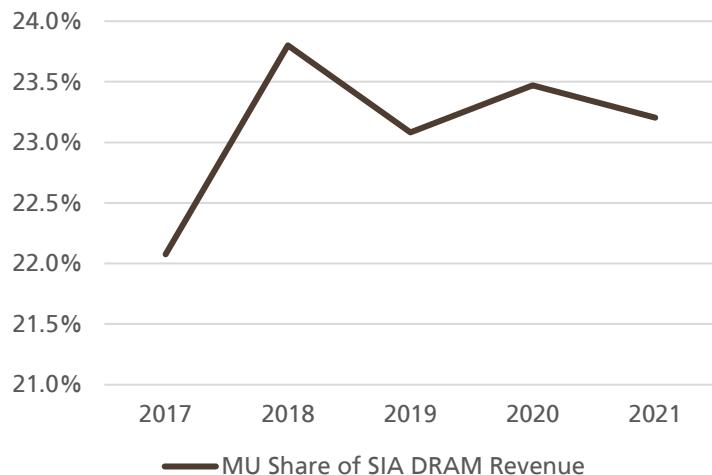
DRAM KPIs – Other Charts

DRAM % of Total Semi Revenue

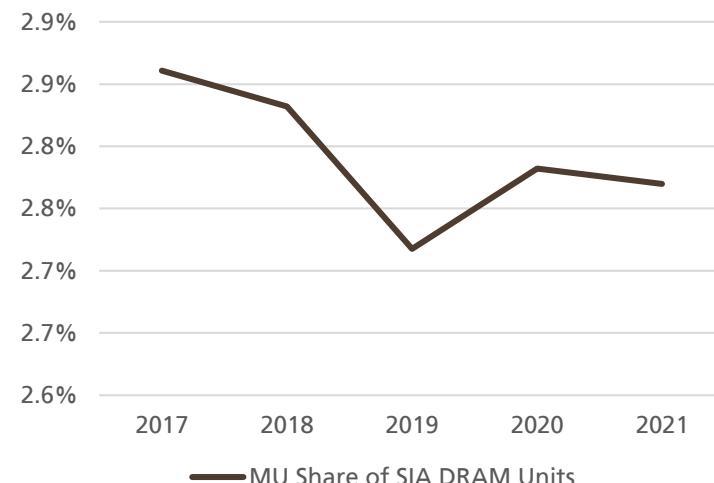


Source: SIA

MU Share of SIA DRAM Revenue



MU Share of SIA DRAM Units



Source: Company data, SIA

Expect DRAM over-supply in 2H:22E, but decelerating supply should cushion pricing in '23

DRAM Supply/Demand Summary

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Revenues (\$ mil)	64,324	18,774	23,679	25,982	24,526	92,960	23,854	26,438	26,208	26,480	102,979	26,924	29,265	32,804	34,707	123,700
% QoQ		12.2%	26.1%	9.7%	-5.6%		-2.7%	10.8%	-0.9%	1.0%		1.7%	8.7%	12.1%	5.8%	
% YoY	3.0%	31.0%	44.2%	54.4%	46.5%	44.5%	27.1%	11.6%	0.9%	8.0%	10.8%	12.9%	10.7%	25.2%	31.1%	20.1%
Supply (Shipments Based) (M 1Gb)	154,785	44,958	48,055	48,822	48,007	189,841	48,384	53,625	57,161	60,160	219,331	59,970	62,080	65,036	65,531	252,616
% QoQ		5.2%	6.9%	1.6%	-1.7%		0.8%	10.8%	6.6%	5.2%		-0.3%	3.5%	4.8%	0.8%	
% YoY	22.9%	27.3%	30.8%	22.1%	12.3%	22.6%	7.6%	11.6%	17.1%	25.3%	15.5%	23.9%	15.8%	13.8%	8.9%	15.2%
Demand (End Consumption) (M 1Gb)	156,192	45,901	46,602	48,103	51,743	192,348	49,933	49,972	56,522	62,167	218,593	60,670	61,230	64,945	68,487	255,333
% QoQ		6.0%	1.5%	3.2%	7.6%		-3.5%	0.1%	13.1%	10.0%		-2.4%	0.9%	6.1%	5.5%	
% YoY	23.2%	31.0%	28.4%	15.8%	19.5%	23.1%	8.8%	7.2%	17.5%	20.1%	13.6%	21.5%	22.5%	14.9%	10.2%	16.8%
Inventory adjustment	-1,600	-400	3,300	1,600	-4,100	400	-1,900	3,700	-100	-2,500	-800	-500	1,500	1,200	-2,300	-100
Inventory Adj. Demand (M 1Gb)	154,592	45,501	49,902	49,703	47,643	192,748	48,033	53,672	56,422	59,667	217,793	60,170	62,730	66,145	66,187	255,233
% QoQ		7.8%	9.7%	-0.4%	-4.1%		0.8%	11.7%	5.1%	5.8%		0.8%	4.3%	5.4%	0.1%	
% YoY	25.7%	28.7%	33.1%	25.6%	12.9%	24.7%	5.6%	7.6%	13.5%	25.2%	13.0%	25.3%	16.9%	17.2%	10.9%	17.2%
Wafer out (k wpm, 12" equi.)	1,350	1,427	1,490	1,543	1,577	1,509	1,622	1,647	1,662	1,681	1,653	1,692	1,698	1,700	1,698	1,697
% QoQ		2.2%	4.4%	3.6%	2.2%		2.8%	1.5%	0.9%	1.1%		0.7%	0.3%	0.1%	-0.1%	
% YoY	2.7%	9.2%	12.2%	12.7%	13.0%	11.8%	13.7%	10.5%	7.7%	6.6%	9.5%	4.3%	3.1%	2.3%	1.0%	2.7%
% Sufficiency Ratio	0.1%	-1.2%	-3.7%	-1.8%	0.8%	-1.5%	0.7%	-0.1%	1.3%	0.8%	0.7%	-0.3%	-1.0%	-1.7%	-1.0%	-1.0%
DRAM ASP (\$/Gb)	0.42	0.42	0.49	0.53	0.51	0.49	0.49	0.49	0.46	0.44	0.47	0.45	0.47	0.50	0.53	0.49
% QoQ		6.7%	18.0%	8.0%	-4.0%		-3.5%	0.0%	-7.0%	-4.0%		2.0%	5.0%	7.0%	5.0%	
% YoY	-16.2%	2.9%	10.2%	26.4%	30.5%	17.8%	18.1%	0.1%	-13.8%	-13.8%	-4.1%	-8.9%	-4.4%	10.0%	20.3%	4.3%
PC DRAM ASP (\$/Gb)	0.38	0.38	0.48	0.51	0.47	0.46	0.43	0.42	0.38	0.37	0.40	0.38	0.41	0.44	0.46	0.43
% QoQ		4.2%	26.7%	8.4%	-8.3%		-9.6%	-1.9%	-9.0%	-4.0%		5.0%	7.0%	7.0%	5.0%	
% YoY	-11.5%	3.8%	15.5%	32.0%	31.1%	21.2%	13.8%	-11.8%	-26.0%	-22.5%	-14.0%	-10.0%	-1.9%	15.4%	26.2%	7.3%

Source: Gartner, Company Data, UBS estimates

DRAM wafer capacity growth to remain very modest

DRAM Bit Market Share, Growth, and Wafers Out by Vendor

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Samsung	44.7%	44.7%	46.4%	46.9%	45.3%	45.9%	45.9%	46.4%	45.6%	44.8%	45.6%	45.3%	45.2%	45.3%	45.3%	45.3%
SK Hynix	29.3%	29.0%	28.3%	27.6%	30.1%	28.7%	27.9%	28.3%	29.1%	29.3%	28.7%	28.6%	29.0%	29.3%	29.0%	29.0%
Micron	22.7%	23.3%	22.4%	22.8%	21.8%	22.5%	23.3%	22.5%	22.6%	23.2%	22.9%	23.5%	23.2%	22.8%	23.1%	23.1%
Nanya Tech	2.7%	2.5%	2.3%	2.1%	2.0%	2.2%	2.0%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.7%	1.7%
CXMT	0.1%	0.1%	0.3%	0.3%	0.4%	0.3%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.7%	0.6%
Others	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%
Total Supply	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

DRAM Bit supply Growth by Vendor (Year % YoY; Quarters % QoQ)

	2020 YoY	Q121 QoQ	Q221 QoQ	Q321 QoQ	Q421 QoQ	2021 YoY	Q122E QoQ	Q222E QoQ	Q322E QoQ	Q422E QoQ	2022E YoY	Q123E QoQ	Q223E QoQ	Q323E QoQ	Q423E QoQ	2023E YoY
Samsung	20.5%	5.0%	11.0%	2.7%	-5.0%	25.8%	2.0%	12.0%	4.8%	3.3%	15.0%	0.8%	3.3%	5.1%	0.7%	14.2%
SK Hynix	22.3%	4.0%	4.0%	-0.9%	7.3%	20.1%	-6.5%	12.5%	9.5%	6.2%	15.4%	-2.9%	5.1%	5.7%	-0.1%	16.2%
Micron	26.8%	7.0%	2.8%	3.4%	-6.0%	22.0%	8.0%	7.0%	7.0%	8.0%	17.4%	1.0%	2.0%	3.0%	2.0%	16.2%
Nanya Tech	35.8%	4.0%	0.0%	-10.0%	-4.0%	-0.6%	-1.0%	7.0%	5.0%	4.0%	-0.9%	-4.0%	2.0%	1.0%	-1.0%	4.7%
CXMT	318.4%	95.5%	107.1%	9.2%	30.6%	277.0%	25.0%	12.5%	0.0%	11.1%	100.5%	10.0%	9.1%	12.5%	7.4%	41.7%
Others	11.7%	-5.4%	2.9%	2.8%	2.7%	2.1%	-2.6%	2.7%	2.6%	2.6%	5.5%	-5.0%	2.6%	2.6%	2.5%	2.6%
Bit supply Growth	22.9%	5.2%	6.9%	1.6%	-1.7%	22.6%	0.8%	10.8%	6.6%	5.2%	15.5%	-0.3%	3.5%	4.8%	0.8%	15.2%

DRAM Wafer supply vendor kwpm 12-inch (out-basis)

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Samsung	522	581	615	645	665	626	685	700	709	718	703	721	721	718	717	719
SK Hynix	352	356	364	379	385	371	394	404	410	420	407	429	434	439	438	435
Micron	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340
Nanya Tech	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
CXMT	26	27	48	56	64	64	80	80	80	80	100	80	80	80	80	100
Other	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Total	1,363	1,427	1,490	1,543	1,577	1,524	1,622	1,647	1,662	1,681	1,673	1,692	1,698	1,700	1,698	1,717
% YoY	2.7%	9.2%	12.2%	12.7%	13.0%	11.8%	13.7%	10.5%	7.7%	6.6%	9.5%	4.3%	3.1%	2.3%	1.0%	2.7%

Source: Gartner, Company data, UBS estimates. Note: wafers out (k wpm, 12 inch equivalent)

We expect server to remain strong even as consumer markets soften

DRAM Bit Demand by Application (MM units, 1Gb)

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Total PC DRAM	23,405	6,021	6,295	6,694	7,802	26,813	6,854	6,666	7,239	7,533	28,292	6,473	6,615	7,098	7,203	27,389
Desktops	4,092	1,116	1,151	1,155	1,426	4,848	1,272	1,228	1,261	1,367	5,128	1,231	1,295	1,354	1,409	5,290
Notebooks	12,748	3,339	3,280	3,612	4,497	14,728	3,847	3,704	3,998	4,320	15,869	3,841	3,903	4,239	4,577	16,561
Upgrade Modules	6,565	1,566	1,864	1,927	1,879	7,236	1,735	1,735	1,980	1,846	7,295	1,401	1,417	1,504	1,217	5,539
Servers	42,341	12,366	13,322	12,463	12,593	50,745	14,078	14,875	17,492	19,543	65,989	21,718	22,061	22,296	22,411	88,486
Graphics	4,979	2,039	2,074	2,153	2,191	8,458	2,161	2,314	2,558	2,510	9,543	2,258	2,689	2,887	2,920	10,754
Game Consoles	2,577	807	902	1,046	1,079	3,834	1,158	1,232	1,349	1,301	5,039	1,310	1,328	1,388	1,288	5,314
HDTVs	7,458	1,897	1,813	1,952	2,536	8,197	1,993	1,858	2,211	2,883	8,945	2,320	2,109	2,455	3,135	10,018
Total Mobile DRAM	50,439	14,694	13,836	15,066	16,468	60,064	14,449	13,418	15,740	17,858	61,465	16,075	15,650	17,737	19,647	69,109
Smartphones	46,316	13,594	12,691	13,874	15,312	55,471	13,380	12,333	14,546	16,759	57,017	15,033	14,577	16,500	18,480	64,590
Apple	6,419	2,056	1,653	1,763	3,177	8,649	2,259	1,608	1,992	3,341	9,200	2,397	1,706	2,183	3,598	9,885
Samsung	9,092	3,036	2,315	2,880	3,003	11,235	3,299	2,875	3,215	3,268	12,656	3,826	3,562	3,820	3,810	15,018
Non-Apple/Samsung	30,806	8,502	8,723	9,231	9,131	35,586	7,823	7,850	9,338	10,150	35,161	8,810	9,308	10,496	11,072	39,687
Tablet PCs	3,943	1,051	1,119	1,159	1,117	4,446	1,039	1,056	1,164	1,070	4,329	1,015	1,049	1,209	1,140	4,413
Other	24,991	8,076	8,359	8,728	9,074	34,238	9,240	9,609	9,933	10,539	39,321	10,516	10,778	11,085	11,884	44,263
Total Bit Demand	156,192	45,901	46,602	48,103	51,743	192,348	49,933	49,972	56,522	62,167	218,593	60,670	61,230	64,945	68,487	255,333
% QoQ		6.0%	1.5%	3.2%	7.6%		-3.5%	0.1%	13.1%	10.0%		-2.4%	0.9%	6.1%	5.5%	
% YoY	23.2%	31.0%	28.4%	15.8%	19.5%	23.1%	8.8%	7.2%	17.5%	20.1%	13.6%	21.5%	22.5%	14.9%	10.2%	16.8%

Source: Gartner, Company Data, UBS estimates

DRAM demand keyed to server

Breakdown of Incremental DRAM Annual Bit Growth (Y/Y)

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Total PC DRAM	16%	12%	6%	6%	13%	9%	21%	11%	6%	-3%	6%	-4%	0%	-2%	-5%	-2%
Desktops	-2%	1%	2%	2%	3%	2%	4%	2%	1%	-1%	1%	0%	1%	1%	1%	0%
Notebooks	12%	12%	1%	0%	6%	5%	13%	13%	5%	-2%	4%	0%	2%	3%	4%	2%
Upgrade Modules	5%	-1%	2%	3%	4%	2%	4%	-4%	1%	0%	0%	-3%	-3%	-6%	-10%	-5%
Servers	42%	12%	23%	24%	38%	23%	42%	46%	60%	67%	58%	71%	64%	57%	45%	61%
Graphics	4%	10%	9%	12%	8%	10%	3%	7%	5%	3%	4%	1%	3%	4%	6%	3%
Game Consoles	2%	3%	3%	4%	3%	3%	9%	10%	4%	2%	5%	1%	1%	0%	0%	1%
HDTVs	5%	5%	4%	-3%	0%	2%	2%	1%	3%	3%	3%	3%	2%	3%	4%	3%
Total Mobile DRAM	11%	38%	30%	20%	13%	27%	-6%	-12%	8%	13%	5%	15%	20%	24%	28%	21%
Smartphones	8%	35%	29%	18%	14%	25%	-5%	-11%	8%	14%	6%	15%	20%	23%	27%	21%
Apple	4%	8%	6%	9%	3%	6%	5%	-1%	3%	2%	2%	1%	1%	2%	4%	2%
Samsung	2%	8%	5%	0%	9%	6%	6%	17%	4%	3%	5%	5%	6%	7%	9%	6%
Non-Apple/Samsung	1%	19%	18%	10%	2%	13%	-17%	-26%	1%	10%	-2%	9%	13%	14%	15%	12%
Tablet PCs	4%	3%	2%	2%	-1%	1%	0%	-2%	0%	0%	0%	0%	0%	1%	1%	0%
Other	20%	20%	25%	37%	24%	26%	29%	37%	14%	14%	19%	12%	10%	14%	21%	13%
Total Bit Demand	100%															

Source: Gartner, Company Data, UBS estimates

PC/Smartphone weakening, but demand mix shifting to server

DRAM Bit Demand Growth by Application

	2020 YoY	Q121 QoQ	Q221 QoQ	Q321 QoQ	Q421 QoQ	2021 YoY	Q122E QoQ	Q222E QoQ	Q322E QoQ	Q422E QoQ	2022E YoY	Q123E QoQ	Q223E QoQ	Q323E QoQ	Q423E QoQ	2023E YoY
Total PC DRAM	24.9%	-9.9%	4.5%	6.3%	16.5%	14.6%	-12.2%	-2.7%	8.6%	4.1%	5.5%	-14.1%	2.2%	7.3%	1.5%	-3.2%
Desktops	-11.6%	-6.8%	3.1%	0.3%	23.5%	18.5%	-10.8%	-3.5%	2.7%	8.4%	5.8%	-9.9%	5.2%	4.6%	4.0%	3.1%
Notebooks	40.4%	-16.2%	-1.8%	10.1%	24.5%	15.5%	-14.5%	-3.7%	8.0%	8.0%	7.7%	-11.1%	1.6%	8.6%	8.0%	4.4%
Upgrade Modules	30.5%	4.4%	19.0%	3.4%	-2.5%	10.2%	-7.7%	0.0%	14.1%	-6.7%	0.8%	-24.1%	1.1%	6.2%	-19.1%	-24.1%
Servers	41.8%	31.5%	7.7%	-6.4%	1.0%	19.8%	11.8%	5.7%	17.6%	11.7%	30.0%	11.1%	1.6%	1.1%	0.5%	34.1%
Graphics	26.1%	34.3%	1.7%	3.8%	1.8%	69.9%	-1.4%	7.1%	10.6%	-1.9%	12.8%	-10.0%	19.1%	7.4%	1.1%	12.7%
Game Consoles	32.3%	3.0%	11.8%	16.0%	3.1%	48.8%	7.3%	6.4%	9.5%	-3.5%	31.4%	0.7%	1.3%	4.6%	-7.2%	5.5%
HDTVs	23.7%	-24.4%	-4.4%	7.7%	29.9%	9.9%	-21.4%	-6.8%	19.0%	30.4%	9.1%	-19.5%	-9.1%	16.4%	27.7%	12.0%
Total Mobile DRAM	6.9%	-4.3%	-5.8%	8.9%	9.3%	19.1%	-12.3%	-7.1%	17.3%	13.5%	2.3%	-10.0%	-2.6%	13.3%	10.8%	12.4%
Smartphones	5.0%	-3.8%	-6.6%	9.3%	10.4%	19.8%	-12.6%	-7.8%	17.9%	15.2%	2.8%	-10.3%	-3.0%	13.2%	12.0%	13.3%
Apple	25.0%	-30.6%	-19.6%	6.6%	80.3%	34.8%	-28.9%	-28.8%	23.9%	67.7%	6.4%	-28.3%	-28.8%	28.0%	64.8%	7.4%
Samsung	7.3%	36.8%	-23.8%	24.4%	4.3%	23.6%	9.8%	-12.8%	11.8%	1.6%	12.7%	17.1%	-6.9%	7.2%	-0.3%	18.7%
Non-Apple/Samsung	1.0%	-5.0%	2.6%	5.8%	-1.1%	15.5%	-14.3%	0.4%	19.0%	8.7%	-1.2%	-13.2%	5.7%	12.8%	5.5%	12.9%
Tablet PCs	38.6%	-11.2%	6.4%	3.6%	-3.6%	12.8%	-7.0%	1.7%	10.2%	-8.1%	-2.6%	-5.1%	3.4%	15.3%	-5.7%	1.9%
Others	31.1%	14.7%	3.5%	4.4%	4.0%	37.0%	1.8%	4.0%	3.4%	6.1%	14.8%	-0.2%	2.5%	2.8%	7.2%	12.6%
Total Bit Demand	23.2%	6.0%	1.5%	3.2%	7.6%	23.1%	-3.5%	0.1%	13.1%	10.0%	13.6%	-2.4%	0.9%	6.1%	5.5%	16.8%

Source: Gartner, Company Data, UBS estimates

CPU platform refresh creates strong content tailwinds in '23

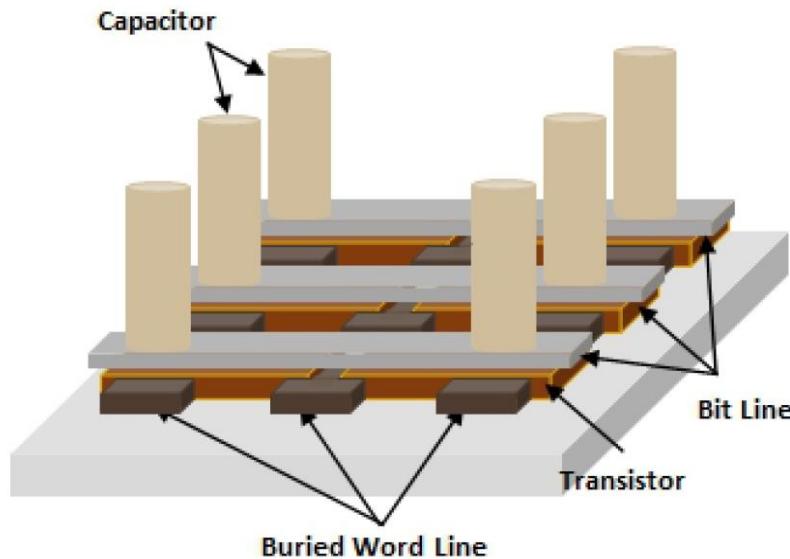
DRAM Content Assumptions (MB/unit) by Application

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Total PC	7,352	7,768	7,830	7,731	8,493	7,971	8,655	8,766	8,972	9,208	8,904	9,406	9,553	9,740	9,956	9,668
% YoY	15%	14%	9%	3%	9%	8%	11%	12%	16%	8%	12%	9%	9%	9%	8%	9%
Desktops	6,562	6,953	7,115	6,987	7,962	7,272	8,062	8,162	8,262	8,362	8,213	8,562	8,662	8,862	8,962	8,767
Notebooks	8,237	8,474	8,440	8,080	9,019	8,522	9,219	9,419	9,619	9,819	9,524	10,019	10,219	10,419	10,619	10,329
Upgrade Modules	6,484	7,100	7,350	7,600	7,800	7,470	8,000	8,000	8,300	8,600	8,226	8,700	8,800	8,900	9,000	8,844
Servers	419,652	470,423	481,299	493,194	499,716	485,883	530,000	560,000	618,500	660,426	594,500	702,000	735,000	759,000	783,950	744,110
% YoY	38%	15%	16%	13%	19%	16%	13%	16%	25%	32%	22%	32%	31%	23%	19%	25%
Smartphones	4,627	5,036	5,182	5,326	5,405	5,240	5,493	5,591	5,682	5,755	5,637	6,037	6,131	6,222	6,288	6,176
% YoY	12%	11%	15%	16%	12%	13%	9%	8%	7%	6%	8%	10%	10%	10%	9%	10%
Apple	4,110	4,700	4,600	4,700	4,900	4,752	4,900	4,900	5,000	5,200	5,027	5,200	5,200	5,400	5,600	5,384
Samsung	4,601	5,114	5,199	5,343	5,571	5,307	5,706	5,888	6,143	6,289	6,000	6,821	6,805	6,887	7,068	6,895
Non-Apple/Samsung	4,759	5,096	5,305	5,460	5,550	5,353	5,600	5,650	5,700	5,800	5,694	6,000	6,100	6,200	6,300	6,158

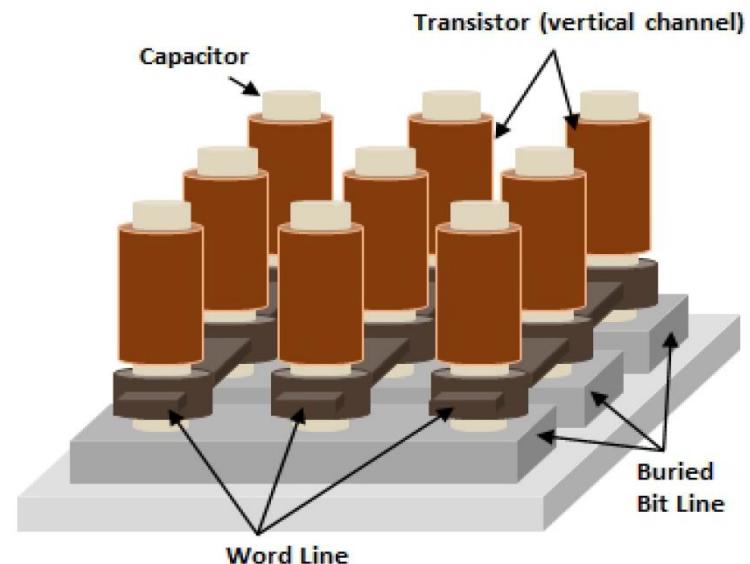
Source: Gartner, Company Data, UBS estimates

What is 3D DRAM (also known as 4F2 VCAT)?

Cross section 6F2 DRAM



Cross section 4F2 VCAT (3D) DRAM

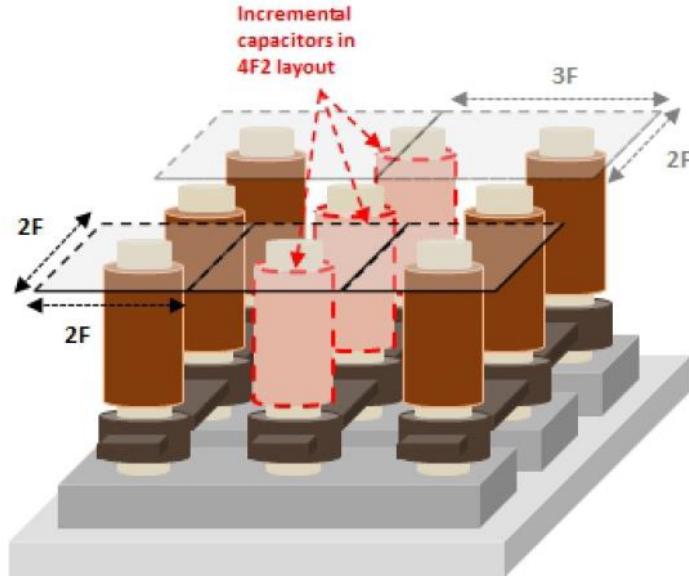


- ❑ 3D DRAM, adopting a vertical channel access transistor (VCAT) structure wrapped around the capacitor, allowing increased density for DRAM arrays (6F2 to 4F2) and improved capacitance is the next main evolution of DRAM process technology
- ❑ Several WFE vendors have recently mentioned 3D DRAM but it is still at an exploration stage; we assess 3D DRAM's initial production may occur from 2027 at the earliest with more meaningful mass production by 2028-2029

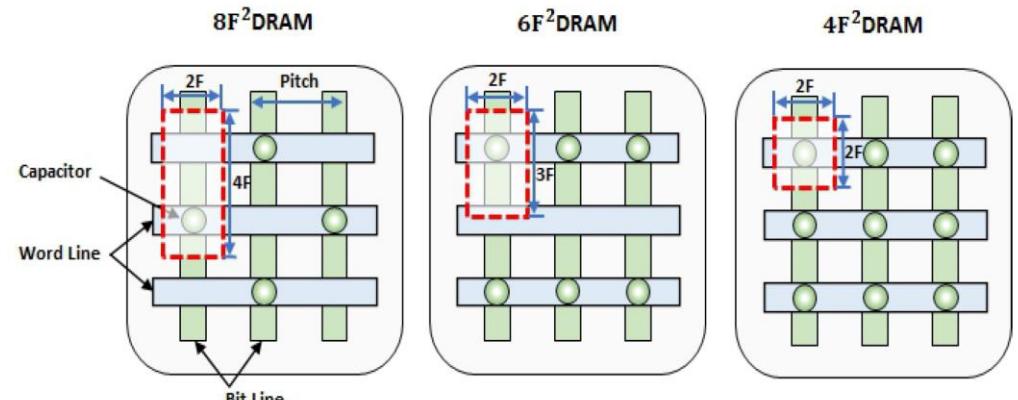
Source: Gartner, Company data, UBS estimates

What is 3D DRAM (also known as 4F² VCAT)?

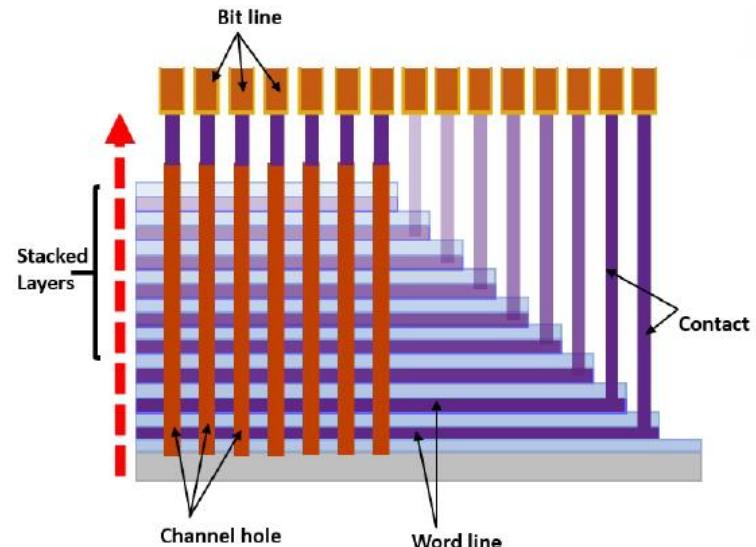
Incremental design changes from 6F² to 4F² DRAM



DRAM cell size comparison across structures



3D NAND flash structure & scaling

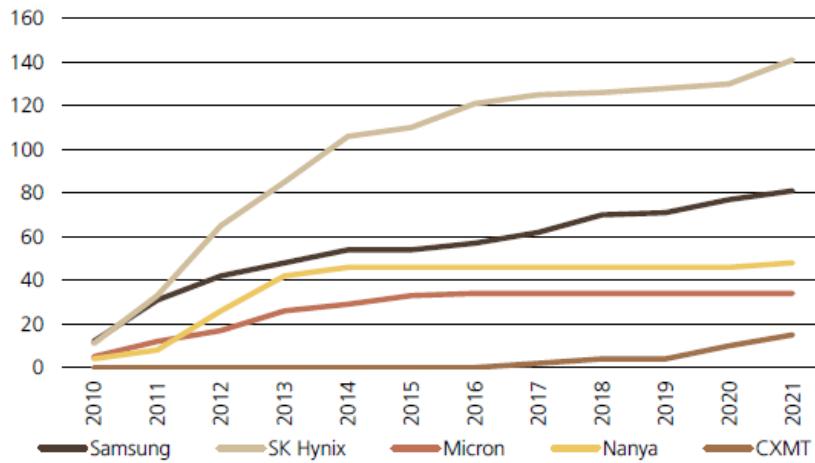


- 3D DRAM is different to 3D NAND flash; 3D NAND's structure is in effect 90 degrees flipped vs 3D DRAM, allowing scaling via stacking and w/o the need for litho shrinks
- 'Stacking' transistors not practical for DRAM with the likely avenue scaling via litho node shrinks in 4F²; skin to logic GAA

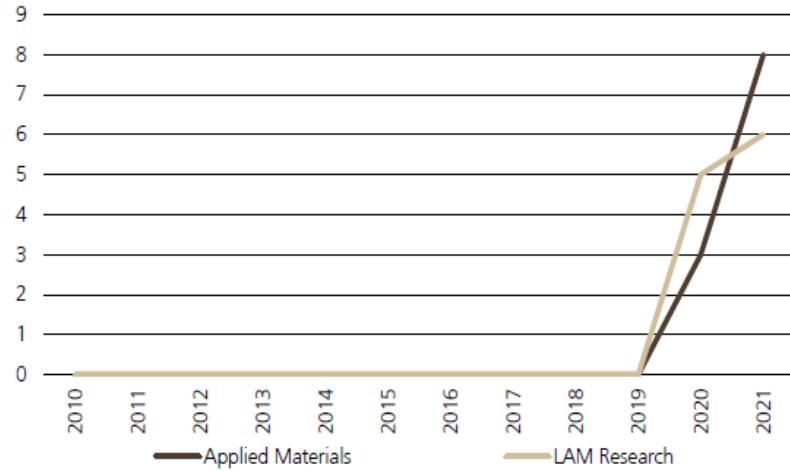
Source: Gartner, Company data, UBS estimates

3D DRAM technology patent tracker analysis

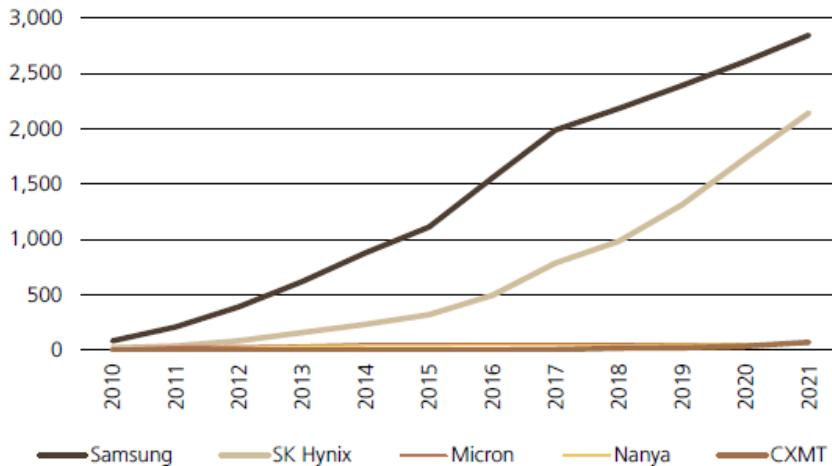
Patents on 4F2 DRAM - memory makers (accumulative)



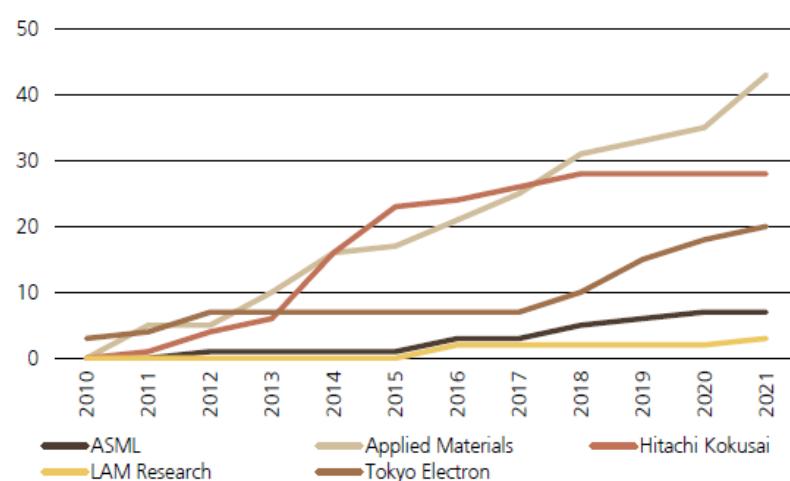
Patents on 4F2 DRAM – equipment (accumulative)



Patents on vertical channel transistors - memory makers (accumulative)



Patents on vertical channel transistors - equipment (accumulative)

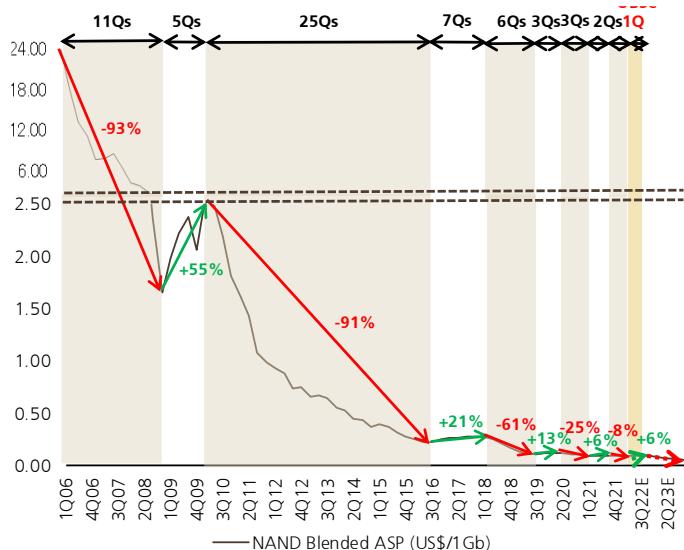


Source: Company Data, UBS estimates

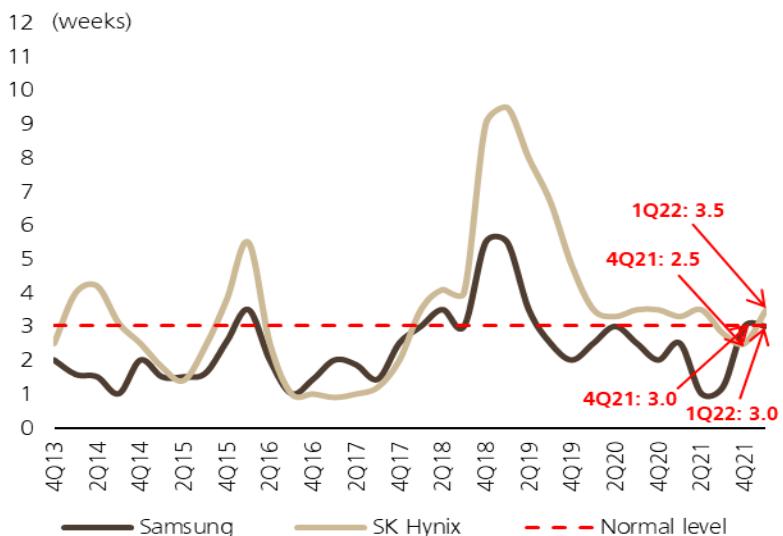


NAND KPIs

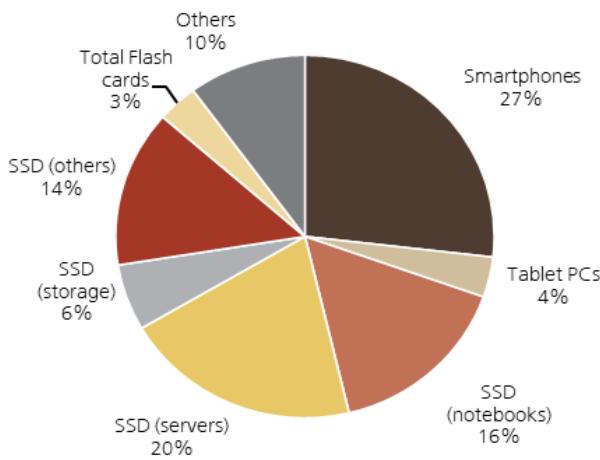
NAND Cycles in Context



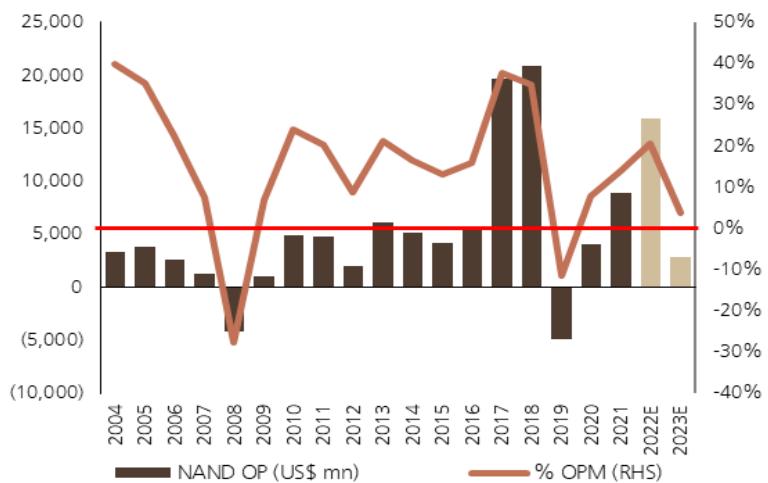
NAND Finished Wafers and Die Inventories



NAND Bits Demand Split by Apps (2022E)



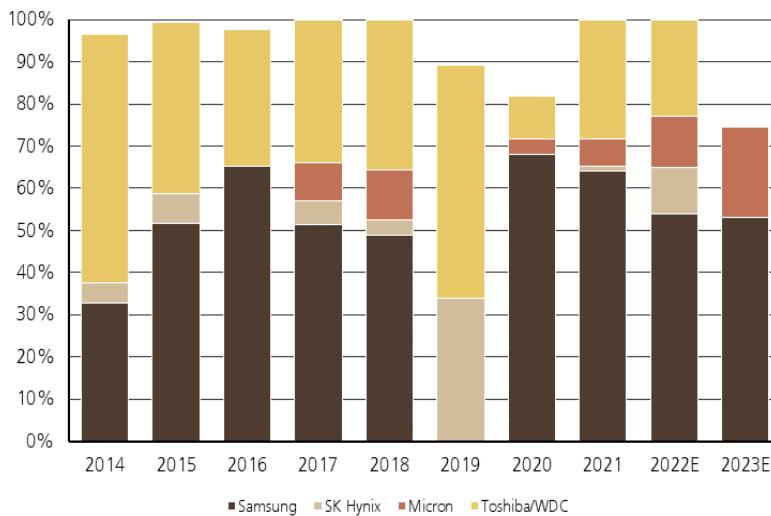
NAND Industry OP and % OP margin



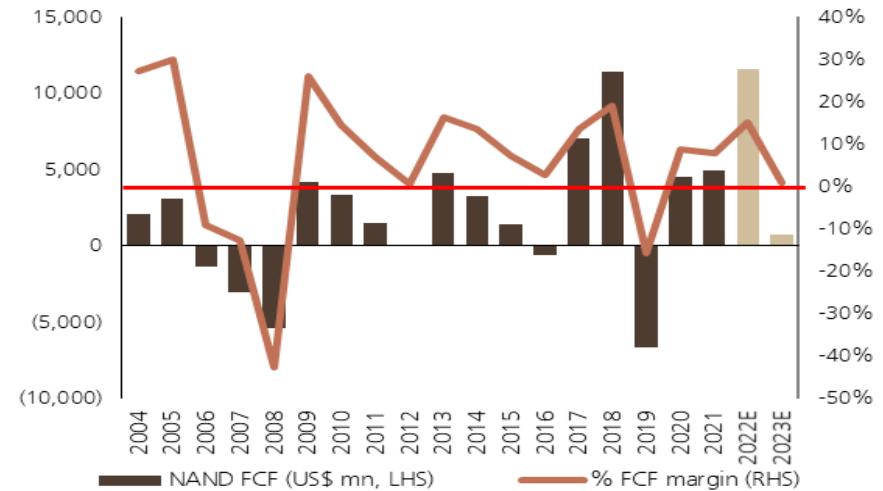
Source: Company data, UBS estimates

NAND KPIs – Other Key Charts

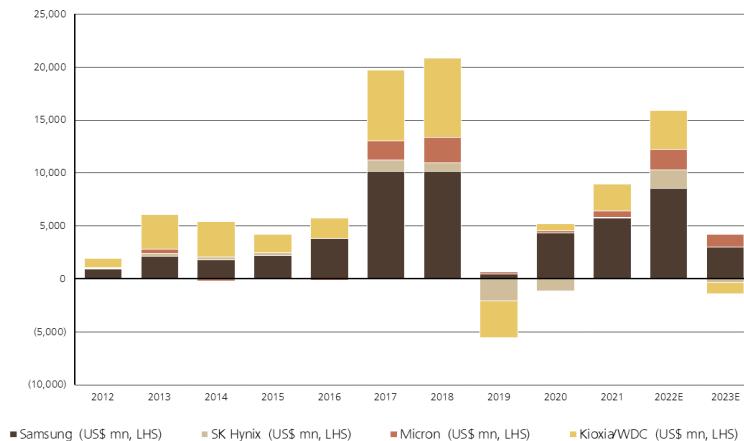
NAND Producer Share of Industry OP



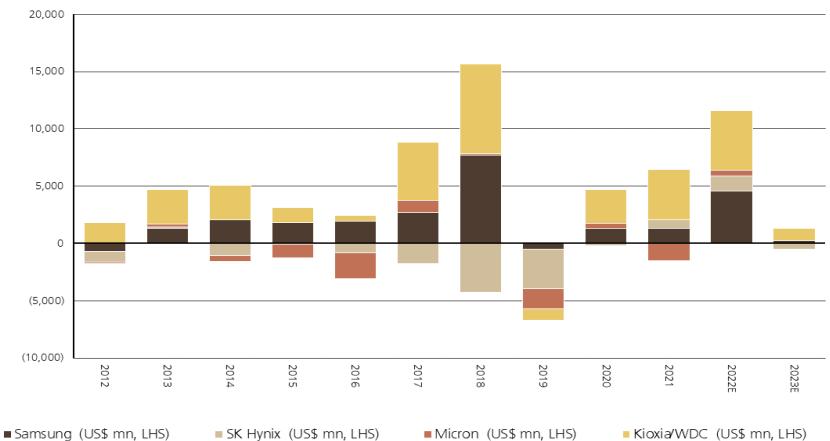
NAND Industry FCF and % FCF Margin



NAND Producer OP



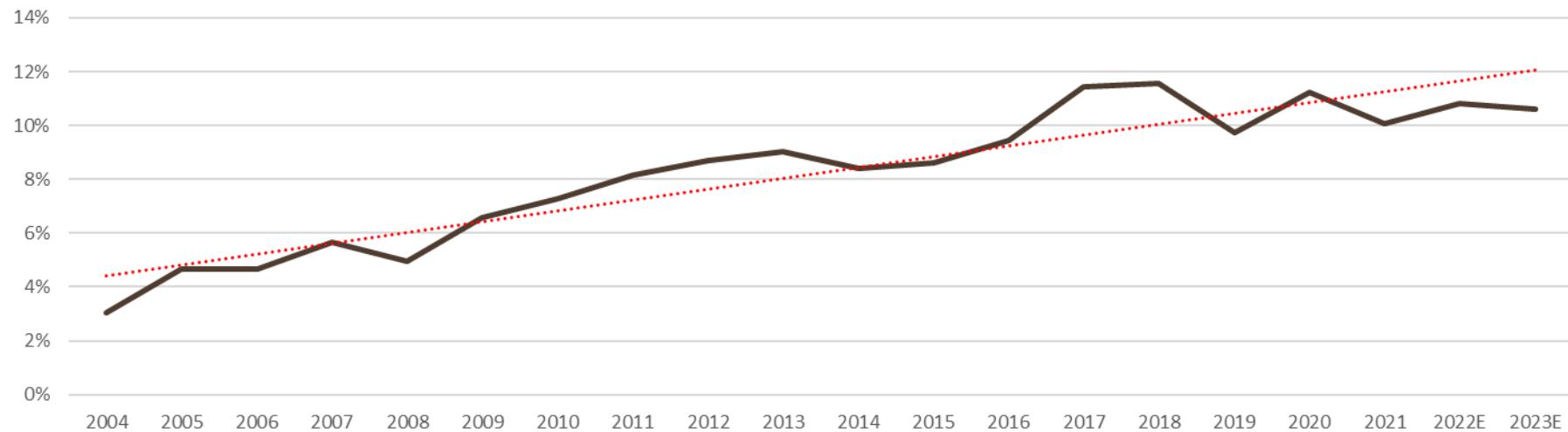
NAND Producer FCF



Source: Company data, UBS estimates

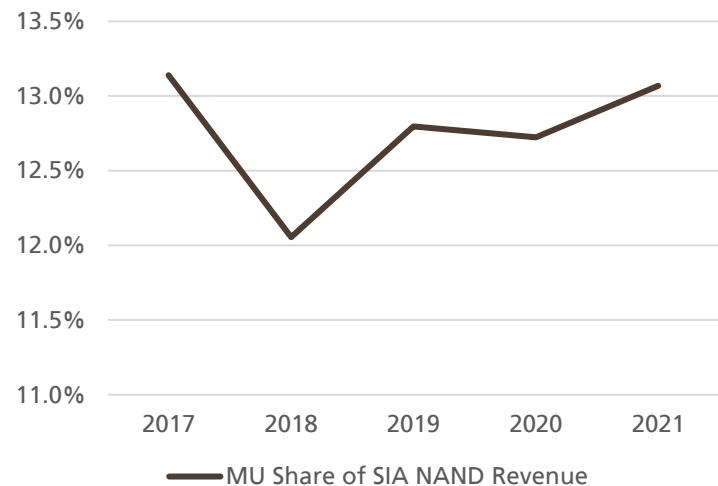
NAND KPIs – Other Charts

NAND % of Total Semi Revenue



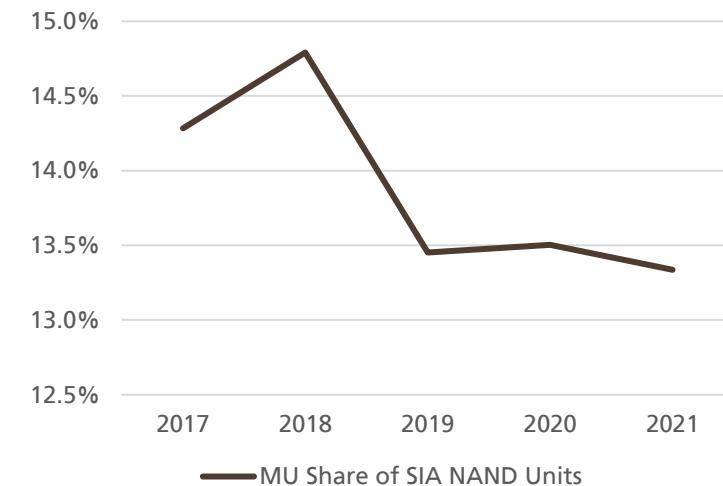
Source: SIA, UBS estimates

MU Share of SIA NAND Revenue



Source: Company data, UBS estimates, SIA

MU Share of SIA NAND Units



Source: Company data, UBS estimates, SIA

ASP will start to weaken significantly later this year and 1H:23 before stabilizing

NAND Flash Supply/Demand Summary

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Revenues (\$ mil)	49,390	12,379	13,488	15,272	14,742	55,881	14,148	15,954	18,447	19,477	68,027	17,459	15,777	15,506	14,921	63,663
% QoQ		2.3%	9.0%	13.2%	-3.5%		-4.0%	12.8%	15.6%	5.6%		-10.4%	-9.6%	-1.7%	-3.8%	
% YoY		23.2%	2.5%	6.7%	21.5%	21.8%	13.1%	14.3%	18.3%	20.8%	32.1%	21.7%	23.4%	-1.1%	-15.9%	-23.4%
Supply (Shipments Based) (M 1GB)	448,108	137,446	145,393	159,573	163,005	605,417	160,449	170,681	205,585	230,919	767,633	229,993	244,508	266,998	276,271	1,017,771
% QoQ		11.1%	5.8%	9.8%	2.2%		-1.6%	6.4%	20.5%	12.3%		-0.4%	6.3%	9.2%	3.5%	
% YoY		27.9%	31.7%	39.1%	38.1%	31.8%	35.1%	16.7%	17.4%	28.8%	41.7%	26.8%	43.3%	43.3%	29.9%	19.6%
Demand (End Consumption) (M 1GB)	459,354	140,389	149,448	165,276	181,597	636,709	175,610	176,638	198,763	226,474	777,485	223,795	228,954	255,120	286,839	994,709
% QoQ		4.1%	6.5%	10.6%	9.9%		-3.3%	0.6%	12.5%	13.9%		-1.2%	2.3%	11.4%	12.4%	
% YoY		26.9%	42.9%	41.1%	37.4%	34.6%	38.6%	25.1%	18.2%	20.3%	24.7%	22.1%	27.4%	29.6%	28.4%	26.7%
Inventory adjustment	-13,500	-400	-3,000	-4,500	-20,200	-28,100	-16,000	-3,900	5,000	1,600	-13,300	1,500	8,000	6,500	-14,500	1,500
Inventory Adj. Demand (M 1GB)	445,854	139,989	146,448	160,776	161,397	608,609	159,610	172,738	203,763	228,074	764,185	225,295	236,954	261,620	272,339	996,209
% QoQ		15.3%	4.6%	9.8%	0.4%		-1.1%	8.2%	18.0%	11.9%		-1.2%	5.2%	10.4%	4.1%	
% YoY		29.3%	32.8%	38.7%	41.7%	33.0%	36.5%	14.0%	18.0%	26.7%	41.3%	25.6%	41.2%	37.2%	28.4%	19.4%
Wafer out (k wpm, 12" equi.)	1,503	1,589	1,607	1,640	1,691	1,631	1,780	1,742	1,845	1,862	1,807	1,867	1,879	1,898	1,914	1,889
% QoQ		1.6%	1.1%	2.1%	3.1%		5.3%	-2.1%	5.9%	0.9%		0.3%	0.6%	1.0%	0.8%	
% YoY		4.0%	9.7%	8.4%	7.9%	8.1%	8.5%	12.0%	8.4%	12.5%	10.1%	10.8%	4.9%	7.8%	2.9%	4.6%
% Sufficiency Ratio	0.5%	-1.8%	-0.7%	-0.7%	1.0%	-0.5%	0.5%	-1.2%	0.9%	1.2%	0.5%	2.1%	3.2%	2.1%	1.4%	2.2%
NAND ASP (\$/1GB)	0.11	0.09	0.09	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.08	0.06	0.06	0.05	0.06
% QoQ		-8.0%	3.0%	3.2%	-5.5%		-2.5%	6.0%	-4.0%	-6.0%		-10.0%	-15.0%	-10.0%	-7.0%	
% YoY		-3.7%	-22.1%	-23.3%	-12.0%	-7.6%	-16.3%	-2.1%	0.8%	-6.2%	-6.7%	-4.0%	-13.9%	-31.0%	-35.3%	-36.0%

Source: Gartner, Company Data, UBS estimates

Consistent wafer capacity adds in NAND; YMTC presence growing

NAND Bit Market Share, Growth, and Wafers Out by Vendor

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Samsung	33.6%	35.4%	36.3%	34.7%	32.8%	34.7%	35.6%	35.2%	34.4%	32.6%	34.3%	32.3%	33.1%	33.2%	33.6%	33.1%
Kioxia	18.1%	17.3%	17.6%	18.9%	18.0%	18.0%	18.1%	15.4%	17.4%	18.6%	17.5%	17.7%	17.4%	18.3%	17.7%	17.8%
Western Digital	14.3%	13.6%	13.4%	13.2%	14.6%	13.7%	12.7%	12.6%	12.1%	11.8%	12.2%	13.0%	13.5%	13.6%	14.4%	13.7%
SK Hynix	12.3%	13.5%	13.0%	14.4%	15.8%	14.2%	19.0%	21.1%	20.9%	20.7%	20.5%	20.6%	20.3%	19.9%	19.7%	20.1%
Micron	12.7%	12.7%	12.2%	11.5%	11.2%	11.8%	11.3%	12.1%	11.8%	13.0%	12.1%	13.0%	12.4%	11.5%	11.2%	12.0%
Intel	7.5%	5.5%	5.4%	5.2%	5.1%	5.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YMTC	0.4%	0.9%	1.0%	1.2%	1.6%	1.2%	2.3%	2.7%	2.6%	2.6%	2.6%	2.5%	2.7%	2.9%	2.8%	2.7%
Total Bit Supply	100%															

NAND Flash Bit supply Growth by Vendor (Year % YoY; Quarters % QoQ)

	2020 YoY	Q121 QoQ	Q221 QoQ	Q321 QoQ	Q421 QoQ	2021 YoY	Q122E QoQ	Q222E QoQ	Q322E QoQ	Q422E QoQ	2022E YoY	Q123E QoQ	Q223E QoQ	Q323E QoQ	Q423E QoQ	2023E YoY
Samsung	19.8%	13.5%	8.6%	5.0%	-3.7%	39.7%	7.0%	5.1%	17.8%	6.4%	25.1%	-1.4%	9.0%	9.6%	4.6%	27.9%
Kioxia	31.0%	6.4%	7.3%	18.3%	-2.6%	34.5%	-1.0%	-10.0%	36.5%	20.0%	23.0%	-5.0%	4.1%	15.0%	0.0%	35.0%
Western Digital	41.2%	8.4%	4.0%	8.0%	12.8%	29.9%	-14.0%	5.5%	15.0%	10.0%	13.2%	10.0%	10.0%	10.0%	10.0%	48.0%
SK Hynix	41.0%	22.2%	2.0%	20.8%	12.5%	56.9%	18.0%	18.3%	19.6%	11.0%	82.2%	-0.7%	4.5%	7.2%	2.4%	30.2%
Micron	20.9%	8.0%	2.0%	3.0%	-0.5%	26.3%	-0.4%	14.0%	17.0%	24.0%	29.7%	0.0%	1.0%	1.0%	1.0%	31.0%
Intel	26.5%	0.0%	5.0%	5.0%	0.0%	-4.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YMTC	461.0%	45.2%	11.4%	29.2%	39.9%	267.8%	39.7%	26.6%	17.8%	10.3%	172.9%	-2.8%	12.0%	17.5%	-0.6%	40.4%
Total Bit Supply	27.9%	11.1%	5.8%	9.8%	2.2%	35.1%	-1.6%	6.4%	20.5%	12.3%	26.8%	-0.4%	6.3%	9.2%	3.5%	32.6%

NAND Flash Wafer supply vendor kwpm 12-inch (out basis)

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Samsung	493	570	588	610	630	599	665	680	674	679	674	678	674	670	666	672
Kioxia / WDC	550	550	550	550	560	553	543	490	580	580	548	580	580	580	580	580
SK Hynix	208	199	195	191	192	194	241	292	301	309	286	314	318	323	328	321
Micron	165	165	165	170	175	169	180	185	190	195	188	200	200	205	210	204
Intel	70	70	70	70	70	70	70	0	0	0	18	0	0	0	0	0
YMTC	25	35	39	49	64	65	81	95	100	100	98	95	107	120	130	115
Total	1,503	1,589	1,607	1,640	1,691	1,631	1,780	1,742	1,845	1,862	1,807	1,867	1,879	1,898	1,914	1,889
% YoY	4.0%	9.7%	8.4%	7.9%	8.1%	8.5%	12.0%	8.4%	12.5%	10.1%	10.8%	4.9%	7.8%	2.9%	2.8%	4.6%

Source: Gartner, Company data, UBS estimates. Note: wafers out (k wpm, 12 inch equivalent)

NAND bit demand growth weaker but issue is more on the supply side

NAND Flash Bit Demand by Application

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Total Embedded	431,935	132,330	141,385	157,390	174,010	605,116	169,152	170,141	191,591	219,721	750,606	217,476	222,517	247,938	279,913	967,844
Mobile Phones - Embedded	133,557	41,056	38,736	45,188	54,661	179,641	48,030	42,666	51,874	66,213	208,783	57,838	53,630	64,339	78,602	254,408
Smartphones	133,084	40,925	38,666	45,097	54,557	179,246	47,946	42,587	51,791	66,132	208,456	57,760	53,560	64,259	78,525	254,104
iPhones	36,687	10,573	8,685	11,858	21,301	52,417	16,803	11,962	15,014	26,267	70,047	20,051	14,515	19,740	31,373	85,679
Samsung	26,812	9,082	7,373	9,571	10,016	36,041	11,063	9,784	11,178	11,428	43,452	13,849	13,294	14,892	15,298	57,333
Non- iPhone/Samsung	69,586	21,271	22,608	23,669	23,240	90,787	20,080	20,842	25,598	28,438	94,958	23,861	25,751	29,627	31,853	111,092
Feature phones	473	130	70	90	104	395	84	78	84	81	327	77	70	80	77	304
Tablet PCs	20,941	6,483	6,365	6,637	6,803	26,289	6,939	6,697	7,102	7,182	27,920	7,649	7,822	8,429	8,756	32,655
Total SSD	233,568	71,592	80,784	88,565	95,029	335,970	96,184	102,278	113,115	124,327	435,903	130,490	138,065	150,671	164,055	583,281
SSD (notebooks)	68,227	20,590	22,378	27,912	32,875	103,754	27,733	27,823	31,718	35,999	123,273	32,762	33,918	37,506	41,175	145,361
SSD (servers)	80,929	24,415	28,773	29,074	30,217	112,479	34,674	37,053	41,196	45,063	157,986	50,813	52,826	57,024	60,363	221,025
SSD (storage)	23,997	7,322	8,622	9,369	9,598	34,911	10,281	11,045	11,777	12,776	45,880	13,494	14,550	15,748	16,985	60,777
SSD (others)	60,415	19,264	21,011	22,210	22,339	84,825	23,496	26,356	28,423	30,488	108,764	33,421	36,771	40,393	45,532	156,117
Other Embedded	43,869	13,200	15,500	17,000	17,517	63,217	18,000	18,500	19,500	22,000	78,000	21,500	23,000	24,500	28,500	97,500
Total Flash cards	27,420	8,059	8,063	7,885	7,586	31,594	6,458	6,497	7,172	6,753	26,879	6,319	6,438	7,182	6,926	26,865
Mobile Phones - Flash Cards	8,245	2,750	2,546	2,522	2,054	9,872	2,101	2,035	2,210	2,047	8,392	2,142	2,332	2,269	2,483	9,226
USB Flash Drives	12,560	3,519	3,627	3,413	3,432	13,991	2,357	2,562	3,162	3,006	11,086	2,577	2,606	3,514	3,143	11,839
Other flash cards	6,615	1,790	1,890	1,950	2,100	7,730	2,000	1,900	1,800	1,700	7,400	1,600	1,500	1,400	1,300	5,800
Total Bit Demand	459,354	140,389	149,448	165,276	181,597	636,709	175,610	176,638	198,763	226,474	777,485	223,795	228,954	255,120	286,839	994,709
% QoQ		4.1%	6.5%	10.6%	9.9%		-3.3%	0.6%	12.5%	13.9%		-1.2%	2.3%	11.4%	12.4%	
% YoY	26.9%	42.9%	41.1%	37.4%	34.6%	38.6%	25.1%	18.2%	20.3%	24.7%	22.1%	27.4%	29.6%	28.4%	26.7%	27.9%

Source: Gartner, Company Data, UBS estimates

SSDs continue to drive most of the bit demand growth

Breakdown of Incremental NAND Annual Bit Growth (Y/Y)

	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Total Embedded	96%	96%	99%	99%	98%	105%	106%	102%	102%	103%	100%	100%	100%	100%	100%
Mobile Phones - Embedded	32%	26%	21%	26%	26%	20%	14%	20%	26%	21%	20%	21%	22%	21%	21%
Smartphones	32%	26%	21%	26%	26%	20%	14%	20%	26%	21%	20%	21%	22%	21%	21%
iPhones	8%	4%	10%	13%	9%	18%	12%	9%	11%	13%	7%	5%	8%	8%	7%
Samsung	6%	5%	3%	7%	5%	6%	9%	5%	3%	5%	6%	7%	7%	6%	6%
Non- iPhone/Samsung	19%	17%	8%	5%	12%	-3%	-6%	6%	12%	3%	8%	9%	7%	6%	7%
Feature phones	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tablet PCs	8%	3%	2%	-1%	3%	1%	1%	1%	1%	1%	1%	1%	2%	2%	3%
Total SSD	52%	55%	61%	63%	58%	70%	79%	73%	65%	71%	71%	68%	67%	66%	68%
SSD (notebooks)	25%	13%	19%	23%	20%	20%	20%	11%	7%	14%	10%	12%	10%	9%	10%
SSD (servers)	9%	18%	19%	24%	18%	29%	30%	36%	33%	32%	33%	30%	28%	25%	29%
SSD (storage)	4%	7%	8%	6%	6%	8%	9%	7%	7%	8%	7%	7%	7%	7%	7%
SSD (others)	14%	17%	16%	10%	14%	12%	20%	19%	18%	17%	21%	20%	21%	25%	22%
Other Embedded	5%	12%	15%	12%	11%	14%	11%	7%	10%	11%	7%	9%	9%	11%	9%
Total Flash cards	4%	4%	1%	1%	2%	-5%	-6%	-2%	-2%	-3%	0%	0%	0%	0%	0%
Mobile Phones - Flash Cards	1%	1%	1%	0%	1%	-2%	-2%	-1%	0%	-1%	0%	1%	0%	1%	0%
USB Flash Drives	2%	2%	0%	-1%	1%	-3%	-4%	-1%	-1%	-2%	0%	0%	1%	0%	0%
Other flash cards	0%	1%	1%	1%	1%	1%	0%	0%	-1%	0%	-1%	-1%	-1%	-1%	-1%
Total Bit Demand	100%														

Source: Gartner, Company Data, UBS estimates

Smartphones and SSDs decelerate through '22E

NAND Flash Bit Demand Growth by Application

	2020 YoY	Q121 QoQ	Q221 QoQ	Q321 QoQ	Q421 QoQ	2021 YoY	Q122E QoQ	Q222E QoQ	Q322E QoQ	Q422E QoQ	2022E YoY	Q123E QoQ	Q223E QoQ	Q323E QoQ	Q423E QoQ	2023E YoY
Total Embedded	29.7%	3.7%	6.8%	11.3%	10.6%	40.1%	-2.8%	0.6%	12.6%	14.7%	24.0%	-1.0%	2.3%	11.4%	12.9%	28.9%
Smartphones	14.9%	-4.0%	-5.5%	16.6%	21.0%	34.7%	-12.1%	-11.2%	21.6%	27.7%	16.3%	-12.7%	-7.3%	20.0%	22.2%	21.9%
iPhones	18.5%	-30.0%	-17.9%	36.5%	79.6%	42.9%	-21.1%	-28.8%	25.5%	74.9%	33.6%	-23.7%	-27.6%	36.0%	58.9%	22.3%
Samsung	-6.5%	39.3%	-18.8%	29.8%	4.7%	34.4%	10.4%	-11.6%	14.2%	2.2%	20.6%	21.2%	-4.0%	12.0%	2.7%	31.9%
Non- iPhone/Samsung	23.8%	1.3%	6.3%	4.7%	-1.8%	30.5%	-13.6%	3.8%	22.8%	11.1%	4.6%	-16.1%	7.9%	15.1%	7.5%	17.0%
Tablet PCs	85.3%	-9.7%	-1.8%	4.3%	2.5%	25.5%	2.0%	-3.5%	6.0%	1.1%	6.2%	6.5%	2.3%	7.8%	3.9%	17.0%
SSD-Total	46.6%	9.1%	12.8%	9.6%	7.3%	43.8%	1.2%	6.3%	10.6%	9.9%	29.7%	5.0%	5.8%	9.1%	8.9%	33.8%
SSD (notebooks)	64.7%	-6.5%	8.7%	24.7%	17.8%	52.1%	-15.6%	0.3%	14.0%	13.5%	18.8%	-9.0%	3.5%	10.6%	9.8%	17.9%
SSD (servers)	64.5%	29.5%	17.8%	1.0%	3.9%	39.0%	14.7%	6.9%	11.2%	9.4%	40.5%	12.8%	4.0%	7.9%	5.9%	39.9%
SSD (storage)	32.8%	5.6%	17.7%	8.7%	2.4%	45.5%	7.1%	7.4%	6.6%	8.5%	31.4%	5.6%	7.8%	8.2%	7.9%	32.5%
SSD (others)	19.4%	8.2%	9.1%	5.7%	0.6%	40.4%	5.2%	12.2%	7.8%	7.3%	28.2%	9.6%	10.0%	9.8%	12.7%	43.5%
Total Flash cards	-4.9%	10.9%	0.0%	-2.2%	-3.8%	15.2%	-14.9%	0.6%	10.4%	-5.8%	-14.9%	-6.4%	1.9%	11.6%	-3.6%	-0.1%
Mobile Phones - Flash cards	-2.4%	47.0%	-7.4%	-1.0%	-18.6%	19.7%	2.3%	-3.1%	8.6%	-7.4%	-15.0%	4.7%	8.9%	-2.7%	9.4%	9.9%
Total Bit Demand	26.9%	4.1%	6.5%	10.6%	9.9%	38.6%	-3.3%	0.6%	12.5%	13.9%	22.1%	-1.2%	2.3%	11.4%	12.4%	27.9%

Source: Gartner, Company Data, UBS estimates

Content growths increase in Notebooks and Servers

NAND Flash Content Assumptions (MB/unit) by Application

	2020	Q121	Q221	Q321	Q421	2021	Q122E	Q222E	Q322E	Q422E	2022E	Q123E	Q223E	Q323E	Q423E	2023E
Smartphones - Blended	93,776	107,459	118,979	126,758	137,600	122,806	142,904	140,194	147,489	166,386	150,128	169,794	166,888	177,644	197,432	178,829
% YoY	27%	23%	32%	37%	34%	31%	33%	18%	16%	21%	22%	19%	19%	20%	19%	19%
iPhones	183,522	193,331	193,331	252,969	262,799	224,964	291,635	291,635	301,466	327,025	299,025	347,996	353,894	390,595	390,595	364,590
Samsung	108,539	122,365	132,456	142,035	148,643	136,186	153,083	160,303	170,841	175,968	164,797	197,507	203,180	214,786	227,034	210,578
Non-iPhone/Samsung	86,000	102,000	110,000	112,000	113,000	109,244	115,000	120,000	125,000	130,000	123,030	130,000	135,000	140,000	145,000	137,901
SSD - Notebook PCs	332	348	377	456	494	421	484	494	527	576	522	606	609	633	667	630
% YoY	19%	9%	15%	34%	47%	27%	39%	31%	16%	17%	24%	25%	23%	20%	16%	21%
SSD - Servers	1,725	1,875	2,109	2,305	2,372	2,162	2,518	2,665	2,762	2,860	2,708	3,055	3,250	3,543	3,836	3,416
% YoY	5%	12%	23%	33%	33%	25%	34%	26%	20%	21%	25%	21%	22%	28%	34%	26%
SSD - Storage	4,013	4,492	4,844	5,205	5,303	4,973	5,498	5,693	5,889	6,084	5,800	6,426	6,768	7,158	7,549	6,986
% YoY	9%	17%	23%	29%	26%	24%	22%	18%	13%	15%	17%	17%	19%	22%	24%	20%

Source: Gartner, Company Data, UBS estimates

Section 4

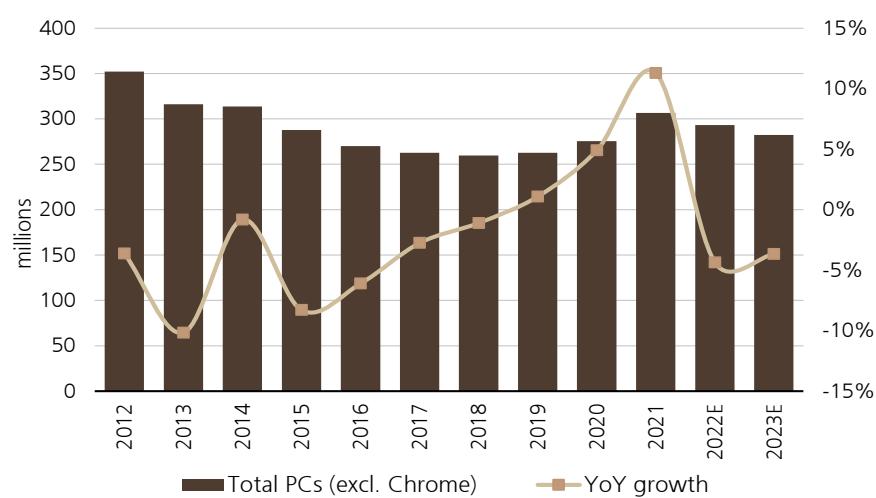
PC's

Key Messages

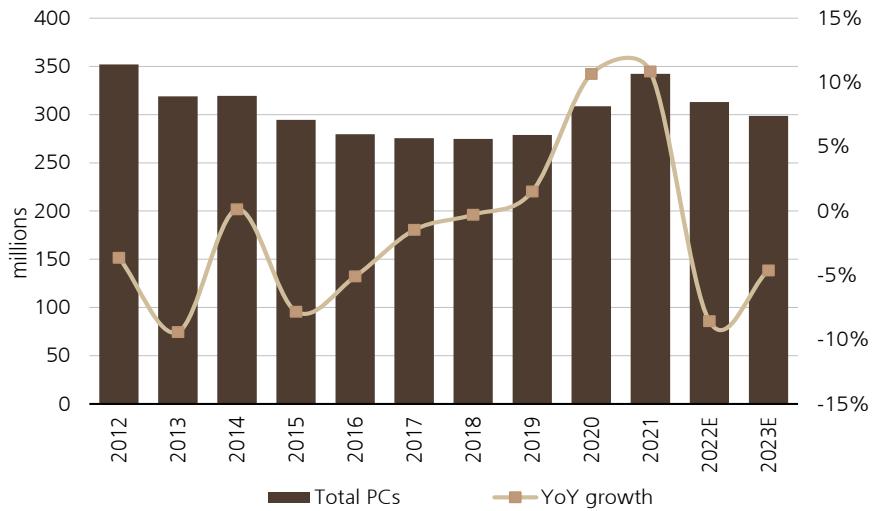
- PC demand is softening, but still mostly driven by Chromebook. Government purchases in mature countries have pressured Chromebook
- Mixed PC demand outlook into 2H22 on macro, material prices, labor shortages and logistics
- Supply constraints are easing; channel inventory starting to grow again amid some demand uncertainty
- Taiwan EMS/ODM now have record inventory levels, leading to some pushback on component procurement
- We model overall PC unit shipments to decline -8.6% YoY in '22E followed by -4.6% in '23E
- AMD continues to gain share in PC MPU with notebook share back to prior highs but desktop share still below prior peak levels

Global PCs: Softening Chromebooks are the main downside driver

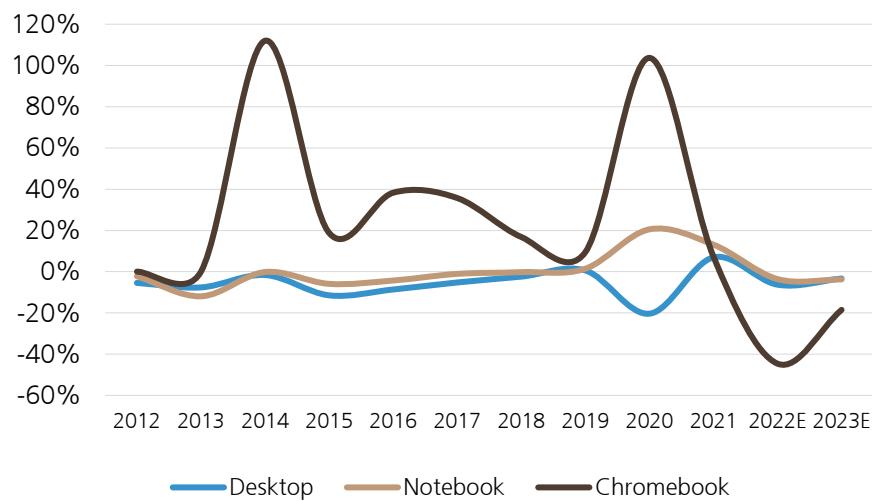
Global PC (excl. C-Books) Shipment and Growth YoY



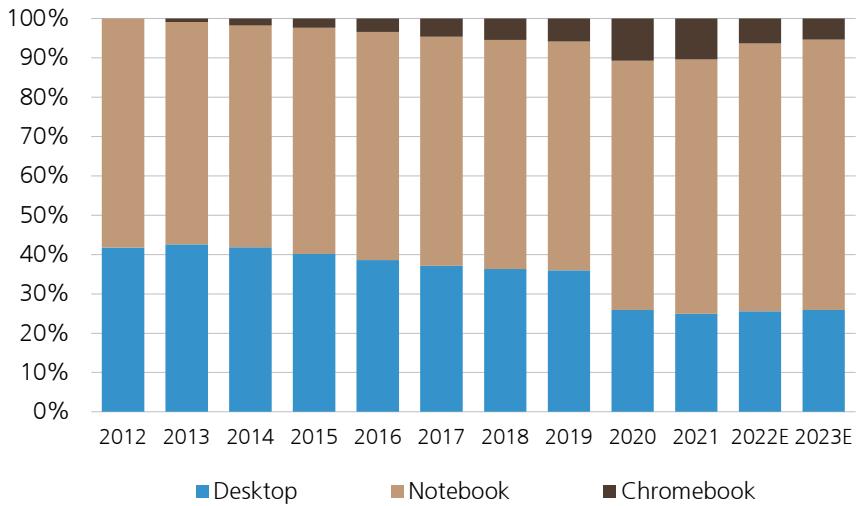
Global PC (incl. C-Books) Shipment and Growth YoY



Global PC Shipment YoY Growth by Form Factor



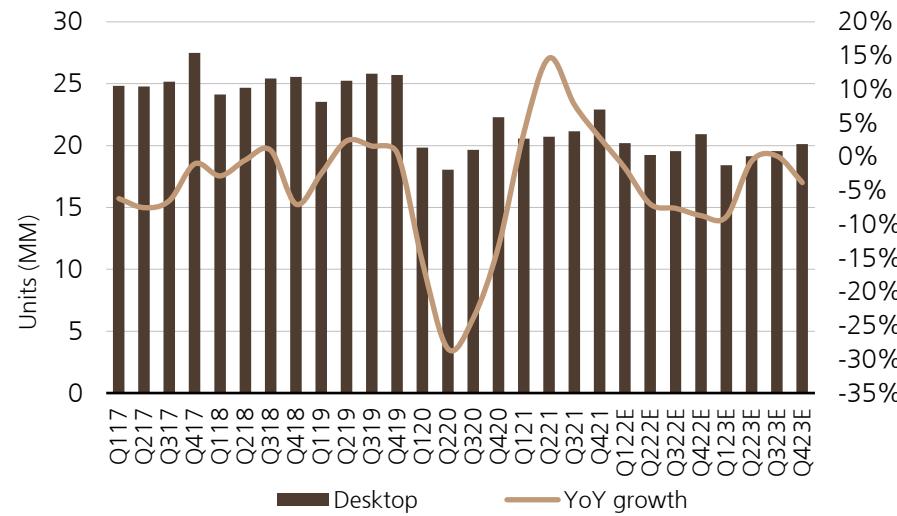
Global PC Shipment Mix by Form Factor



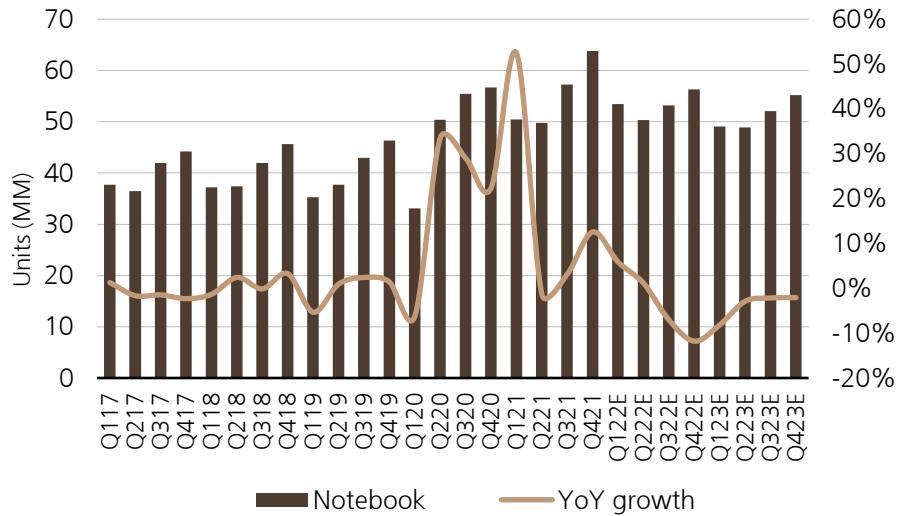
Source : Gartner, UBS estimates

Global PCs: Regular NBs outperforming other form factors

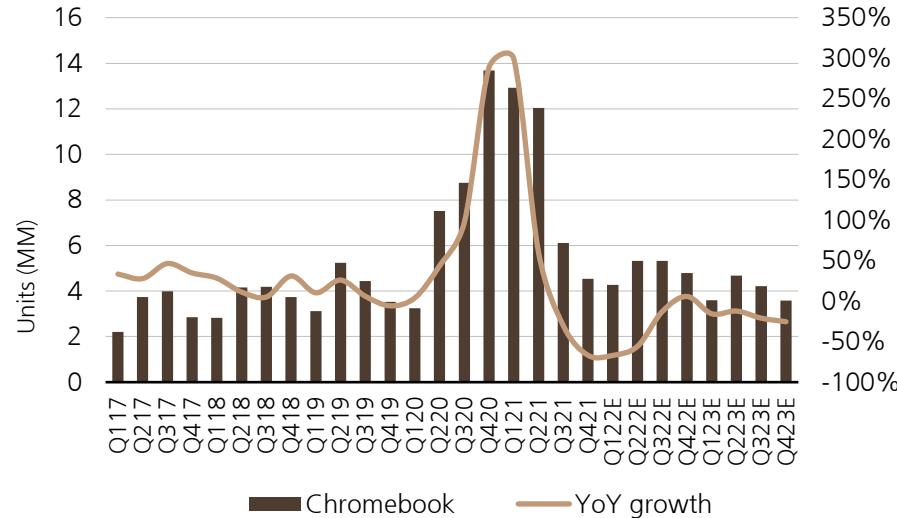
Desktop Shipment and Growth YoY (Quarterly)



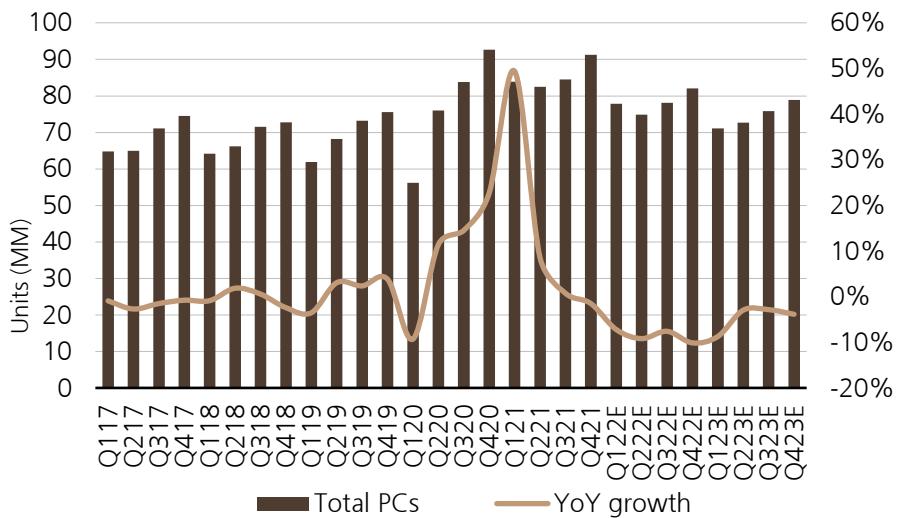
Notebook Shipment and Growth YoY (Quarterly)



Chromebook Shipment and Growth YoY (Quarterly)



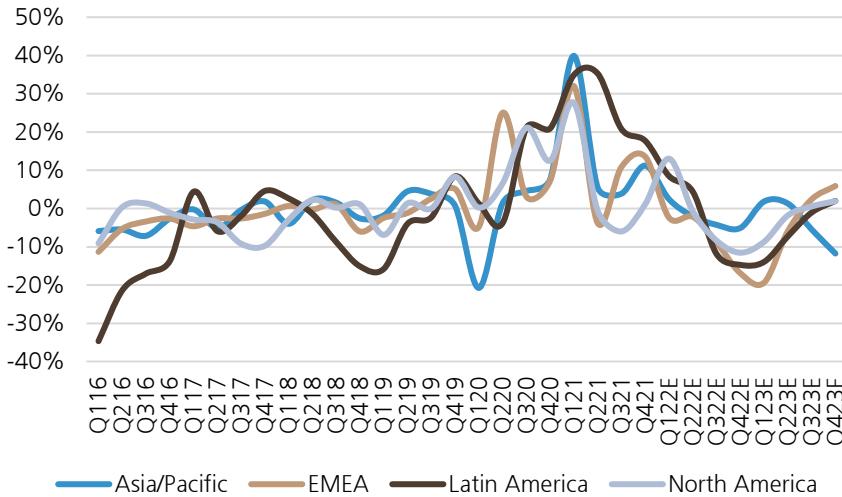
Total PC Shipment and Growth YoY (Quarterly)



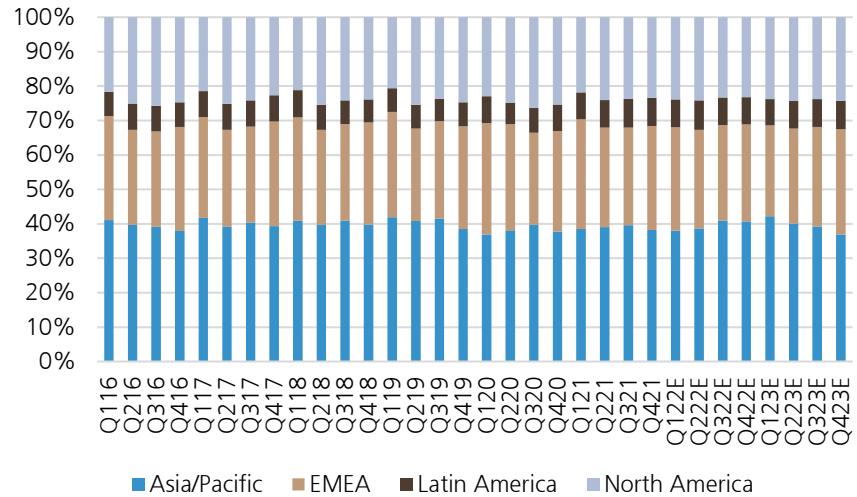
Source : Gartner, UBS estimates

Global PCs: Demand in the APAC has softened

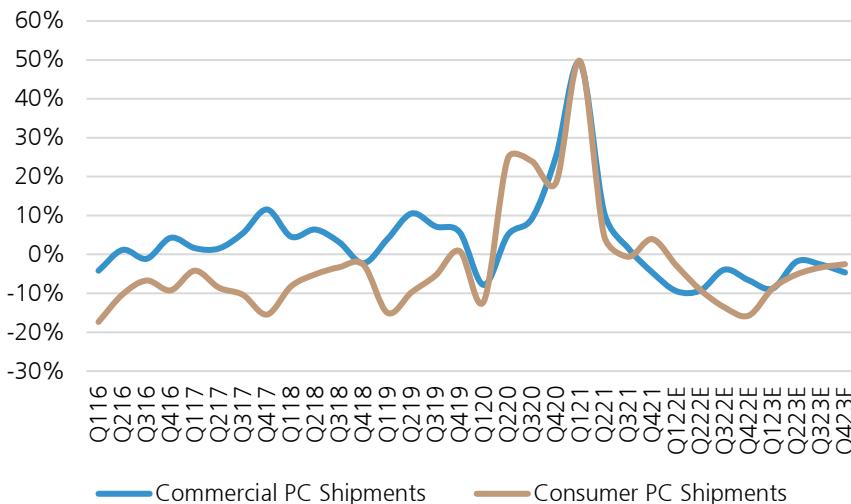
Global PC Shipment YoY Growth by Region



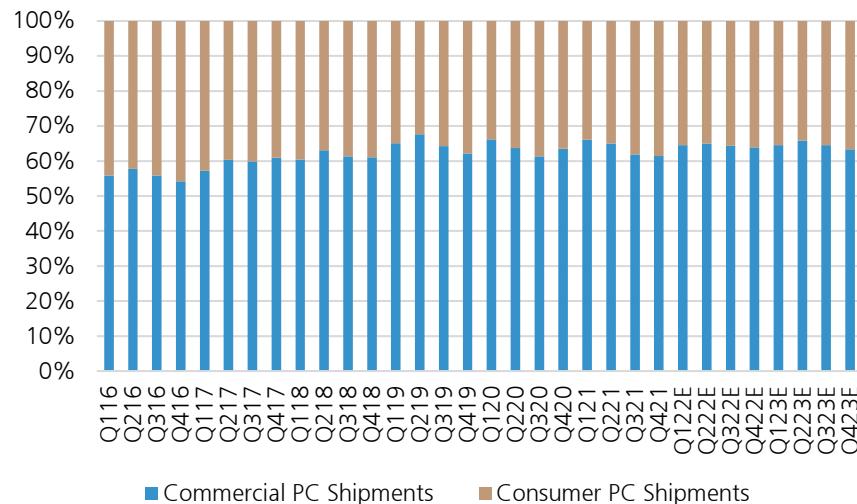
Global PC Shipment Mix by Region



Global PC Shipment YoY Growth by End Market



Global PC Shipment Mix by End Market



Source : Gartner, UBS estimates

UBS Global PC Shipment Forecast: -8.6%/-4.6% Y/Y in '22/'23E

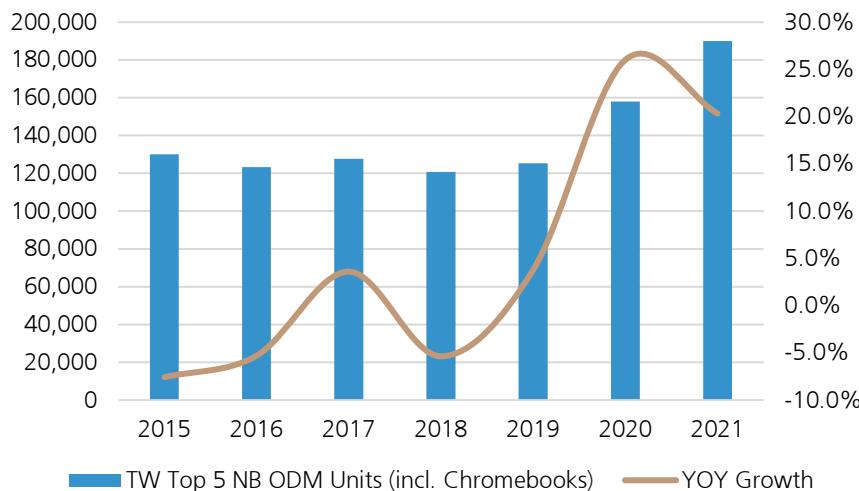
UBS Global PC Model

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E
PC units by form factor (m)												
Desktop	147.1	135.8	133.6	118.2	108.0	102.3	99.8	100.3	79.8	85.3	79.9	77.2
Notebook	205.0	180.5	180.1	169.5	162.2	160.4	160.0	162.3	195.6	221.2	213.3	205.2
Sub-total	352.1	316.3	313.7	287.7	270.1	262.7	259.8	262.6	275.5	306.6	293.2	282.5
Chromebook	NA	2.7	5.7	6.8	9.4	12.8	14.9	16.3	33.2	35.6	19.7	16.1
Total PC	352.1	319.0	319.4	294.5	279.5	275.4	274.7	278.9	308.7	342.2	312.9	298.5
Consumer PC	171.1	149.5	154.2	138.4	123.3	111.1	105.9	98.4	112.8	124.7	111.3	105.9
Consumer NB	117.0	100.9	106.3	98.5	89.5	83.1	80.4	75.5	91.3	100.9	89.4	82.9
Consumer DT	54.1	48.6	47.9	39.9	33.8	28.0	25.5	22.9	21.5	23.8	21.9	23.0
Commercial PC	180.9	169.5	165.3	156.1	156.2	164.3	168.8	180.5	195.9	217.5	201.6	192.6
Commercial NB	88.0	79.5	73.9	71.0	72.6	77.3	79.6	86.8	104.4	120.3	123.9	122.3
Commercial DT	93.0	87.3	85.7	78.3	74.1	74.3	74.3	77.4	58.3	61.6	58.0	54.2
Chromebook	0.0	2.7	5.7	6.8	9.4	12.8	14.9	16.3	33.2	35.6	19.7	16.1
Total PC	352.1	319.0	319.4	294.5	279.5	275.4	274.7	278.9	308.7	342.2	312.9	298.5
Unit growth (%)												
Desktop	-5.5%	-7.7%	-1.7%	-11.5%	-8.7%	-5.3%	-2.4%	0.5%	-20.4%	6.9%	-6.3%	-3.4%
Notebook	-2.2%	-12.0%	-0.2%	-5.9%	-4.3%	-1.1%	-0.2%	1.4%	20.5%	13.1%	-3.6%	-3.8%
Sub-total	-3.6%	-10.2%	-0.8%	-8.3%	-6.1%	-2.8%	-1.1%	1.1%	4.9%	11.3%	-4.4%	-3.7%
Chromebook	0.0%	0.0%	111.9%	18.8%	38.2%	35.7%	16.8%	9.4%	103.6%	7.2%	-44.6%	-18.6%
Total PC	-3.6%	-9.4%	0.1%	-7.8%	-5.1%	-1.5%	-0.3%	1.5%	10.7%	10.9%	-8.6%	-4.6%
Consumer PC	-2.9%	-12.7%	3.2%	-10.2%	-10.9%	-9.9%	-4.7%	-7.0%	14.6%	10.5%	-10.7%	-4.9%
Consumer NB		-13.8%	5.3%	-7.3%	-9.1%	-7.1%	-3.3%	-6.1%	20.9%	10.6%	-11.4%	-7.3%
Consumer DT		-10.3%	-1.3%	-16.7%	-15.3%	-17.2%	-9.0%	-9.9%	-6.1%	10.3%	-7.7%	5.0%
Commercial PC	-4.3%	-6.3%	-2.5%	-5.6%	0.1%	5.2%	2.8%	6.9%	8.5%	11.0%	-7.3%	-4.5%
Commercial NB		-9.6%	-7.1%	-3.9%	2.3%	6.4%	3.1%	9.0%	20.2%	15.3%	3.0%	-1.2%
Commercial DT		-6.1%	-1.9%	-8.6%	-5.3%	0.2%	0.0%	4.1%	-24.6%	5.6%	-5.8%	-6.5%
Chromebook		n.a	111.9%	18.8%	38.2%	35.7%	16.8%	9.4%	103.6%	7.2%	-44.6%	-18.6%
Total PC	-3.6%	-9.4%	0.1%	-7.8%	-5.1%	-1.5%	-0.3%	1.5%	10.7%	10.9%	-8.6%	-4.6%

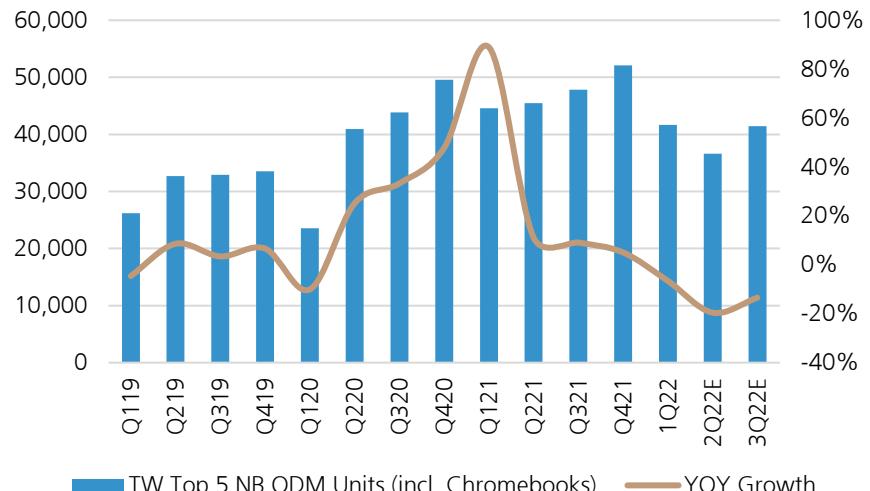
Source : Company data, UBS estimates

NB ODM Shipments: China lockdowns and labor shortages impacted Q2:22E, but the supply chain is gradually normalizing

Taiwan NB ODM Shipment and Growth YoY (Units: K)



Taiwan NB ODM Shipment and Growth YoY (Units: K)



Source : Gartner, UBS estimates

Source : Gartner, UBS estimates

NB ODM Shipments: expect lukewarm Q3:22 on demand concerns

Taiwanese Top-5 NB ODM shipments

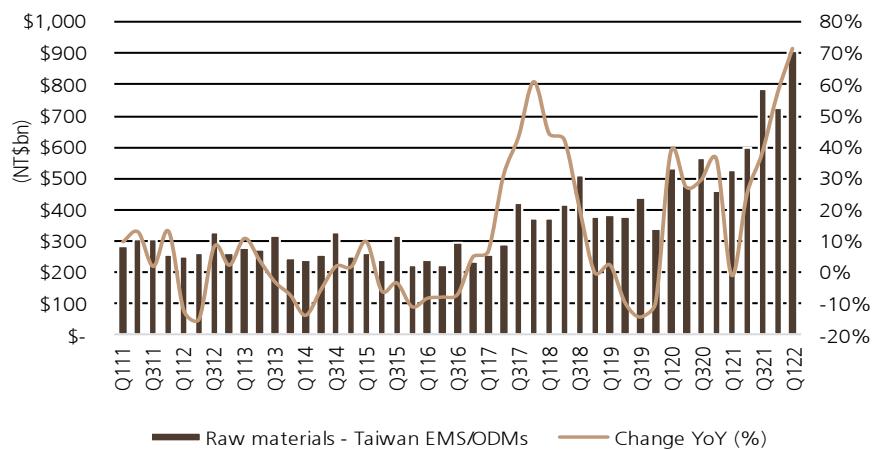
('000 Units)	2019				2020				2021				2022		
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2QE	3QE
Quanta	7,300	8,700	9,300	9,800	7,300	14,500	18,300	19,700	19,000	19,000	17,400	19,900	16,900	13,200	16,000
Compal	9,300	12,500	11,500	10,600	7,800	12,500	11,600	15,700	13,100	13,000	15,300	16,000	11,800	10,300	11,845
Pegatron	1,900	2,400	2,700	3,050	1,525	3,025	3,050	2,575	2,250	2,400	2,650	3,100	2,335	2,075	2,386
Inventec	4,100	4,900	4,900	5,000	3,400	5,700	5,700	5,200	4,800	5,000	5,900	5,600	5,000	5,200	5,200
Wistron	3,600	4,200	4,500	5,100	3,550	5,200	5,200	6,400	5,400	6,100	6,600	7,500	5,600	5,850	6,000
Total	26,200	32,700	32,900	33,550	23,575	40,925	43,850	49,575	44,550	45,500	47,850	52,100	41,635	36,625	41,431
YoY	-4.6%	2.3%	2.7%	3.8%	-10.0%	9.5%	18.0%	26.0%	89.0%	39.6%	27.3%	20.3%	-6.5%	-13.1%	-13.2%
MoM/QoQ	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2QE	3QE
Quanta	-24%	19%	7%	5%	-26%	99%	26%	8%	-4%	0%	-8%	14%	-15%	-22%	21%
Compal	-9%	34%	-8%	-8%	-26%	60%	-7%	35%	-17%	-1%	18%	5%	-26%	-13%	15%
Pegatron	-22%	26%	13%	13%	-50%	98%	1%	-16%	-13%	7%	10%	17%	-25%	-11%	15%
Inventec	-13%	20%	0%	2%	-32%	68%	0%	-9%	-8%	4%	18%	-5%	-11%	4%	0%
Wistron	-20%	17%	7%	13%	-30%	46%	0%	23%	-16%	13%	8%	14%	-25%	4%	3%
Total	-17%	25%	1%	2%	-30%	74%	7%	13%	-10%	2%	5%	9%	-20%	-12%	13%
YoY	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2QE	3QE
Quanta	-18%	-5%	-6%	2%	0%	67%	97%	101%	160%	31%	-5%	1%	-11%	-31%	-8%
Compal	9%	21%	10%	4%	-16%	0%	1%	48%	68%	4%	32%	2%	-10%	-21%	-23%
Pegatron	-3%	60%	50%	24%	-20%	26%	13%	-16%	48%	-21%	-13%	20%	4%	-14%	-10%
Inventec	2%	2%	-2%	6%	-17%	16%	16%	4%	41%	-12%	4%	8%	4%	4%	-12%
Wistron	-12%	-2%	-2%	13%	-1%	24%	16%	25%	52%	17%	27%	17%	4%	-4%	-9%
Total	-5%	9%	3%	7%	-10%	25%	33%	48%	89%	11%	9%	5%	-7%	-20%	-13%

Source : Company data, UBS estimates

ODM/EMS inventory has jumped to record high, leading to some component pushback

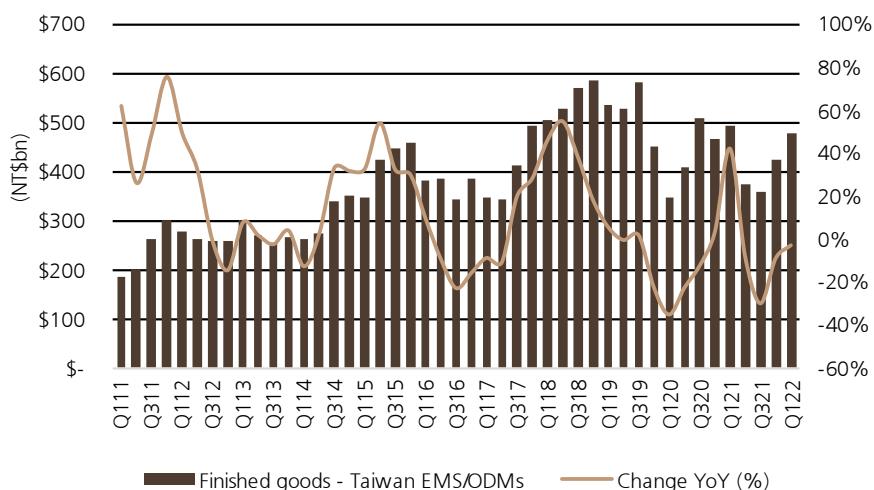
Raw Material Inventory – Taiwan EMS/ODMs

Inventory - Raw material



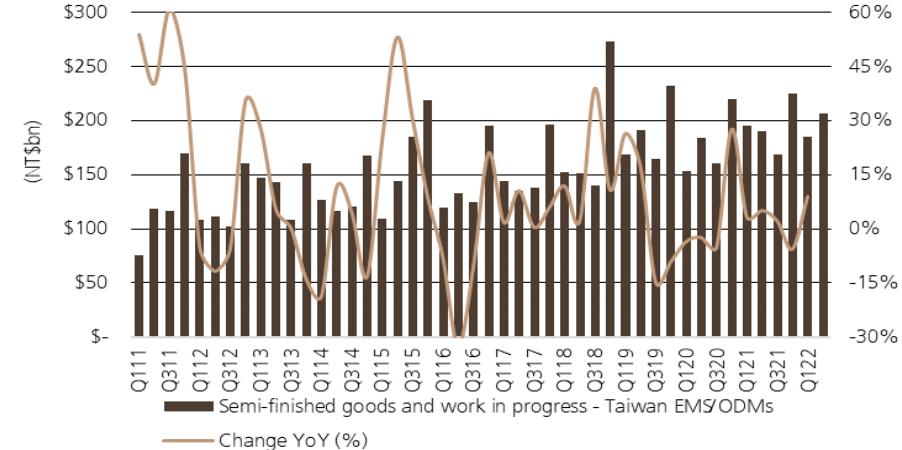
Finished Goods Inventory – Taiwan EMS/ODMs

Inventory - Finished goods



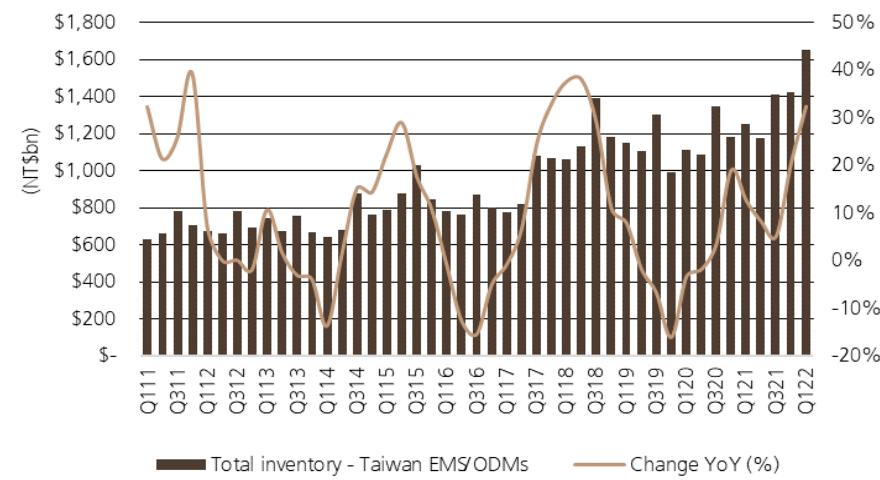
Semi-finished Goods & WIP Inventory – Taiwan EMS/ODMs

Inventory - Semi-finished goods and work in progress



Total Inventory – Taiwan EMS/ODMs

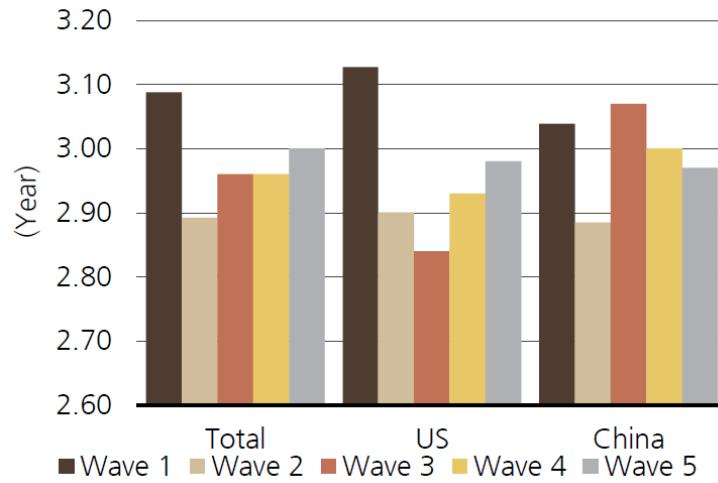
Inventory - Total inventory



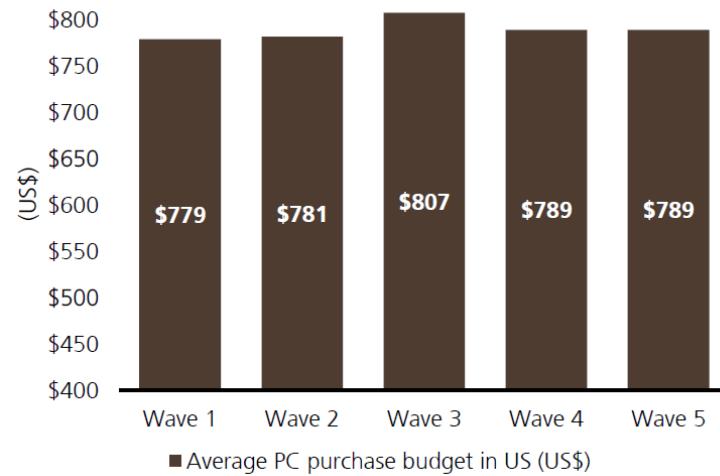
Source : Gartner, UBS estimates

Consumer Survey: PC gaming demand growing, but replacement cycles continue to elongate

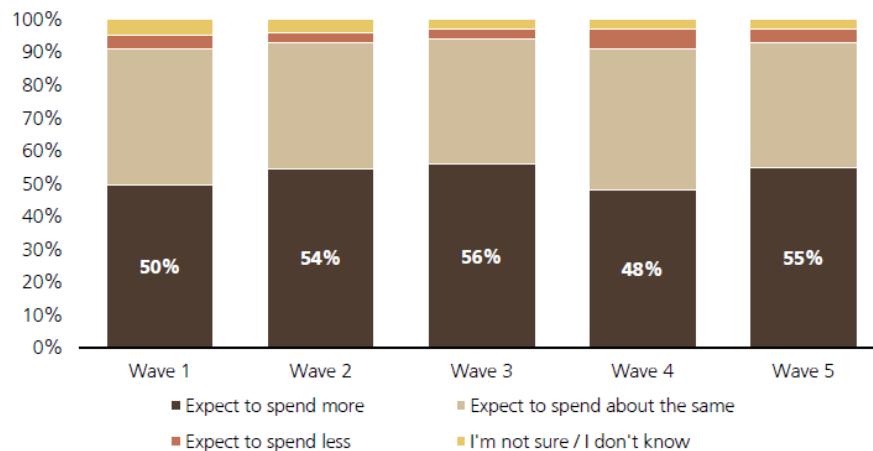
PC Replacement Cycle



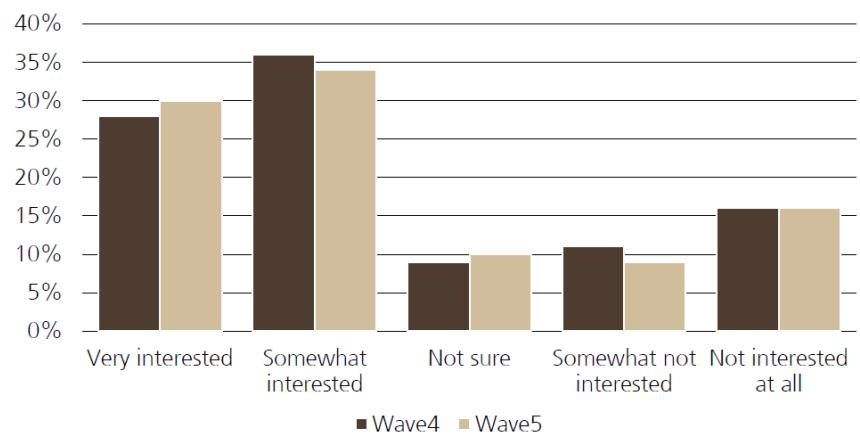
PC Purchase Budget in the US



PC Spending Willingness



Strong Demand for Gaming

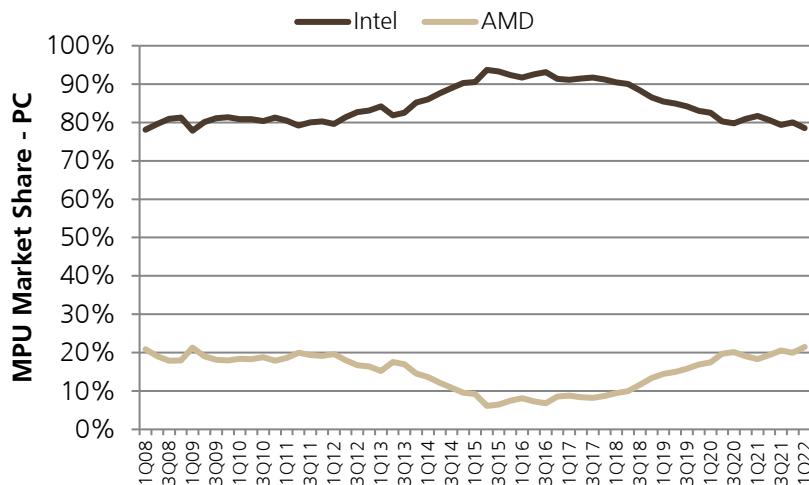


Source : Gartner, UBS Evidence Lab ([> Access Dataset](#))

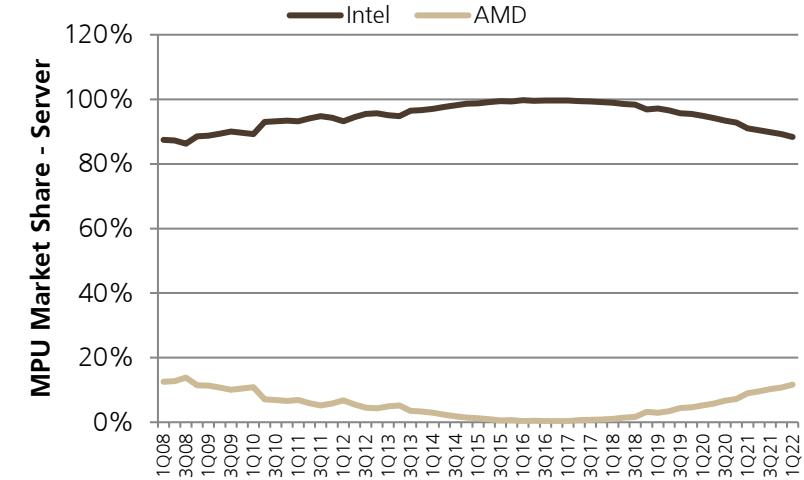
Note: Latest Wave 5 was as of Feb 2022

Processor Market: AMD continues to gain, INTC starting to fight back in DT/NB but not yet in server

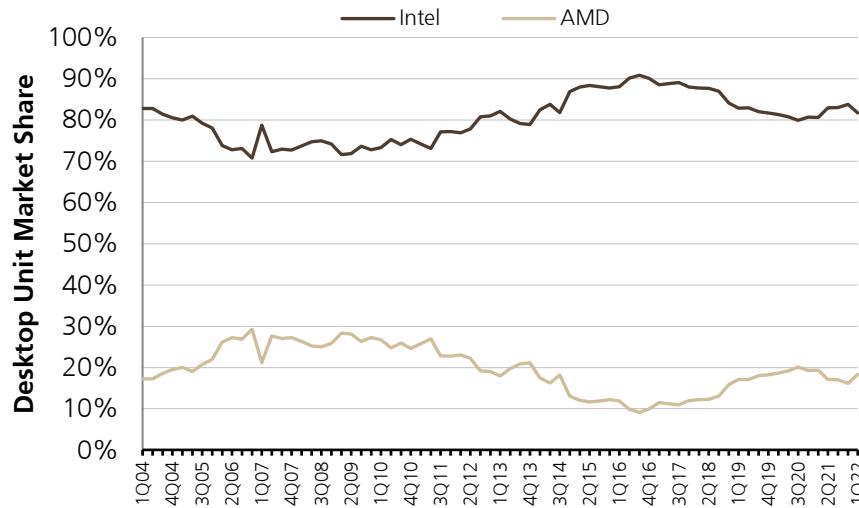
Overall PC MPU Market Share (Units)



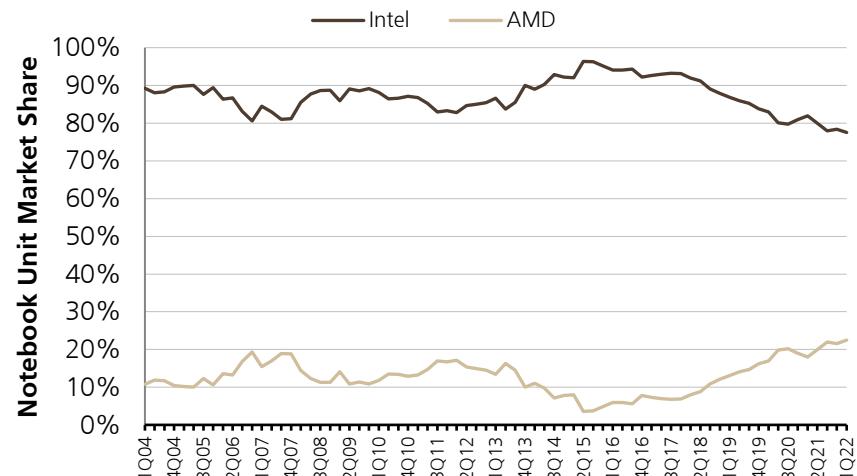
Server MPU Market Share (Units)



Overall Desktop Market Share (Units)



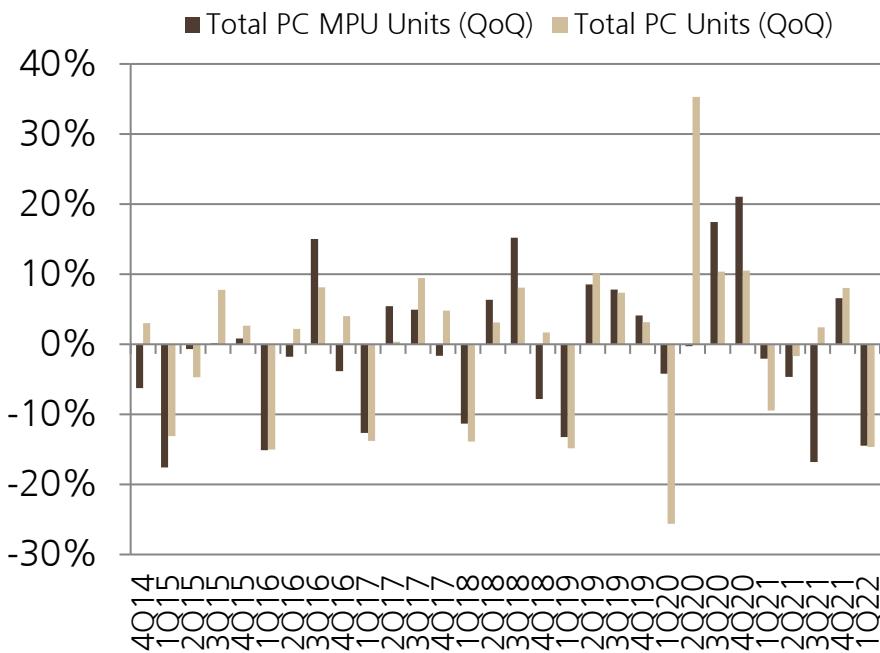
Overall Notebook Market Share (Units)



Source: Mercury Research

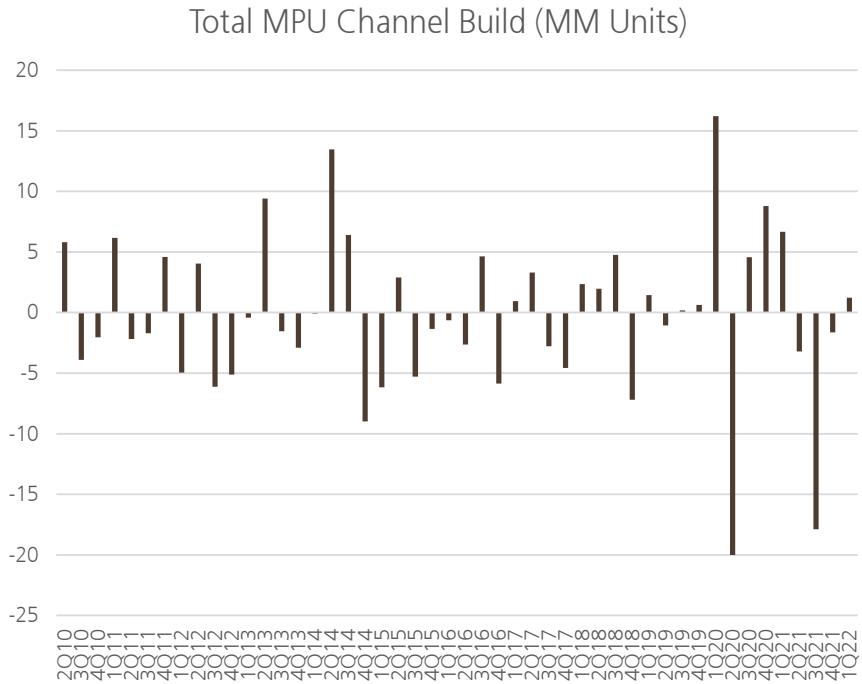
PC MPU channel inventory has been worked down

PC MPU vs. PC Unit Shipments Q/Q



Source: Mercury Research, UBS

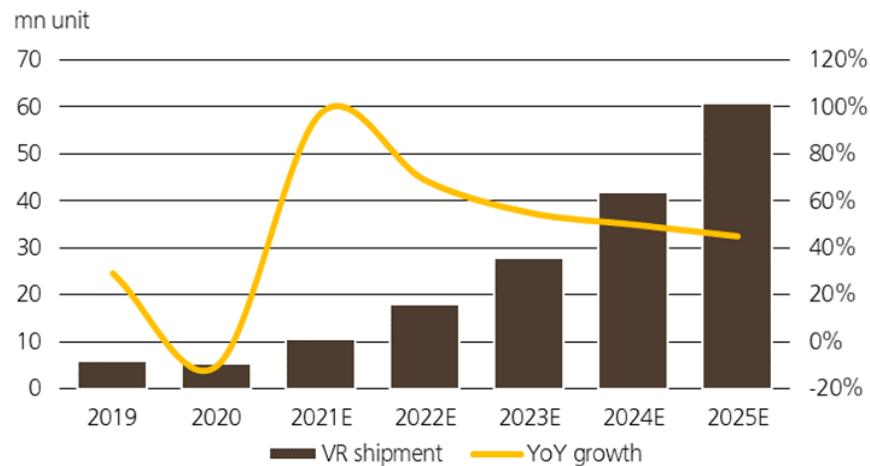
Quarterly PC MPU Channel Inventory



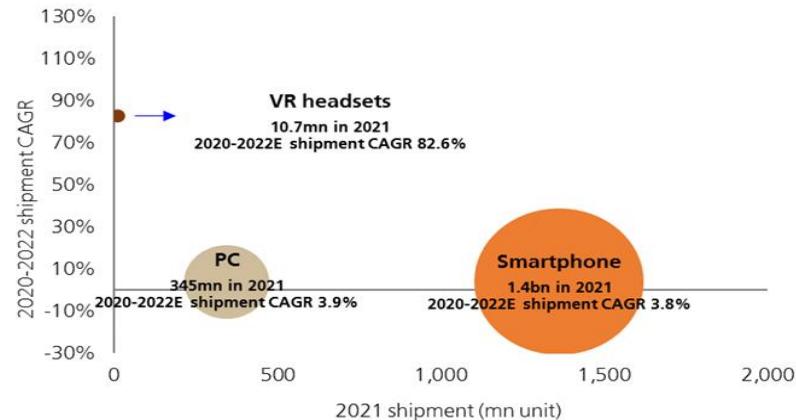
Source: Mercury Research, UBS

Global VR headset/lens shipment forecast and cost breakdown

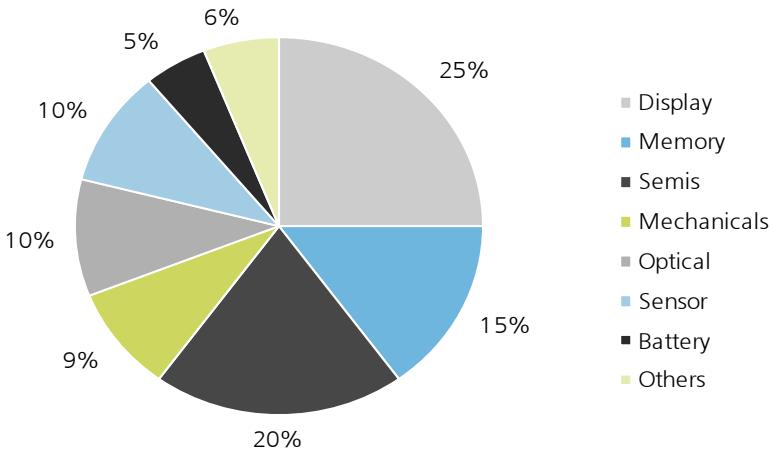
Global VR headset shipment forecast



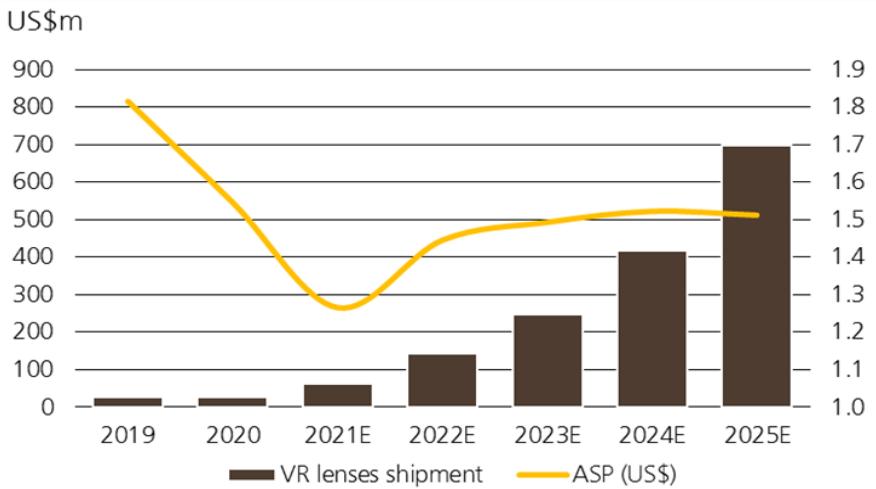
VR headsets vs. Smartphone / PC shipments



VR devices BoM cost breakdown



VR lenses shipments and ASP trend



Source: UBS estimates

VR/AR device suppliers to be key beneficiaries of metaverse

VR headset	Pico Neo 3	Oculus Quest 2	HTC Vive Flow	Sony PSVR 2	Apple MR
Released time	Q221	Q420	Q421	Q222E (target)	Q422E (target)
Components					
Processor		Qualcomm			
Foundry		Samsung			TSMC
Other ICs (PMIC, Controller, Audio, DDIC...)		CMedia, VLI, Texas Instruments, On Semi	CMedia, VLI		
Acoustic	Goertek	Goertek			MerryLuxshare
CMOS sensor					Sony
Camera module		LG Innotek			LG Innotek, Primax, Cowell
Camera lens		Genius, Sunny Optical	Genius		Largan, Genius, Kinko
See-through lens		Genius, Sunny Optical	Genius	Genius	Genius
Display panel					Sony, LGD
Display lamination					GIS
Assembly	Goertek	Goertek	In-house		Pegatron

Source: UBS estimates

Section 5

Server

Key Messages

- Total capex outlook for major hyperscalers remains resilient – expect another strong year in '22 with growth of ~18% Y/Y
 - Within this, servers should be a larger piece of the mix in '22 as we see server units up ~6% in '22E following growth of ~3.5% in '21 – drivers are more AI/ML workloads
- AI/ML is growing as a portion of the server mix – due in part to AAPL's privacy changes and the need to simulate customer behavior due to loss of direct data signals
- We estimate AI/ML is up to ~13% of all servers in '22

Top hyperscalers capex is catalyzed by Metaverse and shift to more ML/AI workloads though decelerating amid macro concerns

Total Capex for Major Hyperscalers

US\$ mn	C2017	C2018	C2019	C2020	C2021	C2022E	C2023E
Capital expenditure							
Apple	11,927	13,858	9,247	8,702	10,388	10,225	10,436
Alphabet	13,139	25,500	24,783	23,822	23,519	31,869	38,421
Microsoft	8,696	14,223	13,546	17,592	23,216	26,178	30,948
Amazon.com	10,057	11,322	13,259	35,046	55,396	56,607	50,795
Meta	6,732	15,277	16,381	17,172	20,142	28,708	27,133
Baidu	1,820	2,336	2,769	773	1,743	2,474	2,969
Alibaba	3,437	6,628	7,358	5,886	6,027	9,434	12,321
Tencent	2,227	3,460	4,520	4,742	4,662	4,132	4,679
Total ex Apple	46,108	78,746	82,615	105,032	134,705	159,403	167,267
% YoY ex Apple	30.3%	70.8%	4.9%	27.1%	28.3%	18.3%	4.9%
Apple	-4.2%	16.2%	-33.3%	-5.9%	19.4%	-1.6%	2.1%
Alphabet	31.8%	94.1%	-2.8%	-3.9%	-1.3%	35.5%	20.6%
Microsoft	-4.6%	63.6%	-4.8%	29.9%	32.0%	12.8%	18.2%
Amazon.com	49.3%	12.6%	17.1%	164.3%	58.1%	2.2%	-10.3%
Meta	49.9%	126.9%	7.2%	4.8%	17.3%	42.5%	-5.5%
Baidu	15.6%	28.4%	18.5%	-72.1%	125.5%	42.0%	20.0%
Alibaba	127.7%	92.8%	11.0%	-20.0%	2.4%	56.5%	30.6%
Tencent	12.3%	55.3%	30.6%	4.9%	-1.7%	-11.4%	13.2%

Source: Company data, UBS estimates

'22 sees solid growth of server unit shipments

Total Server Shipments (K unit)

	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E
Total Server shipments (K unit)	11,451	12,951	12,585	12,915	13,368	14,208	15,221	15,951	17,424
<i>Yoy growth (%)</i>	<i>2.5%</i>	<i>13.1%</i>	<i>-2.8%</i>	<i>2.6%</i>	<i>3.5%</i>	<i>6.3%</i>	<i>7.1%</i>	<i>4.8%</i>	<i>9.2%</i>
Traditional Enterprise	6,138	6,391	6,285	5,333	5,243	5,190	5,139	5,190	5,346
<i>Yoy growth (%)</i>	<i>-6.6%</i>	<i>4.1%</i>	<i>-1.7%</i>	<i>-15.1%</i>	<i>-1.7%</i>	<i>-1.0%</i>	<i>-1.0%</i>	<i>1.0%</i>	<i>3.0%</i>
<i>% of total</i>	<i>54%</i>	<i>49%</i>	<i>50%</i>	<i>41%</i>	<i>39%</i>	<i>37%</i>	<i>34%</i>	<i>33%</i>	<i>31%</i>
Hyperscalers	5,314	6,560	6,300	7,582	8,125	9,017	10,083	10,761	12,078
<i>Yoy growth (%)</i>	<i>15.4%</i>	<i>23.5%</i>	<i>-4.0%</i>	<i>20.3%</i>	<i>7.2%</i>	<i>11.0%</i>	<i>11.8%</i>	<i>6.7%</i>	<i>12.2%</i>
<i>% of total</i>	<i>46%</i>	<i>51%</i>	<i>50%</i>	<i>59%</i>	<i>61%</i>	<i>63%</i>	<i>66%</i>	<i>67%</i>	<i>69%</i>
Light-load servers	5,101	6,101	5,733	6,748	7,150	7,845	8,671	9,147	10,146
<i>Yoy growth (%)</i>	<i>14.3%</i>	<i>19.6%</i>	<i>-6.0%</i>	<i>17.7%</i>	<i>6.0%</i>	<i>9.7%</i>	<i>10.5%</i>	<i>5.5%</i>	<i>10.9%</i>
<i>% of total</i>	<i>96%</i>	<i>93%</i>	<i>91%</i>	<i>89%</i>	<i>88%</i>	<i>87%</i>	<i>86%</i>	<i>85%</i>	<i>84%</i>
AI/ML/database servers	213	459	567	834	975	1,172	1,412	1,614	1,933
<i>Yoy growth (%)</i>	<i>53.9%</i>	<i>116.0%</i>	<i>23.5%</i>	<i>47.1%</i>	<i>16.9%</i>	<i>20.2%</i>	<i>20.4%</i>	<i>14.4%</i>	<i>19.7%</i>
<i>% of total</i>	<i>4%</i>	<i>7%</i>	<i>9%</i>	<i>11%</i>	<i>12%</i>	<i>13%</i>	<i>14%</i>	<i>15%</i>	<i>16%</i>

Source: Dell'Oro Group, Gartner, Company Data, UBS estimates

Total Server Shipments by Top 7 Hyperscalers

Unit: K unit	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E
Google	834	929	602	771	838	967	1,111	1,189	1,368
Amazon	1,098	907	1,116	1,327	1,719	1,977	2,214	2,435	2,800
Microsoft	576	823	801	1,089	1,088	1,308	1,478	1,552	1,707
Meta	828	1,300	1,276	1,798	1,817	2,027	2,331	2,448	2,815
Baidu	89	121	65	52	108	114	125	138	152
Alibaba	145	376	326	391	414	411	473	544	625
Tencent	222	288	263	328	269	251	289	332	382
Total Top 7	3,792	4,745	4,449	5,756	6,254	7,055	8,022	8,638	9,849
<i>YoY %</i>									
<i>QoQ %</i>									
Other hyperscaler	1,522	1,815	1,851	1,826	1,871	1,963	2,061	2,123	2,229
IBM	151	144	82	138	86	78			
Apple	132	174	122	124	150	184			
Oracle	118	82	78	89	145	175			
Other	1,120	1,416	1,569	1,475	1,492	1,525			
Total Hyperscalers	5,314	6,560	6,300	7,582	8,125	9,017	10,083	10,761	12,078

Source: Dell'Oro Group, Gartner, Company Data, UBS estimates

Server DRAM growth driven primarily by content

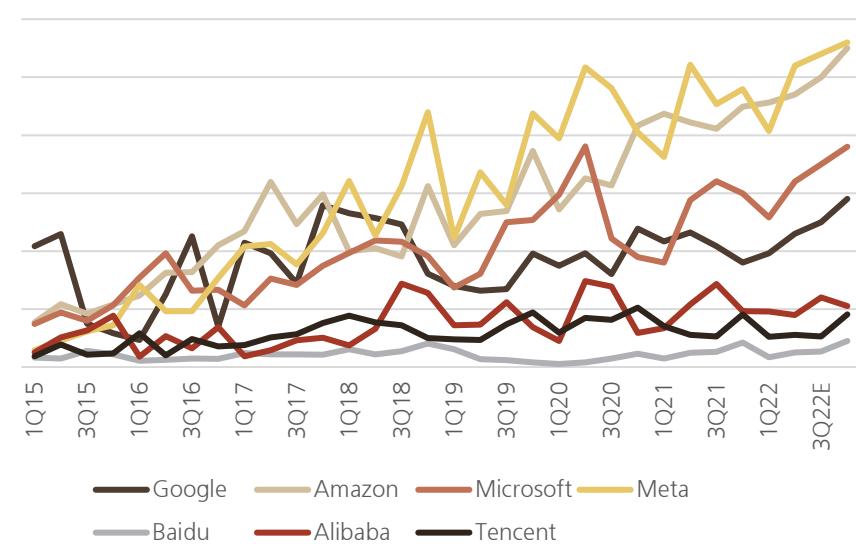
Server DRAM Long Term Model

	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E
Avg. DRAM content (GB)	194.2	237.8	296.5	409.8	474.5	580.6	726.7	872.1	1,064.4
Yoy growth (%)	42.1%	22.5%	24.7%	38.2%	15.8%	22.4%	25.2%	20.0%	22.1%
Traditional enterprise	175	192	236	312	350	400	468	538	630
Yoy growth (%)	35.4%	9.9%	23.0%	32.0%	12.3%	14.3%	17.0%	15.0%	17.0%
Hyperscalers Blended	217	283	357	479	555	685	859	1,033	1,257
Yoy growth (%)	46.7%	30.3%	26.2%	34.3%	15.9%	23.4%	25.4%	20.3%	21.7%
Light-load servers	205	262	328	433	491	600	750	893	1,071
Yoy growth (%)	46.4%	28.0%	24.9%	32.1%	13.4%	22.2%	25.0%	19.0%	20.0%
AI/ML/database servers	500	550	650	850	1,023	1,250	1,525	1,830	2,233
Yoy growth (%)	25.0%	10.0%	18.2%	30.8%	20.3%	22.2%	22.0%	20.0%	22.0%
Total DRAM Demand (mn Gb)	17,789	24,641	29,849	42,341	50,745	65,989	88,486	111,284	148,373
Yoy growth (%)	45.6%	38.5%	21.1%	41.8%	19.8%	30.0%	34.1%	25.8%	33.3%
Traditional enterprise	8,573	9,815	11,873	13,295	14,680	16,609	19,239	22,346	26,929
Yoy growth (%)	26.5%	14.5%	21.0%	12.0%	10.4%	13.1%	15.8%	16.2%	20.5%
% of total	48.2%	39.8%	39.8%	31.4%	28.9%	25.2%	21.7%	20.1%	18.1%
Hyperscalers	9,216	14,827	17,977	29,046	36,065	49,379	69,247	88,938	121,444
Yoy growth (%)	69.3%	60.9%	21.2%	61.6%	24.2%	36.9%	40.2%	28.4%	36.5%
Light-load servers	8,366	12,806	15,028	23,375	28,086	37,657	52,026	65,307	86,928
Yoy growth (%)	67.3%	53.1%	17.4%	55.5%	20.2%	34.1%	38.2%	25.5%	33.1%
% of total	47.0%	52.0%	50.3%	55.2%	55.3%	57.1%	58.8%	58.7%	58.6%
AI/ML/database servers	850	2,020	2,948	5,671	7,979	11,723	17,221	23,631	34,516
Yoy growth (%)	92.4%	137.6%	45.9%	92.4%	40.7%	46.9%	46.9%	37.2%	46.1%
% of total	4.8%	8.2%	9.9%	13.4%	15.7%	17.8%	19.5%	21.2%	23.3%

Source: Gartner, Company data, UBS estimates

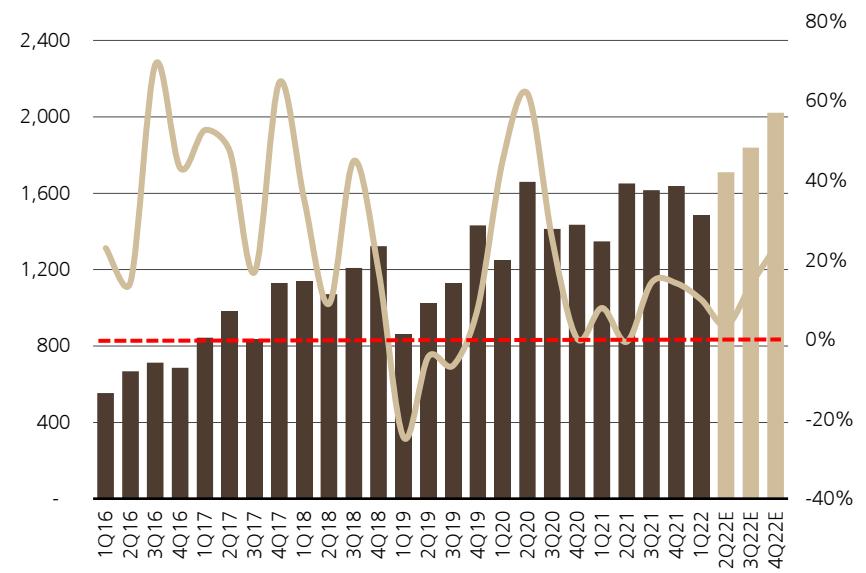
Server Shipment Forecast - Details

Top 7 Hyperscalers Server Unit Shipments



Source: Factset, Company reports, UBS estimates

Top 7 Hyperscalers Server Shipment & Y/Y Growth



Source: Factset, Company reports, UBS estimates

Section 6

Smartphone

Key Messages

- We model smartphone units to decline in '22 considering ongoing macroeconomic risk
- We see ~655MM 5G units for C2022E which implies ~51% of total smartphone but well north of this on a dollar basis
 - So, while 5G remains a tailwind for the industry, most of the incremental penetration is now coming in the mid-tier where there is less incremental dollar content
- Demand in China is very weak by historical standards
- Per the most recent UBS Evidence Lab survey, smartphone purchase intents are weakening in the US, but improving in China
 - iPhone purchase intent remains relatively stable; Purchase intent for Samsung GS22 series flagship smartphones are strong (45%), noticeably up YoY
 - Battery life and price are far more important factors for purchase considerations while 5G is more accretive to smartphone ASP

We model -4.5%/+3.4% smartphone unit growths in '22/23E

Device Market Model – Smartphone Units (MM)

Smartphone volume (m)	FY '20	Q1 '21	Q2 '21	Q3 '21	Q4 '21	FY '21	Q1 '22	Q2 '22E	Q3 '22E	Q4 '22E	FY '22E	Q1 '23E	Q2 '23E	Q3 '23E	Q4 '23E	FY '23E	
Samsung	253	76	57	69	69	271	74	63	67	67	270	72	67	71	69	279	
% YoY	-14.3%	31.0%	5.6%	-13.7%	13.1%	7.1%	-2.6%	9.6%	-2.9%	-3.6%	-0.4%	-3.0%	7.2%	6.0%	3.8%	3.3%	
% QoQ		24.6%	-25.0%	21.1%	0.0%		7.2%	-15.5%	7.2%	-0.7%		8.0%	-6.7%	6.0%	-2.8%		
% of total	19.7%	22.0%	18.2%	20.7%	19.0%	20.0%	23.7%	22.1%	20.4%	17.8%	20.9%	22.5%	22.0%	20.9%	18.3%	20.8%	
Apple	200	56	46	48	83	233	59	42	51	82	234	59	42	52	82	235	
% YoY	3.6%	36.9%	19.8%	18.2%	3.8%	16.6%	5.4%	-8.7%	6.3%	-0.9%	0.5%	0.0%	0.0%	1.5%	0.0%	0.3%	
% QoQ		-30.0%	-17.9%	4.3%	72.9%		-28.9%	-28.8%	21.4%	61.3%		-28.3%	-28.8%	23.2%	58.9%		
% of total	15.6%	16.2%	14.7%	14.4%	22.9%	17.2%	18.9%	14.9%	15.6%	22.1%	18.1%	18.5%	13.8%	15.2%	21.9%	17.6%	
Huawei	189	15	12	6	5	38	6	3	2	1	12						
% YoY	-21.5%	-69.4%	-78.9%	-88.4%	-84.5%	-80.0%	-63.3%	-74.6%	-66.7%	NM	-69.6%						
% QoQ		-53.6%	-21.3%	-49.2%	-16.7%		10.0%	-45.5%	-33.3%	NM							
% of total	14.7%	4.3%	3.8%	1.8%	1.4%	2.8%	1.8%	1.1%	0.6%	0.3%	0.9%						
OPPO*	111	38	33	33	30	134	27	30	35	33	125	34	33	36	32	135	
% YoY	-1.4%	67.4%	36.7%	7.1%	-10.9%	20.1%	-26.9%	-8.5%	5.4%	9.6%	-6.1%	24.1%	10.0%	2.9%	-3.0%	7.7%	
% QoQ		10.9%	-12.5%	1.2%	-9.3%		-9.0%	9.5%	16.7%	-5.7%		3.0%	-2.9%	9.1%	-11.1%		
% of total	8.7%	10.9%	10.5%	10.0%	8.3%	9.9%	8.8%	10.6%	10.7%	8.9%	9.7%	10.7%	10.8%	10.6%	8.5%	10.1%	
Vivo	112	35	31	33	28	128	25	25	33	37	120	34	32	34	31	131	
% YoY	11.5%	40.7%	31.6%	5.7%	-11.8%	13.9%	-28.1%	-19.9%	-0.9%	30.7%	-6.0%	35.5%	28.0%	3.0%	-16.2%	9.1%	
% QoQ		8.7%	-10.6%	6.7%	-15.0%		-11.3%	-0.4%	32.0%	12.1%		-8.1%	-5.9%	6.3%	-8.8%		
% of total	8.7%	10.1%	10.0%	10.0%	7.8%	9.4%	8.1%	8.9%	10.1%	9.9%	9.3%	10.7%	10.5%	10.0%	8.2%	9.8%	
Xiaomi	146	49	53	44	44	190	39	37	43	45	164	42	42	48	49	181	
% YoY	17.0%	69.2%	87.6%	-5.8%	4.3%	30.1%	-22.1%	-30.2%	-2.1%	2.5%	-14.0%	7.9%	14.5%	10.9%	9.0%	10.5%	
% QoQ		16.8%	7.1%	-17.0%	0.5%		-12.7%	-4.0%	16.4%	5.1%		-8.1%	1.9%	12.7%	3.2%		
% of total	11.4%	14.3%	16.9%	13.2%	12.2%	14.0%	12.3%	13.1%	13.1%	12.1%	12.6%	13.0%	13.9%	14.1%	13.1%	13.5%	
Transsion	61	18	19	21	20	78	17	21	27	29	94	22	27	33	35	116	
% YoY	52.8%	106.6%	52.0%	13.7%	-4.3%	28.9%	-7.9%	9.2%	29.8%	44.3%	19.7%	28.6%	28.0%	22.2%	20.7%	24.2%	
% QoQ		-13.1%	3.9%	9.7%	-3.4%		-16.4%	23.2%	30.4%	7.4%		-25.5%	22.7%	24.5%	6.1%		
% of total	4.0%	4.5%	5.5%	5.5%	4.9%	5.1%	4.8%	6.5%	7.4%	7.1%	6.5%	6.1%	7.9%	8.8%	8.5%	7.9%	
LG Electronics	28	7	6	3	0	15											
% YoY	-4.7%	13.8%	-10.6%	-61.5%	NM	-45.4%											
% QoQ		-16.5%	-16.7%	-45.5%	NM												
% of total	2.2%	1.9%	1.8%	0.9%	0.0%	1.1%											
Lenovo	34	9	10	12	12	44	9	10	12	12	43	9	10	13	12	44	
% YoY	-14.5%	59.1%	24.0%	21.8%	29.3%	30.9%	-3.2%	0.0%	0.0%	-4.1%	-1.8%	3.3%	-2.0%	2.5%	3.4%	1.9%	
% QoQ		-2.3%	9.7%	19.6%	0.8%		-26.8%	13.3%	19.6%	-3.3%		-21.2%	7.5%	25.0%	-2.4%		
% of total	2.6%	2.7%	3.3%	3.7%	3.4%	3.2%	2.9%	3.6%	3.7%	3.2%	3.3%	2.9%	3.3%	3.7%	3.2%	3.3%	
Honor				8	15	15	37	15	13	15	13	56	14	15	17	15	61
% YoY								68.8%	3.4%	-13.3%		50.5%	-6.7%	15.4%	13.3%	15.4%	8.9%
% QoQ								0.0%	-13.3%	15.4%	-13.3%		7.7%	7.1%	13.3%	-11.8%	
% of total								2.7%	4.8%	4.6%	4.6%	4.3%	4.4%	4.9%	5.0%	4.0%	4.6%
Other	148	43	39	50	56	187	42	39	43	54	177	34	37	37	51	157	
% YoY	-24.5%	40.1%	53.3%	33.1%	1.6%	26.4%	-2.6%	-1.0%	-14.1%	-3.1%	-5.4%	-19.3%	-6.4%	-14.1%	-6.5%	-11.3%	
% QoQ		-22.3%	-7.5%	25.6%	12.5%		-25.5%	-6.0%	9.0%	27.1%		-38.0%	9.0%	0.0%	38.4%		
% of total	11.6%	12.3%	12.6%	14.8%	15.4%	13.8%	13.3%	13.8%	13.0%	14.5%	13.7%	10.5%	12.0%	10.8%	13.4%	11.7%	
Total smartphone volumes (m)	1,281	346	313	333	363	1,355	312	282	328	373	1,295	319	304	339	376	1,339	
% YoY	-6.5%	25.6%	13.3%	-6.0%	-3.2%	5.7%	-9.8%	-9.9%	-1.7%	2.8%	-4.5%	2.2%	7.8%	3.6%	0.9%	3.4%	
% QoQ		-7.8%	-9.3%	6.4%	8.8%		-14.0%	-9.4%	16.1%	13.7%		-14.5%	-4.5%	11.5%	10.8%		
% of total volumes	84.7%	84.8%	90.3%	88.6%	88.0%	87.8%	88.9%	88.6%	89.4%	90.9%	89.5%	90.1%	90.4%	90.4%	91.5%	90.6%	

Source: Company data, Gartner, UBS estimates



We model mobile revenue to stay flat/grow 2.1% in '22/23E

Device Market Model – Total Revenues (\$MM)

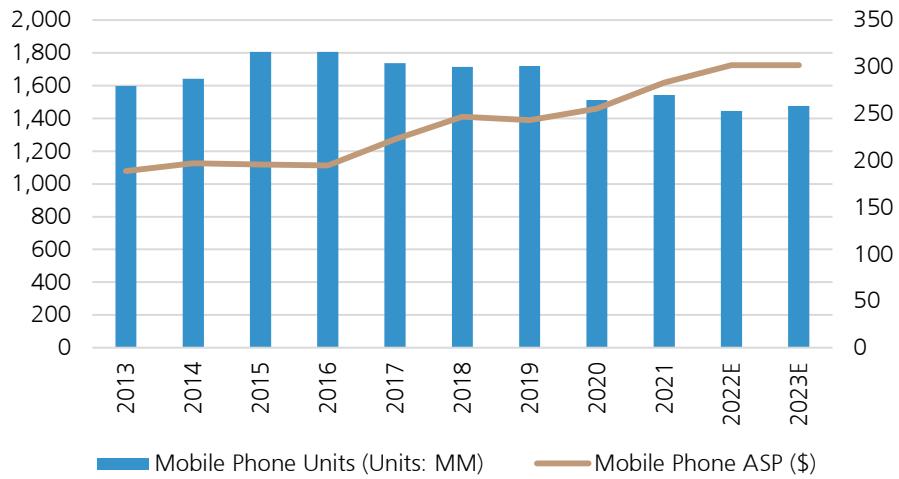
Total revenues (US\$m)	FY '20	Q1 '21	Q2 '21	Q3 '21	Q4 '21	FY '21	Q1 '22	Q2 '22E	Q3 '22E	Q4 '22E	FY '22E	Q1 '23E	Q2 '23E	Q3 '23E	Q4 '23E	FY '23E
Samsung	64,596	19,906	14,168	18,110	18,466	70,650	20,628	17,260	19,449	18,694	76,031	22,260	18,993	20,061	19,242	80,556
% YoY	-12.7%	15.1%	8.5%	-11.0%	32.8%	9.4%	3.6%	21.8%	7.4%	1.2%	7.6%	7.9%	10.0%	3.1%	2.9%	6.0%
% QoQ		43.2%	-28.8%	27.8%	2.0%		11.7%	-16.3%	12.7%	-3.9%		19.1%	-14.7%	5.6%	-4.1%	
% of total	16.7%	18.0%	15.1%	18.3%	13.8%	16.2%	19.4%	19.3%	18.4%	13.9%	17.4%	20.5%	20.3%	18.7%	14.2%	18.1%
Apple	147,421	47,938	39,570	38,868	71,628	198,004	50,570	37,129	44,640	71,262	203,600	49,247	35,642	43,916	72,194	200,999
% YoY	0.7%	65.5%	49.8%	47.0%	9.2%	34.3%	5.5%	-6.2%	14.8%	-0.5%	2.8%	-2.6%	-4.0%	-1.6%	1.3%	-1.3%
% QoQ		-26.9%	-17.5%	-1.8%	84.3%		-29.4%	-26.6%	20.2%	59.6%		-30.9%	-27.6%	23.2%	64.4%	
% of total	38.1%	43.3%	42.2%	39.3%	53.5%	45.3%	47.5%	41.5%	42.2%	52.9%	46.6%	45.2%	38.1%	40.8%	53.1%	45.1%
Huawei	46,654	3,751	2,890	1,543	1,223	9,337	1,348	720	481	240	2,789					
% YoY	-22.7%	-67.3%	-78.2%	-88.5%	-85.7%	-80.0%	-64.1%	-75.1%	-68.8%	NM	-70.1%					
% QoQ		-56.2%	-23.0%	-46.6%	-20.8%		10.2%	-46.6%	-33.2%	NM						
% of total	12.1%	3.4%	3.1%	1.6%	0.9%	2.1%	1.3%	0.8%	0.5%	0.2%	0.6%					
OPPO*	26,391	9,247	8,381	8,784	8,350	34,762	6,824	7,742	9,353	9,246	33,165	8,468	8,516	9,621	8,965	35,571
% YoY	-2.0%	79.9%	54.2%	13.7%	3.2%	31.7%	-26.2%	-7.6%	6.5%	10.7%	-4.6%	24.1%	10.0%	2.9%	-3.0%	7.3%
% QoQ		14.3%	-9.4%	4.8%	-4.9%		-18.3%	13.4%	20.8%	-1.2%		-8.4%	0.6%	13.0%	-6.8%	
% of total	6.8%	8.4%	8.9%	8.9%	6.2%	7.9%	6.4%	8.6%	8.8%	6.9%	7.6%	7.8%	9.1%	8.9%	6.6%	8.0%
Vivo	24,899	8,556	7,948	8,526	7,409	32,439	6,215	6,432	8,534	9,783	30,965	8,587	8,398	8,968	8,361	34,315
% YoY	8.9%	57.8%	60.6%	15.4%	3.8%	30.3%	-27.4%	-19.1%	0.1%	32.0%	-4.5%	38.2%	30.6%	5.1%	-14.5%	10.8%
% QoQ		19.9%	-7.1%	7.3%	-13.1%		-16.1%	3.5%	32.7%	14.6%		-12.2%	-2.2%	6.8%	-6.8%	
% of total	6.4%	7.7%	8.5%	8.6%	5.5%	7.4%	5.8%	7.2%	8.1%	7.3%	7.1%	7.9%	9.0%	8.3%	6.2%	7.7%
Xiaomi	22,126	7,947	9,146	7,391	7,875	32,359	7,209	6,319	7,812	8,135	29,475	7,317	7,464	8,958	9,014	32,753
% YoY	25.6%	82.9%	104.7%	7.5%	22.4%	46.2%	-9.3%	-30.9%	5.7%	3.3%	-8.9%	1.5%	18.1%	14.7%	10.8%	11.1%
% QoQ		23.5%	15.1%	-19.2%	6.6%		-8.5%	-12.3%	23.6%	4.1%		-10.0%	2.0%	20.0%	0.6%	
% of total	5.7%	7.2%	9.8%	7.5%	5.9%	7.4%	6.8%	7.1%	7.4%	6.0%	6.8%	6.7%	8.0%	8.3%	6.6%	7.3%
Transsion	5,198	1,646	1,692	1,854	1,969	7,162	1,666	1,939	2,536	2,678	8,818	2,031	2,431	3,100	3,257	10,819
% YoY	51.5%	112.8%	62.9%	18.9%	5.8%	37.8%	1.2%	14.6%	36.7%	36.0%	23.1%	21.9%	25.4%	22.2%	21.6%	22.7%
% QoQ		-11.5%	2.8%	9.6%	6.2%		-15.4%	16.4%	30.8%	5.6%		-24.1%	19.7%	27.5%	5.1%	
% of total	1.3%	1.5%	1.8%	1.9%	1.5%	1.6%	1.6%	2.2%	2.4%	2.0%	2.0%	1.9%	2.6%	2.9%	2.4%	2.4%
LG Electronics	4,396	887	813	399	0	2,100										
% YoY	-13.6%	7.1%	-23.6%	-68.7%	NM	-52.2%										
% QoQ		-27.8%	-8.3%	-50.9%	NM											
% of total	1.1%	0.8%	0.9%	0.4%	0.0%	0.5%										
Lenovo	8,806	1,482	1,530	1,830	1,907	6,749	1,395	1,601	1,915	1,853	6,764	1,460	1,570	1,963	1,915	6,908
% YoY	4.0%	-24.3%	-21.1%	-21.6%	-25.9%	-23.4%	-5.9%	4.7%	4.7%	-2.8%	0.2%	4.7%	-2.0%	2.5%	3.4%	2.1%
% QoQ		-42.4%	3.2%	19.6%	4.2%		-26.8%	14.8%	19.6%	-3.3%		-21.2%	7.5%	25.0%	-2.4%	
% of total	2.3%	1.3%	1.6%	1.8%	1.4%	1.5%	1.3%	1.8%	1.8%	1.4%	1.5%	1.3%	1.7%	1.8%	1.4%	1.5%
Honor		2,125	3,801	3,735	9,661	3,721	3,211	3,705	3,211	13,848	3,543	3,779	4,283	3,779	15,384	
% YoY								51.1%	-2.5%	-14.0%	43.3%	-4.8%	17.7%	15.6%	17.7%	11.1%
% QoQ								-0.4%	-13.7%	15.4%		10.3%	6.7%	13.3%	-11.8%	
% of total								2.3%	3.8%	2.8%		3.3%	4.0%	4.0%	2.8%	3.5%
Other	29,654	8,061	5,523	6,576	9,693	29,853	6,057	5,969	5,985	7,984	25,995	5,052	5,626	5,238	7,567	23,483
% YoY	-36.6%	0.5%	-9.9%	5.9%	4.4%	0.7%	-24.9%	8.1%	-9.0%	-17.6%	-12.9%	-16.6%	-5.7%	-12.5%	-5.2%	-9.7%
% QoQ		-13.2%	-31.5%	19.1%	47.4%		-37.5%	-1.4%	0.3%	33.4%		-36.7%	11.4%	-6.9%	44.5%	
% of total	7.7%	7.3%	5.9%	6.6%	7.2%	6.8%	5.7%	6.7%	5.7%	5.9%	6.0%	4.6%	6.0%	4.9%	5.6%	5.3%
Total mobile revs (US\$m)	386,627	110,632	93,786	99,022	133,881	437,321	106,508	89,511	105,815	134,706	436,540	108,841	93,608	107,512	135,916	445,876
% YoY	-7.6%	29.6%	18.0%	4.0%	5.8%	13.1%	-3.7%	-4.6%	6.9%	0.6%	-0.2%	2.2%	4.6%	1.6%	0.9%	2.1%
% QoQ		-12.6%	-15.2%	5.6%	35.2%		-20.4%	-16.0%	18.2%	27.3%		-19.2%	-14.0%	14.9%	26.4%	

Source: Company data, Gartner, UBS estimates

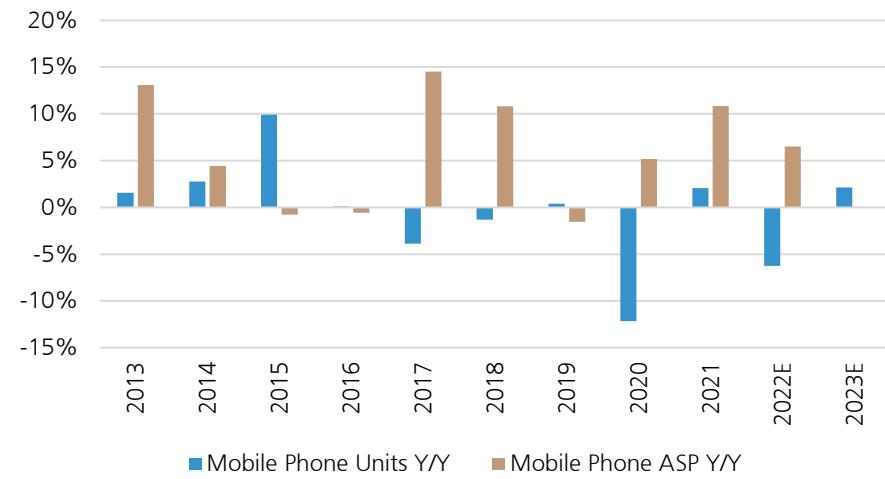


Mobile Phone: Units and ASP

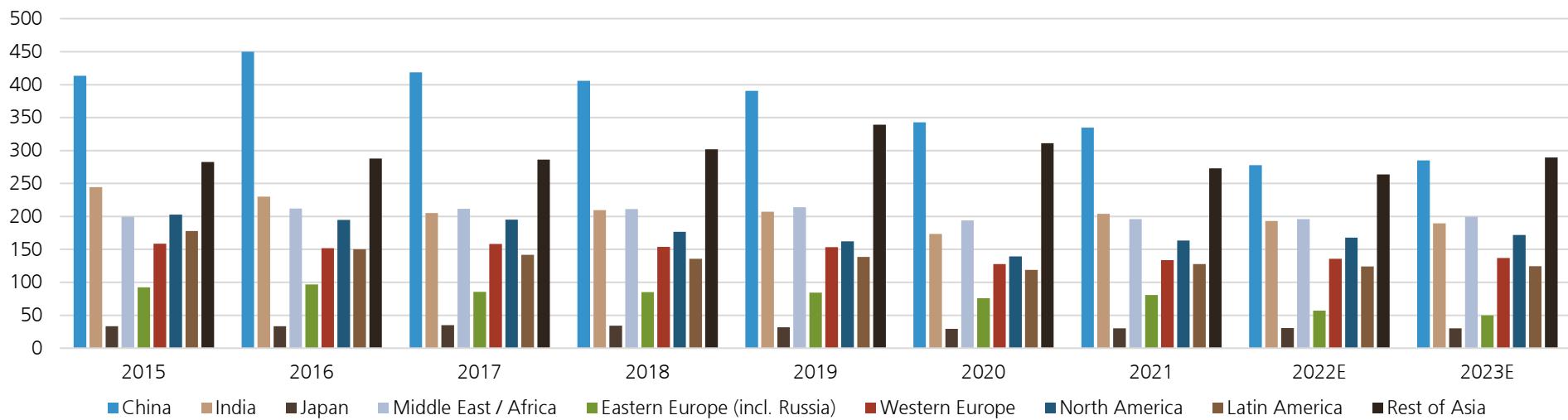
Mobile Phone Units and ASP



Mobile Phone Units and ASP Y/Y Growth



Mobile Phone Units (MM) – By region

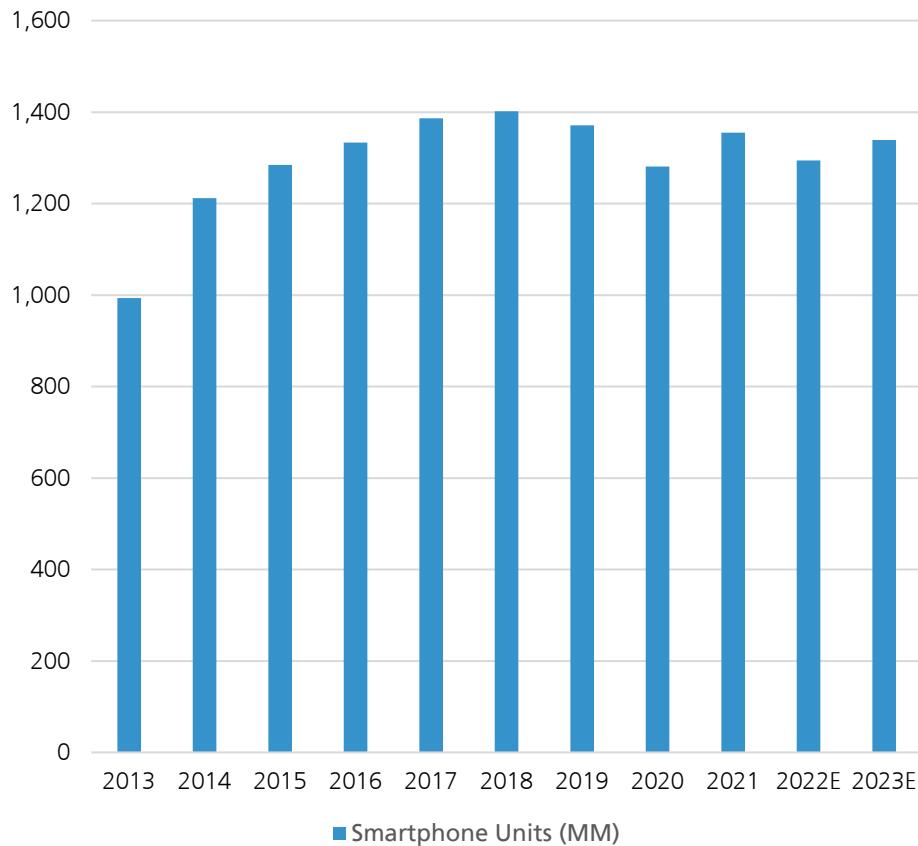


Source: UBS estimates



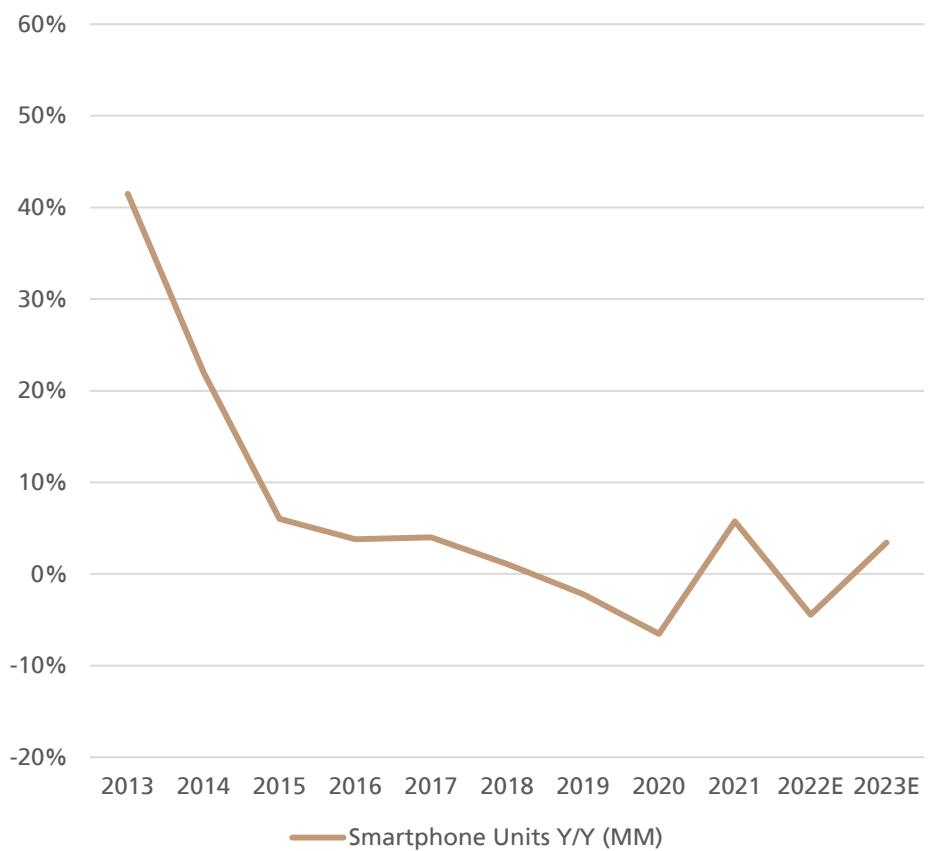
Smartphone: Units and Y/Y Growth

Smartphone Units



Source: UBS estimates

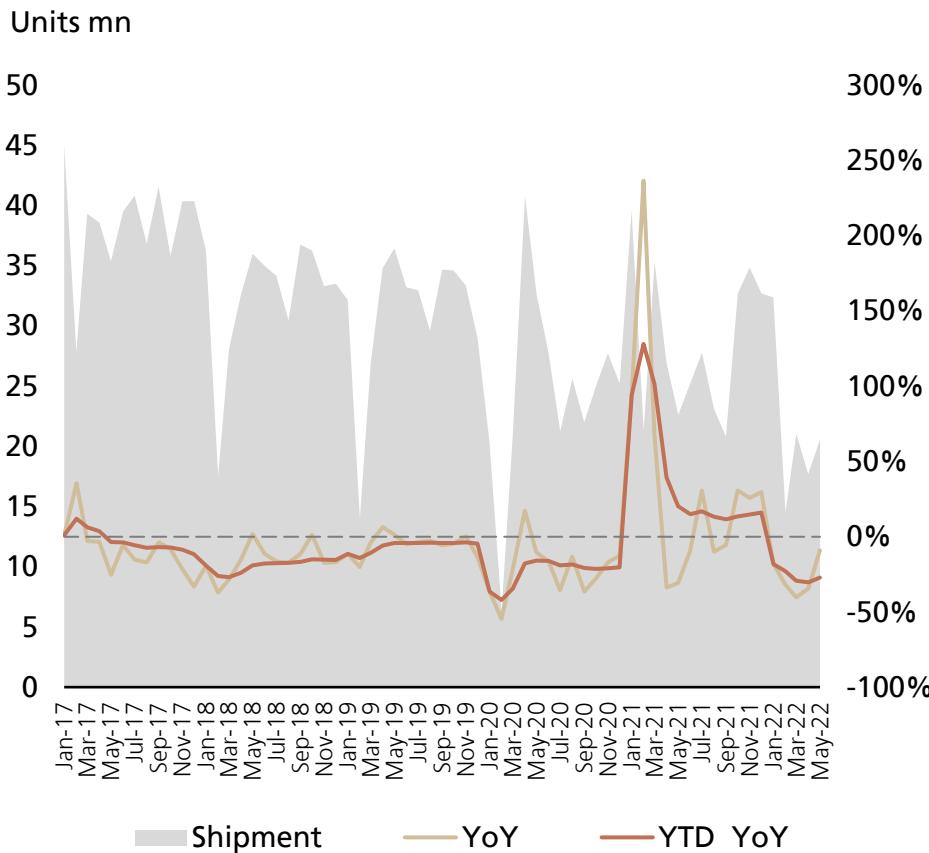
Smartphone Units Y/Y Growth



Source: UBS estimates

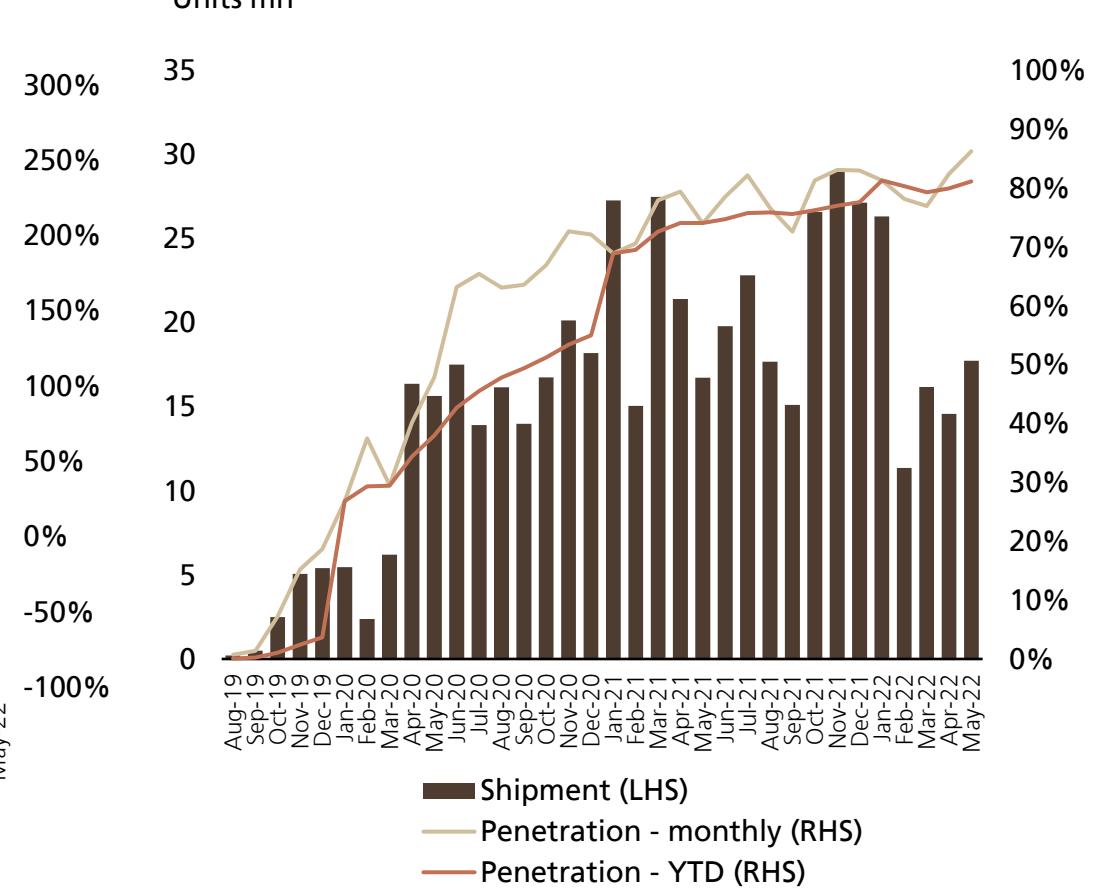
China sell-in has weakened recently, and sell-through remains a big Q

China Smartphone Shipment



Source: CAICT Data, UBS

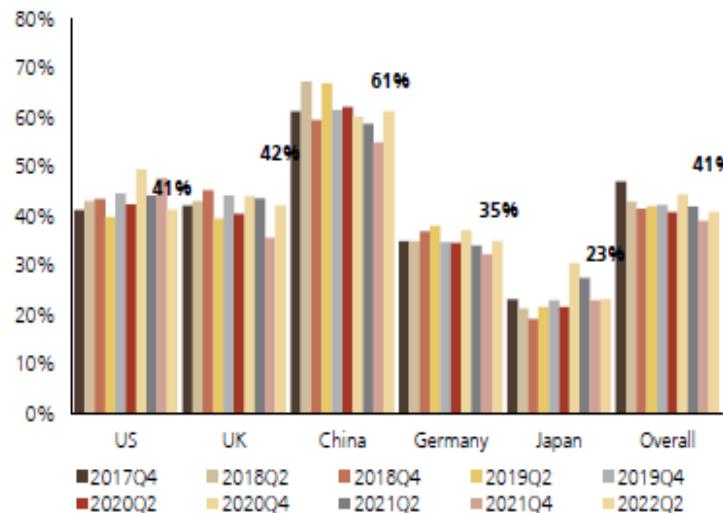
China 5G Smartphone Shipment



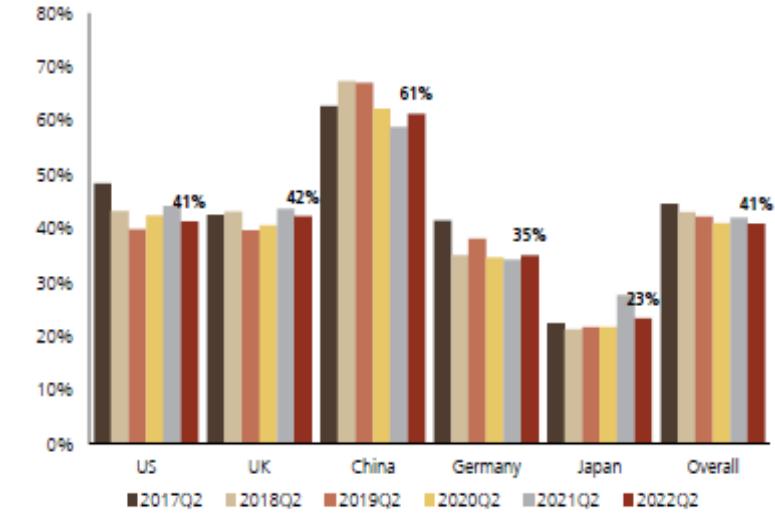
Source: CAICT Data, UBS

Purchase intent was up HoH across most regions with the US the sole exception

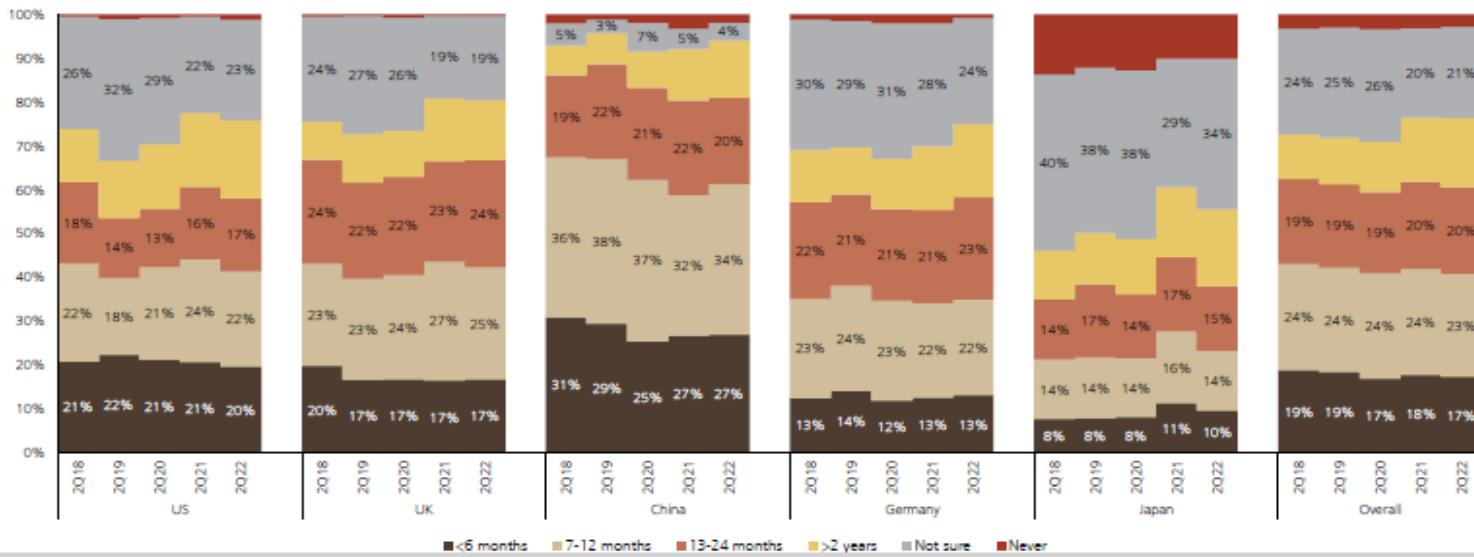
12-month Forward Purchasing Intent (HoH)



12-month Forward Purchase Intent (YoY)



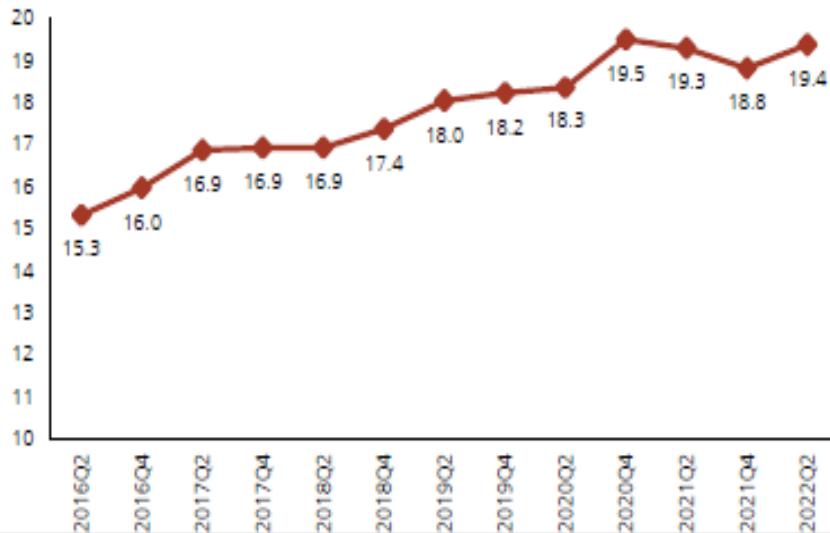
Response Breakdown of Plan Until Next Smartphone Purchase



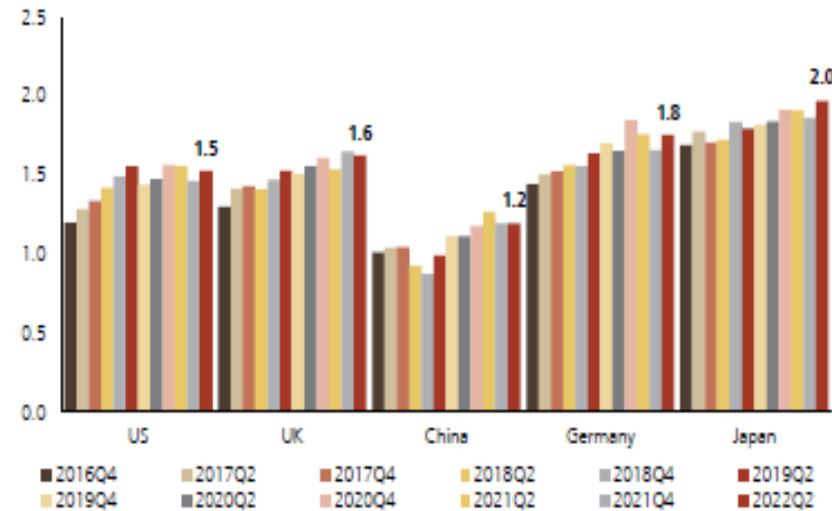
Source: UBS Evidence Lab (Latest Wave as of Apr 2022)

Average age of smartphone installed base begins to re-lengthen with replacement cycle remaining stable

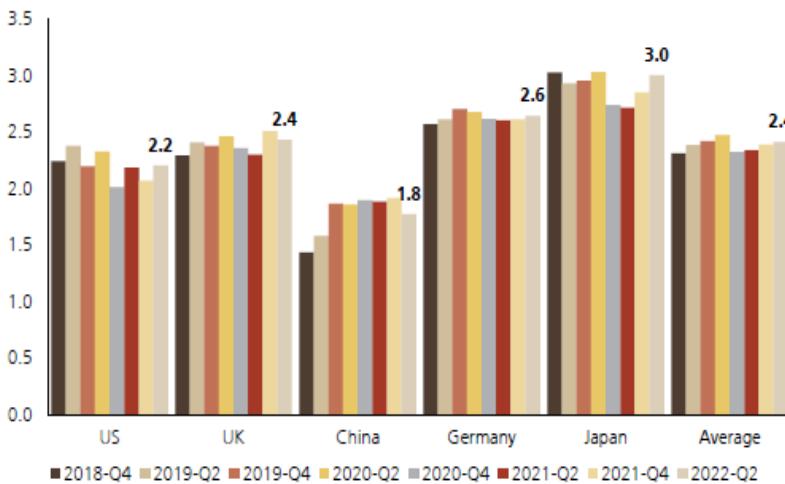
Average Age of Smartphone Installed Base (Months)



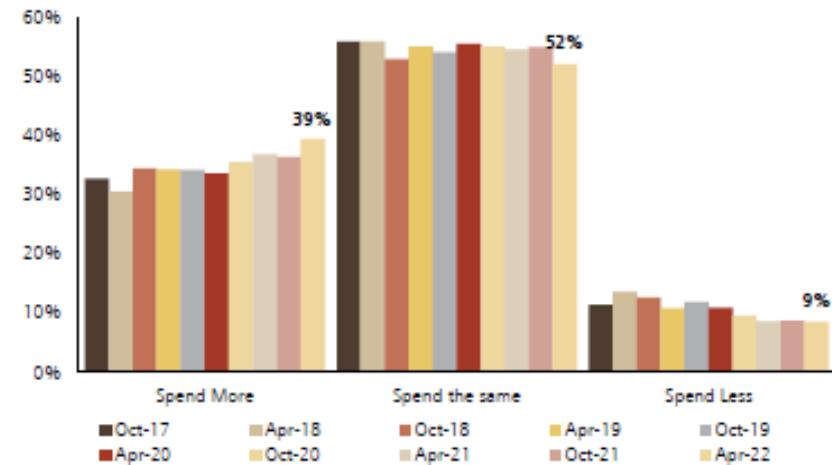
Average Age of Installed Base by Region (Years)



Planned Replacement Cycle by Region (Years)



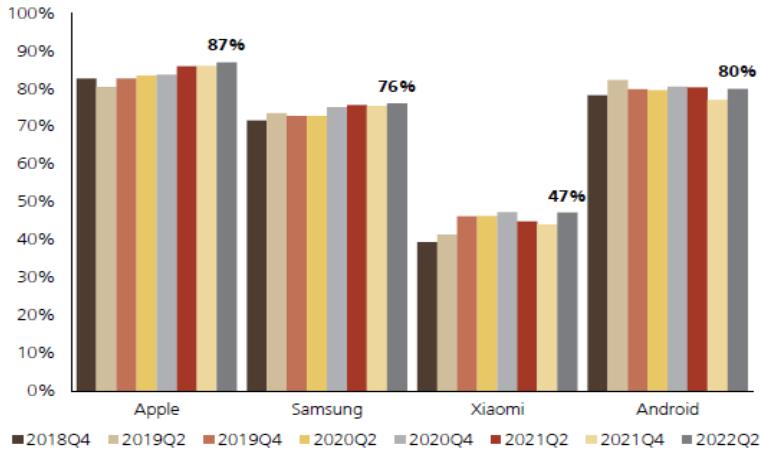
Customers' Willingness to Spend More/Same/Less



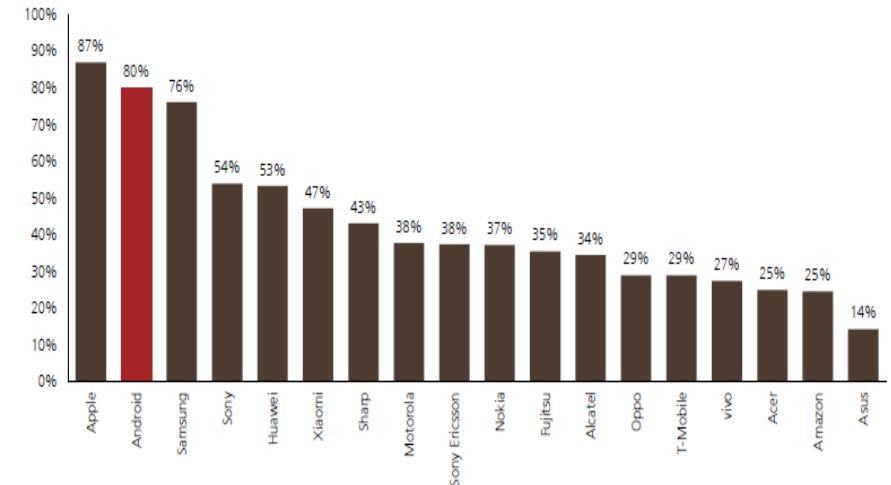
Source: UBS Evidence Lab (Latest Wave as of Apr 2022)

UBS Evidence Lab – iPhone retention remains highest

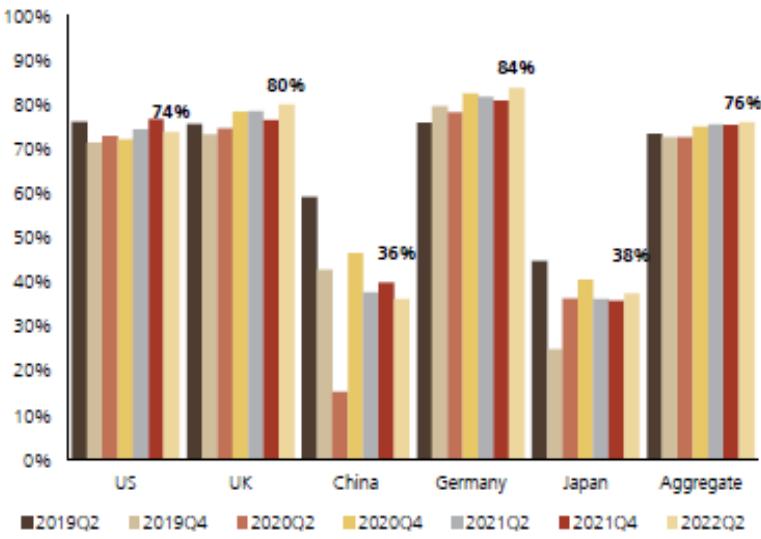
Smartphones Retention Rates by Vendor/OS



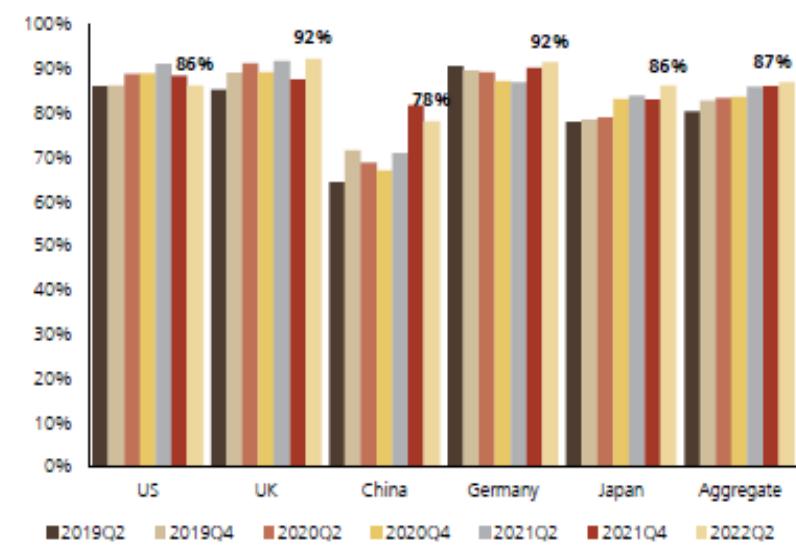
Unweighted OEM/OS Retention Rates for 2Q22



Samsung Smartphones Retention Rate by Region



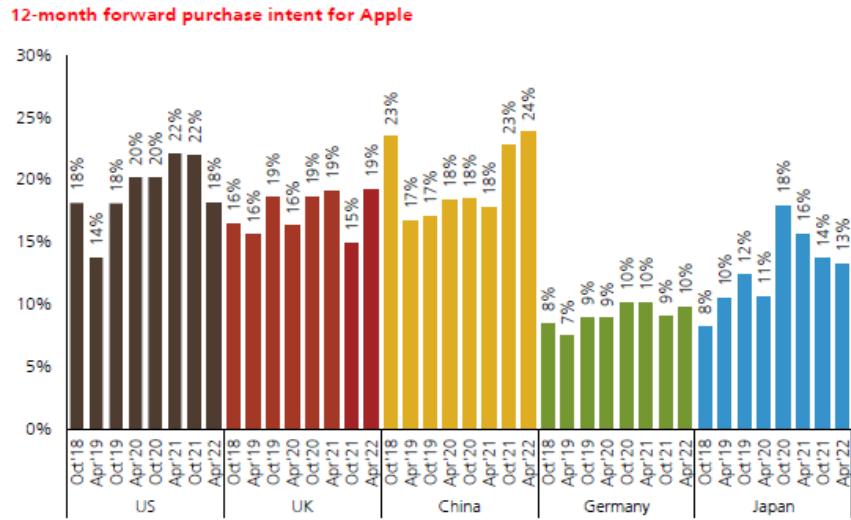
Apple Retention Rate by Region



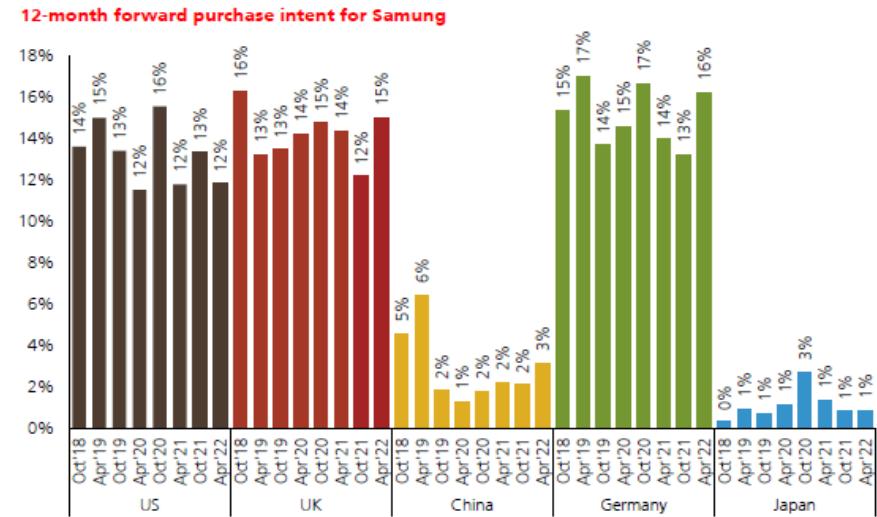
Source: UBS Evidence Lab (Latest Wave as of Apr 2022)

UBS Evidence Lab – Smartphones Survey 2Q22

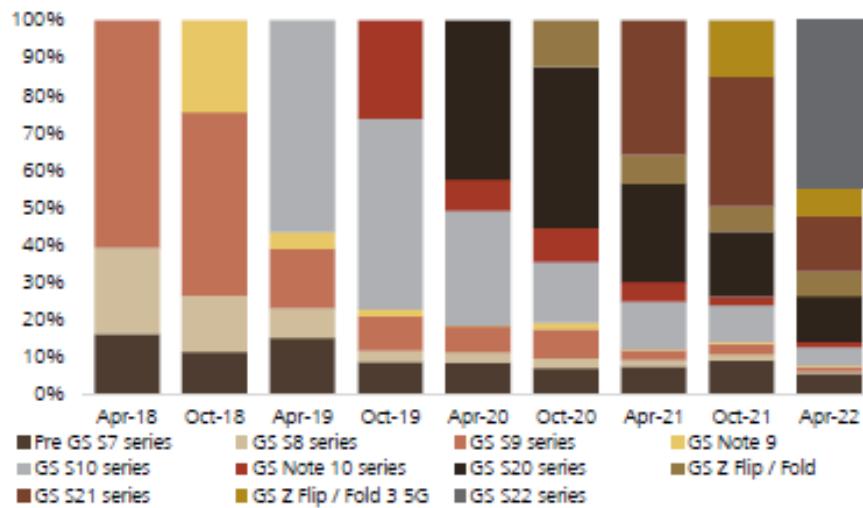
Apple Purchase Intent by Region



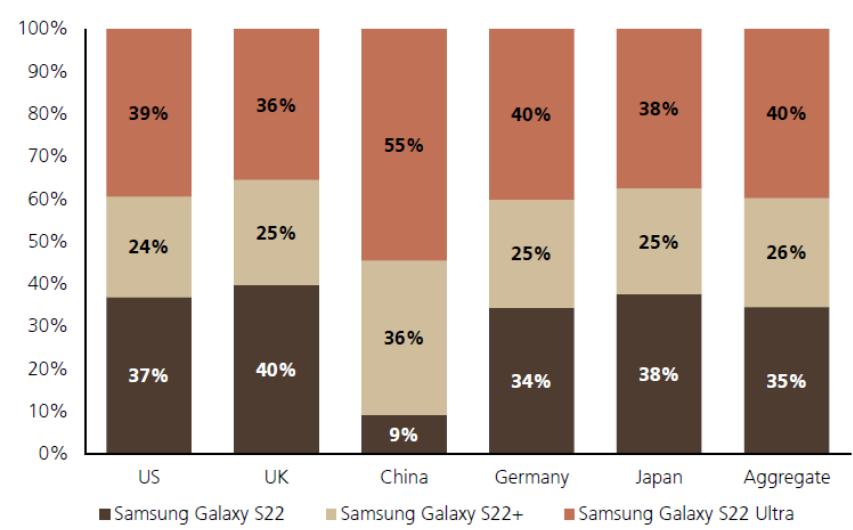
Samsung Purchase Intent by Region



Samsung Galaxy Smartphone Purchase Intent by Series



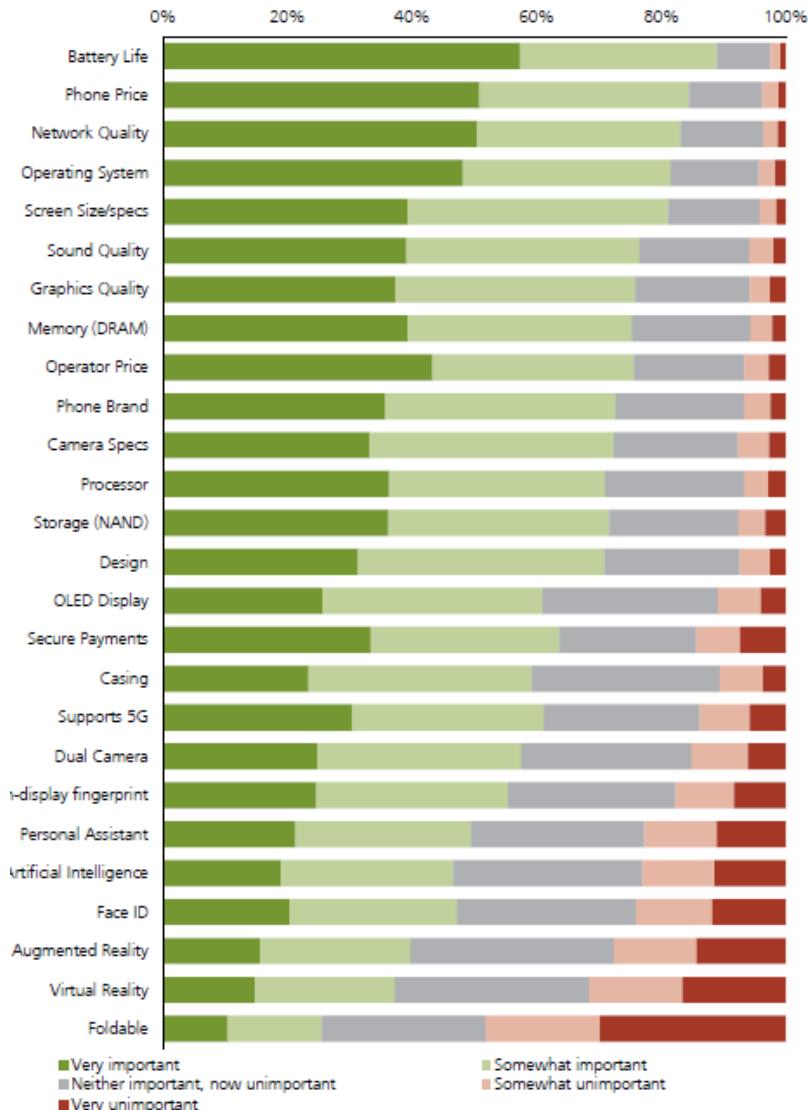
Samsung GS22 Series Purchase Intent by Model



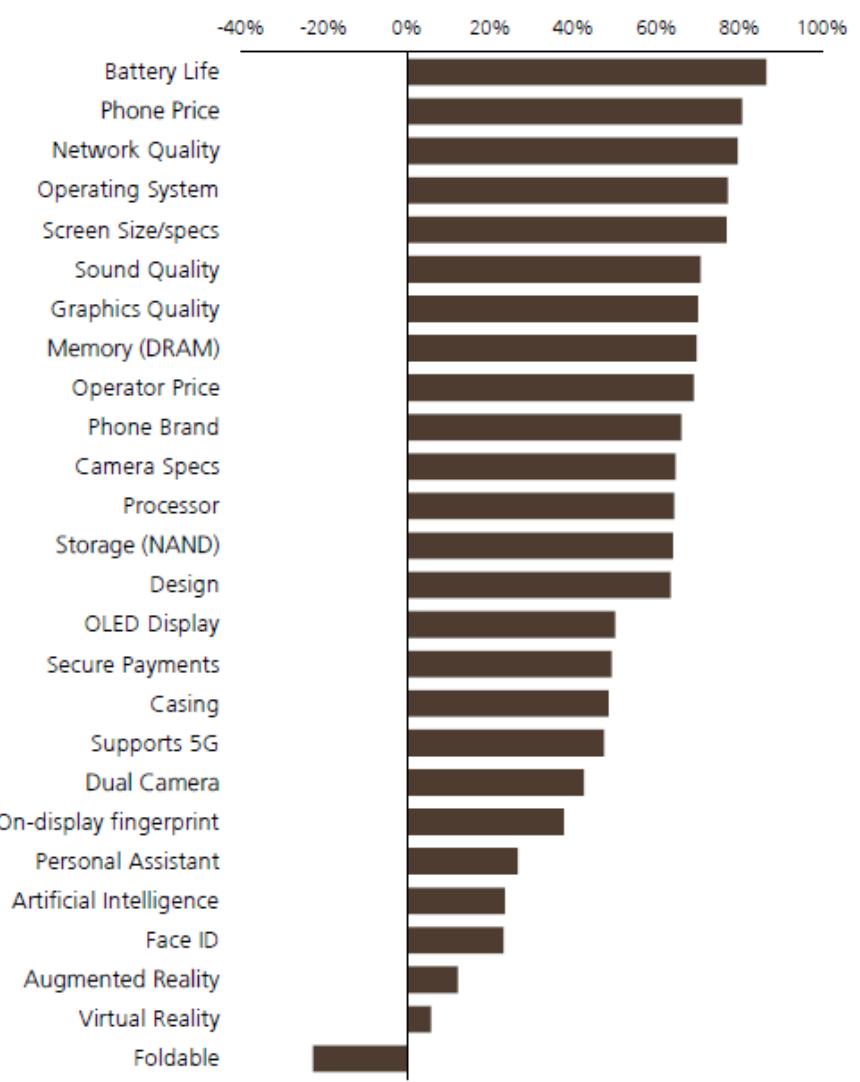
Source: UBS Evidence Lab (Latest Wave as of Apr 2022)

UBS Evidence Lab – battery life and price remain most important; foldable ranked as unimportant

Ranking of Importance of Handset Features



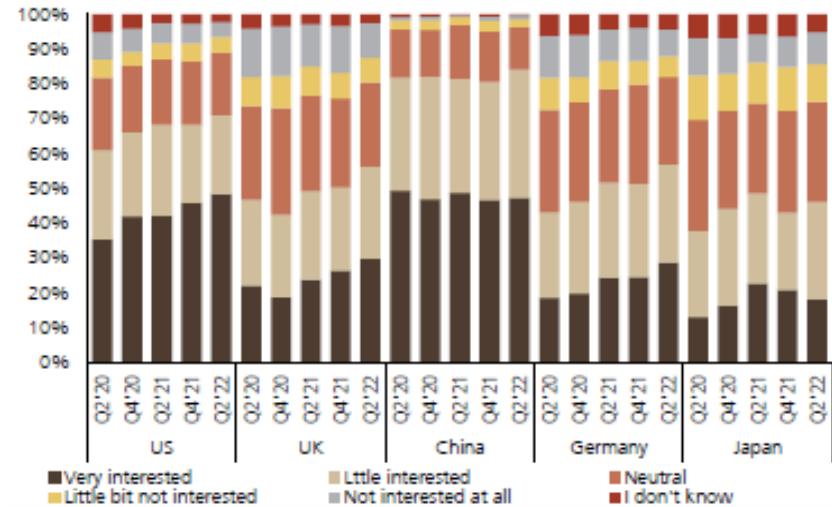
Ranking of Net Importance of Handset Features



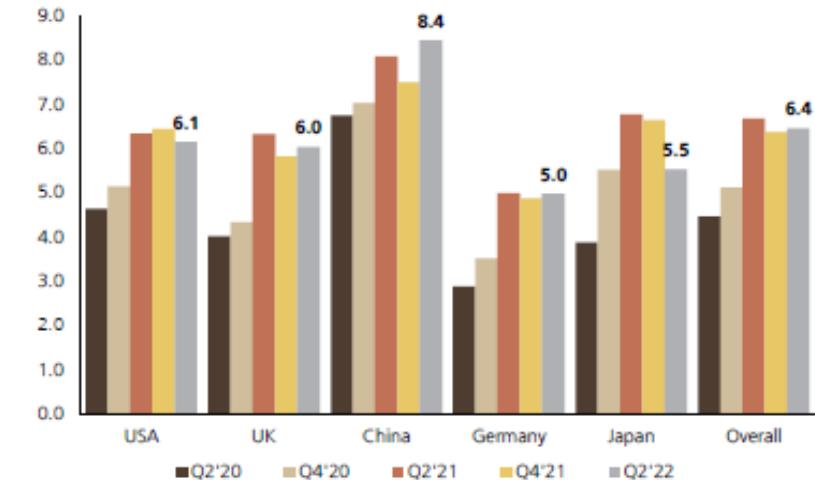
Source: UBS Evidence Lab (Latest Wave as of Apr 2022)

UBS Evidence Lab – Smartphones Survey 2Q22

Consumer Interest in 5G by Region



Willingness to Pay for 5G



Source: UBS Evidence Lab (Latest Wave as of Apr 2022)

Global Telecom Operator Capex: Model

UBS Global Carrier Capex Model – Wireless and Wired

(US\$m)	2016	2017	2018	2019	2020	2021	2022E	2023E
Global Wireless Capex	131,720	125,772	117,718	122,692	130,127	137,028	138,098	130,121
% y-o-y	-6.7%	-4.5%	-6.4%	4.2%	6.1%	5.3%	0.8%	-5.8%
% y-o-y const. currency	-5.4%	-4.3%	-7.2%	6.4%	6.7%	2.7%	2.0%	-5.8%
Global Wireline Capex	92,743	92,079	92,158	94,333	85,520	93,090	97,032	98,532
% y-o-y	-7.8%	-0.7%	0.1%	2.4%	-9.3%	8.9%	4.2%	1.5%
% y-o-y const. currency	-5.7%	-0.4%	-1.0%	4.8%	-8.9%	6.2%	6.0%	1.5%
Total Global Capex	241,688	237,172	231,390	237,398	237,363	252,002	260,493	255,345
% y-o-y	-6.3%	-1.9%	-2.4%	2.6%	0.0%	6.2%	3.4%	-2.0%
% y-o-y const. currency	-4.7%	-1.6%	-3.4%	4.9%	0.4%	3.7%	5.0%	-2.0%

Source: Company reports, UBS estimates

Global Wireless Capex: Model

UBS Global Wireless Capex Model

Global Wireless Capex (US\$m)	2016	2017	2018	2019	2020	2021	2022E	2023E
North America	27,820	29,501	27,440	28,385	32,358	37,486	41,478	37,398
% y-o-y	5.8%	6.0%	-7.0%	3.4%	14.0%	15.8%	10.6%	-9.8%
% y-o-y const. currency	5.8%	6.0%	-7.0%	3.4%	14.0%	15.8%	10.6%	-9.8%
Europe	17,994	17,892	19,287	19,469	19,962	21,847	21,331	20,150
% y-o-y	-4.4%	-0.6%	7.8%	0.9%	2.5%	9.4%	-2.4%	-5.5%
% y-o-y const. currency	-7.3%	-1.8%	3.4%	6.4%	0.9%	5.0%	2.6%	-5.5%
China	33,175	25,441	21,668	25,192	32,600	30,890	30,016	28,097
% y-o-y	-21.6%	-23.3%	-14.8%	16.3%	29.4%	-5.2%	-2.8%	-6.4%
% y-o-y const. currency	-17.2%	-22.0%	-16.6%	21.4%	29.3%	-11.4%	-4.4%	-6.4%
Japan	11,331	11,390	9,200	9,664	10,592	10,164	9,688	9,800
% y-o-y	5.0%	0.5%	-19.2%	5.0%	9.6%	-4.0%	-4.7%	1.2%
% y-o-y const. currency	-5.6%	3.6%	-20.5%	3.7%	7.3%	-1.3%	0.9%	1.2%
Asia ex. China/Japan	16,377	17,397	17,206	19,389	16,852	16,949	16,436	16,571
% y-o-y	6.8%	6.2%	-1.1%	12.7%	-13.1%	0.6%	-3.0%	0.8%
% y-o-y const. currency	10.2%	4.7%	0.0%	14.6%	-11.1%	-0.5%	-0.5%	0.8%
LatAm	12,907	11,658	11,132	9,435	7,249	9,102	9,103	8,923
% y-o-y	-10.2%	-9.7%	-4.5%	-15.2%	-23.2%	25.6%	0.0%	-2.0%
% y-o-y const. currency	-2.7%	-11.0%	-3.1%	-12.8%	-15.2%	21.7%	1.5%	-2.0%
Rest of world	12,115	12,492	11,785	11,159	10,515	10,589	10,047	9,183
% y-o-y	-8.7%	3.1%	-5.7%	-5.3%	-5.8%	0.7%	-5.1%	-8.6%
Total Global Wireless Capex	131,720	125,772	117,718	122,692	130,127	137,028	138,098	130,121
% y-o-y	-6.7%	-4.5%	-6.4%	4.2%	6.1%	5.3%	0.8%	-5.8%
% y-o-y const. currency	-5.4%	-4.3%	-7.2%	6.4%	6.7%	2.7%	2.0%	-5.8%
Total Global Wireless (ex-China)	98,545	100,331	96,050	97,500	97,527	106,137	108,082	102,024
% y-o-y	-0.4%	1.8%	-4.3%	1.5%	0.0%	8.8%	1.8%	-5.6%
% y-o-y const. currency	-0.6%	1.5%	-4.8%	3.1%	0.9%	7.8%	4.0%	-5.6%

Source: Company reports, UBS estimates



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

Smartphone

Autos

Semi Cap Equipment

Company Summaries

Global Wireline Capex: Model

UBS Global Wireline Capex Model

Global Wireline Capex (US\$m)	2016	2017	2018	2019	2020	2021	2022E	2023E
North America	18,732	19,727	20,859	20,332	17,537	19,233	22,234	21,277
% y-o-y	-4.8%	5.3%	5.7%	-2.5%	-13.7%	9.7%	15.6%	-4.3%
% y-o-y const. currency	-4.8%	5.3%	5.7%	-2.5%	-13.7%	9.7%	15.6%	-4.3%
Europe	21,239	21,544	21,888	21,111	21,452	23,549	23,105	23,357
% y-o-y	-2.3%	1.4%	1.6%	-3.6%	1.6%	9.8%	-1.9%	1.1%
% y-o-y const. currency	0.5%	1.0%	-2.2%	1.2%	-0.2%	5.0%	2.4%	1.1%
China	22,986	18,821	18,450	17,188	16,196	19,303	21,828	23,912
% y-o-y	-22.1%	-18.1%	-2.0%	-6.8%	-5.8%	19.2%	13.1%	9.5%
% y-o-y const. currency	-17.7%	-16.7%	-4.0%	-2.7%	-5.9%	11.4%	11.3%	9.5%
Japan	8,600	8,437	8,723	10,075	9,774	8,981	8,740	8,653
% y-o-y	10.4%	-1.9%	3.4%	15.5%	-3.0%	-8.1%	-2.7%	-1.0%
% y-o-y const. currency	-0.8%	1.1%	1.8%	14.0%	-5.0%	-5.5%	3.0%	-1.0%
Asia ex. China/Japan	10,575	12,834	11,326	14,547	10,748	11,080	10,662	10,596
% y-o-y	3.0%	21.4%	-11.8%	28.4%	-26.1%	3.1%	-3.8%	-0.6%
% y-o-y const. currency	6.6%	19.0%	-9.8%	31.2%	-24.0%	1.6%	-1.3%	-0.6%
LatAm	5,817	5,750	5,712	6,409	4,865	6,021	5,857	6,052
% y-o-y	-9.2%	-1.1%	-0.7%	12.2%	-24.1%	23.8%	-2.7%	3.3%
% y-o-y const. currency	0.3%	-2.4%	1.1%	15.7%	-15.7%	19.9%	-1.0%	3.3%
Rest of world	4,794	4,966	5,200	4,672	4,947	4,923	4,605	4,685
% y-o-y	-7.4%	3.6%	4.7%	-10.2%	5.9%	-0.5%	-6.5%	1.7%
Total Global Wireline Capex	92,743	92,079	92,158	94,333	85,520	93,090	97,032	98,532
% y-o-y	-7.8%	-0.7%	0.1%	2.4%	-9.3%	8.9%	4.2%	1.5%
% y-o-y const. currency	-5.7%	-0.4%	-1.0%	4.8%	-8.9%	6.2%	6.0%	1.5%
Total Global Wireline (ex-China)	69,758	73,258	73,707	77,145	69,323	73,787	75,203	74,620
% y-o-y	-1.9%	5.0%	0.6%	4.7%	-10.1%	6.4%	1.9%	-0.8%
% y-o-y const. currency	-0.9%	4.8%	-0.2%	6.6%	-9.6%	4.9%	4.6%	-0.8%

Source: Company reports, UBS estimates



China Telco Capex Model: Telco capex and 5G base stations assumptions

Number of Base Stations (5G vs 4G vs 2/3G)

No. BTS ('000) reported by operators	2016	2017	2018	2019	2020	2021	2022e	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e	2031e
By operator																
2/3G			1,440	1,340	1,470	1,080	980	880	780	680	580	480	380	280	180	80
4G	1,510	1,870	2,410	3,090	3,280	3,320	3,360	3,390	3,410	3,420	3,430	3,440	3,450	3,460	3,470	3,480
5G (incl. co-build with CBN)	-	-	-	50	390	730	1,100	1,450	1,750	2,000	2,200	2,400	2,600	2,800	2,900	3,000
CM Total			3,850	4,480	5,140	5,130	5,440	5,720	5,940	6,100	6,210	6,320	6,430	6,540	6,550	6,560
2/3G					310	-	-	-	-	-	-	-	-	-	-	-
4G	890	1,172	1,380	1,590	1,610	1,610	1,630	1,645	1,655	1,660	1,665	1,670	1,675	1,680	1,685	1,690
5G (incl. co-build with CU)	-	-	-	60	380	690	990	1,290	1,590	1,840	2,040	2,240	2,440	2,640	2,740	2,840
CT Total					2,300	2,300	2,620	2,935	3,245	3,500	3,705	3,910	4,115	4,320	4,425	4,530
2/3G					917	840	760	680	600	520	440	360	280	200	120	40
4G	736	850	990	1,410	1,503	1,560	1,580	1,595	1,605	1,610	1,615	1,620	1,625	1,630	1,635	1,640
5G (incl. co-build with CT)	-	-	-	60	380	690	990	1,290	1,590	1,840	2,040	2,240	2,440	2,640	2,740	2,840
CU Total					2,800	3,090	3,330	3,565	3,795	3,970	4,095	4,220	4,345	4,470	4,495	4,520
By technology																
2/3G					2,697	1,920	1,740	1,560	1,380	1,200	1,020	840	660	480	300	120
4G	3,136	3,892	4,780	6,090	6,393	6,490	6,570	6,630	6,670	6,690	6,710	6,730	6,750	6,770	6,790	6,810
5G	-	-	-	110	770	1,420	2,090	2,740	3,340	3,840	4,240	4,640	5,040	5,440	5,640	5,840
Total					9,860	9,830	10,400	10,930	11,390	11,730	11,970	12,210	12,450	12,690	12,730	12,770

Source: UBS estimates

Total Telco Capex (RMB MM)

Total capex	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Mobile network	156,169	128,617	116,816	146,648	187,834	174,045	162,069	149,868	143,162	142,671	142,312	143,064	143,842	144,647	145,478	146,337
Transmission/broadband	115,905	93,319	89,086	72,597	63,954	74,406	81,007	89,498	96,694	99,697	102,494	104,672	106,917	109,229	111,609	114,481
Other (incl. industrial digitalization)	84,153	86,406	81,008	80,675	81,262	90,872	110,124	123,869	133,510	141,070	145,715	148,943	151,750	154,101	156,504	158,745
Total capex	356,227	308,342	286,910	299,920	333,050	339,323	353,200	363,235	373,366	383,438	390,521	396,679	402,509	407,976	413,590	419,563
% change	-18.8%	-13.4%	-7.0%	4.5%	11.0%	1.9%	4.1%	2.8%	2.8%	2.7%	1.8%	1.6%	1.5%	1.4%	1.4%	1.4%
as % of service revenue	30.4%	24.7%	22.3%	23.1%	24.8%	23.4%	22.5%	21.9%	21.5%	21.4%	21.2%	21.1%	21.0%	20.8%	20.7%	20.6%
Total service revenue	1,171,267	1,248,410	1,285,024	1,296,388	1,345,304	1,450,389	1,569,321	1,661,441	1,737,387	1,794,337	1,845,486	1,881,742	1,919,310	1,958,216	1,998,488	2,040,158

Source: UBS estimates

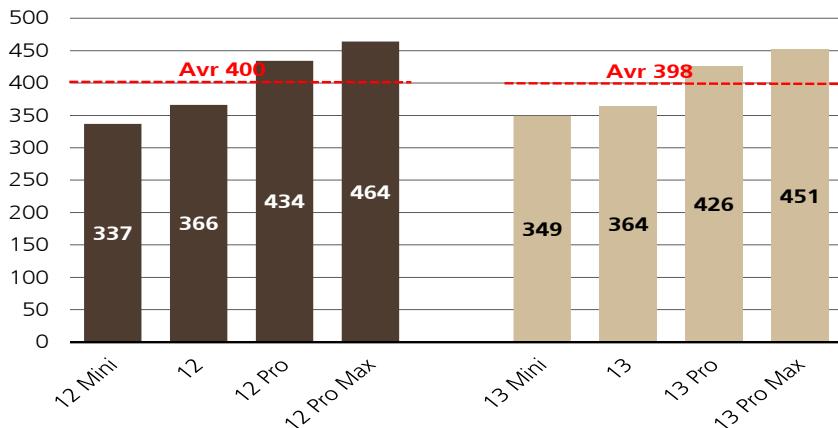
iPhone unit build forecasts

iPhone (m units)	1Q20	2Q20	3Q20	4Q20	1Q21	2Q21	3Q21	4Q21	1Q22E	2Q22E	2018	2019	2020	2021
iPhone 6+											11.0			
iPhone 6S											4.8	3.5		
iPhone 6S+	0.1										15.0	8.5	0.1	
iPhone SE											8.3	0.0	0.0	
iPhone 7	0.3										17.2	12.0	0.3	
iPhone 7+	0.1										6.7	4.5	0.1	
iPhone 8	1.0	0.5									34.5	15.0	1.5	
iPhone 8+	1.0	1.0	0.3								29.2	10.5	2.3	
iPhone X											33.0	2.0	0.0	
iPhone XR	2.0	2.0	1.9	1.8	1.7	1.9	1.5				26.0	38.0	7.7	5.1
iPhone XS Max	0.5	0.3									26.0	8.5	0.8	0.0
iPhone XS	0.5	0.2									15.5	9.5	0.7	0.0
iPhone 11	17.5	16.0	10.5	10.2	9.3	8.2	5.2	5.5	7.7	3.0	41.0	54.2	28.2	
iPhone 11 Pro Max	6.0	4.0	3.4								19.0	13.4	0.0	
iPhone 11 Pro	4.0	3.0	3.4								13.0	10.4	0.0	
iPhone SE2	1.5	12.5	12.0	9.0	4.4	5.0	4.0	2.9	0.4			35.0	16.3	
iPhone 12 Pro Max			0.5	18.0	13.4	8.5	3.0					18.5	24.9	
iPhone 12 Pro			1.0	16.0	11.5	5.2	2.5					17.0	19.2	
iPhone 12			4.5	23.0	9.3	11.0	8.9	8.3	6.8	3.9		27.5	37.5	
iPhone 12 Mini			3.0	10.0	0.5	0.3	0.2	0.2	0.0	0.0		13.0	1.2	
iPhone 13 Pro Max							7.0	20.9	11.2	10.5			27.9	
iPhone 13 Pro							6.5	14.8	10.4	8.4			21.3	
iPhone 13							8.0	32.0	18.7	16.4			40.0	
iPhone 13 Mini							3.0	5.4	2.4	1.5			8.4	
iPhone SE 3 5G									4.2	5.5				
Total iPhones	34.5	39.5	40.5	88.0	50.1	40.1	49.8	90.0	61.8	49.2	227.2	185.0	202.5	230.0
YoY	0%	20%	-23%	35%	45%	2%	23%	2%	23%	23%	-4%	-19%	9%	14%
QoQ	-47%	14%	3%	117%	-43%	-20%	24%	81%	-31%	-20%				

Source: UBS estimates

Smartphone: iPhone 13 Series BOM Comparison

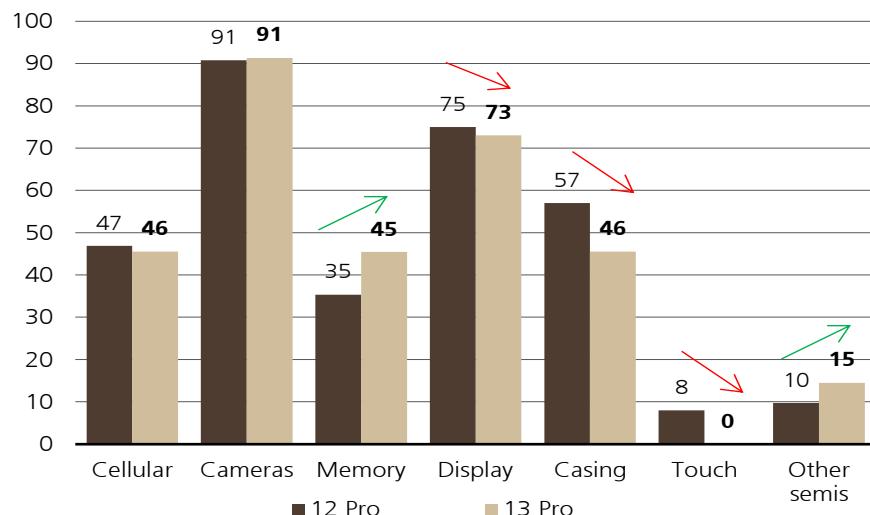
iPhone 13 Series BOM costs (US\$)



mmWave assumption: 35% for 12 series, 45% for 13 series

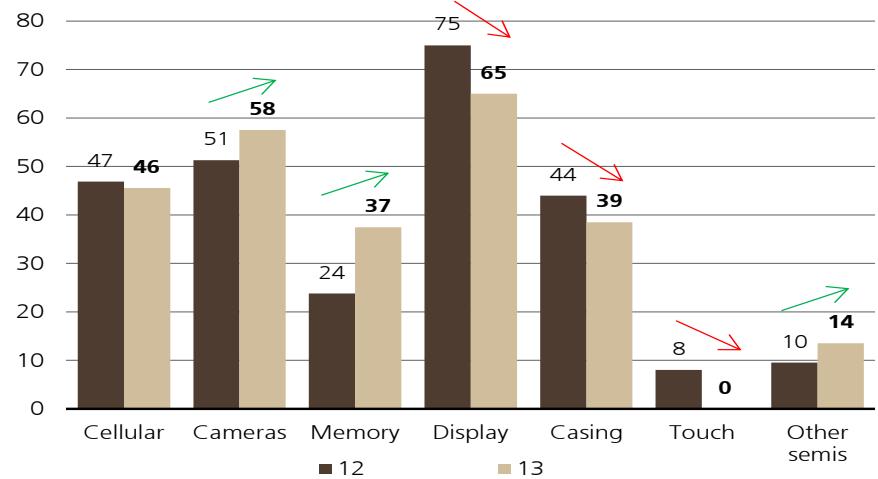
Source: Fomalhaut Techno Solution, UBS

iPhone 13 Pro vs 12 Pro Key Components (US\$)



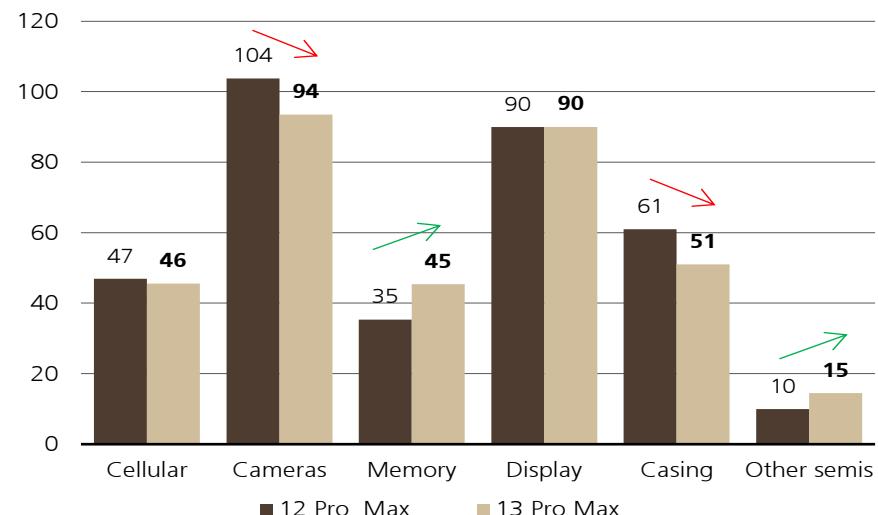
Source: Fomalhaut Techno Solution, UBS

iPhone 13 vs 12 Key Components



Source: Fomalhaut Techno Solution, UBS

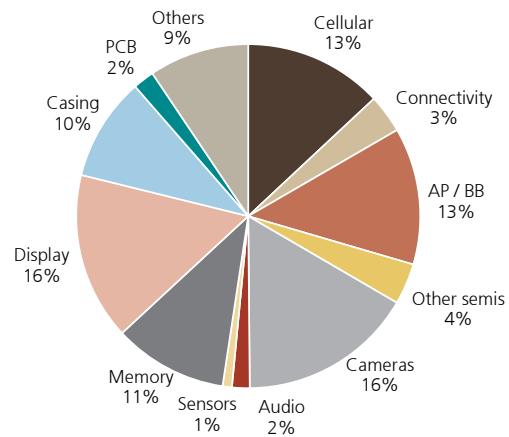
iPhone 13 Pro Max vs 12 Pro Max Key Components



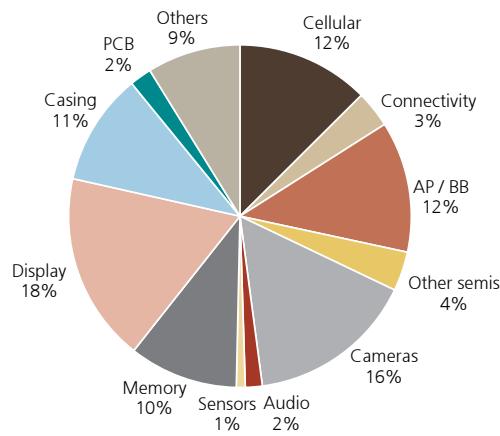
Source: Fomalhaut Techno Solution, UBS

iPhone 13 Series Content by Component

IP13 Mini Content by Component

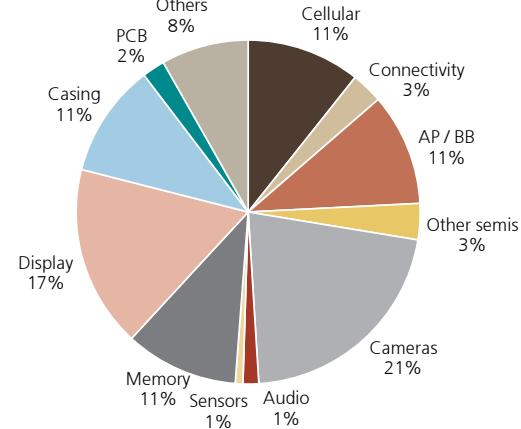


IP13 Content by Component



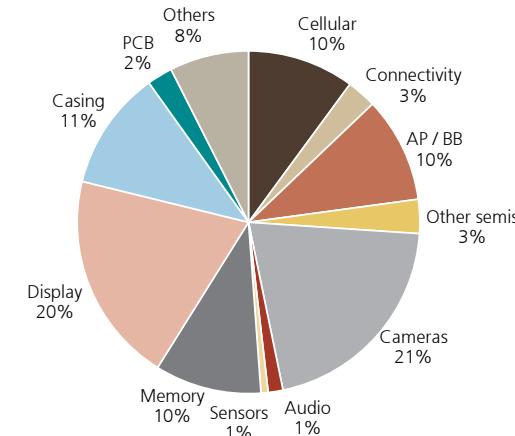
Source: Fomalhaut Techno Solution, UBS

IP13 Pro Content by Component



Source: Fomalhaut Techno Solution, UBS

IP13 Pro Max Content by Component



Source: Fomalhaut Techno Solution, UBS

Source: Fomalhaut Techno Solution, UBS

iPhone 13 Mini (Sub-6) Teardown – Part 1

iPhone 13 Mini (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Cellular	RF transceiver	Qualcomm	5.5	34.4	10.2%	ALSO LTE, WCDMA, GSM, GPS
	Power amplifiers		14.0			ALSO WCDMA, CDMA, GSM
	LTE /WCDMA /CDMA /GSM	Avago				ALSO SUB6, LTE
	SUB-6GHz/LTE	Qorvo, Skyworks				
	U1 Ultra-wideband chip	USI	4.0			
	Diversity receiver	Murata, Skyworks	2.0			
	Antenna switch	Murata	0.5			
	Duplexer	Avago	0.3			
	Duplexer bank	Murata	1.0			
	LTCC duplexer	TDK, Taiyo Yuden, Murata	0.4			
	Front end module	Skyworks	4.0			
	Envelope Tracker	Qualcomm	0.7			
	Antenna tuning switch	Skyworks	1.0			
	RF switch	Avago, Qorvo	1.0			
Connectivity	WLAN/Bluetooth	USI	9.0	12.6	3.7%	ALSO BT, WLAN
	NFC/RFID	NXP	1.6			ALSO RFID, NFC
	Wireless charger	Broadcom	2.0			
AP / BB	Application processor	Apple (foundry TSMC)	30.0	45.0	13.4%	TSMC 5nm, avr 20% die size increase
	Baseband	Qualcomm (foundry Samsung)	15.0			ANALOG & DIGITAL BB
Other semis	Audio processor/Audio codec		1.8	13.5	4.0%	
	Audio power amplifier	Cirrus Logic	1.7			
	Power management	Apple, Dialog, Qualcomm, STM	5.0			
	Quick charger		1.5			
	Display power supply	Samsung, TI	1.0			
	Display controller	NXP	1.5			
	LED controller	TI	0.5			
	E-SIM	STM	0.5			

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Mini (Sub-6) Teardown – Part 2

iPhone 13 Mini (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
Camera	Rear dual camera module			38.5	11.5%
	12MP Wide camera		25.0		
	CMOS image sensor	Sony	5.8		12MP CMOS - 4.98
	Module assembly	LG Innotek, Sharp	3.8		
	Lens	Lagan, Genius, Sunny Optical	1.6		
	OIS actuator	Alps, Mitsumi	10.0		SENSOR SHIFT
	TMR sensor	TDK	1.5		
	Other		2.4		
	12MP Ultra-wide camera		10.0		
	CMOS image sensor	Sony	2.7		12MP CMOS - 5.19
	Module assembly	Sharp, Hon Hai	1.5		
	Lens	Lagan, Genius	1.1		
	Other		4.7		
	Rear module assembly	Hon Hai	3.5		
	Front single camera module		6.0	6.0	1.8%
	CMOS image sensors	Sony	2.8		12MP CMOS - 4.6
	Module assembly	Cowell, Hon Hai	1.0		
	Lens	Lagan, Genius	0.8		
	Other		1.4		
	Face ID		13.0	13.0	3.9%
	Flood illuminator infrared		1.5		
	Dot projector VCSEL		1.5		
	Dot projector DOE		3.2		
	Infrared camera	STM	3.0		
	Infrared filter		0.5		
	Lens	Lagan, Genius	1.0		
	Module assembly	LG Innotek, Hon Hai	2.0		
	Other		0.4		
Audio	Microphone	Knowles Acoustics, GoerTek	0.8	5.8	1.7%
	Speaker	Goertek, AAC, Luxshare	5.0		

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Mini (Sub-6) Teardown – Part 3

iPhone 13 Mini (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Sensor	Accelerometer/Gyroscope	Bosch Sensortec	1.3	3.1	0.9%	ALSO GYROSCOPE
	Digital compass	Alps	0.5			
	Barometer		0.8			
	Light sensor/Proximity sensor	STM, ams	0.5			ALSO PROXIMITY SENSOR
Memory	DRAM	Samsung	19.0	37.4	11.1%	LPDDR4, 4GBYTE
	NAND flash memory	Kioxia	18.5			128GBYTE
Display	Main display	Samsung Display, LG Display	47.0	55.0	16.4%	5.4" FHD+ OLED, Y-OCTA
	Cover glass	Lens Tech, Biel Crystal (Corning glass)	5.0			
	Touch panel controller	Apple	3.0			
Casing	Center panel	Foxconn Industrial Internet, Foxconn Tech, Lens Tech	25.0	34.0	10.1%	Aluminum
	Rear cover	Lens Tech, Biel Crystal (Corning glass)	5.0			
	Keypad buttons	Casetek	1.0			
	Waterproof	Jabil, Tongda	3.0			IP68
PCB	PCB	AT&S	3.0	7.0	2.1%	
	FPC	FM, MK, Sumitomo	4.0			
Antenna	Cellular/GPS		0.2	3.3	1.0%	ALSO 2G,3G,4G,GPS, BUILT-IN
	WLAN/Bluetooth		0.2			ALSO WLAN, BT, BUILT-IN
	U1 Ultra-wideband		0.2			
	NFC /RFID		0.2			ALSO NFC, RFID
	Wireless charger		2.5			
Small components	Chip capacitor	Murata, Taiyo Yuden, SEMCO	5.3	7.1	2.1%	
	Chip resistor		0.2			
	Chip inductor		0.1			
	Chip diode		0.0			
	Chip filter		0.6			
	Power inductor	Taiyo Yuden, Murata, Cyntec	1.0			
Other	Li-on polymer battery	Sunwoda (cells from TDK/ATL, LGC, SDI)	5.5	20.4	6.1%	2406MAH
	Vibrator		4.0			
	SIM		0.2			
	Timing device	NDK, TXC	0.4			
	EMI shield metal cap		0.8			
	Screw		0.6			
	Unidentified large IC		4.6			
	Connector		2.3			
	Heat treatment - CU foil		0.1			
	Heat treatment - carbon graphite		1.8			
	Mobile light LED		0.2			
Total			336.1	336.1		
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Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 (Sub-6) Teardown – Part 1

iPhone 13 (Sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
Cellular	RF transceiver	Qualcomm	5.5	34.4	9.8% ALSO LTE, WCDMA, GSM, GPS
	Power amplifiers		14.0		
	LTE /WCDMA /CDMA /GSM	Avago			
	SUB-6GHz/LTE	Qorvo, Skyworks			ALSO WCDMA, CDMA,GSM
	U1 Ultra-wideband chip	USI	4.0		ALSO SUB6, LTE
	Diversity receiver	Murata, Skyworks	2.0		
	Antenna switch	Murata	0.5		
	Duplexer	Avago	0.3		
	Duplexer bank	Murata	1.0		
	LTCC duplexer	TDK, Taiyo Yuden, Murata	0.4		
	Front end module	Skyworks	4.0		
	Envelope Tracker	Qualcomm	0.7		
	Antenna tuning switch	Skyworks	1.0		
	RF switch	Avago, Qorvo	1.0		
Connectivity	WLAN/Bluetooth	USI	9.0	12.6	3.6% ALSO BT, WLAN ALSO RFID, NFC
	NFC/RFID	NXP	1.6		
	Wireless charger	Broadcom	2.0		
AP / BB	Application processor	Apple (foundry TSMC)	30.0	45.0	12.8% TSMC 5nm, avr 20% die size increases ANALOG & DIGITAL BB
	Baseband	Qualcomm (foundry Samsung)	15.0		
Other semis	Audio processor/Audio codec		1.8	13.5	3.9%
	Audio power amplifier	Cirrus Logic	1.7		
	Power management	Apple, Dialog, Qualcomm, STM	5.0		
	Quick charger		1.5		
	Display power supply	Samsung, TI	1.0		
	Display controller	NXP	1.5		
	LED controller	TI	0.5		
	E-SIM	STM	0.5		

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 (Sub-6) Teardown – Part 2

iPhone 13 (Sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
Camera	Rear dual camera module			38.5	11.0%
	12MP Wide camera		25.0		
	CMOS image sensor	Sony	5.8		12MP CMOS - 8.45
	Module assembly	LG Innotek, Sharp	3.8		
	Lens	Lagan, Genius, Sunny Optical	1.6		
	OIS actuator	Alps, Mitsumi	10.0		SENSOR SHIFT
	TMR sensor	TDK	1.5		
	Other		2.4		
	12MP Ultra-wide camera		10.0		
	CMOS image sensor	Sony	2.7		12MP CMOS - 5.11
	Module assembly	Sharp, Hon Hai	1.5		
	Lens	Lagan, Genius	1.1		
	Other		4.7		
	Rear module assembly	Hon Hai	3.5		
	Front single camera module		6.0	6.0	1.7%
	CMOS image sensors	Sony	2.8		12MP CMOS - 4.64
	Module assembly	Cowell, Hon Hai	1.0		
	Lens	Lagan, Genius	0.8		
	Other		1.4		
	Face ID		13.0	13.0	3.7%
	Flood illuminator infrared		1.5		
	Dot projector VCSEL		1.5		
	Dot projector DOE		3.2		
	Infrared camera	STM	3.0		
	Infrared filter		0.5		
	Lens	Lagan, Genius	1.0		
	Module assembly	LG Innotek, Hon Hai	2.0		
	Other		0.4		
Audio	Microphone	Knowles Acoustics	0.8	5.8	1.7%
	Speaker	Goertek, AAC, Luxshare	5.0		

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 (Sub-6) Teardown – Part 3

iPhone 13 (Sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
Sensor	Accelerometer/Gyroscope	Bosch Sensortec	1.3	3.1	0.9% ALSO GYROSCOPE
	Digital compass	ALPS	0.5		
	Barometer		0.8		
	Light sensor/Proximity sensor	STM, ams	0.5		
Memory	DRAM	Samsung	19.0	37.4	10.7% LPDDR4, 4GBYTE 128GBYTE
	NAND flash memory	Kioxia	18.5		
Display	Main display	Samsung Display, LG Display, BOE	56.5	65.0	18.6% 6.1" FHD+ OLED, Y-OCTA
	Cover glass	Lens Tech, Biel Crystal (Corning glass)	5.5		
	Touch panel controller	Apple	3.0		
Casing	Center panel	Foxconn Industrial Internet, Foxconn Tech, Lens Tech	28.0	38.5	11.0% Aluminum
	Rear cover	Lens Tech, Biel Crystal (Corning glass)	6.5		
	Keypad buttons	Casetek	1.0		
	Waterproof	Jabil, Tongda	3.0		
PCB	PCB	AT&S	3.0	7.6	2.2%
	FPC	CPQ, MK, MFC, MYC, Sumitomo, Avary, Dongshan	4.6		
Antenna	Cellular/GPS		0.2	3.3	0.9% ALSO 2G,3G,4G,GPS, BUILT-IN ALSO WLAN, BT, BUILT-IN IN FPC#4 ALSO NFC, RFID
	WLAN/Bluetooth		0.2		
	U1 Ultra-wideband		0.2		
	NFC /RFID		0.2		
	Wireless charger		2.5		
Small components	Chip capacitor	Murata, Taiyo Yuden, SEMCO	4.8	6.2	1.8%
	Chip resistor		0.2		
	Chip inductor		0.0		
	Chip diode		0.0		
	Chip filter		0.0		
	Power inductor	Taiyo Yuden, Murata, Cyntec	1.1		
Other	Li-on polymer battery	Sunwoda (cells from TDK/ATL, LGC, SDI)	7.5	20.5	5.8% 3227MAH
	Vibrator		4.0		
	SIM		0.2		
	Timing device	TXC	0.4		
	EMI shield metal cap		0.5		
	Screw		0.7		
	Unidentified large IC		2.7		
	Connector		2.4		
	Heat treatment - CU foil		0.1		
	Heat treatment - carbon graphite		1.8		
	Mobile light LED		0.2		
Total			350.3	350.3	

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Source: Fomalhaut Techno Solution, UBS estimates



iPhone 13 Pro (Sub-6) Teardown – Part 1

iPhone 13 Pro (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Cellular	RF transceiver	Qualcomm	5.5	34.9	8.5%	Sub-6, LTE, WCDMA, CDMA, GSM,
	Power amplifiers		14.0			LTE, WCDMA, CDMA, GSM
	LTE /WCDMA /CDMA /GSM	Avago				Sub-6, LTE
	SUB-6GHz/LTE	Qorvo, Skyworks				
	U1 Ultra-wideband chip	USI	4.0			
	Diversity receiver	Murata, Skyworks	2.0			
	Antenna switch	Murata	0.5			
	Duplexer	Avago	0.3			
	Duplexer bank	Murata	1.0			
	LTCC duplexer	TDK, Taiyo Yuden, Murata	0.4			
	Front end module	Skyworks	4.0			
	Envelope Tracker	Qualcomm	0.7			
	Antenna tuning switch	Skyworks	1.0			
	RF switch	Avago, Qorvo	1.5			
Connectivity	WLAN/Bluetooth	USI	9.0	12.6	3.1%	ALSO BT, WLAN
	NFC/RFID	NXP	1.6			ALSO RFID, NFC
	Wireless charger	Broadcom	2.0			
AP / BB	Application processor	Apple (foundry TSMC)	30.0	45.0	10.9%	TSMC 5nm, avr 20% die size increase
	Baseband	Qualcomm (foundry Samsung)	15.0			ANALOG & DIGITAL BB
Other semis	Audio processor/Audio codec		1.8	14.5	3.5%	
	Audio power amplifier	Cirrus Logic	1.7			
	Power management	Apple, Dialog, Qualcomm, STM	6.0			
	Quick charger		1.5			
	Display power supply	Samsung, TI	1.0			
	Display controller	NXP	1.5			
	LED controller	TI	0.5			
	E-SIM	STM	0.5			

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Pro (Sub-6) Teardown – Part 2

iPhone 13 Pro (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Camera	Rear triple camera module			58.3	14.1%	
	12MP Wide camera		28.0			
	CMOS image sensor	Sony	6.5			12MP CMOS - 9.14
	Module assembly	LG Innotek, Sharp	4.2			
	Lens	Largan, Genius, Sunny Optical	2.0			
	OIS actuator	Alps, Mitsumi	12.0			SENSOR SHIFT
	TMR sensor	TDK	1.5			
	Other		1.8			
	12MP Telephoto		14.0			
	CMOS image sensors	Sony	2.7			12MP CMOS - 5.22
	Module assembly	LG Innotek	2.1			
	Lens	Largan, Genius	1.7			
	OIS actuator	Alps, Mitsumi	3.0			
	Other		4.6			
	12MP Ultra-wide		11.0			
	CMOS image sensors	Sony	2.7			12MP CMOS - 4.98
	Module assembly	LG Innotek, Sharp	2.1			
	Lens	Largan, Genius	1.1			
	Voice coil motor	Alps	1.0			
	Other		4.1			
	Rear module assembly	Hon Hai	5.3			
	Rear ToF (LiDAR) module		14.0	14.0	3.4%	
	ToF image sensor		2.1			
	Module assembly	LG Innotek	2.7			
	Lens	Largan, Genius	1.0			
	VCSEL		2.0			
	LiDAR processor		2.0			
	Other		4.2			
	Front single camera module		6.0	6.0	1.5%	
	CMOS image sensors	Sony	2.8			12MP CMOS - 4.53
	Module assembly	Cowell, Hon Hai	1.0			
	Lens	Largan, Genius	0.8			
	Other		1.4			
	Face ID		13.0	13.0	3.1%	
	Flood illuminator infrared		1.5			
	Dot projector VCSEL		1.5			
	Dot projector DOE		3.2			
	Infrared camera	STM	3.0			
	Infrared filter		0.5			
	Lens	Largan, Genius	1.0			
	Module assembly	LG Innotek, Hon Hai	2.0			
	Other		0.4			
Audio	Microphone	GoerTek, Knowles Acoustics	0.8	6.3	1.5%	
	Speaker	Goertek, AAC, Luxshare	5.5			

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Pro (Sub-6) Teardown – Part 3

iPhone 13 Pro (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
Sensor	Accelerometer/Gyroscope	Bosch Sensortec	1.3	3.1	0.7% ALSO GYROSCOPE
	Digital compass	Alps	0.5		
	Barometer		0.8		
	Light sensor/Proximity sensor	STM, ams	0.5		ALSO PROXIMITY SENSOR
Memory	DRAM	Samsung	27.0	45.4	11.0% LPDDR4, 6GBYTE
	NAND flash memory	Kioxia	18.5		128GBYTE
Display	Main display	Samsung Display	64.5	73.0	17.7% 6.1" FHD+ OLED, Y-OCTA, LTPO
	Cover glass	Lens Tech, Biel Crystal (Corning glass)	5.5		
	Touch panel controller	Apple	3.0		
Casing	Center panel	Foxconn Industrial Internet, Foxconn Tech	35.0	45.5	11.0% Stainless
	Rear cover	Lens Tech, Biel Crystal (Corning glass)	6.5		
	Keypad buttons	Casetek	1.0		
	Waterproof	Jabil, Tongda	3.0		IP68
PCB	PCB	AT&S	3.5	9.1	2.2%
	FPC	FM, MK, Sumitomo, Fujikura, Avary, Dongshan	5.6		
Antenna	Cellular/GPS		0.2	3.3	0.8% ALSO 2G,3G,4G,GPS, BUILT-IN
	WLAN/Bluetooth		0.2		ALSO WLAN, BT, BUILT-IN
	U1 Ultra-wideband		0.2		IN FPC#4
	NFC /RFID		0.2		ALSO NFC, RFID
	Wireless charger		2.5		
Small components	Chip capacitor	Murata, Taiyo Yuden, SEMCO	4.8	7.0	1.7%
	Chip resistor		0.3		
	Chip inductor		0.0		
	Chip diode		0.0		
	Chip filter		0.5		
	Power inductor	Taiyo Yuden, Murata, Cyntec	1.4		
Other	Li-on polymer battery	Huizhou Desay (cells from TDK/ATL, LGC)	7.5	22.1	5.4% 3095mAh, L-shape
	Vibrator		4.0		
	SIM		0.2		
	Timing device	EPSON, NDK, TXC	0.4		
	EMI shield metal cap		0.6		
	Screw		0.7		
	Unidentified large IC		4.0		
	Connector		2.6		
	Heat treatment - CU foil		0.1		
	Heat treatment - carbon graphite		1.8		
	Mobile light LED		0.2		
Total			413.1	413.1	

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Source: Fomalhaut Techno Solution, UBS estimates



iPhone 13 Pro (mmWave) Teardown – Part 1

iPhone 13 Pro (mmWave) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Cellular	RF transceiver	Qualcomm, USI	10.5	58.6	13.2%	
	2G: GSM	Qualcomm	0.0			
	3G: WCDMA	Qualcomm	0.0			
	4G: LTE	Qualcomm	0.0			
	5G: sub-6GHz	Qualcomm	5.5			Sub-6, LTE, WCDMA, CDMA, GSM, inc
	5G: mmWave (IF converter)	Qualcomm	5.0			
	Power amplifiers		22.0			
	LTE /WCDMA /CDMA /GSM	Avago	8.0			LTE, WCDMA, CDMA, GSM
	SUB-6GHz/LTE	Qorvo, Skyworks	6.0			Sub-6, LTE
	mmWave	Murata	8.0			ASSUMPTION
	mmWave antenna module (AiP)	USI	12.5			mmWave assumption
	U1 Ultra-wideband chip	USI	4.0			
	Diversity receiver	Skyworks, Murata	1.0			
	Antenna switch	Murata	0.5			
	Duplexer	Avago	0.3			
	Duplexer bank	Murata	1.0			
	LTCC duplexer	TDK, Taiyo Yuden, Murata	0.1			
	Front end module	Skyworks	4.0			
	Envelope Tracker	Qualcomm	0.7			
	Antenna tuning switch	Skyworks	1.0			
	RF switch	Avago, Qorvo	1.0			
Connectivity	WLAN/Bluetooth	USI	9.0	12.6	2.8%	ALSO BT, WLAN
	NFC	NXP	1.6			
	Wireless charger	Broadcom	2.0			
AP / BB	Application processor	Apple (foundry TSMC)	30.0	45.0	10.2%	TSMC 5nm, avr 20% die size increase
	Baseband	Qualcomm (foundry Samsung)	15.0			ANALOG & DIGITAL BB
Other semis	Audio processor/Audio codec		1.8	14.5	3.3%	
	Audio power amplifier	Cirrus Logic	1.7			
	Power management	Apple, Dialog, Qualcomm, STM	6.0			
	Quick charger		1.5			
	Display power supply	Samsung, TI	1.0			
	Display controller	NXP	1.5			ASSUMPTION
	LED controller	TI	0.5			
	E-SIM	STM	0.5			

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Pro (mmWave) Teardown – Part 2

iPhone 13 Pro (mmWave) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Camera	Rear triple camera module			58.3	13.2%	
	12MP Wide camera		28.0			
	CMOS image sensor	Sony	6.5			12MP CMOS
	Module assembly	LG Innotek, Sharp	4.2			
	Lens	Largan, Genius, Sunny Optical	2.0			
	OIS actuator	Alps, Mitsumi	12.0			SENSOR SHIFT
	TMR sensor	TDK	1.5			
	Other		1.8			
	12MP Telephoto		14.0			
	CMOS image sensors	Sony	2.7			12MP CMOS
	Module assembly	LG Innotek	2.1			
	Lens	Largan, Genius	1.7			
	OIS actuator		3.0			
	Other		4.6			
	12MP Ultra-wide		11.0			
	CMOS image sensors	Sony	2.7			12MP CMOS
	Module assembly	LG Innotek, Sharp	1.7			
	Lens	Largan, Genius	1.1			
	Voice coil motor	Alps	1.0			
	Other		4.6			
	Rear module assembly	Hon Hai	5.3			
	Rear ToF (LiDAR) module		14.0	14.0	3.2%	
	ToF image sensor		2.1			
	Module assembly	LG Innotek	2.7			
	Lens	Largan, Genius	1.0			
	VCSEL		2.0			
	LiDAR processor		2.0			
	Other		4.2			
	Front single camera module		6.0	6.0	1.4%	
	CMOS image sensors	Sony	2.8			12MP CMOS
	Module assembly	Cowell, Hon Hai	1.0			
	Lens	Largan, Genius	0.8			
	Other		1.4			
	Face ID		13.0	13.0	2.9%	
	Flood illuminator infrared		1.5			
	Dot projector VCSEL		1.5			
	Dot projector DOE		3.2			
	Infrared camera	STM	3.0			
	Infrared filter		0.5			
	Lens	Largan, Genius	1.0			
	Module assembly	LG Innotek, Hon Hai	2.0			
	Other		0.4			
Audio	Microphone	Goertek, Knowles Acoustics	0.8	6.3	1.4%	
	Speaker	Goertek, AAC, Luxshare	5.5			

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Pro (mmWave) Teardown – Part 3

iPhone 13 Pro (mmWave) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Sensor	Accelerometer/Gyroscope	Bosch Sensortec	1.3	3.1	0.7%	ALSO GYROSCOPE
	Digital compass	Alps	0.5			
	Barometer		0.8			
	Light sensor/Proximity sensor	STM, ams	0.5			ALSO PROXIMITY SENSOR
Memory	DRAM	SK Hynix	27.0	45.4	10.3%	LPDDR4, 6GBYTE
	NAND flash memory	Kioxia	18.5			128GBYTE
Display	Main display	Samsung Display	64.5	73.0	16.5%	6.1" FHD+ OLED
	Cover glass	Lens Tech, Biel Crystal (Corning glass)	5.5			
	Touch panel controller	Apple	3.0			
Casing	Center panel	Foxconn Industrial Internet, Foxconn Tech	35.0	45.5	10.3%	
	Rear cover	Lens Tech, Biel Crystal (Corning glass)	6.5			
	Keypad buttons	Casetek	1.0			
	Waterproof	Jabil, Tongda	3.0			
PCB	PCB	AT&S	3.5	9.1	2.1%	
	FPC	FM, MFC, MK, MYC, SEMCO, Sumitomo, Avary, Dongshan	5.6			
Antenna	Cellular/GPS		7.2	10.3	2.3%	
	GSM/WCDMA/CDMA/LTE		0.2			ALSO 2G,3G,4G,GPS, BUILT-IN
	5G: MILLIMETER WAVE	USI	7.0			INCLUDING PACKAGING
	WLAN/Bluetooth		0.2			ALSO WLAN, BT, BUILT-IN
	U1 Ultra-wideband		0.2			
	NFC		0.2			
	Wireless charger		2.5			
Small components	Chip capacitor	Murata, Taiyo Yuden, SEMCO	5.3	6.7	1.5%	
	Chip resistor		0.2			
	Chip diode		0.0			
	Chip filter		0.0			
	Power inductor	Taiyo Yuden, Murata, Cyntec	1.1			
Other	Li-on polymer battery	Huizhou Desay (cells from TDK/ATL, LGC)	7.5	21.2	4.8%	3095MAH
	Vibrator		4.0			
	SIM		0.2			
	Timing device	Epson, TXC	0.4			
	EMI shield metal cap		0.6			
	Screw		0.7			
	Unidentified large IC		2.9			
	Connector		2.8			
	Heat treatment - CU foil		0.1			
	Heat treatment - carbon graphite		1.8			
	Mobile light LED		0.2			
Total			442.6			

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Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Pro Max (Sub-6) Teardown – Part 1

iPhone 13 Pro Max (Sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
Cellular	RF transceiver	Qualcomm	5.5	34.9	8.0% Sub-6, LTE, WCDMA, CDMA, GSM, LTE, WCDMA, CDMA, GSM ALSO SUB6, LTE
	Power amplifiers		14.0		
	LTE /WCDMA /CDMA /GSM	Avago			
	SUB-6GHz/LTE	Qorvo, Skyworks			
	U1 Ultra-wideband chip	USI	4.0		
	Diversity receiver	Murata, Skyworks	2.0		
	Antenna switch	Murata	0.5		
	Duplexer	Avago	0.3		
	Duplexer bank	Murata	1.0		
	LTCC duplexer	TDK, Taiyo Yuden, Murata	0.4		
	Front end module	Skyworks	4.0		
	Envelope Tracker	Qualcomm	0.7		
	Antenna tuning switch	Skyworks	1.0		
	RF switch	Avago, Qorvo	1.5		
Connectivity	WLAN/Bluetooth	USI	9.0	12.6	2.9% ALSO BT, WLAN ALSO RFID, NFC
	NFC/RFID	NXP	1.6		
	Wireless charger	Broadcom	2.0		
AP / BB	Application processor	Apple (foundry TSMC)	30.0	45.0	10.3% TSMC 5nm, avg 20% die size increase ANALOG & DIGITAL BB
	Baseband	Qualcomm (foundry Samsung)	15.0		
Other semis	Audio processor/Audio codec		1.8	14.5	3.3%
	Audio power amplifier	Cirrus Logic	1.7		
	Power management	Apple, Dialog, Qualcomm, STM	6.0		
	Quick charger		1.5		
	Display power supply	Samsung, TI	1.0		
	Display controller	NXP	1.5		
	LED controller	TI	0.5		
	E-SIM	STM	0.5		

Source: Fomalhaut Techno Solution, UBS estimates



iPhone 13 Pro Max (Sub-6) Teardown – Part 2

iPhone 13 Pro Max (Sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	%	Remark
Camera	Rear triple camera module			60.5	13.8%	
	12MP Wide camera		28.0			
	CMOS image sensor	Sony	6.5			12MP CMOS - 9.54
	Module assembly	LG Innotek	4.2			
	Lens	Largan, Genius, Sunny Optical	2.0			
	Sensor-shift OIS	Alps, Mitsumi	12.0			SENSOR SHIFT
	TMR sensor	TDK	1.5			
	Other		1.8			
	12MP Telephoto		15.0			
	CMOS image sensors	Sony	3.5			12MP CMOS - 5.27
	Module assembly	LG Innotek	2.3			
	Lens	Largan, Genius	1.7			
	OIS actuator		3.0			
	Other		4.6			
	12MP Ultra-wide		12.0			
	CMOS image sensors	Sony	3.5			12MP CMOS - 8.42??
	Module assembly	LG Innotek, Sharp	1.8			
	Lens	Largan, Genius	1.1			
	Voice coil motor		1.0			
	Other		4.6			
	Rear module assembly	Hon Hai	5.5			
	Rear ToF (LiDAR) module		14.0	14.0	3.2%	
	ToF image sensor		2.1			
	Module assembly	LG Innotek	2.7			
	Lens	Largan, Genius	1.0			
	VCSEL		2.0			
	LiDAR processor		2.0			
	Other		4.2			
	Front single camera module		6.0	6.0	1.4%	
	CMOS image sensors	Sony	2.8			12MP CMOS - 4.86
	Module assembly	Cowell, Hon Hai	1.0			
	Lens	Largan, Genius	0.8			
	Other		1.4			
	Face ID		13.0	13.0	3.0%	
	Flood illuminator infrared		1.5			
	Dot projector VCSEL		1.5			
	Dot projector DOE		3.2			
	Infrared camera	STM	3.0			
	Infrared filter		0.5			
	Lens	Largan, Genius	1.0			
	Module assembly	LG Innotek, Hon Hai	2.0			
	Other		0.4			
Audio	Microphone	GoerTek, Knowles Acoustics	0.8	6.3	1.4%	
	Speaker	Goertek, AAC, Luxshare	5.5			

Source: Fomalhaut Techno Solution, UBS estimates

iPhone 13 Pro Max (Sub-6) Teardown – Part 3

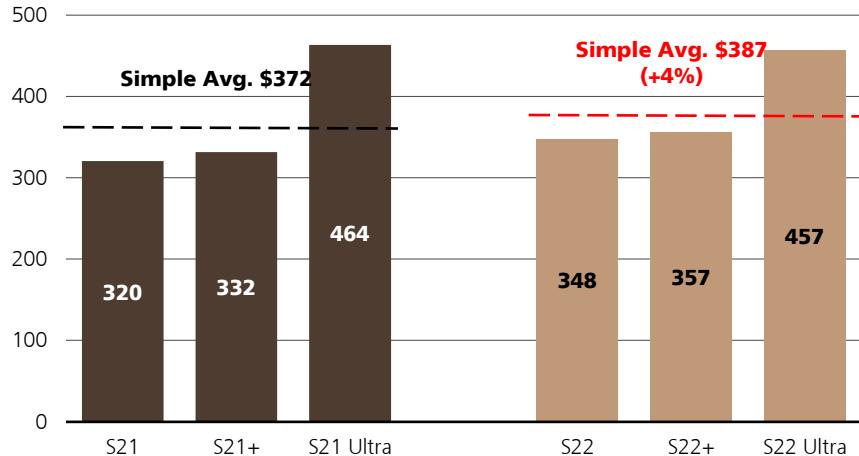
iPhone 13 Pro Max (Sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
Sensor	Accelerometer/Gyroscope	Bosch Sensortec	1.3	3.1	0.7% ALSO GYROSCOPE
	Digital compass	Alps	0.5		
	Barometer		0.8		
	Light sensor/Proximity sensor	STM, ams	0.5		ALSO PROXIMITY SENSOR
Memory	DRAM	Samsung	27.0	45.4	10.4% LPDDR4, 6GBYTE 128GBYTE
	NAND flash memory	Kioxia	18.5		
Display	Main display	Samsung Display	81.0	90.0	20.5% 6.7" FHD+ OLED, Y-OCTA, LTPO
	Cover glass	Lens Tech, Biel Crystal (Corning glass)	6.0		
	Touch panel controller	Apple	3.0		
Casing	Center panel	Foxconn Industrial Internet, Foxconn Tech	40.0	51.0	11.6% Stainless IP68
	Rear cover	Lens Tech, Biel Crystal (Corning glass)	7.0		
	Keypad buttons	Casetek	1.0		
	Waterproof	Jabil, Tongda	3.0		
PCB	PCB	AM	3.5	10.8	2.5%
	FPC	FM, MK, Sumitomo, Fujikura, Avary, Dongshan	7.3		
Antenna	Cellular/GPS		0.2	0.8	0.2% ALSO 2G,3G,4G,GPS, BUILT-IN ALSO WLAN, BT, BUILT-IN IN FPC#4 ALSO NFC, RFID
	WLAN/Bluetooth		0.2		
	U1 Ultra-wideband		0.2		
	NFC /RFID		0.2		
Small components	Chip capacitor	Murata, Taiyo Yuden, SEMCO	5.3	6.8	1.5%
	Chip resistor		0.2		
	Chip diode		0.0		
	Chip filter		0.0		
	Power inductor	Taiyo Yuden, Murata, Cyntec	1.3		
Other	Li-on polymer battery	Sunwoda (cells from TDK/ALT, LGC)	10.5	23.6	5.4% 4352MAH, L-shape
	Vibrator		4.0		
	SIM		0.2		
	Timing device	TXC	0.4		
	EMI shield metal cap		0.6		
	Screw		0.7		
	Unidentified large IC		2.5		
	Connector		2.7		
	Heat treatment - CU foil		0.1		
	Heat treatment - carbon graphite		1.8		
	Mobile light LED		0.2		
Total			438.2		
<i>Fomalhaut</i>			438.2		

Source: Fomalhaut Techno Solution, UBS estimates

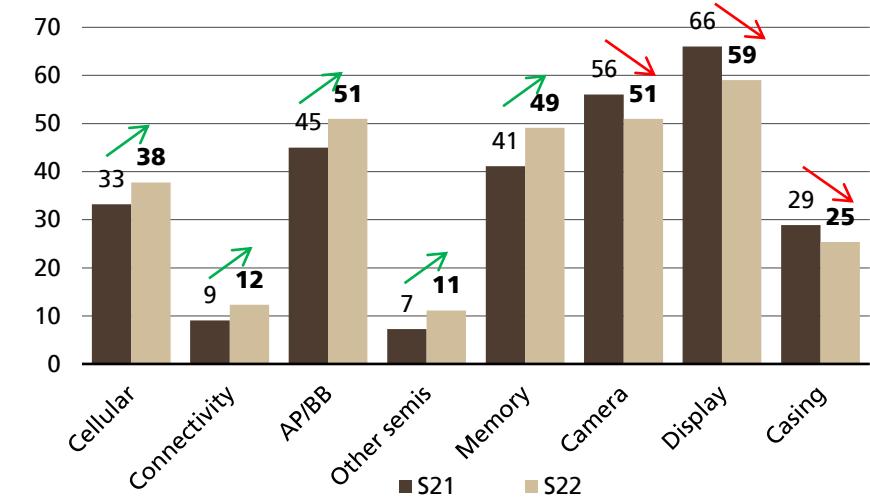
Smartphone: Galaxy S22 Series BOM Comparison

Galaxy S22 Series BOM Costs (US\$)



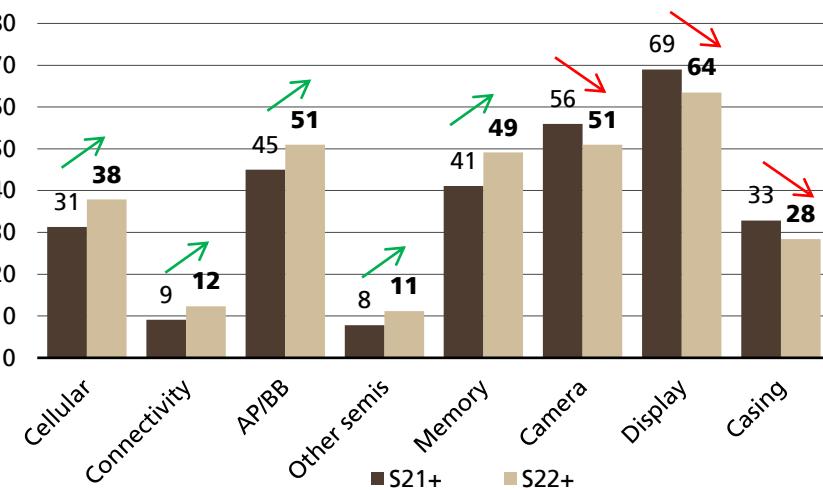
Source: Fomalhaut Techno Solution, UBS

Galaxy S22 vs S21 Key Components (US\$)



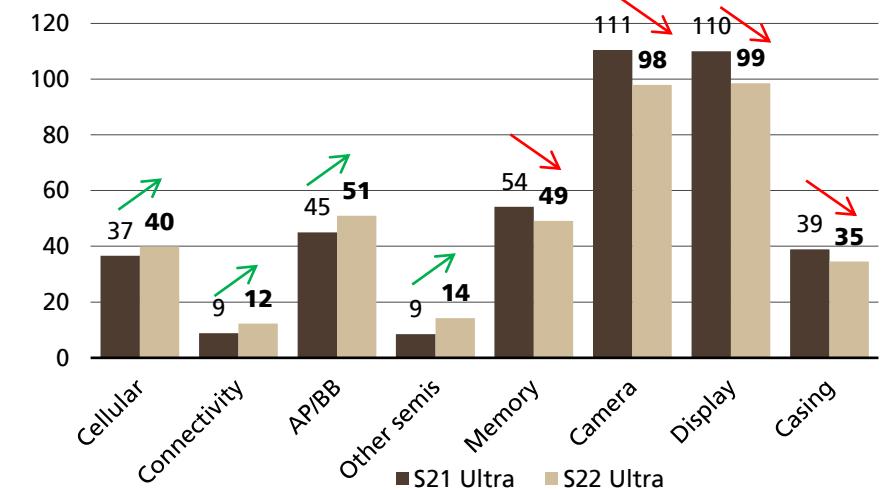
Source: Fomalhaut Techno Solution, UBS

Galaxy S22+ vs S21+ Key Components (US\$)



Source: Fomalhaut Techno Solution, UBS

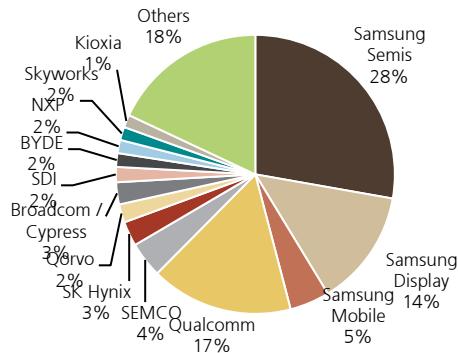
Galaxy S22 Ultra vs S21 Ultra Key Components (US\$)



Source: Fomalhaut Techno Solution, UBS

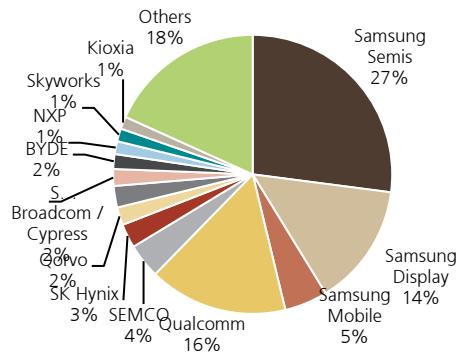
Galaxy S22 Content per Vendor and Component

S22 Content by Vendor



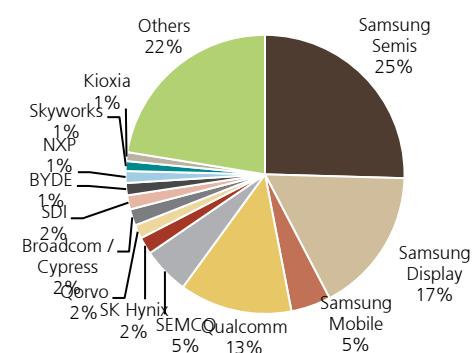
Source: Fomalhaut, UBS estimates

S22+ Content by Vendor



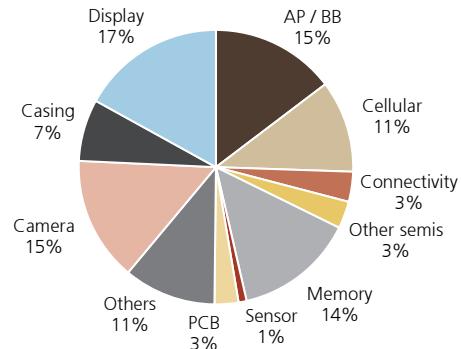
Source: Fomalhaut, UBS estimates

S22 Ultra Content by Vendor



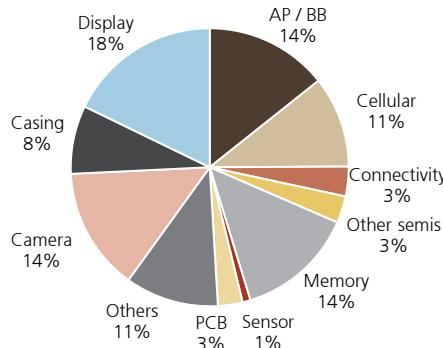
Source: Fomalhaut, UBS estimates

S22 Content by Component



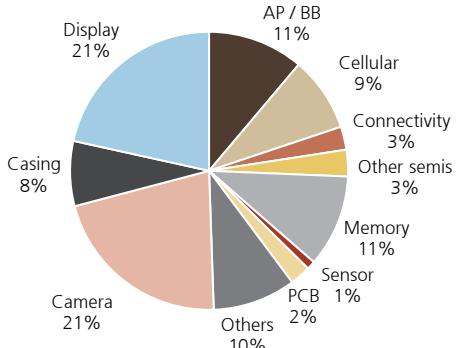
Source: Fomalhaut, UBS estimates

S22+ Content by Component



Source: Fomalhaut, UBS estimates

S22 Ultra Content by Component



Source: Fomalhaut, UBS estimates

Galaxy S22 5G Snapdragon (Sub-6) Teardown – Part 1

Galaxy S22 5G Snapdragon (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Cellular	RF transceivers	Qualcomm, Samsung	6.0	33.9	10.0%	
	2G: GSM TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	3G: WCDMA TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	4G: LTE TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	5G: SUB-6GHz TX/RX	Qualcomm, Samsung	6.0			ALSO LTE, WCDMA, GSM, GPS
	Power amplifiers	Qorvo, Qualcomm, Skyworks	20.0			
	2G: GSM PAM	Qorvo	0.0			IN SUB-6 PAM
	3G: WCDMA PAM	Qorvo	0.0			IN SUB-6 PAM
	4G: LTE PAM	Qorvo	0.0			IN SUB-6 PAM
	4G: LTE PAM	Qualcomm	0.0			IN SUB-6 PAM
	4G: LTE PAM	Qualcomm	0.0			IN SUB-6 PAM
	4G: LTE PAM	Skyworks	0.0			IN SUB-6 PAM
	5G: SUB-6GHz PAM	Qorvo	8.0			ALSO LTE, WCDMA, GSM
	5G: SUB-6GHz PAM	Qualcomm	6.0			ALSO LTE
	5G: SUB-6GHz PAM	Qualcomm	3.0			ALSO LTE
	5G: SUB-6GHz PAM	Skyworks	3.0			ALSO LTE
Connectivity	UWB transceiver	NXP	4.0			
	Antenna switch		1.5			
	Filter	Murata, Wisol	0.3			
	Duplexer bank	Murata	0.5			
	Duplexer	TDK	1.0			
	LTCC duplexer	Murata, TDK, Taiyo Yuden	0.3			
	Envelope tracker		0.4			
	WLAN / bluetooth	Qualcomm	6.0	12.3	3.6%	WLAN ALSO BT
	WLAN front end module	Qorvo	3.0			
	NFC	NXP	1.3			
AP / BB	Wireless charger	IDT	2.0			
	Application processor / baseband	Qualcomm, Samsung (Samsung 5nm+,4nm)	51.0	51.0	15.0%	Analog and digital BB, 5G BB, image processor, USB and display controller
Other Semis	Audio power amplifier	Cirrus Logic	1.4	11.2	3.3%	
	Power management	Qualcomm, Samsung, Maxim	5.0			Also AUDIO PROCESSOR / AUDIO CODEC
	Quick charger	NXP	1.5			
	Display power supply	Silicon Mitus	1.0			
	Touch panel controller	STM	2.3			

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22 5G Snapdragon (Sub-6) Teardown – Part 2

Galaxy S22 5G Snapdragon (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Camera	Main camera module		44.0	51.0	15.0%	
	50MP Wide camera		25.0			
	Image sensor	Samsung LSI	13.0			50MP CMOS
	Lens		3.0			
	OIS		2.0			
	Module assembly	SEMCO, Partron	3.8			
	Other		3.3			
	10MP Tele camera		11.0			
	Image sensor	Samsung LSI	5.0			10MP CMOS
	Lens		2.0			
	OIS		2.0			
	Module assembly	SEMCO, Power Logics	1.5			
	Other		0.5			
	12MP Ultra-wide camera		8.0			
	Image sensor	Samsung LSI, Sony	4.0			12MP CMOS
	Lens		1.5			
	Module assembly	Power Logics, Cammsys	1.2			
	Other		1.3			
	Front camera module		7.0			
	Image sensor	Samsung LSI, Sony	3.0			10MP CMOS
	Lens		1.5			
	Module assembly	Cammsys, MC Nex, Coasia	1.1			
	Other		1.5			
Audio	Microphone	GoerTek, Knowles Acoustics	0.6	2.6	0.8%	
	Speaker		2.0			
Sensors	Accelerometer / gyroscope	STM	1.3	3.3	1.0%	ALSO GYROSCOPE
	Digital compass	Asahi Kasei	0.5			
	Barometer	STM	0.8			
	Light / proximity sensor		0.5			ALSO PROXIMITY SENSOR
	RGB-C		0.3			

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22 5G Snapdragon (Sub-6) Teardown – Part 3

Galaxy S22 5G Snapdragon (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Memory	DRAM	Samsung	32.4	49.1	14.5%	LPDDR5, 8GBYTE
	NAND flash	Samsung	16.7			256GBYTE
Display	Display panel	Samsung Display	46.0	59.0	17.4%	6.1" FHD+ OLED FLEXIBLE
	Cover glass	Corning	6.0			
	Touch panel		3.0			
	Ultrasonic fingerprint	Qualcomm (module by O-Film)	4.0			
Casing	Center panel	Samsung, BYD Elec	18.0	25.4	7.5%	
	Keypad buttons		0.4			
	Inner cover		1.0			
	Rear cover glass		3.0			
	Waterproof		3.0			
PCB	PCB	IEB, DAP	3.0	9.8	2.9%	
	FPC	SEMCO	6.8			
Antenna	Cellular/ WLAN / bluetooth		0.2	2.7	0.8%	2G,3G,4G,5G,GPS
	NFC / wireless charger		1.5			ALSO WIRELESS CHARGER
	UWB		1.0			
Small components	Chip capacitor		3.4	4.6	1.4%	6332 ()5025 ()3216 ()2012 (3)1608 (15)1005 (184)0603 (587)0402 (110)OTHER ()
	Chip resistor		0.1			6332 ()5025 ()3216 ()2012 ()1608 ()1005 (16)0603 (125)0402 (20)OTHER ()
	Chip inductor		0.1			6332 ()5025 ()3216 (9)2012 (14)1608 (2)1005 (8)0603 ()0402 ()OTHER ()
	Chip diode		0.1			6332 ()5025 ()3216 ()2012 (4)1608 ()1005 (8)0603 (8)0402 ()OTHER ()
	Chip filter		0.3			6332 ()5025 ()3216 ()2012 ()1608 ()1005 (23)0603 (79)0402 ()OTHER ()
	Power inductor		0.6			
Other	Li-on polymer battery	Ningde Amperex	7.5	24.1	7.1%	3700MAH
	Connectors	Hirose, JNTC	3.2			
	Timing device	Kyocera	0.1			
	SIM	Molex	0.2			
	Vibrator		4.0			
	ID sticker		0.0			
	EMI shield tapes		0.1			
	EMI shield metal cap		0.6			
	Screw		0.2			
	Unidentified large IC		3.0			
	Mobile light LED		0.1			
	Heat treatment - carbon graphite		5.0			
Total BOM cost			339.95		100.0%	

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22+ 5G Snapdragon (Sub-6) Teardown – Part 1

Galaxy S22 Plus 5G Snapdragon (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Cellular	RF transceivers	Qualcomm, Samsung	6.0	34.1	9.8%	
	2G: GSM TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	3G: WCDMA TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	4G: LTE TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	5G: SUB-6GHz TX/RX	Qualcomm, Samsung	6.0			ALSO LTE, WCDMA, GSM, GPS
	Power amplifiers	Qorvo, Avago, Skyworks	20.0			
	2G: GSM PAM	Qorvo	0.0			IN SUB-6 PAM
	3G: WCDMA PAM	Qorvo	0.0			IN SUB-6 PAM
	4G: LTE PAM	Qorvo	0.0			IN SUB-6 PAM
	4G: LTE PAM	Avago	0.0			IN SUB-6 PAM
	4G: LTE PAM	Skyworks	0.0			IN SUB-6 PAM
	4G: LTE PAM	Skyworks	0.0			IN SUB-6 PAM
	5G: SUB-6GHz PAM	Qorvo	8.0			ALSO LTE, WCDMA, GSM
	5G: SUB-6GHz PAM	Avago	6.0			ALSO LTE
	5G: SUB-6GHz PAM	Skyworks	3.0			ALSO LTE
	5G: SUB-6GHz PAM	Skyworks	3.0			ALSO LTE
Connectivity	UWB transceiver	NXP	4.0	12.3	3.5%	
	Antenna switch		1.5			
	Filter	Murata	0.4			
	Duplexer bank	Murata	0.5			
	Duplexer	TDK, Wisol	1.1			
	LTCC duplexer	TDK	0.3			
	Envelope tracker	Qualcomm	0.4			
AP / BB	WLAN / bluetooth	Broadcom	6.0	12.3	3.5%	WLAN ALSO BT
	WLAN front end module	Qorvo	3.0			
	NFC	NXP	1.3			
	Wireless charger	IDT	2.0			
Other Semis	Application processor / baseband	Qualcomm, Samsung (Samsung 5nm+,4nm)	51.0	51.0	14.6%	Analog and digital BB, 5G BB, image processor, USB and display controller
	Audio power amplifier	Cirrus Logic	1.4			3.2%
	Power management	Qualcomm, Samsung, Maxim	5.0			Also AUDIO PROCESSOR / AUDIO CODEC
	Quick charger	NXP	1.5			
	Display power supply	Silicon Mitus	1.0			
	Touch panel controller	STM	2.3			

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22+ 5G Snapdragon (Sub-6) Teardown – Part 2

Galaxy S22 Plus 5G Snapdragon (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Camera	Main camera module		44.0	51.0	14.6%	
	50MP Wide camera		25.0			
	Image sensor	Samsung LSI	13.0			50MP CMOS
	Lens		3.0			
	OIS		2.0			
	Module assembly	SEMCO, Partron	3.8			
	Other		3.3			
	10MP Tele camera		11.0			
	Image sensor	Samsung LSI	5.0			10MP CMOS
	Lens		2.0			
	OIS		2.0			
	Module assembly	SEMCO, Power Logics	1.5			
	Other		0.5			
	12MP Ultra-wide camera		8.0			
	Image sensor	Samsung LSI, Sony	4.0			12MP CMOS
	Lens		1.5			
	Module assembly	Power Logics, Cammsys	1.2			
	Other		1.3			
	Front camera module		7.0			
	Image sensor	Samsung LSI, Sony	3.0			10MP CMOS
	Lens		1.5			
	Module assembly	Cammsys, MC Nex, Coasia	1.1			
	Other		1.5			
Audio	Microphone	GoerTek, Knowles Acoustics	0.6	2.6	0.7%	
	Speaker		2.0			
Sensors	Accelerometer / gyroscope	STM	1.3	3.3	0.9%	ALSO GYROSCOPE
	Digital compass	Asahi Kasei	0.5			
	Barometer	STM	0.8			
	Light / proximity sensor		0.5			ALSO PROXIMITY SENSOR
	RGB-C		0.3			

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22+ 5G Snapdragon (Sub-6) Teardown – Part 3

Galaxy S22 Plus 5G Snapdragon (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Memory	DRAM	Samsung	32.4	49.1	14.1%	LPDDR5, 8GBYTE
	NAND flash	Samsung	16.7			256GBYTE
Display	Display panel	Samsung Display	49.5	63.5	18.2%	6.6" FHD+ OLED FLEXIBLE
	Cover glass	Corning	7.0			
	Touch panel		3.0			
	Ultrasonic fingerprint	Qualcomm (module by O-Film)	4.0			
Casing	Center panel	Samsung, BYD Elec	20.0	28.4	8.1%	
	Keypad buttons		0.4			
	Inner cover		1.0			
	Rear cover glass		4.0			
	Waterproof		3.0			
PCB	PCB	KM, DAP	3.2	10.2	2.9%	
	FPC	SEMCO	7.0			
Antenna	Cellular/ WLAN / bluetooth		0.2	2.7	0.8%	2G,3G,4G,5G,GPS
	NFC / wireless charger		1.5			ALSO WIRELESS CHARGER
	UWB		1.0			
Small components	Chip capacitor		3.4	4.6	1.3%	6332 ()5025 ()3216 ()2012 (7)1608 (22)1005 (174)0603 (601)0402 (90)OTHER ()
	Chip resistor		0.1			6332 ()5025 ()3216 ()2012 ()1608 ()1005 (5)0603 (125)0402 (14)OTHER ()
	Chip inductor		0.1			6332 ()5025 ()3216 (10)2012 (10)1608 ()1005 (9)0603 ()0402 ()OTHER ()
	Chip diode		0.1			6332 ()5025 ()3216 ()2012 (4)1608 ()1005 (6)0603 (7)0402 ()OTHER ()
	Chip filter		0.4			6332 ()5025 ()3216 ()2012 ()1608 ()1005 (27)0603 (91)0402 ()OTHER ()
	Power inductor		0.6			
Other	Li-on polymer battery	Ningde Aperex	8.5	25.1	7.2%	4500MAH
	Connector	Hirose, JNTC	3.3			
	Timing device	Kyocera	0.4			
	SIM	Hirose	0.2			
	Vibrator		4.0			
	ID sticker		0.0			
	EMI shield tapes		0.2			
	EMI shield metal cap		0.7			
	Screw		0.2			
	Unidentified large IC		2.6			
	Mobile light LED		0.1			
Heat treatment - carbon graphite			5.0			
Total BOM cost			348.97		100.0%	

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22 Ultra 5G Snapdragon (mmW) Teardown – Part 1

Galaxy S22 Ultra 5G Snapdragon (mmW) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Cellular	RF transceivers	Qualcomm, Samsung	36	74.3	15.2%	
	2G: GSM TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	3G: WCDMA TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	4G: LTE TX/RX	Qualcomm, Samsung	0.0			IN SUB-6 TX/RX
	5G: SUB-6GHz TX/RX	Qualcomm, Samsung	6.0			ALSO LTE, WCDMA, GSM, GPS
	5G: MILLIMETER WAVE TX/RX	Qualcomm, Samsung	30.0			AS AIP (TX/RX/FQ CVT + PMIC + ANT)
	Power amplifiers	Qualcomm, Qorvo, Avago, Skyworks	22.0			
	2G: GSM PAM	Avago	0.0			IN SUB-6 PAM
	3G: WCDMA PAM	Avago	0.0			IN SUB-6 PAM
	4G: LTE PAM	Avago	0.0			IN SUB-6 PAM
	4G: LTE PAM	Qualcomm	0.0			IN SUB-6 PAM
	4G: LTE PAM	Skyworks	0.0			IN SUB-6 PAM
	4G: LTE PAM	Qorvo	0.0			IN SUB-6 PAM
	5G: SUB-6GHz PAM	Avago	8.0			ALSO LTE, WCDMA, GSM
	5G: SUB-6GHz PAM	Qualcomm	8.0			ALSO LTE
	5G: SUB-6GHz PAM	Skyworks	3.0			ALSO LTE
	5G: SUB-6GHz PAM	Qorvo	3.0			ALSO LTE
	5G: MILLIMETER WAVE IF CONVERTER	Qualcomm	0.0			IN MILLIMETER WAVE TX/RX
	5G: IF CONVERTER	Qualcomm	5.0			
	UWB transceiver	NXP	4.0			
	Diversity receiver	Qualcomm	4.0			
	Antenna switch		1.0			
Connectivity	Filter	Murata	0.4	12.3	2.5%	
	Duplexer bank	Murata	0.5			
	Duplexer	Murata, TDK, Wisol	0.8			
	LTCC duplexer	Murata, TDK, Taiyo Yuden	0.4			
	Envelope tracker	Qualcomm	0.4			
	WLAN / bluetooth	Broadcom	6.0			ALSO BT
	WLAN front end module	Qorvo	3.0			
AP / BB Other Semis	NFC	NXP	1.3	51.0	10.5%	
	Wireless charger	IDT	2.0			Analogue and digital BB, 5G BB, image processor, USB and display controller
	Application processor / baseband	Qualcomm, Samsung (Samsung 5nm+, 4nm)	51.0			
	Audio power amplifier	Cirrus Logic	1.4			2.9%
	Microcontroller	Dialog	1.0			ALSO BT
AP / BB Other Semis	Power management	Qualcomm, Maxim, Samsung	5.0	14.2	2.9%	Also AUDIO PROCESSOR / AUDIO CODEC
	Quick charger	NXP, Samsung	3.0			
	Display power supply	Silicon Mitus	1.0			
	Touch panel controller	STM	2.3			
	S-pen controller	Wacom	0.5			

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22 Ultra 5G Snapdragon (mmW) Teardown – Part 2

Galaxy S22 Ultra 5G Snapdragon (mmW) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Camera	Main camera module					
	108MP Wide camera		85.5	98.0	20.1%	
	Image sensor	Samsung LSI	33.5			
	Lens	SEMCO	21.0			108MP CMOS
	OIS	SEMCO	4.0			
	Module assembly	SEMCO, Power Logics	2.0			
	Other		5.0			
	10MP Folded Tele camera		1.5			
	Image sensor	Samsung LSI	35.0			
	Lens	SEMCO	9.0			10MP CMOS
	OIS	SEMCO	4.0			
	Module assembly	SEMCO, Sunny Optical	5.0			
	Other		7.0			
	10MP 2nd Tele camera		10.0			
	Image sensor	Samsung LSI	9.0			
	Lens	SEMCO	3.5			10MP CMOS
	Actuator	SEMCO	1.5			
	Module assembly	MC Nex, Partron, Power Logics	0.5			
	Other		1.4			
	12MP Ultra-wide camera		2.2			
	Image sensor	Samsung LSI, Sony	8.0			
	Lens	Sony	4.0			12MP CMOS
	Voice coil motor	SEMCO	1.5			
	Module assembly	Sunny Optical, Namuga, Power Logics	0.5			
	Other		1.2			
	12MP Ultra-wide camera		0.8			
Front camera module						
	Image sensor	Samsung LSI, Sony	12.5			
	Lens	Sony	7.0			40MP CMOS
	Module assembly	Namuga, Coasia	1.5			
	Other		1.9			
			2.1			
Audio	Microphone	GoerTek, Knowles Acoustics	0.6	2.6	0.5%	
	Speaker		2.0			
Sensors	Accelerometer / gyroscope	STM	2.5	4.6	0.9%	ALSO GYROSCOPE
	Digital compass	Asahi Kasei	0.5			
	Barometer	STM	0.8			
	Light / proximity sensor		0.5			ALSO PROXIMITY SENSOR
	RGB-C		0.3			

Source: Fomalhaut Techno Solution, UBS estimates

Galaxy S22 Ultra 5G Snapdragon (mmW) Teardown – Part 3

Galaxy S22 Ultra 5G Snapdragon (mmW) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	REMARK
Memory	DRAM	Samsung	32.4	49.1	10.1%	LPDDR5, 8GBYTE
	NAND flash	Samsung	16.7			128GBYTE
Display	Display panel	Samsung Display	82.5	98.5	20.2%	6.8" QHD+ OLED FLEXIBLE
	Cover glass	Corning	9.0			
	Touch panel		3.0			
	Ultrasonic fingerprint	Qualcomm (module by O-Film)	4.0			
Casing	Center panel	Samsung, BYD Elec	23.0	34.6	7.1%	
	Keypad buttons		0.5			
	Inner cover		1.0			
	Rear cover glass		7.0			
	Waterproof		3.0			
	S-pen cover		0.1			
PCB	PCB	IET	3.5	11.0	2.3%	
	FPC	SEMCO	7.5			
Antenna	Cellular/ WLAN / bluetooth		0.2	3.2	0.6%	2G,3G,4G,5G,GPS
	NFC / wireless charger		1.5			ALSO WIRELESS CHARGER
	UWB		1.0			
	S-pen coil		0.5			
Small components	Chip capacitor		3.8	5.2	1.1%	6332 (5025 (3216 (2012 (6)1608 (24)1005 (209)0603 (635)0402 (129)OTHER ()
	Chip resistor		0.1			6332 (5025 (3216 (2012 (6)1608 (1005 (11)0603 (142)0402 (27)OTHER ()
	Chip inductor		0.1			6332 (5025 (3216 (7)2012 (15)1608 (2)1005 (9)0603 (0)0402 (0)OTHER ()
	Chip diode		0.1			6332 (5025 (3216 (2012 (6)1608 (1005 (11)0603 (8)0402 (0)OTHER ()
	Chip filter		0.5			6332 (5025 (3216 (2012 (6)1608 (1)1005 (29)0603 (104)0402 (22)OTHER ()
	Power inductor		0.6			
Other	Li-on polymer battery	Samsung SDI	10.0	29.4	6.0%	5000MAH
	Connector	Hirose, JNTC	4.0			
	Timing device	Hosonic, Kyocera, TXC	0.6			
	SIM	Molex	0.2			
	Vibrator		4.0			
	ID sticker		0.0			
	EMI shield tapes		0.2			
	EMI shield metal cap		0.9			
	Screw		0.2			
	Unidentified large IC		3.5			
	Mobile light LED		0.1			
	Heat treatment - carbon graphite		5.5			
	Backup battery		0.3			
Total BOM cost				487.9	100.0%	

Source: Fomalhaut Techno Solution, UBS estimates

Section 7

Auto-Industrial

Key Messages

- We now see an inflection point as inventories are growing much faster than revenues. We observe some end-market demand uncertainty alongside concerns on macro/inflation in 2022
 - UBS Autos team sees global auto production growing at ~3% Y/Y in 2022E as chip supply shortage persists into 2022 but will gradually ease by the end of the year.
 - Industrial customer inventory levels have normalized in aggregate and are even slightly elevated for select commodity Analog components (Passives/Commodity Op Amps) as the cycle transitions deeper into the inventory build phase.
 - Orders should start to decline as inventory has grown – lead time reduction could start to lead to cancellations as availability improves.
- **UBS Evidence Lab: Big Data Nowcasting**
 - Most North America industrial end-markets are seeing slight deceleration between Q1 and Q2 on a Y/Y basis. General Industrials are holding steady with deceleration in Machinery, Electronics and Electrical Equipment.
 - Global automotive end-markets in North America and Europe are observing improvement in their growths vs. Q1

UBS estimates auto production to grow ~3% Y/Y in 22'E as the industry has been supply constrained

Global Auto Production Estimates

(Production, m units)	2016	2017	2018	2019	2020	2021	Q122	Q222	Q322	Q422	2022E	2023E	2024E	2025E
Western Europe	14.7	14.9	14.3	13.4	10.1	9.4	2.4	2.3	2.4	2.4	9.5	10.1	11.3	11.8
% growth	3.5%	1.4%	-4.3%	-6.4%	-24.7%	-6.4%	-18.5%	-5.1%	38.8%	3.2%	0.9%	6.0%	12.0%	5.0%
Eastern Europe	6.8	7.4	7.7	7.7	6.5	6.5	1.5	1.4	1.7	1.8	6.4	6.8	7.2	7.8
% growth	1.3%	8.6%	3.8%	0.1%	-15.4%	-0.7%	-18.1%	-19.4%	36.0%	8.4%	-1.1%	6.0%	6.0%	8.0%
Europe	21.5	22.3	22.0	21.1	16.6	15.9	3.9	3.7	4.1	4.2	15.9	16.9	18.5	19.6
% growth	2.8%	3.7%	-1.6%	-4.1%	-21%	-4%	-18%	-11%	38%	5%	0.1%	6.0%	9.6%	0.0%
North America	17.8	17.1	17.0	16.3	13.0	13.0	3.6	3.6	3.8	3.9	14.9	16.1	17.4	17.4
% growth	2.0%	-3.9%	-1.0%	-4.0%	-20.0%	0.2%	-1.8%	12.7%	29.7%	19.3%	14.2%	8.0%	8.0%	0.0%
South America	2.7	3.3	3.4	3.3	2.2	2.6	0.6	0.7	0.8	0.6	2.7	2.8	3.0	3.0
% growth	-11.5%	20.3%	4.1%	-4.4%	-31.5%	16.1%	-12.7%	14.3%	36.8%	-18.8%	3.5%	5.0%	5.0%	0.0%
of which: Brazil	2.1	2.6	2.8	2.8	1.9	2.1	0.5	0.6	0.7	0.5	2.2	2.3	2.3	2.3
% growth	-11.1%	26.1%	5.2%	0.9%	-32.1%	8.8%	-18.5%	14.0%	43.3%	-6.9%	6.1%	5.0%	0.0%	0.0%
Asia	48.7	50.0	49.2	46.1	41.0	43.6	11.1	10.3	10.8	12.0	44.2	47.1	49.8	51.1
% growth	7.6%	2.6%	-1.4%	-6.4%	-11.1%	6.4%	0.2%	-0.3%	12.6%	-4.9%	1.3%	6.6%	5.7%	2.6%
of which: Japan	8.8	9.2	9.2	9.2	7.8	7.5	1.9	1.8	1.9	2.1	7.7	8.3	8.7	8.7
% growth	-5.7%	5.2%	0.3%	-0.3%	-15.8%	-3.8%	-11.6%	-5.0%	25.0%	10.6%	3.3%	8.0%	5.0%	0.0%
of which: China	27.1	27.6	26.6	24.3	23.3	24.6	6.1	5.0	5.8	7.0	24.0	25.2	26.5	27.0
% growth	14.3%	2.1%	-3.7%	-8.5%	-4.1%	5.3%	6.1%	-12.7%	6.9%	-7.6%	-2.4%	5.0%	5.0%	2.0%
of which: South Korea	4.2	4.2	4.0	3.9	3.5	3.4	0.8	0.9	0.9	0.9	3.5	3.7	3.9	3.9
% growth	-7.2%	0.1%	-4.7%	-1.9%	-11.1%	-1.1%	-7.3%	2.9%	13.0%	2.2%	2.3%	5.0%	5.0%	0.0%
of which: India	4.2	4.4	4.7	4.2	3.3	4.2	1.2	1.1	1.2	1.3	4.7	5.3	5.8	6.3
% growth	9.7%	6.0%	6.7%	-11.0%	-22.6%	27.7%	-2.2%	19.3%	15.7%	23.0%	13.2%	12.0%	10.0%	8.0%
of which: ASEAN	3.9	3.9	4.2	4.0	2.8	3.5	1.1	0.9	0.9	0.9	3.8	4.2	4.5	4.8
% growth	3.0%	0.3%	7.7%	-3.9%	-30.5%	24.4%	15.0%	15.0%	30.0%	-15.7%	8.9%	9.6%	7.0%	6.4%
Other	0.7	0.6	0.5	0.4	0.4	0.5	0.0	0.6	0.1	-0.2	0.5	0.5	0.5	0.5
% growth	180.8%	-5.5%	-19.3%	-15.7%	-17.5%	39.5%	-110.1%	405.0%	-25.5%	-247.2%	-5.4%	0.0%	0.0%	0.0%
ROW	2.3	2.6	2.6	2.0	1.8	2.1	0.6	0.6	0.6	0.3	2.0	2.2	2.5	2.6
% growth	15.7%	12.2%	0.3%	-22.3%	-12.0%	16.5%	13.5%	13.3%	17.1%	-44.7%	-0.7%	10.0%	10.0%	5.0%
Total	93.1	95.3	94.2	88.7	74.6	77.2	19.7	18.8	20.1	21.0	79.7	85.1	91.1	93.6
% growth	4.9%	2.3%	-1.2%	-5.8%	-15.9%	3.5%	-4.5%	0.4%	21.1%	-0.7%	3.3%	6.8%	7.0%	2.8%

Source: UBS estimates



...and global auto sales expected to contract by 0.8% in 22'E

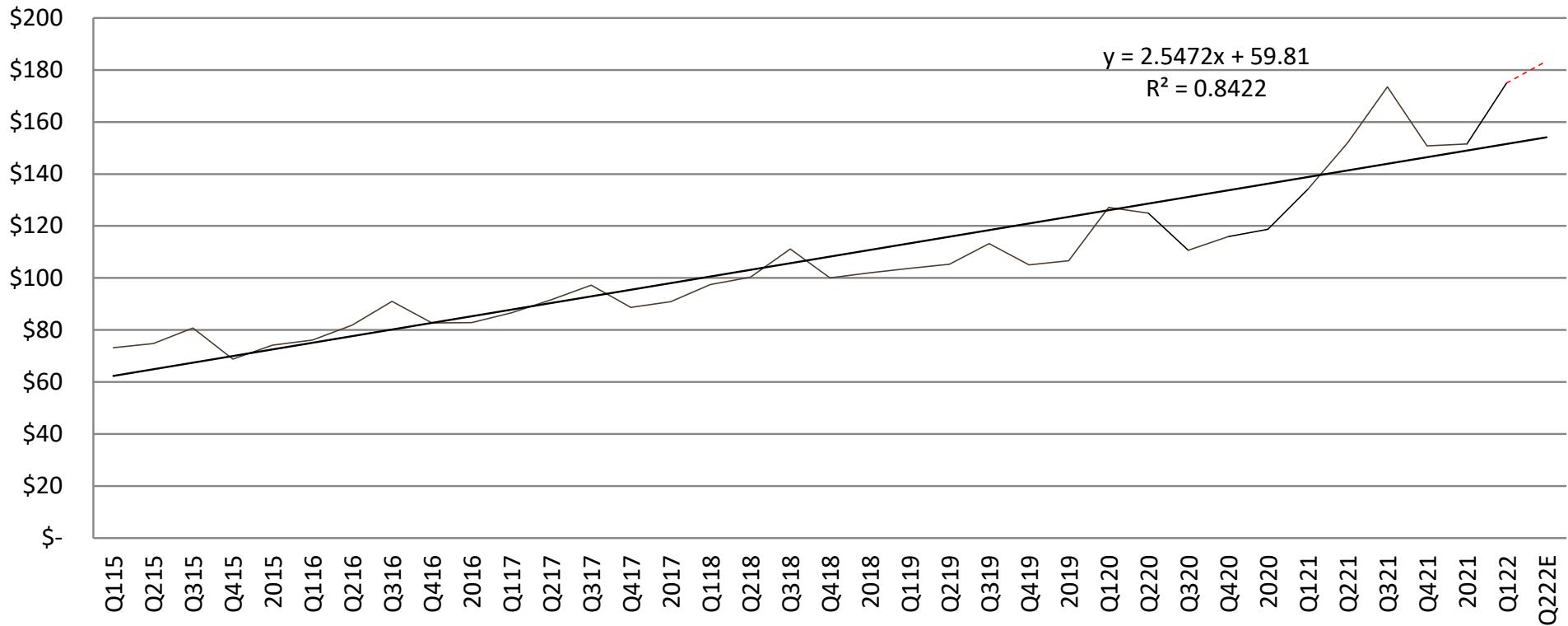
Sales, m units	2016	2017	2018	2019	2020	2021	Q122	Q222	Q322	Q422	2022E	2023E	2024E	2025E
Western Europe	15.9	16.3	16.2	16.4	12.5	12.5	2.9	3.4	3.2	3.1	12.5	13.1	14.2	14.9
% growth	6.6%	2.4%	-0.2%	0.9%	-23.8%	-0.1%	-12.4%	-6.2%	15.0%	10.4%	0.6%	4.1%	8.7%	0.0%
of which: Germany	3.6	3.7	3.7	3.9	3.2	2.9	0.7	0.8	0.8	0.7	3.0	3.1	3.4	3.5
% growth	4.8%	2.5%	0.6%	5.1%	-18.5%	-9.3%	-6.4%	2.3%	10.8%	8.8%	3.6%	4.0%	8.0%	5.0%
of which: France	2.4	2.5	2.6	2.7	2.1	2.1	0.5	0.6	0.4	0.5	2.0	2.1	2.3	2.4
% growth	5.6%	4.3%	4.1%	2.3%	-23.9%	1.8%	-18.9%	-2.5%	4.0%	3.2%	-4.2%	5.0%	8.0%	6.0%
of which: Italy	2.0	2.2	2.1	2.1	1.5	1.6	0.4	0.4	0.4	0.4	1.6	1.7	1.8	1.9
% growth	19.8%	6.2%	-4.0%	0.8%	-27.3%	7.1%	-17.7%	-12.7%	9.5%	24.2%	-2.3%	4.0%	9.0%	5.0%
of which: Spain	1.3	1.4	1.5	1.5	1.0	1.0	0.2	0.3	0.3	0.2	1.0	1.0	1.1	1.2
% growth	11.0%	8.5%	7.1%	-4.0%	-31.6%	0.3%	-16.0%	-10.0%	17.9%	-13.6%	-6.1%	4.0%	9.0%	10.0%
of which: UK	3.1	2.9	2.7	2.7	1.9	2.0	0.5	0.5	0.6	0.5	2.1	2.2	2.4	2.5
% growth	2.0%	-5.2%	-6.3%	-1.8%	-28.1%	4.1%	-6.0%	-14.0%	23.9%	20.8%	4.5%	5.0%	8.0%	7.0%
RoWE	3.4	3.5	3.5	3.5	2.8	2.8	0.7	0.7	0.8	0.7	2.9	3.0	3.3	3.4
% growth	4.8%	3.2%	0.2%	-0.3%	-20.9%	1.9%	-13.3%	-6.3%	21.8%	12.7%	2.4%	3.0%	10.0%	3.0%
Eastern Europe	4.0	4.3	4.3	4.3	4.0	4.3	0.8	0.8	0.8	1.1	3.5	3.6	3.7	3.9
% growth	-0.8%	8.8%	0.4%	-1.5%	-6.7%	7.2%	-17.8%	-33.5%	-22.1%	5.2%	-17.9%	2.0%	5.0%	5.0%
of which: Russia	1.4	1.6	1.8	1.8	1.6	1.7	0.3	0.2	0.2	0.3	1.0	1.0	1.2	1.3
% growth	-11.2%	11.6%	13.1%	-2.5%	-8.7%	3.7%	-28.0%	-56.4%	-44.8%	-26.3%	-39.8%	0.0%	15.0%	15.0%
Europe	19.8	20.6	20.6	20.6	16.5	16.7	3.7	4.2	4.0	4.1	16.0	16.6	17.9	18.9
% growth	5.0%	3.7%	-0.1%	0.4%	-20.3%	1.6%	-13.7%	-13.1%	5.0%	9.0%	-4.1%	3.6%	7.9%	5.3%
North America	21.1	20.8	20.7	20.3	17.1	17.7	3.9	4.6	4.8	4.6	17.9	18.8	19.5	20.3
% growth	1.7%	-1.5%	-0.2%	-2.0%	-15.9%	3.8%	-14.6%	-10.6%	15.8%	18.4%	0.9%	5.0%	4.0%	4.0%
of which: USA	17.6	17.2	17.3	17.1	14.6	15.1	3.3	3.9	4.0	4.0	15.2	16.0	16.6	17.3
% growth	0.4%	-2.1%	0.8%	-1.3%	-14.6%	3.3%	-15.8%	-11.4%	17.6%	19.7%	0.8%	5.0%	4.0%	4.0%
South America	3.9	4.4	4.7	4.5	3.3	3.7	0.8	0.9	1.0	1.1	3.8	3.9	4.1	4.1
% growth	-10.9%	12.7%	6.5%	-3.6%	-28.0%	13.7%	-14.3%	-5.6%	6.3%	18.6%	1.1%	5.0%	5.0%	0.0%
of which: Brazil	2.0	2.2	2.5	2.7	2.0	2.0	0.4	0.5	0.5	0.6	2.0	2.1	2.2	2.2
% growth	-19.9%	9.7%	13.0%	8.2%	-26.6%	1.2%	-25.4%	0.5%	17.4%	12.1%	0.9%	5.0%	5.0%	0.0%
Asia	41.3	42.6	42.1	39.0	35.8	36.7	9.8	7.1	9.2	10.6	36.6	39.1	41.0	42.1
% growth	8.7%	3.0%	-1.0%	-7.3%	-8.2%	2.6%	2.1%	-18.9%	10.8%	4.4%	-0.3%	6.6%	4.9%	2.8%
of which: Japan	4.8	5.1	5.2	5.1	4.5	4.4	1.2	0.9	1.1	1.1	4.2	4.6	4.7	4.6
% growth	-2.0%	5.9%	0.5%	-1.3%	-11.5%	-3.4%	-16.3%	-11.1%	6.5%	10.8%	-4.0%	11.0%	0.5%	-1.0%
of which: China	27.6	28.0	27.0	24.7	23.6	23.8	6.4	4.0	5.8	7.0	23.1	24.3	25.5	26.0
% growth	12.8%	1.6%	-3.5%	-8.6%	-4.3%	0.5%	9.0%	-30.0%	8.7%	0.8%	-2.8%	5.0%	5.0%	2.0%
of which: India	3.4	3.7	4.0	3.5	2.8	3.6	1.0	0.9	1.0	1.2	4.1	4.5	4.9	5.3
% growth	8.2%	9.1%	7.3%	-11.6%	-21.6%	28.3%	-6.9%	19.9%	12.4%	41.7%	15.4%	10.0%	8.0%	8.0%
of which: South Korea	1.8	1.8	1.8	1.7	1.9	1.7	0.4	0.4	0.4	0.5	1.7	1.8	1.9	1.9
% growth	-1.0%	-1.6%	1.4%	-3.3%	8.3%	-10.0%	-10.3%	-11.4%	-5.6%	35.3%	1.3%	7.0%	5.0%	2.0%
of which: ASEAN	3.0	3.2	3.4	3.3	2.4	2.7	0.8	0.7	0.7	0.6	2.8	3.1	3.3	3.5
% growth	2.4%	5.8%	5.5%	-1.6%	-27.0%	10.7%	23.1%	10.2%	25.5%	-27.1%	5.4%	8.6%	6.2%	6.0%
Other	0.7	0.7	0.8	0.6	0.6	0.7	0.0	0.2	0.3	0.2	0.7	0.7	0.8	0.8
% growth	-3.3%	7.4%	7.6%	-16.5%	-8.2%	16.3%	-74.0%	7.2%	76.7%	-0.2%	3.0%	5.0%	5.0%	5.0%
ROW	6.1	6.2	5.6	4.9	4.2	4.9	1.3	1.2	1.3	1.1	4.8	5.1	5.4	5.8
% growth	-2.3%	1.9%	-10.0%	-11.4%	-15.6%	18.2%	3.0%	-3.9%	3.4%	-9.4%	-1.6%	5.0%	7.0%	7.0%
Total	92.2	94.5	93.7	89.5	76.8	79.9	19.6	17.9	20.2	21.5	79.2	83.5	88.0	91.3
% growth	4.5%	2.5%	-0.9%	-4.5%	-14.1%	4.0%	-5.5%	-14.0%	10.0%	7.8%	-0.8%	5.5%	5.4%	3.7%

Source: UBS estimates



Auto semis revenue/car is ahead of trendline, but this is due entirely to shortages and the supply chain will need to continue building inventory

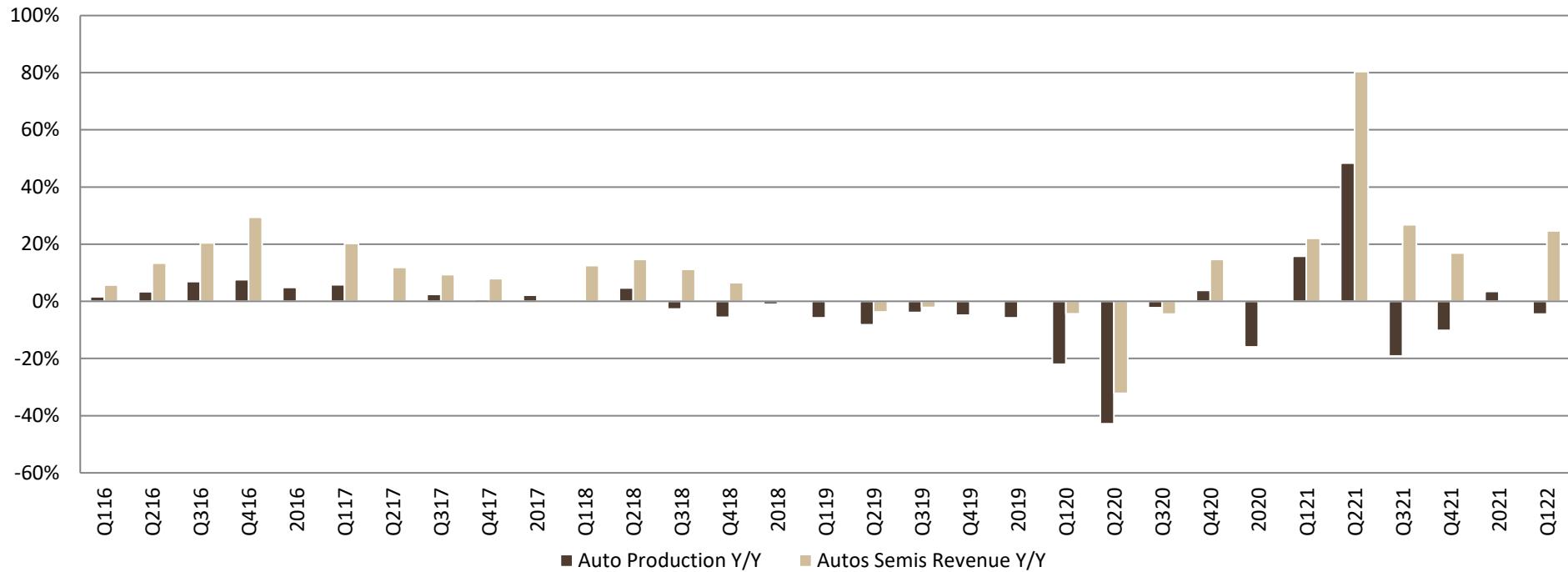
Auto Semis Revenue/Auto Production unit



Source: SIA, UBS

Autos semis vs. production Y/Y comps should normalize

Autos Analog Revenue vs. Auto Production (Y/Y)



Source: SIA, UBS

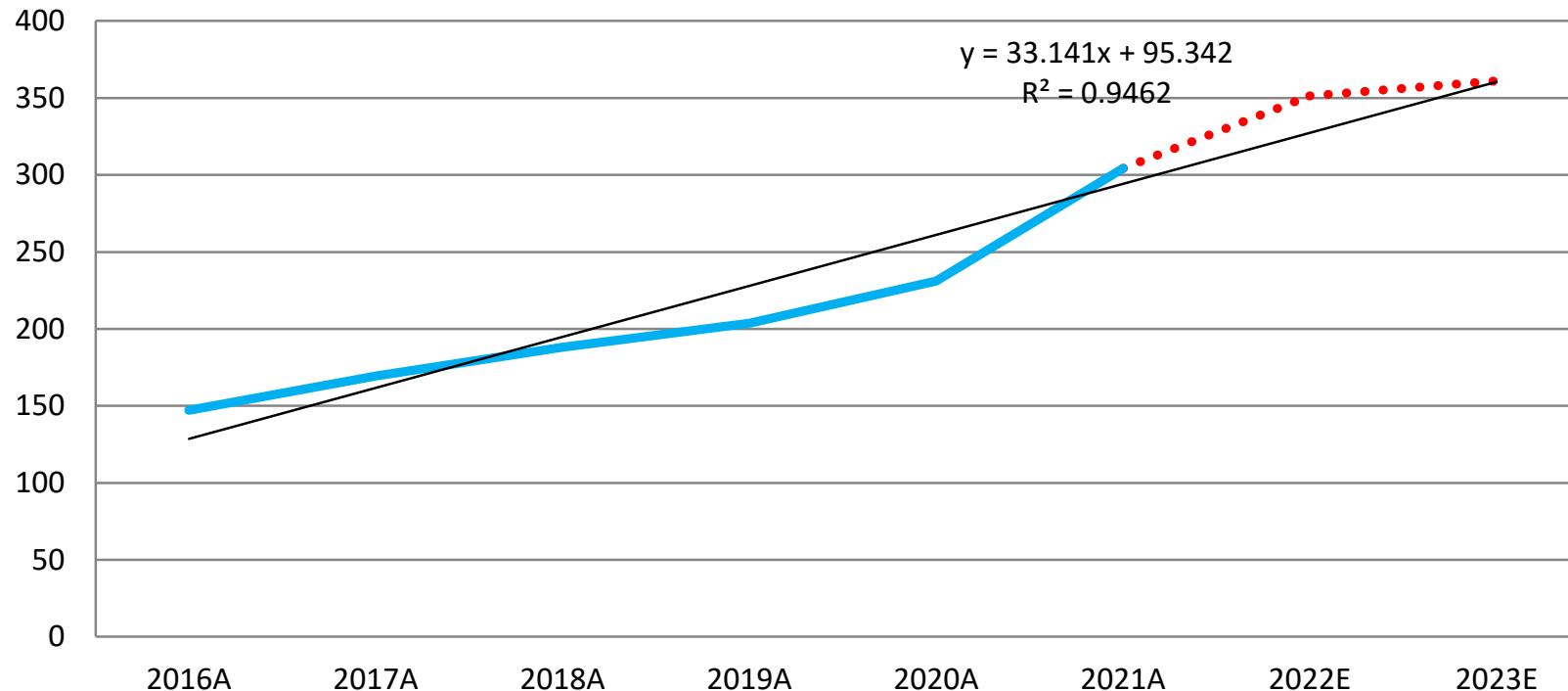
Street estimates for autos semis are quite reasonable for '22E and likely even '23E

Auto Consensus Forecasts	2016A	2017A	2018A	2019A	2020A	2021A	2022E	2023E
ON	1337	1666	1834	1809	1677	2289	3075	3469.2
NXPI	3379	3762	3953	4212	3825	5493	6718.3	7420.3
IFX(sept)	2796	3512	3695	3858	4187	5576	6479.6	7172.3
ST	2813	3059	3556	3606	3284	4350	5359	5929
MXIM	414.4	482.2	532.2	555.8	627.7			
ADI (Oct)	541	783	989	993	779	1924	2504.3	2767.7
TI	2,407	2,843	3,157	3,041	2,852	3,852	3,882	3,967
Auto Sems Revenue (\$MM) - Street	13,687	16,107	17,716	18,075	17,232	23,484	28,018	30,725
Y/Y		18%	10%	2%	-5%	36%	19%	10%

Source: Factset, Visible Alpha, UBS

...and based on these estimates, content growth should normalize to trendline by '23E

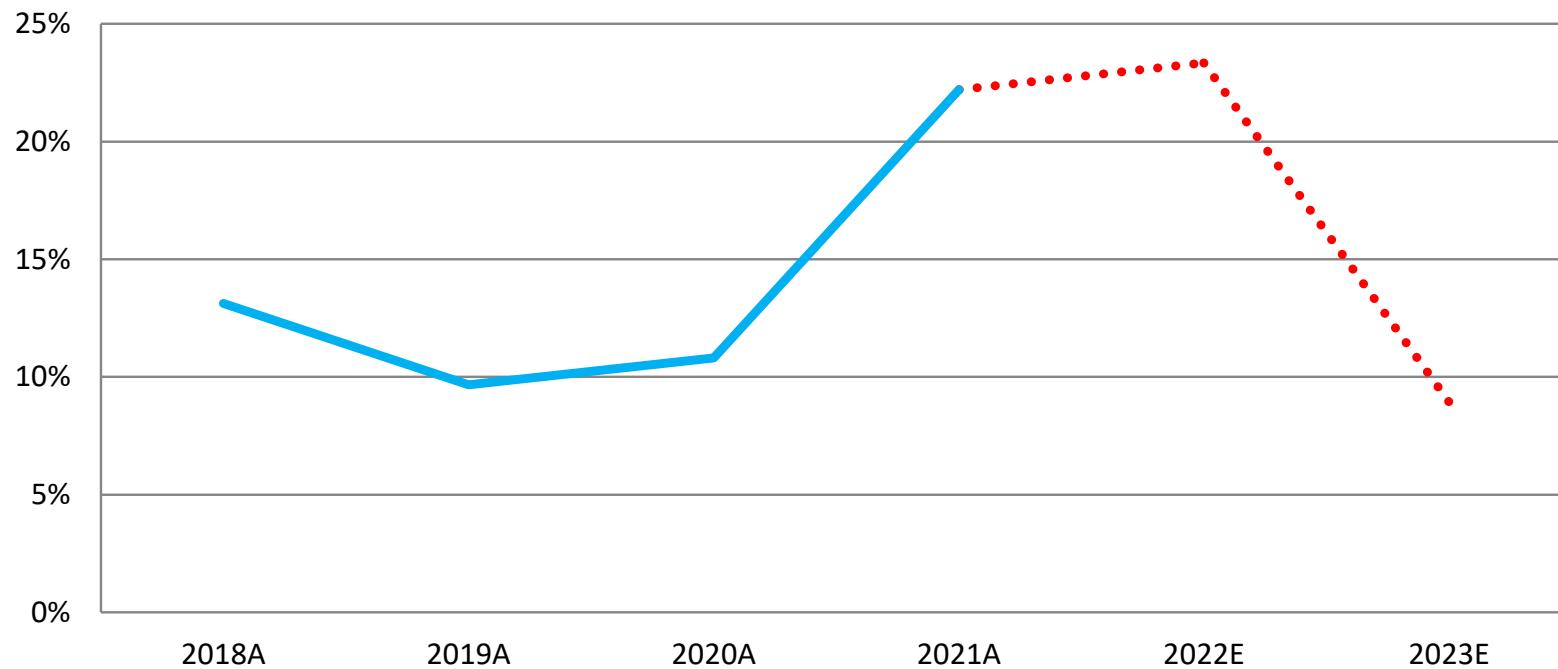
Auto Semis Revs \$/Auto Unit Production



Source: Company Reports, Factset, UBS estimates

2 Year CAGR suggests a relatively low growth rate in '23E

Auto Semis Revs/Auto Unit Production (Rolling 2 yr CAGR)



Source: Company reports, Factset, UBS estimates

North America: All end markets show better 2Y growth

North America End Markets

North America	Quarterly Trend	Organic Growth (Y/Y)				2-Yr. Organic Growth*			
		CQ3 2021	CQ4 2021	CQ1 2022	CQ2 2022	CQ3 2021	CQ4 2021	CQ1 2022	CQ2 2022
Construction		1%	-1%	1%	2%	-2%	-1%	-3%	12%
Autos		-2%	-1%	6%	10%	-9%	-2%	2%	60%
General Industrials		6%	2%	1%	1%	0%	0%	-3%	20%
Mining, Oil, and Gas		19%	15%	12%	5%	-7%	-5%	-5%	30%
Machinery		16%	14%	15%	9%	1%	5%	14%	40%
Chemicals		23%	17%	13%	9%	13%	10%	13%	38%
Commercial Vehicles		-10%	-21%	-19%	-1%	-37%	-34%	-20%	119%
Electrical Equipment		12%	9%	5%	3%	6%	2%	10%	25%
Foods		9%	8%	9%	7%	7%	6%	11%	36%
Healthcare		6%	4%	6%	4%	6%	5%	10%	14%
HVAC		10%	8%	10%	7%	10%	11%	17%	44%
Autos Aftermarket		16%	13%	10%	10%	6%	10%	11%	51%
Metals		17%	12%	10%	4%	3%	7%	3%	35%
Aerospace		4%	1%	-5%	-7%	-21%	-19%	-21%	13%
Electronics		15%	11%	10%	2%	7%	5%	22%	34%
Consumption		12%	11%	8%	7%	4%	6%	8%	39%
Power Generation		-2%	-1%	3%	5%	1%	-5%	5%	7%
Other		0%	4%	9%	20%	-9%	6%	26%	74%
Overall		8%	5%	5%	6%	-2%	0%	3%	39%

Source: UBS Evidence Lab

Europe End Markets: Most end markets show better 2Y growth

Europe End Markets

Europe	Quarterly Trend	Organic Growth (Y/Y)				2-Yr. Organic Growth*			
		CQ3 2021	CQ4 2021	CQ1 2022	CQ2 2022	CQ3 2021	CQ4 2021	CQ1 2022	CQ2 2022
Construction		1%	2%	1%	-3%	2%	6%	-2%	48%
Autos		-11%	-14%	-1%	8%	-25%	-11%	-9%	350%
General Industrials		12%	7%	3%	0%	3%	5%	1%	56%
Mining, Oil, and Gas		-10%	-7%	-6%	-8%	-19%	-9%	-8%	22%
Machinery		-2%	-2%	-2%	1%	-2%	1%	-2%	33%
Chemicals		9%	5%	6%	2%	3%	10%	8%	27%
Commercial Vehicles		-12%	-21%	-25%	-27%	-20%	-24%	-26%	46%
Electrical Equipment		15%	9%	5%	2%	8%	10%	6%	45%
Foods		2%	3%	3%	1%	0%	4%	-2%	13%
Healthcare		1%	1%	2%	-3%	9%	9%	7%	18%
HVAC		8%	3%	-2%	1%	-1%	4%	-5%	59%
Autos Aftermarket		5%	6%	5%	6%	-7%	0%	1%	63%
Metals		24%	16%	14%	12%	2%	15%	11%	80%
Aerospace		10%	6%	4%	6%	-23%	-18%	-26%	-3%
Electronics		15%	12%	10%	5%	12%	11%	16%	41%
Consumption		7%	6%	5%	5%	0%	5%	-2%	27%
Power Generation		2%	2%	6%	6%	-3%	5%	5%	30%
Other		5%	2%	1%	-2%	-4%	-2%	-3%	32%
Overall		1%	-2%	0%	1%	-6%	-1%	-3%	96%

Source: UBS Evidence Lab

Asia End Markets: Decelerating Y/Y growth, but better 2Y growth in Q2:22

Asia End Markets

Asia	Quarterly Trend	Organic Growth (Y/Y)				2-Yr. Organic Growth*			
		CQ3 2021	CQ4 2021	CQ1 2022	CQ2 2022	CQ3 2021	CQ4 2021	CQ1 2022	CQ2 2022
Construction		4%	-1%	-8%	-13%	-3%	-9%	-5%	-11%
Autos		3%	2%	13%	-10%	-3%	8%	36%	30%
General Industrials		6%	6%	0%	-5%	5%	11%	7%	11%
Mining, Oil, and Gas		39%	34%	34%	26%	20%	30%	35%	75%
Machinery		6%	1%	4%	2%	10%	14%	39%	13%
Chemicals		20%	18%	20%	10%	6%	20%	28%	39%
Commercial Vehicles		-8%	-22%	-33%	-52%	10%	-14%	3%	-52%
Electrical Equipment		9%	8%	5%	-3%	5%	16%	17%	72%
Foods		10%	12%	16%	11%	6%	20%	28%	48%
Healthcare		22%	12%	14%	1%	20%	15%	35%	22%
HVAC		4%	5%	1%	-4%	10%	4%	43%	-6%
Autos Aftermarket		0%	-11%	-8%	-30%	6%	-2%	38%	-23%
Metals		19%	13%	8%	-6%	24%	24%	20%	25%
Aerospace		43%	40%	50%	30%	-25%	-9%	18%	205%
Electronics		20%	19%	17%	2%	30%	22%	39%	33%
Consumption		7%	12%	8%	7%	2%	15%	14%	20%
Power Generation		13%	1%	4%	0%	25%	16%	22%	13%
Other		7%	4%	5%	-3%	-7%	-8%	5%	3%
Overall		12%	8%	9%	0%	8%	12%	26%	26%

Source: UBS Evidence Lab

Section 8

Semiconductor Capital Equipment

Key Messages

- We see WFE growing ~12% in '22E to ~\$97.3B (vs. \$86.5B in '21) and down just slightly in '23 but this assumes foundry/logic remains strong
- WFE is likely to peak in CQ4:22 at ~\$27B/Q before starting to decline through 2023 and more precipitously in 2024 – a draconian scenario would be ~\$65-70B/yr in WFE, but would likely be more '24 than '23
 - This represents a headwind as we have yet to see quarterly WFE peak
 - We remain generally neutral on SPE
- Given the large cuts we have seen to memory capex, stocks like LRCX that are over-indexed to memory carry less risk going forward than stocks like KLAC that are over-indexed to foundry as history suggests foundry spending cannot diverge from memory spending for long
- WFE intensity will come down slightly from ~15.6% to ~15.2% in '22 and compress back down to the ~14% range for '23 - a range that we consider to be much more fundamentally sustainable
- ASML should continue to gain WFE share and could gain top position in '22 and '23
- In the US, we prefer LRCX but rate other major SPE suppliers (AMAT/KLAC) Neutral as we see stock movement as likely being more sideways.

We see WFE tracking to \$97.3B in '22 (up ~12%) with '23 down just slightly.... 2024 is likely down and potentially significantly

Semis Capex Forecast / Capital Intensity

Semis Capex

SMM	2016	2017	2018	2019	2020	2021	2022E	2023E
Memory Total	28,639	43,205	55,225	41,189	47,010	61,035	52,429	47,478
DRAM	9,398	16,364	25,053	17,816	23,790	31,252	27,422	23,847
NAND/non-volatile	19,241	26,840	30,172	23,373	23,221	29,783	25,007	23,631
other								
Large non Memory IDMs	10,761	12,885	14,692	18,960	16,384	22,312	38,527	37,988
Tier-one/two foundries	20,475	23,627	20,137	25,340	35,125	51,103	69,139	69,495
Other & SATS	10,517	12,365	16,746	17,044	19,049	28,115	33,126	33,479
Total	70,392	92,082	106,800	102,533	117,569	162,565	193,222	188,439

Capex YoY %

Memory Total	11.3%	50.9%	27.8%	-25.4%	14.1%	29.8%	-14.1%	-9.4%
DRAM	-24.3%	74.1%	53.1%	-28.9%	33.5%	31.4%	-12.3%	-13.0%
NAND/non-volatile	44.6%	39.5%	12.4%	-22.5%	-0.7%	28.3%	-16.0%	-5.5%
other								
Large non Memory IDMs	-7.0%	19.7%	14.0%	29.1%	-13.6%	36.2%	72.7%	-1.4%
Tier-one/two foundries	7.3%	15.4%	-14.8%	25.8%	38.6%	45.5%	35.3%	0.5%
Total	8.8%	30.8%	16.0%	-4.0%	14.7%	38.3%	18.9%	-2.5%

Segment % of total

Memory Total	40.7%	46.9%	51.7%	40.2%	40.0%	37.5%	27.1%	25.2%
DRAM	13.4%	17.8%	23.5%	17.4%	20.2%	19.2%	14.2%	12.7%
NAND/non-volatile	27.3%	29.1%	28.3%	22.8%	19.8%	18.3%	12.9%	12.5%
other								
Logic	15.3%	14.0%	13.8%	18.5%	13.9%	13.7%	19.9%	20.2%
Foundries ex DRAM	29.1%	25.7%	18.9%	24.7%	29.9%	31.4%	35.8%	36.9%

Semis revenue, SMM

Memory Total	76,769	123,974	157,967	106,432	117,482	153,838	176,217	192,417
DRAM	41,179	72,802	99,308	62,475	64,324	92,960	102,979	123,700
NAND/non-volatile	32,023	47,227	54,227	40,180	49,390	55,953	68,027	63,663
other	3,573	3,944	4,273	3,777	3,769	4,925	5,211	5,054
Non-memory	262,057	288,111	310,812	305,670	322,907	402,054	461,985	486,242
Total	338,826	412,085	468,778	412,101	440,389	555,893	638,202	678,659
% YoY	1.1%	21.6%	13.8%	-12.1%	6.9%	26.2%	14.8%	6.3%

IC revenue, \$MM

Memory Total	76,769	123,974	157,967	106,432	117,482	153,838	176,217	192,417
DRAM	41,179	72,802	99,308	62,475	64,324	92,960	102,979	123,700
NAND/non-volatile	32,023	47,227	54,227	40,180	49,390	55,953	68,027	63,663
other	3,573	3,944	4,273	3,777	3,769	4,925	5,211	5,054
Non-memory	199,926	219,036	235,321	226,725	243,743	309,163	366,307	388,651
Total	276,695	343,010	393,288	333,157	361,226	463,002	542,525	581,068
% YoY	0.8%	24.0%	14.7%	-15.3%	8.4%	28.2%	17.2%	7.1%

Capex Intensity %

Memory Total	37.3%	34.8%	35.0%	38.7%	40.0%	39.7%	29.8%	24.7%
DRAM	22.8%	22.5%	25.2%	28.5%	37.0%	33.6%	26.6%	19.3%
NAND	60.1%	56.8%	55.6%	58.2%	47.0%	53.2%	36.8%	37.1%
Non-memory	15.9%	17.0%	16.6%	20.1%	21.9%	25.3%	30.5%	29.0%
Total	20.8%	22.3%	22.8%	24.9%	26.7%	29.2%	30.3%	27.8%
Total (excluding discretes)	25.4%	26.8%	27.2%	30.8%	32.5%	35.1%	35.6%	32.4%

Source: Company reports, UBS estimates

WFE Forecast / Capital Intensity

WFE

SMM	2016	2017	2018	2019	2020	2021	2022E	2023E
Memory Total	16,977	26,400	34,350	22,850	29,050	43,250	37,350	32,250
DRAM	6,100	9,100	15,550	10,250	13,200	22,700	19,600	15,500
NAND	10,877	17,300	18,800	12,600	15,850	20,550	17,750	16,750
Non-memory Total	18,323	20,750	19,500	28,050	30,950	43,250	59,900	63,250
Logic	5,800	5,500	6,750	9,900	8,200	11,600	17,400	20,750
Foundry	12,523	15,250	12,750	18,150	22,750	31,650	42,500	42,500
Total	35,300	47,150	53,850	50,900	60,000	86,500	97,250	95,500

YoY %

Memory Total	6.0%	55.5%	30.1%	-33.5%	27.1%	48.9%	-13.6%	-13.7%
DRAM	-30.5%	49.2%	70.9%	-34.1%	28.8%	72.0%	-13.7%	-20.9%
NAND	50.3%	59.0%	8.7%	-33.0%	25.8%	29.7%	-13.6%	-5.6%
Non-memory Total	6.3%	13.2%	-6.0%	43.8%	10.3%	39.7%	38.5%	5.6%
Logic	2.8%	-5.2%	22.7%	46.7%	-17.2%	41.5%	50.0%	19.3%
Foundry	8.0%	21.8%	-16.4%	42.4%	25.3%	39.1%	34.3%	0.0%
Total	6.1%	33.6%	14.2%	-5.5%	17.9%	44.2%	12.4%	-1.8%

Segment % of total

Memory Total	48.1%	56.0%	63.8%	44.9%	48.4%	50.0%	38.4%	33.8%
DRAM	17.3%	19.3%	28.9%	20.1%	22.0%	26.2%	20.2%	16.2%
NAND	30.8%	36.7%	34.9%	24.8%	26.4%	23.8%	18.3%	17.5%
Non-memory Total	51.9%	44.0%	36.2%	55.1%	51.6%	50.0%	61.6%	66.2%
Logic	16.4%	11.7%	12.5%	19.4%	13.7%	13.4%	17.9%	21.7%
Foundry	35.5%	32.3%	23.7%	35.7%	37.9%	36.6%	43.7%	44.5%
Total	100.0%							

WFE Intensity %

Memory Total	22.1%	21.3%	21.7%	21.5%	24.7%	28.1%	21.2%	16.8%
DRAM	14.8%	12.5%	15.7%	16.4%	20.5%	24.4%	19.0%	12.5%
NAND	34.0%	36.6%	34.7%	31.4%	32.1%	36.7%	26.1%	26.3%
Non-memory	7.0%	7.2%	6.3%	9.2%	9.6%	10.8%	13.0%	13.0%
Total	10.4%	11.4%	11.5%	12.4%	13.6%	15.6%	15.2%	14.1%
Total (excluding discretes)	12.8%	13.7%	13.7%	15.3%	16.6%	18.7%	17.9%	16.4%

Source: Company reports, UBS estimates



Capex Forecast Details

Semiconductor Capex by Top Spenders

	2013	% YoY	2014	% YoY	2015	% YoY	2016	% YoY	2017	% YoY	2018	% YoY	2019	% YoY	2020	% YoY	2021	% YoY	2022E	% YoY	2023E	% YoY
N.America																						
Intel	10,711	(0)	10,105	(0)	7,326	(0)	9,625	0	11,778	22.4%	15,181	28.9%	16,213	6.8%	14,259	-12.1%	18,733	31.4%	29,797	31,000		
Logic/Foundry	10,711	-2.9%	10,105	-5.7%	7,326	-27.5%	8,125	10.9%	9,278	14.2%	10,681	15.1%	14,438	35.2%	12,259	-15.1%	16,733	36.5%	29,797	31,000		
NAND					1,500	#DIV/0!	2,500	66.7%	4,500	80.0%	1,775	-60.6%	2,000		2,000		2,000		2,000	2,000		
NAND (pro-forma pending deal closure)																				--	--	
Micron	1,368		2,790		4,342		6,091		5,390	-11.5%	8,730	62.0%	8,533	-2.3%	9,030	5.8%	10,557	16.9%	10,589	10,000		
DRAM	631	-4.8%	1,116	76.8%	1,737	55.7%	2,589	49.0%	3,219	24.4%	4,365	35.6%	4,267	-2.3%	6,773	58.7%	5,806	-14.3%	6,353	6,000		
NAND	737	-26.3%	1,674	127.2%	2,605	55.6%	3,516	35.0%	2,380	-32.3%	4,365	83.4%	4,267	-2.3%	2,258	-47.1%	4,751	110.4%	4,236	4,000		
Texas Instruments	412	-16.8%	459	11.3%	551	20.1%	531	-3.6%	695	30.9%	1,131	62.7%	847	-25.1%	649	-23.4%	2,462	279.4%	2,504	3,698		
Global Foundries	4,000	5.3%	3,500	-12.5%	2,750	-21.4%	2,250	-18.2%	2,000	-11.1%	2,500	25.0%	750	-70.0%	500	-33.3%	1,766	253.2%	4,000	3,431		
Western Digital	859	11.6%	1,008	17.4%	1,353	34.2%	1,570	16.0%	788	-49.8%	1,070	35.8%	1,080	0.9%	1,000	-7.4%	1,500	50.0%	1,764	1,950		
Europe																						
ST Micro	531	10.6%	496	-6.6%	467	-5.8%	607	30.0%	1,298	113.8%	1,262	-2.8%	1,137	-9.9%	1,183	4.0%	1,828	54.5%	3,496	91.2%	2,638	-24.5%
Infineon	496	-44.5%	719	44.7%	902	25.5%	946	4.8%	1,092	15.5%	1,418	29.8%	808	-43.0%	1,129	39.7%	1,351	19.6%	2,274	68.4%	2,150	-5.5%
NXP	191	-23.9%	306	60.2%	342	11.9%	389	13.6%	618	58.9%	661	7.0%	594	-10.1%	454	-23.6%	899	98.0%	1,307	45.4%	1,064	-18.6%
Korea																						
Samsung	11,643		12,961		12,929		11,178		23,547	110.7%	21,546	-8.5%	19,046	-11.6%	28,244	48.3%	39,137	38.6%	35,847	33,877		
Memory	7,120	21.9%	10,456	46.9%	9,554	-8.6%	8,903	-6.8%	17,512	96.7%	18,185	3.8%	12,747	-29.9%	18,838	47.8%	26,930	43.0%	22,558	-16.2%	20,363	-9.7%
DRAM	3,560		4,705		3,822		3,258		5,840	79.2%	10,184	74.4%	5,713	-43.9%	9,558		15,247		11,755		10,602	
NAND	3,560		5,751		5,733		5,645		11,672	106.8%	8,001	-31.4%	7,034	-12.1%	9,280		11,683		10,802		9,762	
Foundry/Logic	4,523	-31.4%	2,505	-44.6%	3,375	34.7%	2,275	-32.6%	6,035	165.3%	3,361	-44.3%	6,299	87.4%	9,406	49.3%	12,207	29.8%	13,289	8.9%	13,513	1.7%
SK Hynix	3,412	-1.9%	4,668	36.8%	6,186	32.5%	5,337	-13.7%	8,698	63.0%	14,206	63.3%	11,240	-20.9%	8,224	-26.8%	11,324	37.7%	12,021	6.2%	9,221	-23.3%
DRAM	2,167		3,268		4,949		3,522		4,349	23.5%	6,842	57.3%	7,093	3.7%	5,609		7,793		7,152		5,152	
NAND	1,245		1,400		1,237		1,814		4,349	139.7%	7,364	69.3%	4,147	-43.7%	2,615		3,531		4,869		4,069	
Japan																						
Kioxia	1,435	58.7%	1,924	34.1%	1,857	-3.5%	3,333	79.5%	5,200	56.0%	4,091	-21.3%	3,182	-22.2%	3,818	20.0%	3,818	0.0%	3,600	-5.7%	2,800	-22.2%
NAND	1,076		1,202		929		2,667		4,940	85.3%	3,942	-20.2%	3,150	-20.1%	3,818		3,818		3,600		2,800	
Logic/other	359		721		929		667		260	-61.0%	149	-42.6%	32	-78.7%	--		--		--		--	
Sony	687	-23.9%	661	-3.7%	1,950	195.0%	417	-78.6%	957	129.7%	1,182	23.5%	2,545	115.4%	1,813	-28.8%	2,400	32.4%	2,960	23.3%	2,200	-25.7%
Taiwan																						
TSMC	9,694	16.5%	9,522	-1.8%	8,051	-15.4%	10,228	27.0%	10,869	6.3%	10,376	-4.5%	14,891	43.5%	17,124	15.0%	30,037	75.4%	42,000	39.8%	44,000	4.8%
UMC	1,092	-37.8%	1,429	30.8%	1,875	31.2%	2,834	51.1%	1,485	-47.6%	1,100	-25.9%	800	-27.3%	895	11.9%	1,723	92.5%	3,600	108.9%	2,300	-36.1%
Inotera	215	56.3%	613	185.1%	1,790	191.8%	1,341	-25.1%														
Nanya	189	191.4%	222	17.1%	122	-45.2%	701	476.8%	956	36.3%	662	-30.7%	244	-63.2%	250	2.7%	406	62.4%	961	136.8%	843	-12.3%
China																						
SMIC	677	35.5%	959	41.7%	1,401	46.1%	2,625	87.4%	2,488	-5.2%	2,300	-7.6%	2,000	-13.0%	5,700	185.0%	4,120	-27.7%	5,000	21.4%	5,000	0.0%
Hua Hong																						
Shanghai Huali																						
YMTC																						
Memory																						
DRAM																						
NAND																						
Logic																						
Fujian Jinhua IC																						
Chengdu Gaozhen																						
Changxin Memory (CXMT)																						
DRAM																						
Others																						
Total	10,230	-5.8%	12,229	19.5%	10,477	-14.3%	9,927	-5.3%	10,473	5.5%	13,884	32.6%	13,601	-2.0%	15,596	14.7%	21,565	38.3%	25,631	18.9%	24,997	-2.5%
Wafer fab equipment	57,841	-1.5%	64,570	11.6%	64,671	0.2%	70,392	8.8%	92,082	30.8%	106,800	16.0%	102,533	-4.0%	117,569	14.7%	162,565	38.3%	193,222	18.9%	188,439	-2.5%
Wafer fab equipment	27,473	-7.3%	31,953	16.3%	33,258	4.1%	35,300	6.1%	47,150	33.6%	53,850	14.2%	50,900	-5.5%	60,000	17.9%	86,500	44.2%	97,250	12.4%	95,500	-1.8%

Source: Company reports, UBS estimates

WFE Forecast Details

WFE by Top Spenders

	2013	% YoY	2014	% YoY	2015	% YoY	2016	% YoY	2017	% YoY	2018	% YoY	2019	% YoY	2020	% YoY	2021	% YoY	2022E	% YoY	2023E	% YoY	
Intel	6,130		5,150		5,000		5,975		6,014		8,350		8,828		7,742		10,203		14,250		16,500		
Logic/Foundry	6,130		5,150		5,000		5,000		4,639		5,875		7,941		6,742		9,203		14,250		16,500		
NAND							975		1,375		2,475		888		1,000		1,000		--		--		
Micron	825		1,625		2,750		3,533		2,918		5,675		5,194		3,330		6,149		6,142		5,500		
DRAM	381		650		1,200		1,424		1,610		2,837		3,797		2,540		3,774		3,812		3,300		
NAND	444		975		1,550		2,110		1,309		2,837		1,397		790		2,375		2,330		2,200		
Global Foundries	2,400		2,625		1,650		1,350		1,100		1,500		413		250		883		2,000		2,059		
Western Digital	601		706		947		1,099		433		749		648		600		900		1,235		1,365		
Samsung	6,904		7,478		8,191		7,097		16,654		14,718		10,671		19,663		28,865		25,700		22,290		
Memory	3,738		5,725		5,828		5,505		12,430		12,366		6,262		13,079		20,198		17,062		13,236		
DRAM	1,869		2,705		2,675		2,118		4,330		7,256		1,822		6,679		11,208		9,062		6,891		
NAND	1,869		3,019		3,153		3,387		8,100		5,110		4,440		6,400		8,990		8,000		5,345		
Logic/Foundry	3,166		1,754		2,363		1,593		4,224		2,352		4,409		6,584		8,667		8,638		9,054		
SK Hynix	1,831		2,567		4,206		3,898		5,284		8,064		5,510		4,509		7,049		7,821		5,790		
DRAM	1,083		1,797		3,464		2,483		2,501		4,264		3,610		3,009		5,497		5,011		3,349		
NAND	747		770		742		1,415		2,783		3,800		1,900		1,500		1,552		2,810		2,442		
Kioxia	852		1,190		1,161		1,967		2,974		2,462		2,226		2,864		2,596		2,000		2,000		
NAND	619		721		557		1,533		2,841		2,365		2,205		2,864		2,596		2,000		2,000		
Logic/other	233		469		604		433		133		97		21		--		--		--		--		
Sony	481		463		1,365		250		670		650		1,800		1,300		1,800		2,760		2,000		
TSMC	6,058		8,094		5,233		6,137		7,065		6,226		10,796		10,703		17,722		24,990		26,400		
UMC	710		1,072		1,219		1,700		1,188		715		360		448		948		2,160		1,150		
Nanya							200		478		331		122		125		203		481		422		
SMIC	474		671		980		1,706		1,555		1,750		1,700		3,500		1,900		2,500		2,750		
Hua Hong																810		563		912		612	
Shanghai Huali																750		750		750		750	
YMTC																250		1,000		2,250		2,600	
Memory	--	--	--	--	--	--	--	--	250		1,000		1,000		2,250		2,600		900		2,275		
DRAM	--	--	--	--	--	--	--	--	--		--		--		--		--		--		175		
NAND	--	--	--	--	--	--	--	--	250		1,000		1,000		2,250		2,600		900		2,100		
Logic	--	--	--	--	--	--	--	--	--		--		--		--		--		--		--		
Fujian Jinhua IC	--	--	--	--	--	--	--	--	--		500		--		--		--		--		--		
Chengdu Gaozhen	--	--	--	--	--	--	--	--	--		--		--		--		550		260		488		
Chanzxin Memory (CXMT)	--	--	--	--	--	--	--	--	175		250		750		750		1,000		600		500		
OTHERS	208		313		555		387		183		322		379		212		587		538		616		
Total																							
Wafer Fab Equipment (\$MM)	27,473	(7.3%)	31,953	16.3%	33,258	4.1%	35,300	6.1%	47,150	33.6%	53,850	14.2%	50,900	(5.5%)	60,000	17.9%	86,500	44.2%	97,250	12.4%	95,500	(1.8%)	
Memory, \$MM	9,325		12,720		16,017		16,977		26,400		34,350		22,850		29,050		43,250		37,350		32,250		
YoY	32%		36%		26%		6%		56%		30%		(33%)		27%		49%		(14%)		(14%)		
DRAM	4,111		6,309		8,780		6,100		9,100		15,550		10,250		13,200		22,700		19,600		15,500		
YoY	50%		53%		39%		(31%)		49%		71%		(34%)		29%		72%		(14%)		(21%)		
NAND/other	5,214		6,411		7,237		10,877		17,300		18,800		12,600		15,850		20,550		17,750		16,750		
YoY	20%		23%		13%		50%		59%		9%		(33%)		26%		30%		(14%)		(6%)		
Foundry, \$MM	11,430		13,738		11,600		12,523		15,250		12,750		18,150		22,750		31,650		42,500		42,500		
YoY	(20%)		20%		(16%)		8%		22%		(16%)		42%		25%		39%		34%		--		
Logic, \$MM	6,718		5,495		5,640		5,800		5,500		6,750		9,900		8,200		11,600		17,400		20,750		
YoY	(18%)		(18%)		3%		3%		(5%)		23%		47%		(17%)		41%		50%		19%		
check																							
Foundry + logic, \$MM									20,750		19,500		28,050		30,950		43,250		59,900		63,250		
YoY									(6%)		44%		10%		40%		38%		6%				
% total																							
Memory	34%		40%		48%		48%		56%		64%		45%		48%		50%		38%		34%		
DRAM	15%		20%		26%		17%		19%		29%		20%		22%		26%		20%		16%		
NAND/other	19%		20%		22%		31%		37%		35%		25%		26%		24%		18%		18%		
Foundry	42%		43%		35%		35%		32%		24%		36%		38%		37%		44%		45%		
Logic	24%		17%		17%		16%		12%		13%		19%		14%		13%		18%		22%		
Total WFE	100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		

Source: Company reports, UBS estimates

Quarterly WFE: 2011-2016 Historicals

WFE Data by Quarter and End Market (2011-2016)

Product	2011				2012				2013				2014				2015				2016				
	1Q'11	2Q'11	3Q'11	4Q'11	1Q'12	2Q'12	3Q'12	4Q'12	1Q'13	2Q'13	3Q'13	4Q'13	1Q'14	2Q'14	3Q'14	4Q'14	1Q'15	2Q'15	3Q'15	4Q'15	1Q'16	2Q'16	3Q'16	4Q'16	
ASML	\$1,757	\$1,738	\$1,658	\$1,338	\$1,380	\$1,294	\$1,315	\$1,007	\$895	\$1,211	\$1,272	\$1,972	\$1,409	\$1,733	\$1,172	\$1,378	\$1,405	\$1,256	\$1,085	\$965	\$944	\$1,417	\$1,382	\$1,319	
AMAT	\$1,783	\$1,726	\$1,067	\$1,344	\$1,777	\$1,545	\$870	\$969	\$1,291	\$1,272	\$1,243	\$1,484	\$1,584	\$1,476	\$1,434	\$1,446	\$1,560	\$1,635	\$1,494	\$1,373	\$1,587	\$1,786	\$2,127	\$2,150	
LRCX	\$611	\$597	\$381	\$418	\$548	\$631	\$709	\$588	\$684	\$833	\$733	\$860	\$957	\$848	\$722	\$777	\$928	\$1,006	\$1,085	\$896	\$774	\$986	\$1,042	\$1,282	
KLAC	\$664	\$720	\$633	\$501	\$550	\$708	\$591	\$524	\$580	\$570	\$561	\$544	\$670	\$570	\$477	\$504	\$565	\$580	\$461	\$528	\$523	\$731	\$562	\$684	
TEL	\$1,553	\$1,114	\$1,333	\$861	\$1,463	\$1,057	\$1,056	\$494	\$916	\$449	\$928	\$700	\$1,467	\$967	\$909	\$726	\$1,054	\$822	\$1,059	\$867	\$894	\$819	\$1,428	\$1,193	
ex TEL	\$4,815	\$4,781	\$3,739	\$3,600	\$4,255	\$4,178	\$3,485	\$3,088	\$3,449	\$3,887	\$3,810	\$4,860	\$4,621	\$4,627	\$3,805	\$4,105	\$4,458	\$4,478	\$4,124	\$3,762	\$3,828	\$4,920	\$5,113	\$5,435	
incl TEL	\$6,368	\$5,895	\$5,071	\$4,461	\$5,717	\$5,235	\$4,541	\$3,582	\$4,365	\$4,336	\$4,738	\$5,560	\$6,087	\$5,595	\$4,714	\$4,831	\$5,513	\$5,300	\$5,184	\$4,628	\$4,722	\$5,739	\$6,541	\$6,628	
Big 3 US					\$2,875	\$2,884	\$2,171	\$2,081	\$2,554	\$2,676	\$2,537	\$2,888	\$3,211	\$2,894	\$2,633	\$2,727	\$3,053	\$3,221	\$3,040	\$2,796	\$2,885	\$3,503	\$3,731	\$4,116	
Memory																									
ASML	\$457	\$1,025	\$969	\$548	\$345	\$349	\$394	\$131	\$268	\$545	\$483	\$690	\$939	\$953	\$328	\$896	\$773	\$591	\$607	\$425	\$394	\$496	\$221	\$514	
AMAT	\$480	\$471	\$204	\$411	\$315	\$339	\$96	\$204	\$326	\$457	\$500	\$502	\$632	\$563	\$427	\$742	\$886	\$1,144	\$751	\$650	\$1,298	\$642	\$477	\$1,406	
LRCX	\$257	\$332	\$212	\$176	\$219	\$290	\$298	\$117	\$212	\$383	\$352	\$550	\$632	\$500	\$362	\$554	\$758	\$747	\$830	\$554	\$702	\$742	\$665	\$850	
KLAC	\$149	\$179	\$92	\$68	\$132	\$87	\$67	\$72	\$129	\$253	\$256	\$250	\$155	\$131	\$219	\$222	\$96	\$359	\$170	\$253	\$105	\$212	\$236	\$287	
TEL	\$730	\$385	\$210	\$418	\$266	\$143	\$95	\$94	\$271	\$244	\$561	\$544	\$479	\$333	\$435	\$538	\$539	\$378	\$519	\$416	\$492	\$401	\$614	\$477	
ex TEL	\$1,342	\$2,007	\$1,477	\$1,203	\$1,012	\$1,065	\$856	\$524	\$935	\$1,638	\$1,592	\$1,993	\$2,357	\$2,147	\$1,336	\$2,413	\$2,513	\$2,841	\$2,359	\$1,883	\$2,498	\$2,092	\$1,599	\$3,057	
incl TEL	\$2,073	\$2,392	\$1,687	\$1,622	\$1,278	\$1,208	\$951	\$618	\$1,206	\$1,882	\$2,153	\$2,537	\$2,836	\$2,480	\$1,771	\$2,951	\$3,052	\$3,220	\$2,878	\$2,299	\$2,990	\$2,493	\$2,213	\$3,534	
DRAM % of Memory (reported)	34%	30%	33%	36%	28%	53%	48%	49%	49%	50%	37%	34%	52%	59%	56%	67%	66%	48%	45%	61%	38%	38%	34%	36%	
NAND % of Memory (reported)	66%	70%	67%	64%	72%	47%	52%	51%	51%	50%	63%	66%	48%	41%	44%	33%	34%	52%	55%	39%	62%	62%	66%	64%	
F/L																									
ASML	\$989	\$790	\$492	\$880	\$975	\$1,064	\$751	\$792	\$555	\$415	\$1,251	\$1,212	\$559	\$774	\$753	\$485	\$649	\$1,160	\$448	\$438	\$626	\$885	\$1,101	\$717	
AMAT	\$1,235	\$768	\$722	\$1,007	\$1,654	\$828	\$645	\$1,159	\$1,225	\$746	\$890	\$1,067	\$1,032	\$1,002	\$907	\$684	\$818	\$863	\$693	\$625	\$668	\$1,573	\$1,356	\$1,351	
LRCX	\$354	\$265	\$168	\$242	\$329	\$341	\$411	\$471	\$472	\$450	\$381	\$310	\$326	\$348	\$461	\$385	\$391	\$498	\$323	\$299	\$301	\$382	\$404	\$543	
KLAC	\$403	\$418	\$345	\$357	\$323	\$493	\$353	\$348	\$335	\$323	\$288	\$294	\$516	\$439	\$257	\$272	\$469	\$220	\$290	\$274	\$419	\$519	\$326	\$397	
TEL	\$824	\$628	\$427	\$1,131	\$798	\$507	\$464	\$687	\$633	\$434	\$686	\$566	\$719	\$646	\$532	\$496	\$584	\$444	\$540	\$451	\$402	\$418	\$814	\$716	
ex TEL	\$2,980	\$2,242	\$1,727	\$2,486	\$3,282	\$2,726	\$2,160	\$2,769	\$2,587	\$1,934	\$2,809	\$2,882	\$2,433	\$2,563	\$2,378	\$1,827	\$2,327	\$2,742	\$1,754	\$1,636	\$2,014	\$3,359	\$3,188	\$3,008	
incl TEL	\$3,804	\$2,870	\$2,154	\$3,618	\$4,080	\$3,233	\$2,624	\$3,455	\$3,220	\$2,368	\$3,495	\$3,449	\$3,151	\$3,209	\$2,910	\$2,323	\$2,910	\$3,186	\$2,294	\$2,087	\$2,416	\$3,777	\$4,001	\$3,724	
WFE																									
Total	\$9,760	\$9,842	\$8,805	\$7,867	\$8,935	\$8,177	\$6,886	\$5,502	\$6,373	\$6,367	\$6,359	\$8,324	\$9,074	\$8,019	\$7,055	\$7,776	\$8,597	\$8,217	\$8,802	\$7,616	\$6,945	\$8,849	\$9,457	\$10,092	
Memory	\$3,554	\$4,077	\$2,849	\$2,067	\$2,144	\$2,208	\$1,653	\$1,045	\$1,554	\$2,061	\$2,504	\$3,207	\$3,400	\$3,000	\$2,150	\$4,199	\$4,242	\$4,459	\$4,108	\$3,208	\$3,964	\$3,738	\$3,294	\$5,962	
% total	36%	41%	32%	26%	24%	27%	24%	19%	24%	32%	39%	39%	37%	37%	30%	54%	49%	54%	47%	42%	57%	42%	35%	59%	
DRAM	\$1,224	\$1,223	\$935	\$738	\$552	\$1,036	\$708	\$456	\$817	\$1,117	\$1,006	\$1,170	\$1,477	\$1,467	\$1,005	\$2,360	\$2,819	\$2,128	\$1,863	\$1,954	\$1,519	\$1,420	\$1,124	\$2,120	
NAND/other	\$2,330	\$2,854	\$1,913	\$1,329	\$1,612	\$1,172	\$945	\$589	\$737	\$944	\$1,498	\$2,036	\$1,923	\$1,533	\$1,145	\$1,839	\$1,424	\$2,331	\$2,244	\$1,254	\$2,445	\$2,318	\$2,170	\$3,842	
DRAM % of Memory (estimated)	34%	30%	33%	36%	25%	47%	43%	44%	53%	54%	40%	37%	43%	49%	47%	56%	66%	48%	45%	61%	38%	38%	34%	36%	
DRAM % of Memory (reported)	34%	30%	33%	36%	28%	53%	48%	49%	49%	50%	37%	34%	52%	59%	56%	67%	66%	48%	45%	61%	38%	38%	34%	36%	
NAND % of Memory (estimated)	66%	70%	67%	64%	75%	53%	57%	56%	47%	46%	60%	57%	57%	51%	53%	44%	34%	52%	55%	39%	62%	62%	66%	64%	
F/L	\$6,206	\$5,765	\$5,956	\$5,800	\$6,791	\$5,969	\$5,233	\$4,457	\$4,820	\$4,306	\$3,855	\$5,117	\$5,674	\$5,019	\$4,905	\$3,577	\$4,355	\$3,758	\$4,695	\$4,408	\$2,982	\$5,111	\$6,163	\$4,130	
	\$36,387				\$29,644				\$27,473				\$31,953				\$33,258				\$35,300				
	\$12,547				\$7,082				\$9,325				\$12,720				\$16,017				\$16,977				
	\$4,120				\$2,732				\$4,111				\$6,309				\$8,780				\$6,100				
	\$8,427				\$4,350				\$5,214				\$6,411				\$7,237				\$10,877				
	\$23,840				\$22,562				\$18,148				\$19,233				\$17,241				\$18,323				

Source: Company reports, UBS



Quarterly WFE: Run-rate to decline modestly from ~\$93B in 2H:21 to ~\$89B in 1H:22E and grow to \$106B in 2H:22E but starts to moderate/decline from there

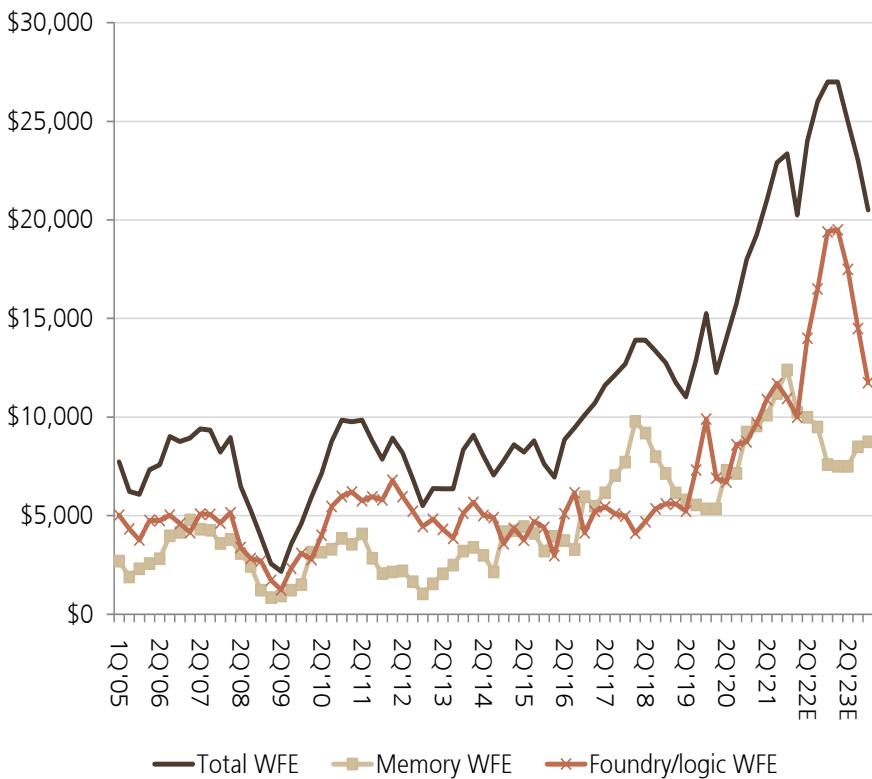
WFE Data by Quarter and End Market (2017-2023E)

Source: Company reports, UBS estimates



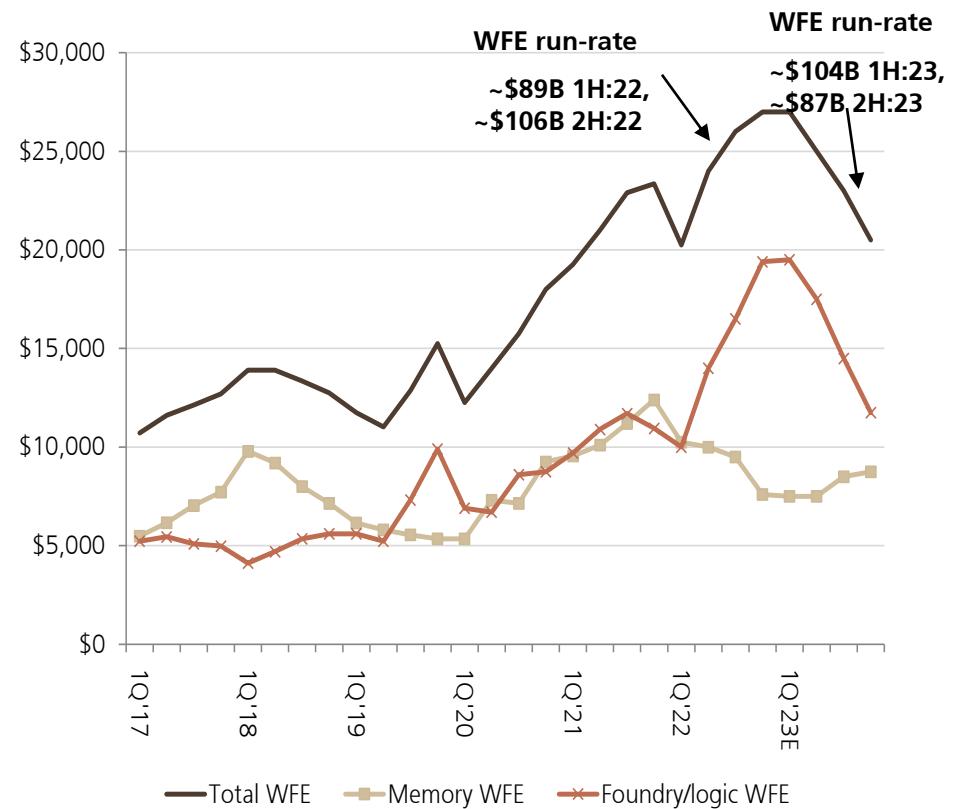
WFE is set to PEAK in Q4:22/Q1:23 but start to moderate/decline from there

WFE by Quarter and End Market (2005-2023) in \$Mn



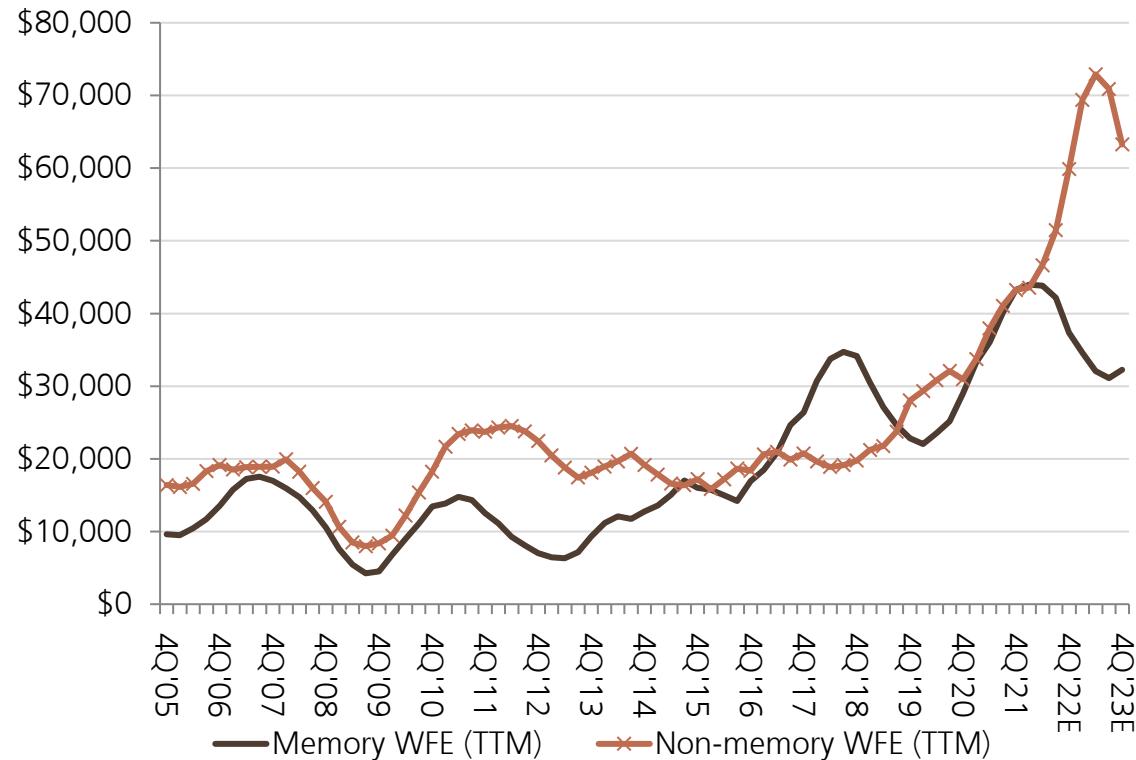
Source: Company reports, UBS

WFE by Quarter and End Market (2017-2023) in \$Mn



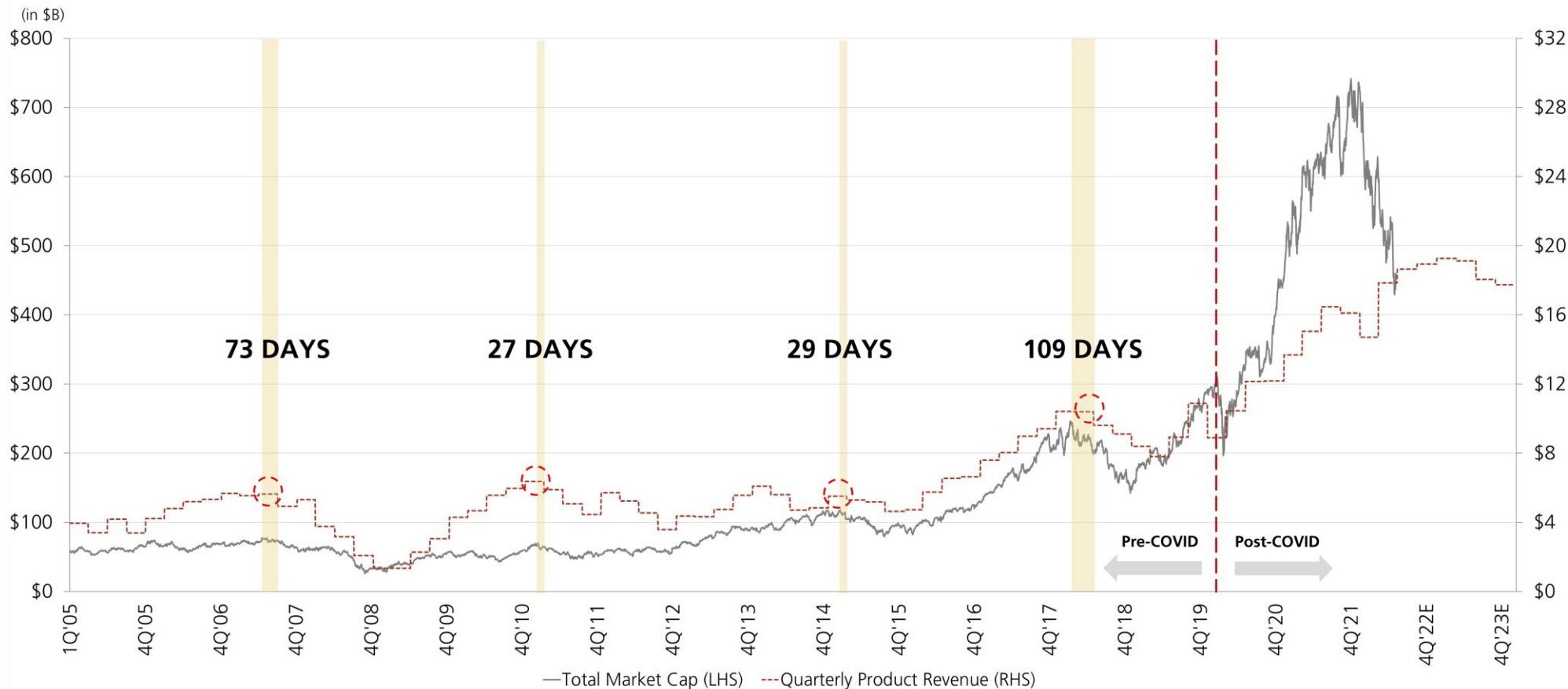
Absolute memory WFE peaked in Q1:22 while absolute non-memory WFE is set to peak in Q2:23

TTM WFE by Quarter and End Market (2005-2023) in \$Mn



Source: Company reports, UBS

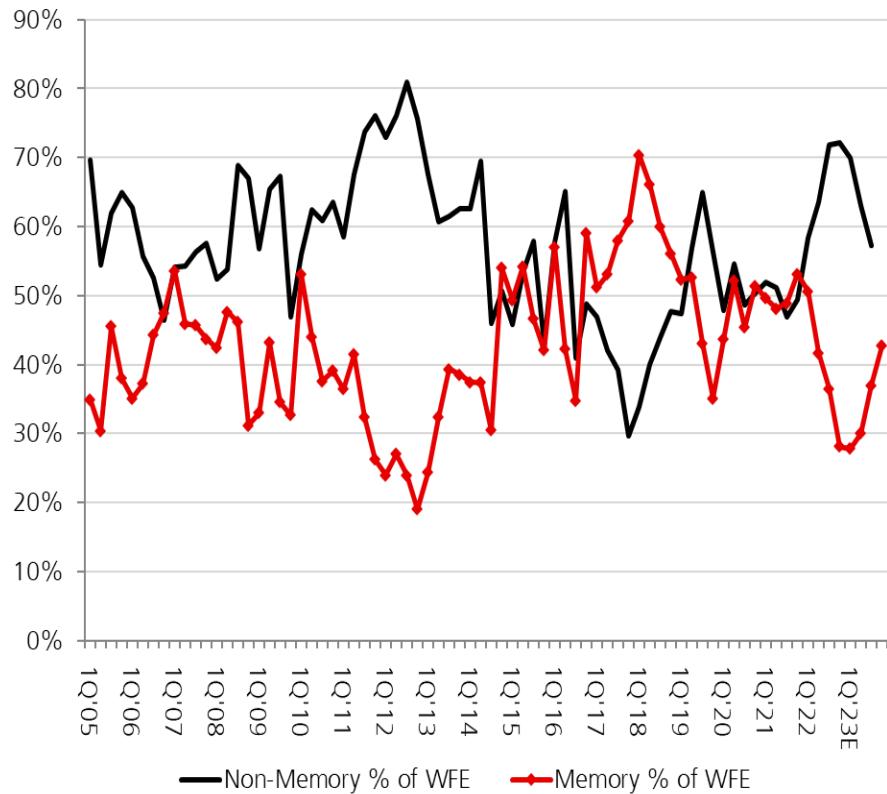
Pre-COVID, SPE stocks have typically discounted revenue peaks by only ~2-3mos



Source: Company reports, UBS

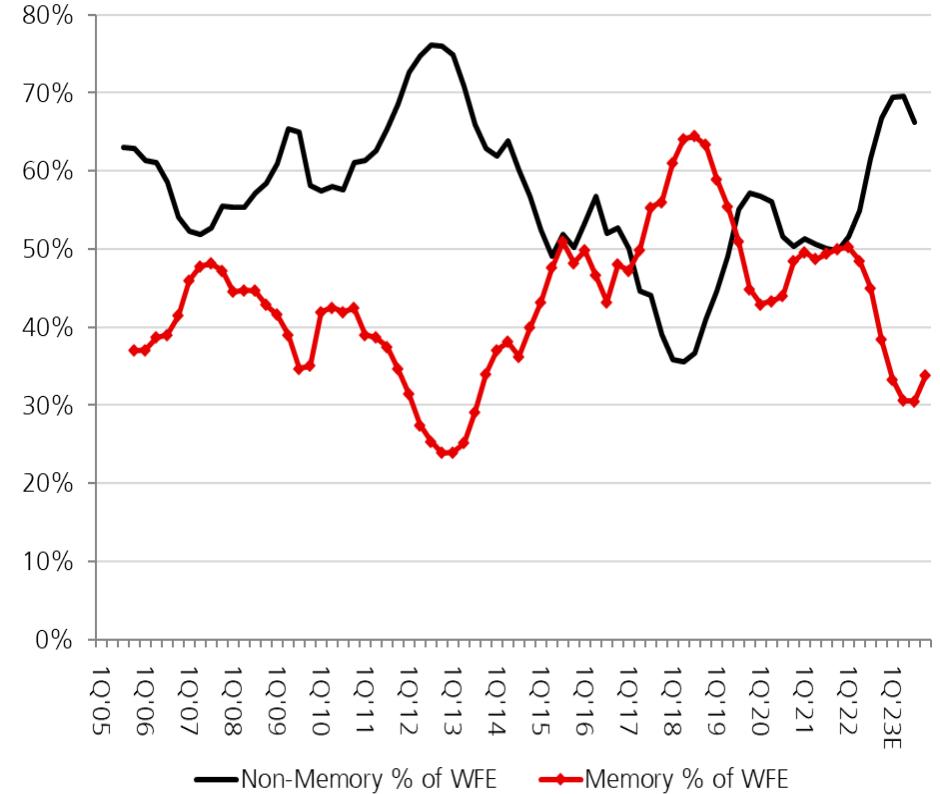
Spending is as skewed to foundry/logic as any time in the past 10yrs

Memory and Non-Memory as % of WFE, Quarterly



Source: Company reports, UBS estimates

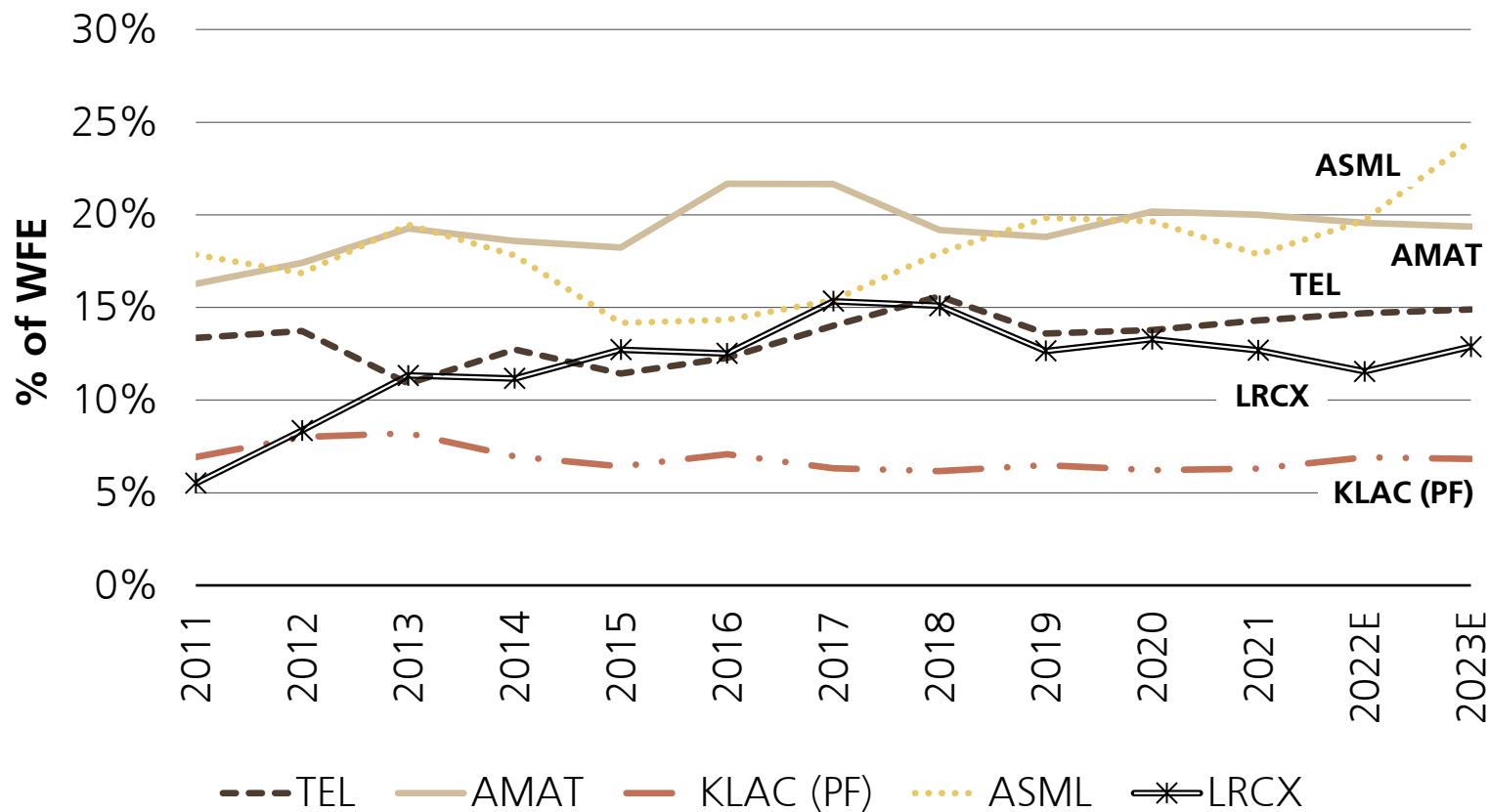
Memory and Non-Memory as % of WFE, TTM



Source: Company reports, UBS estimates

ASML, AMAT, and Tokyo Electron showing best share trends

WFE Share by Company



Source: Company reports, UBS estimates

Summary of WFE share by company

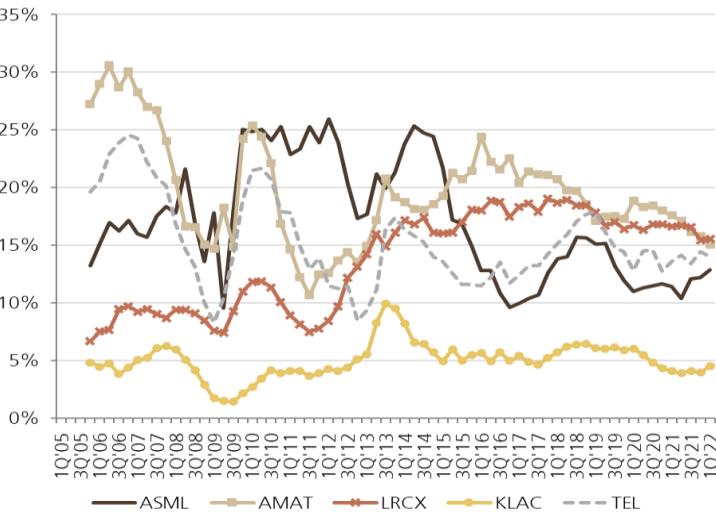
WFE Share by Company

US \$MM	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E
TEL	4,860	4,069	2,993	4,069	3,803	4,334	6,609	8,400	6,918	8,270	12,367	14,280	14,214
AMAT	5,920	5,161	5,290	5,940	6,062	7,650	10,214	10,324	9,573	12,106	17,300	19,023	18,500
KLAC (PF)	2,518	2,373	2,255	2,221	2,133	2,500	2,981	3,320	3,303	3,728	5,442	6,712	6,510
ASML	6,491	4,996	5,350	5,692	4,711	5,061	7,258	9,666	10,097	11,790	15,447	19,153	22,904
LRCX	2,006	2,476	3,110	3,567	4,229	4,419	7,229	8,126	6,438	7,968	10,974	11,226	12,300
WFE	36,387	29,644	27,473	31,953	33,258	35,300	47,150	53,850	50,900	60,000	86,500	97,250	95,500
	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022E</u>	<u>2023E</u>
TEL	13.4%	13.7%	10.9%	12.7%	11.4%	12.3%	14.0%	15.6%	13.6%	13.8%	14.3%	14.7%	14.9%
AMAT	16.3%	17.4%	19.3%	18.6%	18.2%	21.7%	21.7%	19.2%	18.8%	20.2%	20.0%	19.6%	19.4%
KLAC (PF)	6.9%	8.0%	8.2%	7.0%	6.4%	7.1%	6.3%	6.2%	6.5%	6.2%	6.3%	6.9%	6.8%
ASML	17.8%	16.9%	19.5%	17.8%	14.2%	14.3%	15.4%	18.0%	19.8%	19.7%	17.9%	19.7%	24.0%
LRCX	5.5%	8.4%	11.3%	11.2%	12.7%	12.5%	15.3%	15.1%	12.6%	13.3%	12.7%	11.5%	12.9%

Source: Company reports, UBS estimates

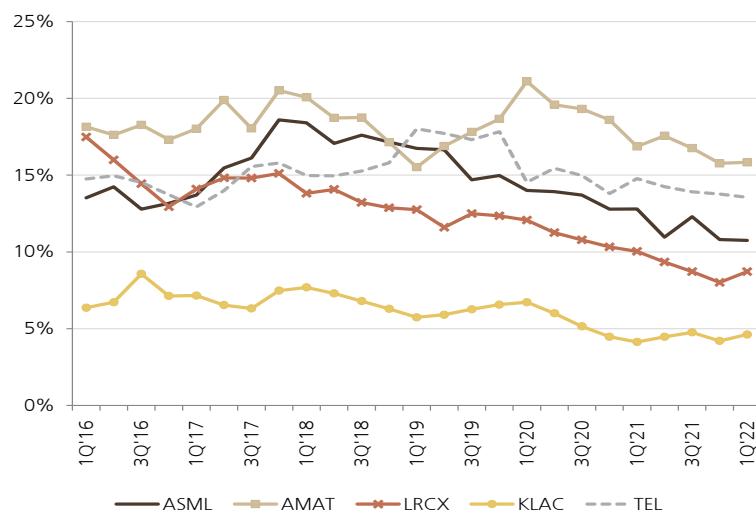
LRCX nearly as strong in NAND as AMAT/ASML are in Foundry

Memory WFE Share TTM



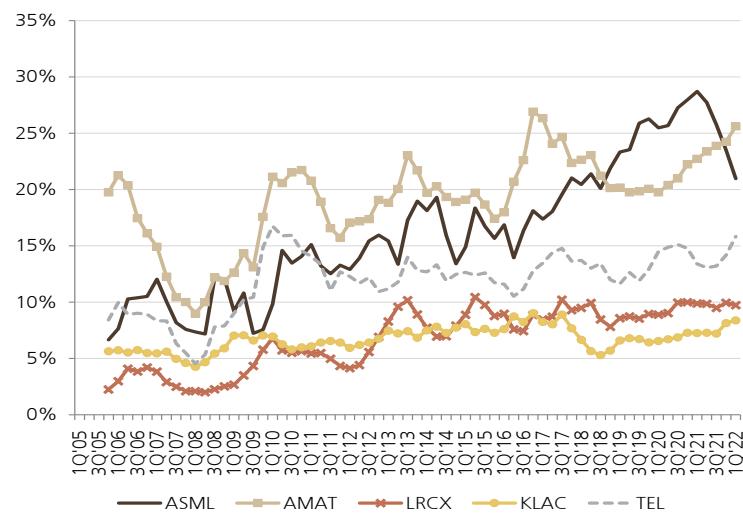
Source: Company reports, UBS estimates

DRAM WFE Share TTM



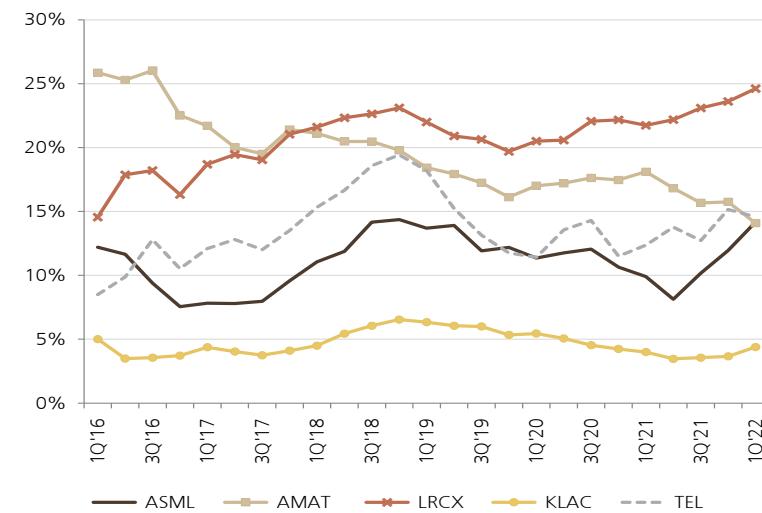
Source: Company reports, UBS estimates

Foundry/Logic WFE Share TTM



Source: Company reports, UBS estimates

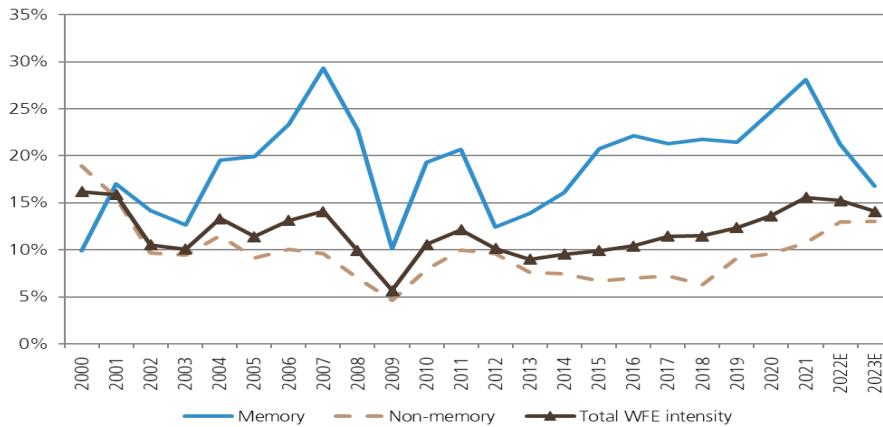
NAND WFE Share TTM



Source: Company reports, UBS estimates

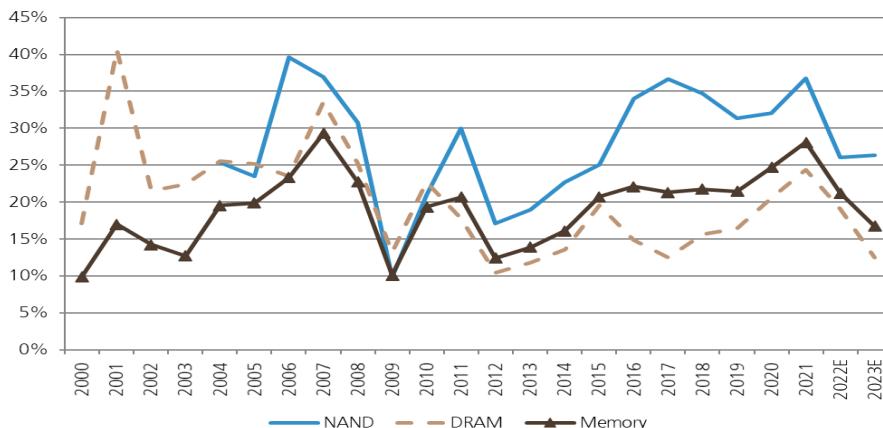
WFE intensity is very elevated by historical standards; some is secular...but we think a lot of this is cyclical

Total WFE Intensity by Segment



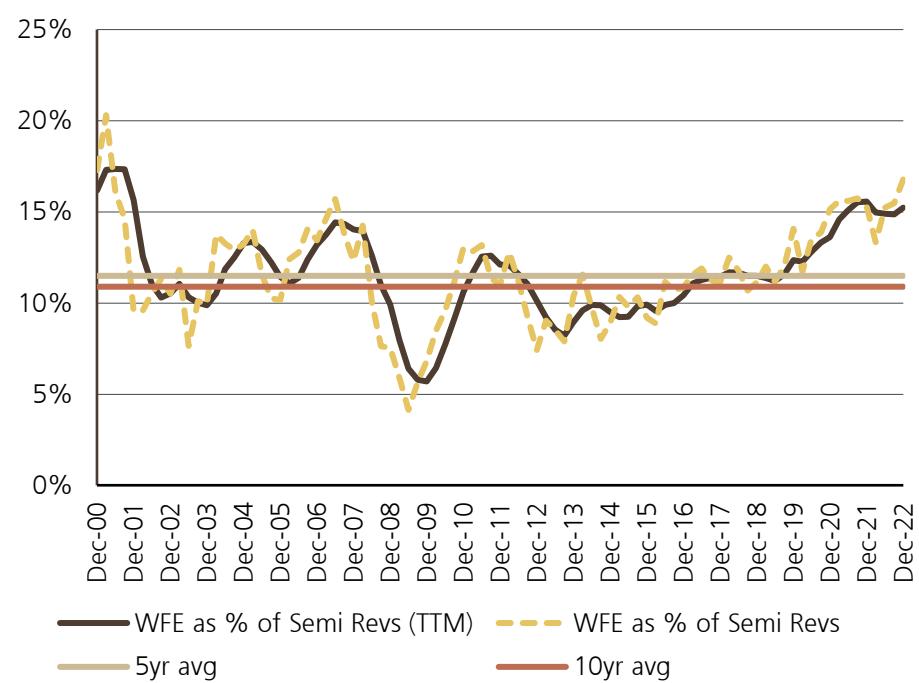
Source: Company reports, UBS estimates

Memory WFE Intensity



Source: Company reports, UBS estimates

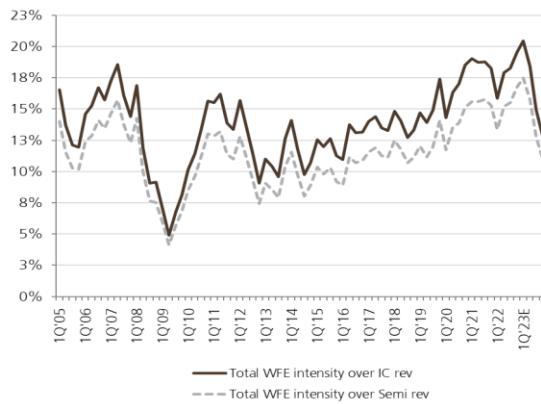
Total WFE Intensity TTM



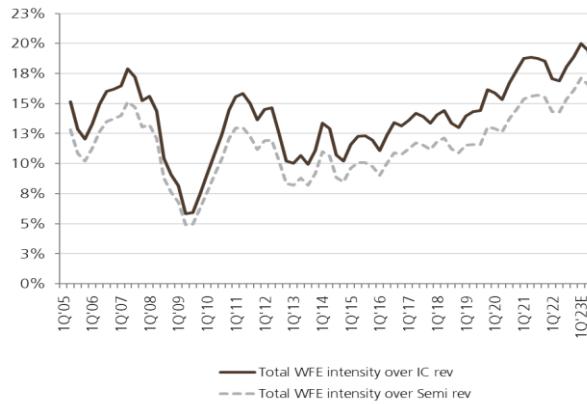
Source: Company reports, UBS estimates

The industry needs to digest current levels of WFE, which is driving a peak in WFE intensity

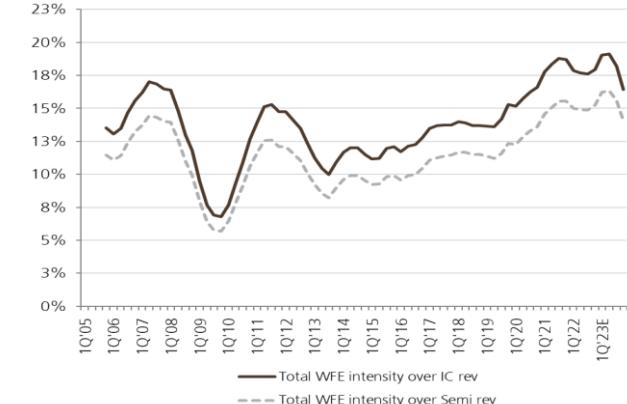
WFE Intensity, Quarterly



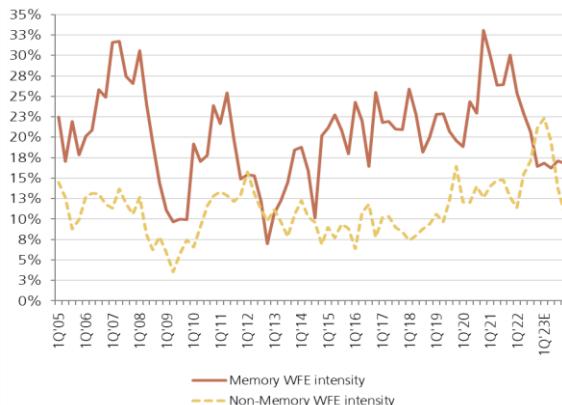
WFE Intensity, Trailing 6M



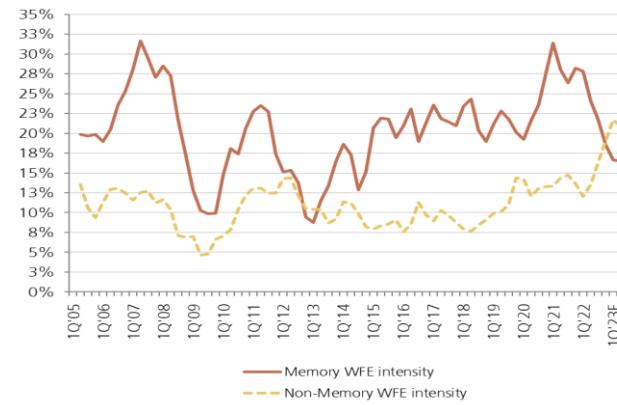
WFE Intensity, TTM



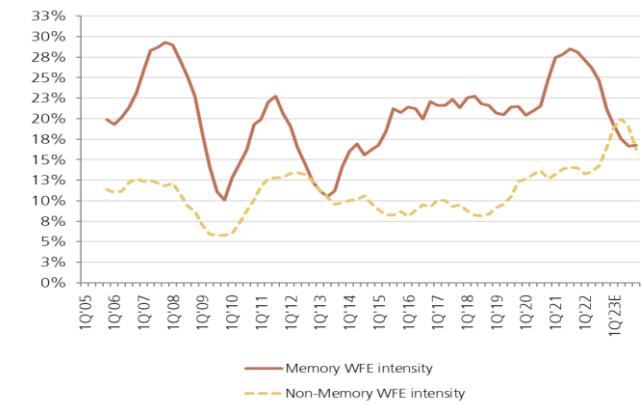
WFE Intensity, Quarterly, by Segment



WFE Intensity, T6M, by Segment



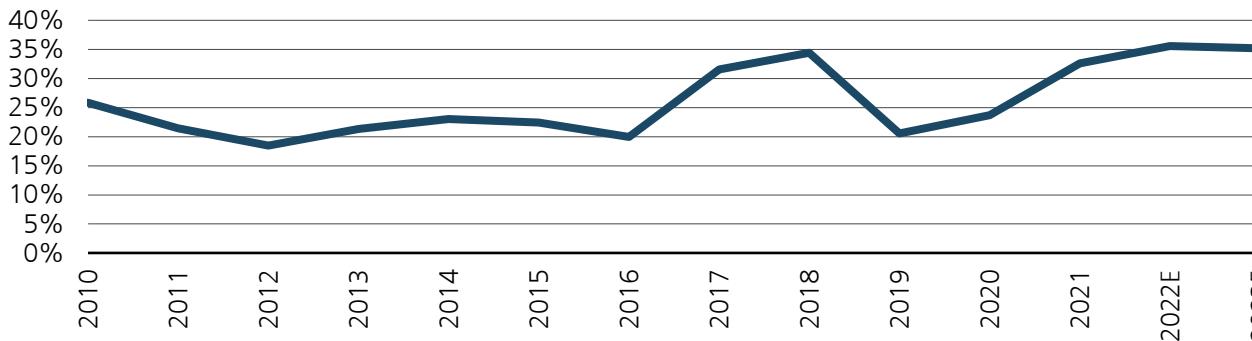
WFE Intensity, TTM, by Segment



Note: We calculate WFE intensity two ways: 1) using IC revenue as the denominator (which excludes discretes/ opto/ passive, and 2) using semiconductor revenue as the denominator (in which we use UBSe Semi revenue forecast).

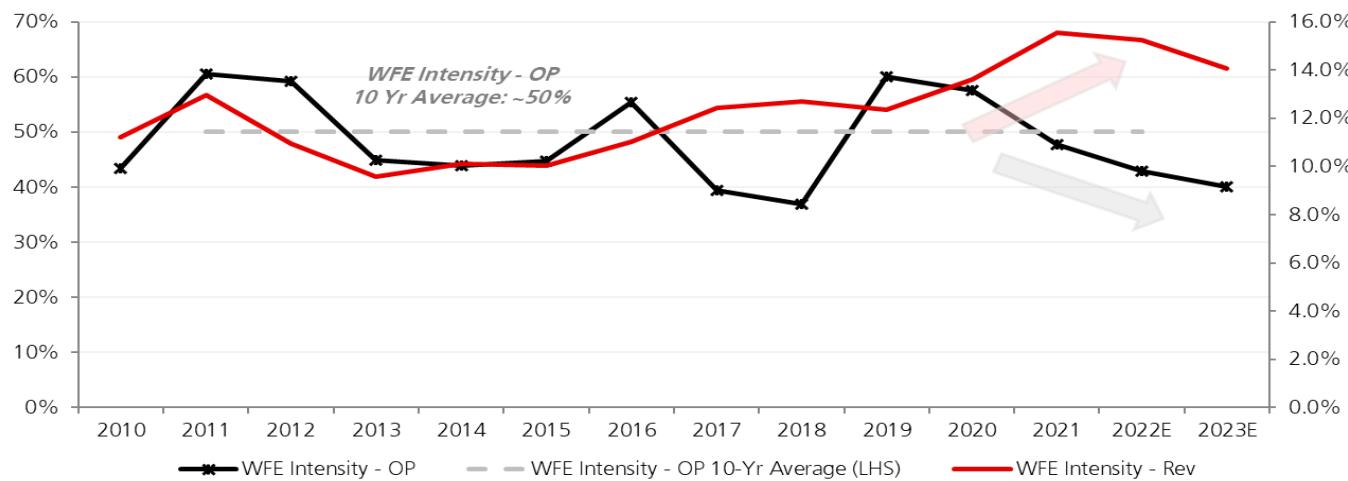
Higher semis margins provide better support for WFE, but chipmakers plan capex based on revenue and not OP

Semiconductor Industry OpM



Source: Factset, Company reports, UBS estimates

WFE Intensity – OpM & Rev

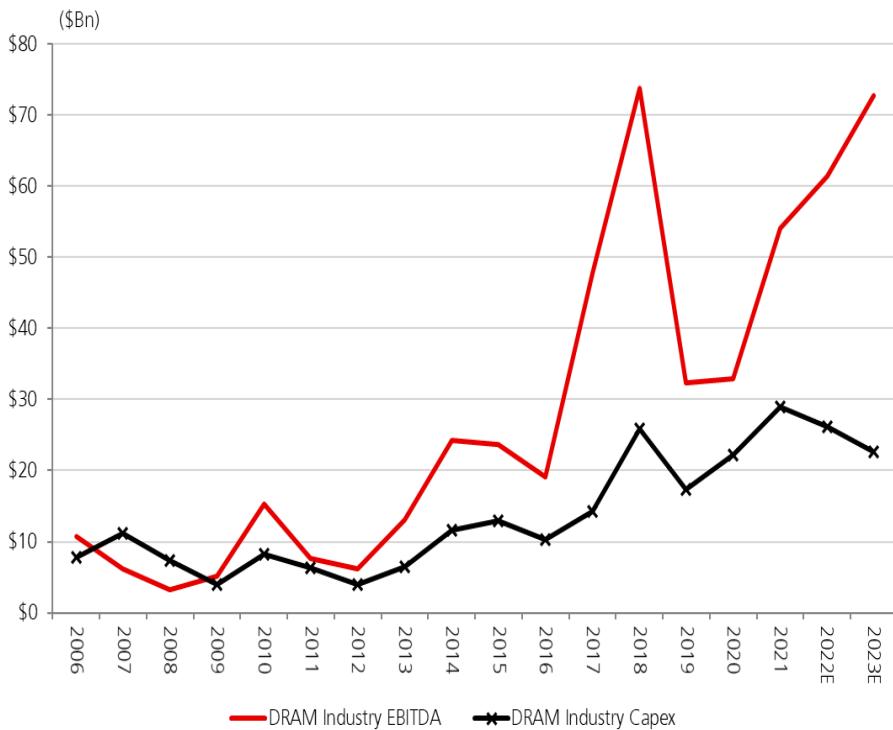


Source: Factset, Company reports, UBS estimates.

Note: Revenue and OP numbers are based on Street estimates and this analysis includes the following companies - Samsung (semis only), INTC, TSMC, SK Hynix, MU, AVGO, QCOM (QCT starting in 2014), TXN, STM, WDC, NXPI, IFX, NVDA, MediaTek, Renesas, Sony (semis only), AMD, ADI, HiSilicon, ON, MCHP, SWKS, and Rohm

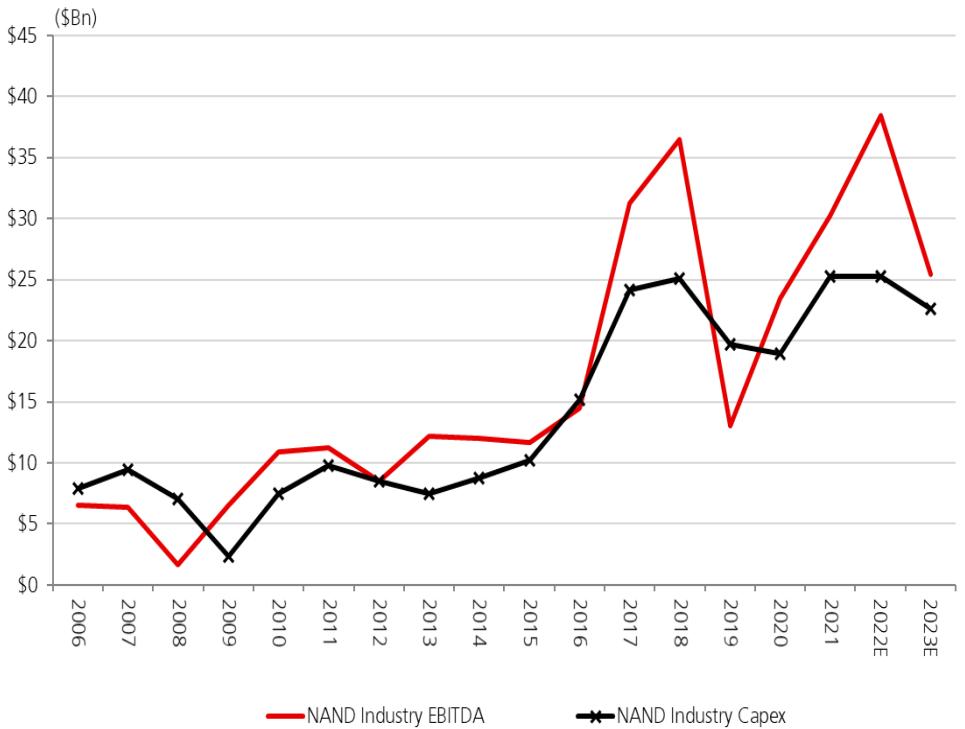
DRAM capex supports much better fundamentals than is the case in NAND where capex oscillates around EBITDA

DRAM Industry Capex & EBITDA



Source: Factset, Company Reports, UBS estimates

NAND Industry Capex & EBITDA



Source: Factset, Company Reports, UBS estimates

EUV: ASML Shipment Summary

ASML EUV shipments by customer

EUV 0.33 NA shipments	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	0.33 + 0.55 NA
<u>Logic</u>															
TSMC	3	10	15	15	20	22	21	21	21	18	18	18	18	18	18
Samsung Foundry	1	2	4	9	11	11	11	12	13	8	9	10	10	10	9
Intel	2	3	3	2	2	8	9	8	12	9	5	5	5	5	5
Global Foundries	1														
Other	1	1	2		1		1			23	27	28	18	19	
Total - Logic	8	16	24	26	34	41	42	41	46	58	59	61	51	51	
<u>DRAM</u>															
Samsung DRAM	0	1	1	4	7	8	8	18	19	14	14	13	12	12	12
SK Hynix	0	1	1	1	1	3	4	5	6	8	8	8	7	7	7
Micron	1	1	0	0	1	1	1	3	4	2	2	3	4	4	4
Total - DRAM	1	3	2	5	9	12	13	26	29	24	24	24	23	23	
Total EUV shipments	9	19	26	31	43	53	55	67	75	82	83	85	74	74	
<u>EUV shipments (product page)</u>															
0.33 NA															
0.55 NA															
0.33 NA	26	31	42	53	68	69	80	82	83	85	85	74	74	74	
0.55 NA	26	31	42	51	66	65	73	72	72	70	70	53	53	53	

Source: UBS estimates

KPIs: Capex/WFE rules of thumb and foundry/logic process node comparisons

Conversion costs, per 1k wsm

Foundry/Logic	Greenfield	Shrink	3D NAND	Greenfield	2D-3D	3D-3D
65nm	50	15	24L	40	N/A	N/A
45nm	70	20	32L TLC	47	18	N/A
32/28nm	85	25	48L TLC	53	25	7
20nm	110	30	64L TLC/QLC	57	29	7
16/14nm FinFET	130	40	96L TLC/QLC	60	32	7
10nm	160	45	128L QLC	63	35	7
7nm	175	50	Dep/Etch Capture of WFE	40%	50%	75%

Note: 3D conversion costs are relative to the prior node

2D NAND	Greenfield	Shrink	DRAM	Greenfield	Shrink
4x to 3x	25	5	3x	15	3
3x to 2x	25	5	25nm	25	7
2x to 1x	30	6	20nm	40	12
1x to 1y	35	9	1y	50	15
1y to 1z	35	9	1z	65	20

Comparison of leading edge process nodes

	IBM	Samsung	TSMC	
Process	HNS	HNS	HNS (FS)	FF
Node name	2nm	3nm	2nm	3nm
CPP (nm)	44	45	44	45
MMP (nm)	18	32	25	22
Density (MTx/mm ²)	333	180	327	315
TEN (TSMC equivalent node)	2.9	4.7	2.9	3.0
				2.1

Source: Company reports, UBS estimates NOTE: 3D layer conversion from 48L to 96L, for example, would require 2x7=14MM/1k wsm

Race in the next generation advanced nodes

Samsung Foundry, TSMC, and Intel's process roadmap



Source: Company reports, UBS estimates

TSMC gen /gen comparison

Node	Launch	Logic density gain	Power reduction	Performance improvement
28nm	Q411	-	-	45%
20nm	Q314	1.9x	33%	15%
16nm	Q315	1.6x	50%	40%
10nm	Q217	2.0x	35%	15%
7nm	Q318	1.6x	40%	20%
5nm	Q220	1.8x	40%	20%
3nm	H222	1.7x	30%	15%
2nm	H225	n.a.	25-30%	10-15%

Source: Company reports, UBS estimates

Samsung gen /gen comparison

Node	Launch	Logic density gain	Power reduction	Performance improvement
32nm/28nm	Q411	1.3x	30%	30%
20nm	Q314	-	-	-
14nm	Q115	-	35%	20%
10nm	Q416	1.6x	-	10%
8nm	Q119	1.2x	-	-
7nm	Q419	1.4x	50%	20%
5nm	Q320	1.33x	20%	10%
3nm	Q322	1.54x	50%	30%

Source: Company reports, UBS estimates

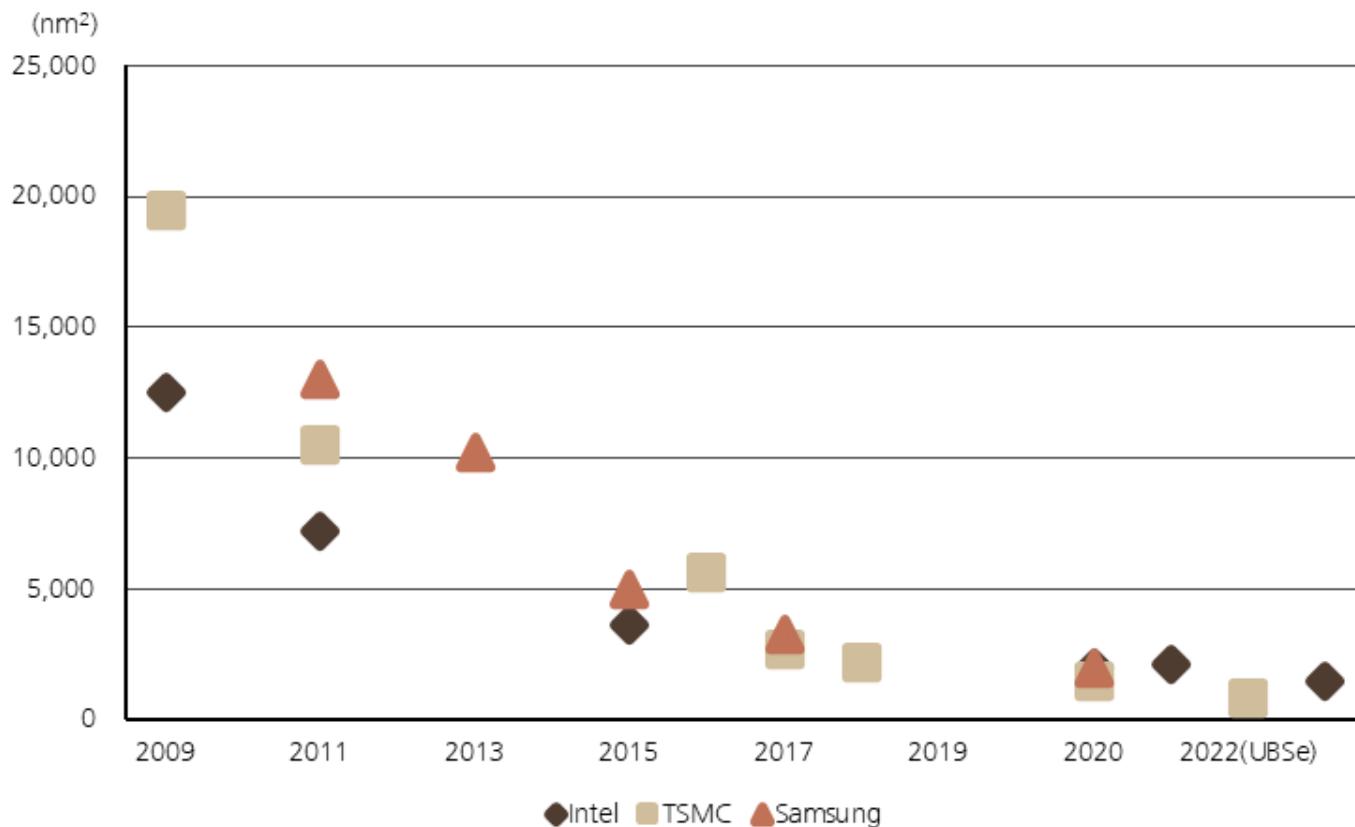
Intel gen /gen comparison

Node	Logic density gain	Power reduction	Performance improvement	Timeline for Client	Timeline for Server
32nm	2.3x	-	20-30%	Westmere - Q110	Westmere - Q110
22nm	1.7x	50%	20%	Ivy bridge - Q212	Ivy bridge - Q313
14nm	2.5x	-	20%	Broadwell - Q314	Broadwell - Q115
14nm+	-	-	12% vs. 14nm	Kaby Lake - Q316	Skylake SP - Q317
14nm++	-	52% vs. 14nm	24% vs. 14nm	Coffee Lake - Q417	Cascade Lake - Q219
10nm	2.7x	50%	25%	Cannon Lake - Q218	Ice Lake SP - Q221
10nm SuperFin	-	-	17.5%	Tiger Lake - Q320	
	-	-	10-15%	Alder Lake - Q421	Sapphire Rapids - production in Q122, shipment in H222;
Intel 7 (prior 10nm ESF)	-	-	Double-digit %	Raptor Lake - shipment in H222	Emerald Rapids (next-gen with improved performance and extension of the memory and security benefits) in 2023
Intel 4 (prior 7nm)	2x	40%	22%	Manufacturing-ready in H222; Meteor Lake (Intel 4 + External N3) - shipment in 2023	
Intel 3 (half-node jump)	-	-	~18%	Begin production in H223; test wafers running in fab in H222	Granite Rapids (Intel 3; P-core) [upgrade from Intel 4 to Intel 3] and Sierra Forest (Intel 3; E-core) in 2024.
Intel 20A	-	-	~15%	Manufacturing-ready in H124; Arrow Lake (Intel 20A + External N3) shipment in 2024; IP test wafers running in fab in H222	
Intel 18A (half-node jump)	-	-	~10%	Manufacturing-ready in H224; Lunar Lake (Intel 18A+ External) shipment in 2024+ foundry customers test chips in H122; first IP shuttle in H222	
Beyond 18A	-	-	TBA		Beyond 2025

Source: Company reports, UBS estimates

Quantifying the three giants' process capability

Process comparison-density (gate pitch times metal pitch; mm²)



Source: Company reports, UBS estimates

ARM-based processors are becoming more powerful with expanding applications to computing-heavy segments

Major developments in ARM-based server CPUs

Company name	Processor	Launch time	Process
Nvidia	Grace	2023E	TSMC 5nm
	Project Denver	Server project cancelled in 2014	
AMD	K12-based Seattle (Opteron A1100)	Suspended 2015	GF 14nm GF 28nm
	Polaris	2023E	TBA
	Siryn	2022E	TSMC 5nm
	Mystique (Altra Max)	2021	TSMC 7nm
Ampere Computing	Quicksilver (Altra)	2020	TSMC 7nm
	Polaris	2023E	TBA
	Siryn	2022E	TSMC 5nm
	Mystique (Altra Max)	2021	TSMC 7nm
AppliedMicro (sold to Ampere)	Skylark (X-Gene 3)	2018 (relaunched under Ampere)	TSMC 16nm
	Shadowcat (X-Gene 2)	2015	TSMC 28nm
	Storm (X-Gene)	2012	TSMC 40nm
	Falkor (Centriq 2400)	2017	Samsung 10nm
Qualcomm	ARMADA XP	2010	40nm
	Triton (ThunderX3)	2020	TSMC 7nm
	Vulcan (ThunderX2)	2018	TSMC 16nm
	ThunderX	2014	28nm
Marvell	EnergyCore ECX-2000	2013	28nm
	EnergyCore ECX-1000	2012	40nm
	Gen 3	2024E	TBA
	Cronos	2022-23E	TSMC 5nm
Cavium (acquired by Marvell)	Rhea	2021-22E	TSMC 6nm
	Kunpeng 920	2019	TSMC 7nm
	S6000	Restricted by Entity List	TSMC 5nm
	S5000	Restricted by Entity List	TSMC 7nm
Calxeda (ceased operations)	S2500	2020	TSMC 16nm
	FT-2000+	2016	TSMC 16nm
	FT-1500A	2014	28nm
	Yitian 710	2021	TSMC 5nm
Phytium	Graviton3	2021	TSMC 5nm
	Graviton2	2018	TSMC 7nm
	Graviton1	2017	TSMC 16nm
	A64FX	2019	TSMC 7nm
Cloud service provider & System house		Potentially developing?	
		Potentially developing?	
		Potentially developing?	

Overview of Apple's M-series CPU

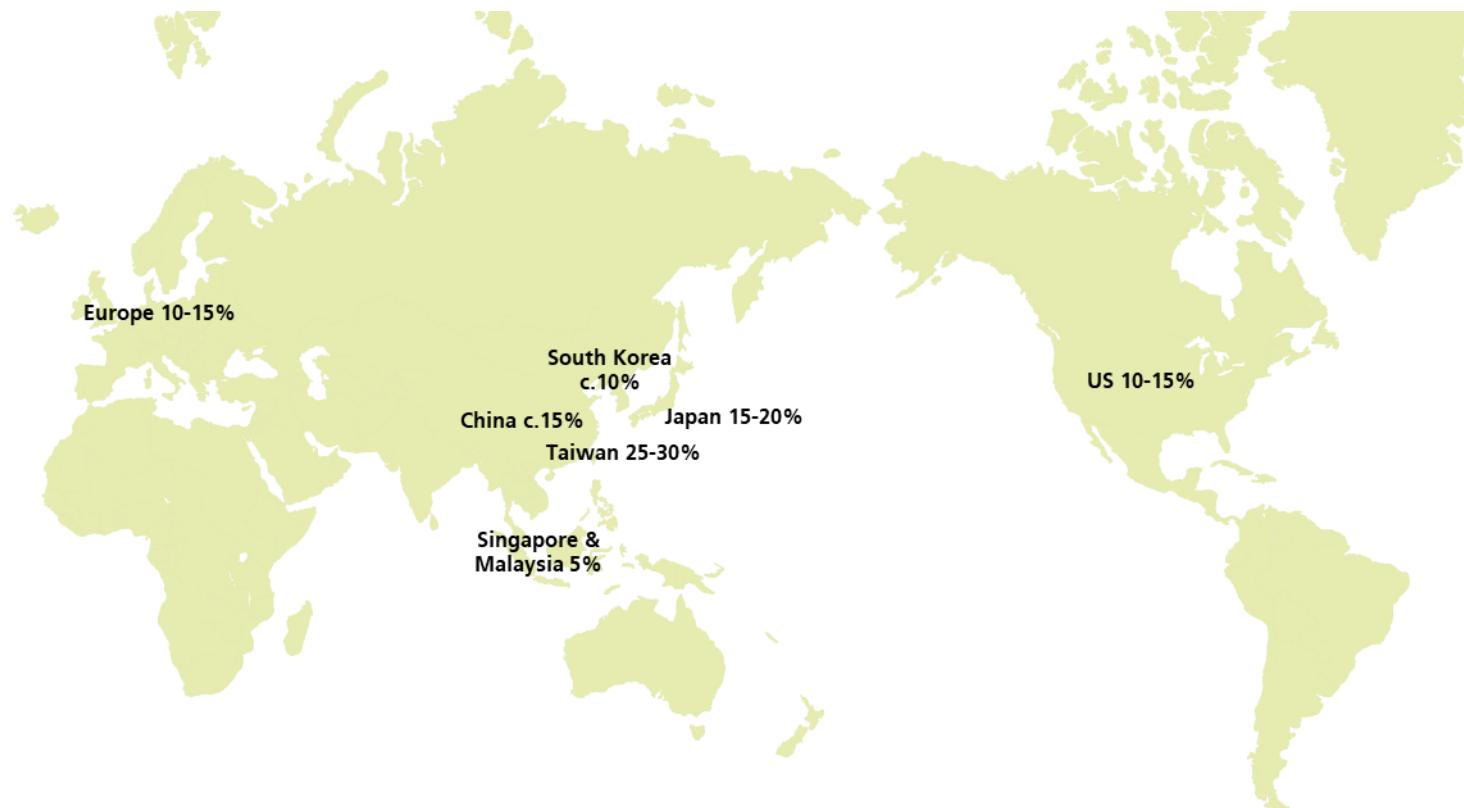
Year	Model number	Manufacturer	Process	Packaging	# of transistors (bn)	Die size	MTr/mm ²
2020	M1	TSMC	N5 FinFET	FCBGA	16	120.4	132.9
2021	M1 Pro	TSMC	N5P FinFET	InFO_oS	34	245.9	137.0
2021	M1 Max	TSMC	N5P FinFET	InFO_oS	57	432.4	131.8
2022	M1 Ultra	TSMC	N5P FinFET	InFO-LSI	114	860.0	132.6
2022	M2	TSMC	N5P FinFET	TBC	20	TBC	TBC

Source: Company reports, UBS estimates

Note: GF is abbreviation for GlobalFoundries

Increasing government efforts in pushing domestic semiconductor production

Global logic semiconductor capacity by region in 2020



Source: Gartner, UBS estimates

The US has dedicated itself to revitalize domestic semiconductor production to reduce reliance on Asia

Key milestones of the US Chips Act

Name of the Act	Description	Time of introduction	Latest status
H.R.6395 - William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021	Federal investment in any individual project shall not exceed US\$3bn unless a larger investment is necessary to (i) significantly increase the proportion of reliable domestic supply of semiconductors relevant for national security and economic competitiveness that can be met through domestic production; and (ii) meet the needs of national security.	Introduced in the House on 03/26/2020	Public Law No: 116-283 (01/01/2021)
S.3933 - CHIPS for the America Act Creating Helpful Incentives to Produce Semiconductors for America Act or the CHIPS for America Act	The bill provides an income tax credit for semiconductor equipment or manufacturing facility investment through 2026. The bill also establishes a trust fund to be allocated upon reaching an agreement with foreign government partners to promote (1) consistency in policies related to microelectronics, (2) transparency in microelectronic supply chains, and (3) alignment in policies towards nonmarket economies.	Introduced in House 06/10/2020	
S.1260 - United States Innovation and Competition Act of 2021	Provides funding US\$52bn in total for FY2022-FY2026 to support US semiconductor manufacturing, research and development, and supply chain security Provides funding for wireless supply chain innovation	Introduced in the Senate on 04/20/2021	Passed Senate on 06/08/2021
S.2107 - FABS Act <i>Facilitating American-Built Semiconductors Act or the FABS Act</i>	This bill allows a new tax credit for investment in a semiconductor manufacturing facility and semiconductor manufacturing property	Introduced in the Senate on 06/17/2021	
H.R.4521 - America COMPETES Act of 2022 <i>United States Innovation and Competition Act of 2021</i>	The America COMPETES Act includes investments for: 1) Supercharging investments in semiconductor chips with US\$52bn to support US production of semiconductors; 2) Strengthening supply chains and manufacturing at home with US\$45bn to improve our nation's supply chains and strengthen our economy and national security by preventing shortages of critical goods and ensuring that more of these goods are made right here in the United States; 3) Advancing American scientific research and innovation excellence with a suite of bipartisan science, research and technology bills to increase American innovation; 4) Promoting US global leadership by positioning the interests and values of the United States to win on the world stage, including strong action to hold the People's Republic of China accountable for its trade abuses and human rights violations.	Introduced in the House on 07/19/2021	The Senate voted 68-28 to substitute the text of H.R. 4521, the America COMPETES Act of 2022, with the text of the Senate's U.S. Innovation and Competition (USICA) of 2021. It then voted 68-28 to approve the amended bill, sending it back to the House. The House is expected to reject the substituted legislation and request a Senate and House conference to reconcile the differences.
H.R.7104 - FABS Act <i>Facilitating American-Built Semiconductors Act or the FABS Act</i>	This bill allows a new tax credit through 2032 for investment in any semiconductor manufacturing facility and for semiconductor design expenditures.	Introduced in the House on 03/16/2022	

Source: Congress.gov, UBS

The European Chips Act aims to increase Europe's semiconductor production capacity share to 20% of the global market by 2030

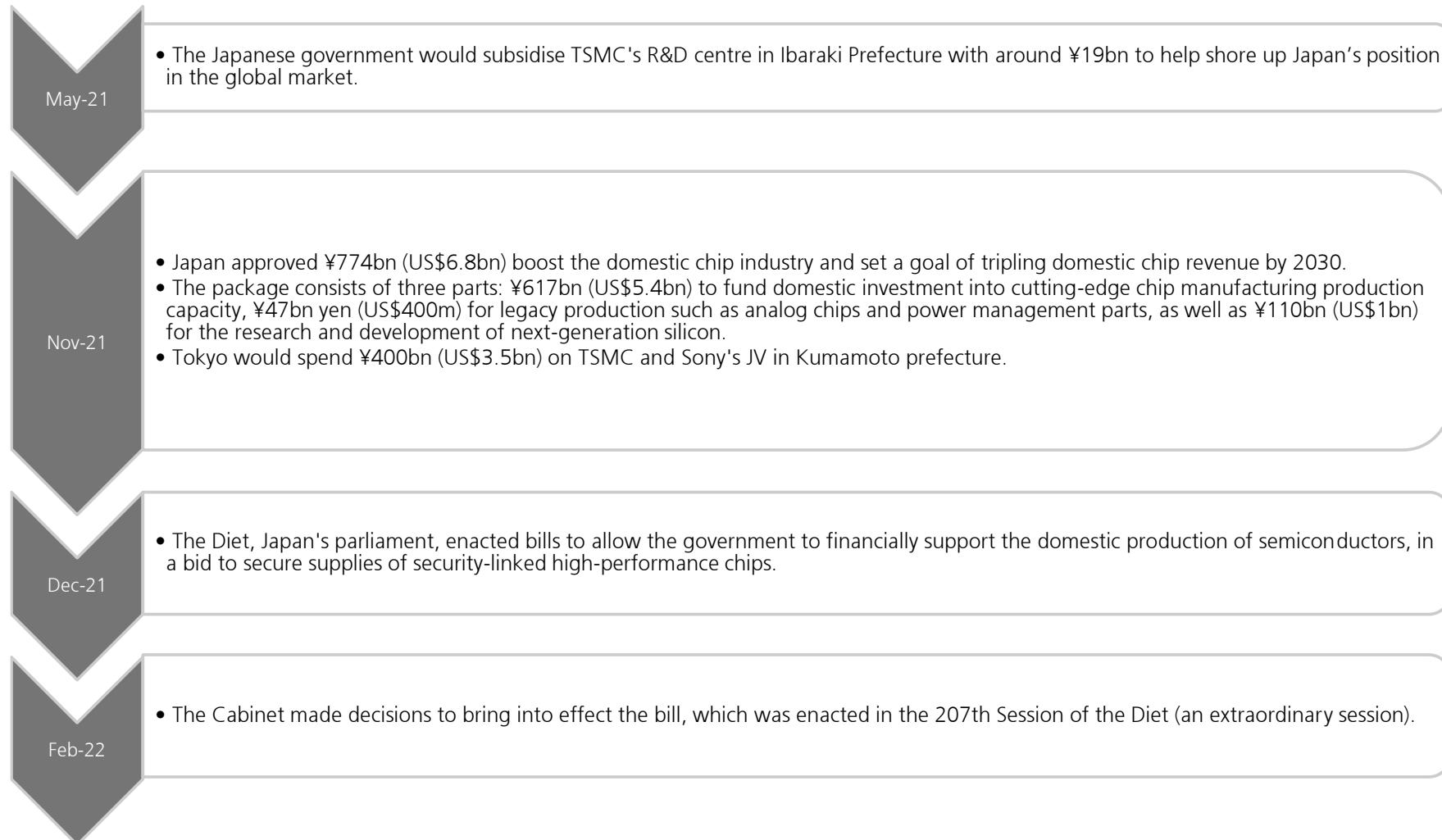
Key milestones of the European Chips Act



Source: European Commission, UBS

The Japanese government first approved a ¥19bn package to fund TSMC's advanced packaging and testing R&D center in Ibaraki Prefecture

Key milestones of the Japan's government support of semiconductor production



Source: METI, Bloomberg, UBS

Intel's new business strategy “IDM 2.0” aims to reaccelerate its process roadmap, reenter the foundry space but also co-work with external foundry partners

Intel's major expansion projects

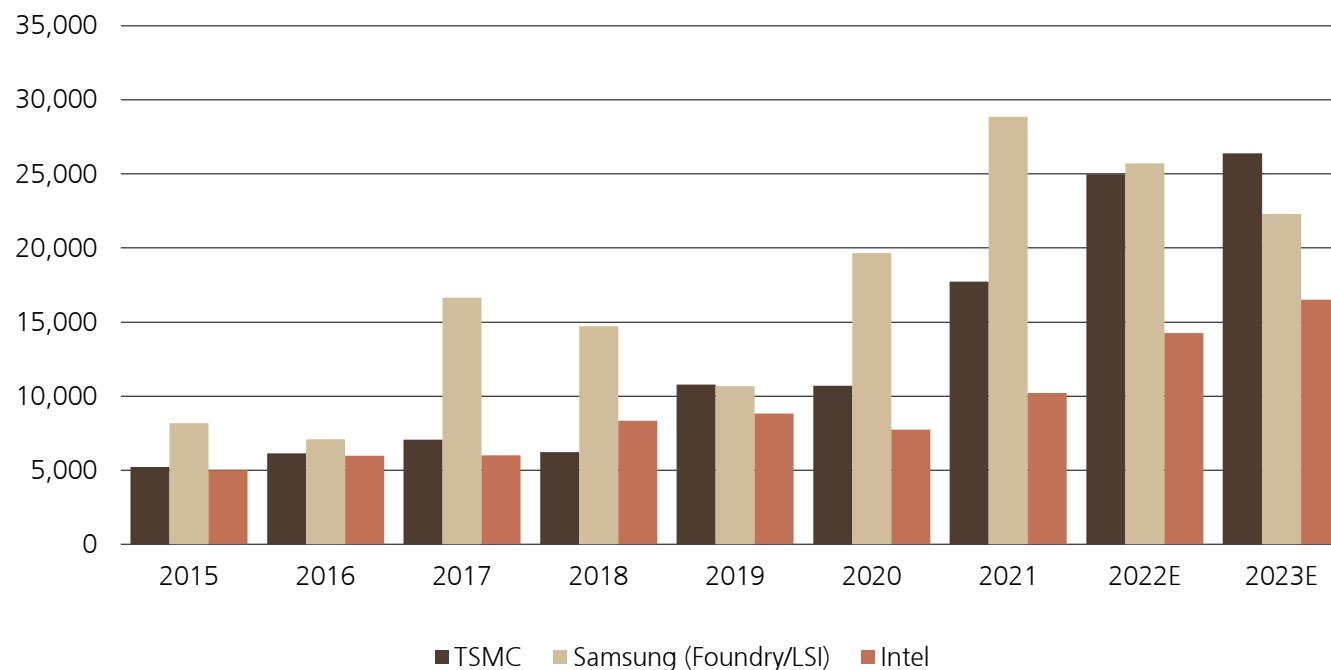
Company	Location	Technology	Invested capital (US\$bn)	Expected timeline	Remarks
	Magdeburg, Germany	Angstrom scale	18.6	Construction: H123 Production: 2027	Intel plans to invest €17bn initially to build 2 new advanced fabs in Germany to serve foundry customers and itself. Construction is expected to begin in H123, and production timeline is expected in 2027, pending European Commission approval.
	Ohio, US	Angstrom scale (Intel 18A)	20+	Construction: Late 2022 Production: End-2025	1) The initial investment will be US\$20bn+ including two new advanced fabs to serve Intel itself and foundry customers. It will be able to provide Angstrom-era technologies, including Intel 18A. 2) Intel will invest US\$100bn in the Ohio site over the next decade, while the scope and pace depend on the funding from the CHIPS Act. The megasite in Ohio can accommodate up to eight fabs.
	Leixlip, Ireland	Intel 4	13	TBA	Intel will spend an additional €12bn to double the manufacturing space of its Ireland fab to bring Intel 4 process and expand foundry services.
Intel	Leixlip, Ireland	Intel 7	7	Construction: 2019 Production: 2023	The Fab 34 project in Ireland began in 2019, and Intel kicked off the equipment move-in in early 2022. It plans to commence fab operations in 2023.
	Arizona, US	Intel 7 and below	20	Construction: 2021 Production: 2024	Intel is now building Fab 52 and Fab 62 in Arizona, and plans a US\$20bn outlay.
	Kiryat Gat, Israel	10nm and Intel 7	10	Construction: 2021	Intel CEO Patrick Gelsinger confirmed a new US\$10bn fab in Kiryat Gat, Israel in May 2021.
	Agrate Brianza, Italy	90/65nm	N/A	Production: H222	1) The Agrate R3 facility is acquired via the TowerJazz transaction. TowerJazz has pledged to co-invest in the fab with STMicro. 2) The total design capacity is 60kwpm, and TowerJazz could share 20kwpm. TowerJazz previously expected the equipment move-in to take place by end-2021, and the production to commence for automotive, industrial and personal electronics in H222.
	Italy	Advanced packaging	4.9	Production: 2025-27	Still under negotiation with the Italian government. Potential investment will be up to €4.5bn, operational between 2025 and 2027.
	Malaysia	Advanced packaging	7.1	Production: 2024	Intel CEO Patrick Gelsinger commented the company would spend RM30bn (US\$7.1bn) in Malaysia over a decade to build backend facilities.
	New Mexico, US	Advanced packaging	3.5	TBC	Intel CEO Patrick Gelsinger announced Intel would spend US\$3.5bn in its Rio Rancho campus in New Mexico to expand advanced packaging production, notably Foveros and EMIB.

Source: Company data, UBS

Note: The Agrate R3 facility is acquired via the TowerJazz transaction

Intel has demonstrated firm commitment and aggressive planning to expand capacity scale to support its own production and foundry business

WFE of TSMC vs Intel vs Samsung Foundry, 2015-23E (US\$ MM)



Source: Company data, UBS estimates

Section 9

Company Summaries

ADI: Analog Devices

Investment Thesis/Risks

Our thesis	We see ADI as one of the highest-quality diversified Analog franchises that is levered to multiple growth vectors - Industrial Automation, Electric Vehicles, 5G, Space, Renewables and Healthcare. Capital allocation strategies of the two largest players in Analog are diverging and we see ADI as being best positioned for through cycle performance in the specialized Analog era and this was highlighted by: 1) ADI integrating software on top of its premium product portfolio to build customized solutions in Autos/Industrial/Comms that ultimately sets it on a path to ~40% FCF margins; 2) expanding 300 mm capacity within a balanced manufacturing model that builds in flexibility/resilience in a cycle; 3) consistent capital return.
Risks to our thesis	ADI is subject to macro cycles – particularly exposed to the industrial vertical – and remains supply constrained in the near term.

Source: UBS estimates

UBS vs Street

	F2019	F2020	F2021	2022/1F	2022/2F	2022/3F	2022/4F	F2022	F2023	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)															
UBS	\$5,991	\$5,603	\$7,318	\$2,684	\$2,972	\$3,054	\$3,097	\$11,807	\$12,530	\$6,199	\$5,754	\$5,858	\$8,444	\$12,284	\$12,536
UBS (old)						\$3,054	\$3,097	\$11,807	\$12,530					\$12,284	\$12,536
Consensus						\$3,055	\$3,107	\$11,818	\$12,546					\$12,216	\$12,652
Delta						(0.0%)	(0.3%)	(0.1%)	(0.1%)					0.6%	(0.9%)
EPS (non-GAAP)															
UBS	\$5.15	\$4.91	\$6.46	\$1.94	\$2.40	\$2.44	\$2.51	\$9.29	\$10.39	\$5.83	\$4.85	\$5.31	\$6.92	\$9.96	\$10.27
UBS (old)						\$2.44	\$2.51	\$9.29	\$10.39					\$9.96	\$10.27
Consensus						\$2.43	\$2.50	\$9.27	\$9.98					\$9.76	\$10.12
Delta						0.6%	0.6%	0.3%	4.2%					2.1%	1.5%

Source: Company reports, UBS estimates

ADI: Model Summary

Analog Devices (ADI) - Key Metrics (in \$MM except EPS)	C2018A	C2019A	C2020A	C2021A	FQ2A CQ1A	Estimates FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	FQ2E CQ1E	FQ3E CQ2E	FQ4:23E CQ3E	FQ1E CQ4E	C2023E	FISCAL YEAR SUMMARY							
	\$6,199	\$5,754	\$5,858	\$8,444	\$2,972	\$3,054	\$3,097	\$3,161	\$12,284	\$3,101	\$3,112	\$3,156	\$3,167	\$12,536	F2018A	F2019A	F2020A	F2021A	F2022E	F2023E		
Revenue	\$6,199	\$5,754	\$5,858	\$8,444	\$2,972	\$3,054	\$3,097	\$3,161	\$12,284	\$3,101	\$3,112	\$3,156	\$3,167	\$12,536	\$6,225	\$5,991	\$5,603	\$7,318	\$11,807	\$12,530		
Y/Y Growth	9%	(7%)	2%				32%	18%		4%	2%	2%	0%	2%	22%	(4%)	(6%)				6%	
Gross Profit (Non-GAAP)	\$4,399	\$3,999	\$4,067	\$6,027	\$2,205	\$2,260	\$2,292	\$2,339	\$9,096	\$2,285	\$2,287	\$2,310	\$2,312	\$9,195	\$4,431	\$4,189	\$3,870	\$5,186	\$8,688	\$9,222		
Gross Margin	71.0%	69.5%	69.4%	71.4%	74.2%	74.0%	74.0%	74.0%	74.0%	73.7%	73.5%	73.2%	73.0%	73.3%	71.2%	69.9%	69.1%	70.9%	73.6%	73.6%		
R&D SG&A	\$1,164	\$1,100	\$1,082	\$1,435	\$421	\$435	\$435	\$443	\$1,733	\$436	\$450	\$450	\$458	\$1,795	\$1,165	\$1,130	\$1,051	\$1,296	\$1,718	\$1,779		
SG&A	\$686	\$680	\$646	\$1,028	\$305	\$315	\$315	\$311	\$1,247	\$312	\$291	\$279	\$293	\$1,176	\$696	\$648	\$660	\$915	\$1,233	\$1,194		
Opx (Non-GAAP)	\$1,790	\$1,720	\$1,679	\$2,330	\$710	\$750	\$750	\$754	\$2,964	\$748	\$742	\$730	\$841	\$3,061	\$1,787	\$1,756	\$1,636	\$2,083	\$2,913	\$2,973		
Y/Y Growth	5%	(4%)	(2%)		39%	47%	52%	15%	7%	27%	5%	(1%)	(3%)	12%	3%	15%	(2%)	(7%)	27%	40%	2%	
Operating Income (Non-GAAP)	\$2,609	\$2,279	\$2,388	\$3,697	\$1,495	\$1,510	\$1,542	\$1,585	\$6,132	\$1,537	\$1,546	\$1,580	\$1,471	\$6,134	\$2,644	\$2,433	\$2,234	\$3,104	\$5,775	\$6,248		
Operating Margin	42.1%	39.6%	40.8%	43.8%	50.3%	49.4%	49.8%	50.1%	49.9%	49.6%	49.7%	50.1%	46.4%	48.9%	42.5%	40.6%	39.9%	42.4%	48.9%	49.9%		
Non-GAAP EPS	\$5.83	\$4.85	\$5.31	\$6.92	\$2.40	\$2.44	\$2.51	\$2.61	\$9.96	\$2.55	\$2.58	\$2.66	\$2.48	\$10.27	\$5.99	\$5.15	\$4.91	\$6.46	\$9.29	\$10.39		
Free Cash Flow																						
CFFO	\$2,425	\$2,231	\$2,087	\$3,164	\$1,222	\$1,178	\$1,352	\$1,443	\$5,195	\$1,449	\$1,409	\$1,414	\$1,530	\$5,803	\$2,442	\$2,253	\$2,008	\$2,735	\$4,608	\$5,715		
Capex	\$283	\$239	\$178	\$387	\$119	\$183	\$186	\$253	\$741	\$248	\$218	\$221	\$253	\$940	\$255	\$275	\$166	\$344	\$599	\$940		
FCF	\$2,143	\$1,992	\$1,909	\$2,776	\$1,103	\$994	\$1,166	\$1,190	\$4,454	\$1,201	\$1,191	\$1,193	\$1,277	\$4,862	\$2,187	\$1,978	\$1,843	\$2,391	\$4,009	\$4,776		
% revenue	35%	35%	33%	33%	37%	33%	38%	38%	36%	39%	38%	38%	40%	39%	35%	33%	33%	33%	34%	38%		
Y/Y Growth	26%	(7%)	(4%)		45%	63%	83%	44%	60%	9%	20%	2%	7%	9%	141%	(10%)	(7%)	30%	68%	19%		
Segment Revenue																						
Industrial				\$4,330	\$1,501	\$1,531	\$1,531	\$1,546	\$6,110	\$1,562	\$1,531	\$1,531	\$1,500	\$6,123				\$4,008	\$5,904	\$6,170		
ADI Stand-alone	\$3,095	\$2,966	\$3,152			12%	2%	--	1%		1%	(2%)	--	(2%)		\$3,143	\$3,011	\$2,988	\$3,844			
Q/Q Growth											4%	(0%)	(0%)	(3%)	0%							
Y/Y Growth	14%	(4%)	6%								4%	(0%)	(0%)	(3%)	0%	17%	(4%)	(1%)	29%		4%	
Automotive				\$1,367	\$634	\$640	\$653	\$679	\$2,606	\$659	\$672	\$672	\$685	\$2,688				\$1,246	\$2,480	\$2,682		
ADI Stand-alone	\$991	\$896	\$820			15%	1%	2%	4%		(3%)	2%	--	2%	3%		\$1,010	\$931	\$779	\$1,060		
Q/Q Growth											4%	5%	3%	1%	3%							
Y/Y Growth	7%	(10%)	(8%)								4%	5%	3%	1%	3%	9%	(8%)	(16%)	36%		8%	
Communications				\$1,263	\$473	\$483	\$492	\$502	\$1,950	\$512	\$512	\$512	\$527	\$2,064				\$1,198	\$1,860	\$2,038		
ADI Stand-alone	\$1,238	\$1,187	\$1,234			15%	2%	2%	22%		2%	--	--	3%	6%		\$1,151	\$1,295	\$1,196	\$1,132		
Q/Q Growth											8%	6%	4%	5%	6%							
Y/Y Growth	24%	(4%)	4%								8%	6%	4%	5%	6%	10%	12%	(8%)	(5%)		10%	
Consumer				\$925	\$364	\$400	\$420	\$433	\$1,618	\$368	\$397	\$441	\$454	\$1,661				\$866	\$1,563	\$1,640		
ADI Stand-alone	\$896	\$712	\$653			(4%)	10%	5%	3%		(15%)	8%	11%	3%	3%		\$934	\$754	\$640	\$723		
Q/Q Growth											1%	(1%)	5%	5%	3%		(11%)	(19%)	(15%)	13%		
Y/Y Growth	(14%)	(21%)	(8%)												3%						5%	

Source: Company reports, UBS estimates

AMD: Advanced Micro Devices

Investment Thesis/Risks

Our thesis	AMD's core business is well positioned to continue gaining share in core CPU markets through at least 2024 in both client and server applications. For server, we see AMD exiting C2022 ~15% share (of the full ~40MM server unit TAM) followed by an incremental ~400bps+ of gain in 2023. The question to us remains one of sustainability beyond that timeframe as we see INTC's new Alder Lake (PC) SKU as being much more competitive part and this could foreshadow a more competitive Sapphire Rapids product in 2023 and Granite Rapids on a more competitive process node in 2024. In the meantime, we see the XLNX deal as being growth dilutive and although XLNX diversifies AMD into other verticals, we do not see XLNX bolstering AMD's Data Center software ecosystem.
Risks to our thesis	INTC has set a very aggressive path that should close the competitive balance, but it has a lot of balls in the air and execution has been poor. Further, capacity allocation should continue to favor AMD given a long term partnership with TSMC. Additionally, the XLNX deal diversifies the story into Comms, which should further bolster the AMD story and add scale to accelerate development and push into new verticals.

Source: UBS estimates

UBS vs Street

	2018	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	2024	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	CY2024
Revenues (\$MM)	\$6,475	\$6,731	\$9,763	\$16,434	\$5,887	\$6,574	\$6,812	\$7,088	\$26,360	\$30,038	\$33,006	\$6,475	\$6,731	\$9,763	\$16,434	\$26,360	\$30,038	\$33,006
UBS				\$16,167					\$26,360	\$30,038	\$33,006					\$26,360	\$30,038	\$33,006
UBS (old)				\$16,434					\$26,138	\$29,706	\$34,076					\$26,138	\$29,706	\$34,076
Consensus																		
Delta																		
EPS	\$0.44	\$0.64	\$1.28	\$2.79	\$1.13	\$1.05	\$1.08	\$1.08	\$4.33	\$4.76	\$5.26	\$0.44	\$0.64	\$1.28	\$2.79	\$4.33	\$4.76	\$5.26
UBS				\$2.65					\$4.33	\$4.76	\$5.26					\$4.33	\$4.76	\$5.26
UBS (old)				\$2.79					\$4.31	\$4.79	\$5.73					\$4.31	\$4.79	\$5.73
Consensus																		
Delta																		

Source: Company reports, UBS estimates

AMD: Model Summary

Advanced Micro Devices (AMD) - Key Metrics (in \$MM except EPS and Units)	F2018A C2018A	F2019A C2019A	F2020A C2020A	F2021A C2021A	FQ1A CQ1A	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2023E C2023E	F2024E C2024E
Revenue	\$6,475	\$6,731	\$9,763	\$16,434	\$5,887	\$6,574	\$6,812	\$7,088	\$26,360	\$6,962	\$7,239	\$7,665	\$8,173	\$30,038	\$33,006
YY Growth	23%	4%	45%	68%	71%	71%	58%	47%	60%	18%	10%	13%	15%	14%	10%
Gross Profit (Non-GAAP)	\$2,496	\$2,874	\$4,352	\$7,934	\$3,100	\$3,550	\$3,678	\$3,827	\$14,155	\$3,773	\$3,945	\$4,193	\$4,495	\$16,406	\$18,323
Gross Margin	38.5%	42.7%	44.6%	48.3%	52.6%	54.0%	54.0%	54.0%	53.7%	54.2%	54.5%	54.7%	55.0%	54.6%	55.5%
Semi-Custom GM (UBSe)					18%	18%	24%	25%	26%	27%	26%	28%	29%	28%	30%
Ex-Semi-Custom GM (UBSe)					47%	50%	55%	60%	60%	60%	60%	60%	60%	60%	60%
R&D (GAAP)	\$1,434	\$1,547	\$1,983	\$2,845	\$1,060	\$1,060	\$1,100	\$1,200	\$4,420	\$1,200	\$1,250	\$1,300	\$1,350	\$5,100	\$5,625
SG&A (GAAP)	\$562	\$750	\$995	\$1,448	\$597	\$600	\$650	\$700	\$2,547	\$650	\$675	\$675	\$700	\$2,700	\$2,950
Other & Non-GAAP Adjustment (GAAP)	--	(\$60)	--	(\$12)	\$210	--	--	--	\$210	--	--	--	--	--	--
Total Opex (Non-GAAP)	\$1,863	\$2,094	\$2,696	\$3,877	\$1,346	\$1,555	\$1,640	\$1,785	\$6,326	\$1,730	\$1,805	\$1,855	\$1,930	\$7,320	\$8,075
Y/Y Growth	19%	12%	29%	44%	62%	71%	58%	62%	63%	29%	16%	13%	8%	16%	10%
Operating Income (Non-GAAP)	\$633	\$840	\$1,657	\$4,069	\$1,837	\$1,994	\$2,037	\$2,041	\$7,909	\$2,042	\$2,139	\$2,337	\$2,564	\$9,082	\$10,244
Operating Margin	9.8%	12.5%	17.0%	24.8%	31.2%	30.3%	29.9%	28.8%	30.0%	29.3%	29.6%	30.5%	31.4%	30.2%	31.0%
Non-GAAP EPS	\$0.44	\$0.63	\$1.28	\$2.79	\$1.13	\$1.05	\$1.08	\$1.08	\$4.33	\$1.08	\$1.12	\$1.22	\$1.33	\$4.76	\$5.26
Free Cash Flow															
CFFO	\$34	\$493	\$1,071	\$3,521	\$995	\$1,445	\$1,777	\$1,770	\$5,987	\$1,063	\$1,833	\$1,941	\$2,111	\$6,948	\$8,712
Capex	\$163	\$217	\$294	\$301	\$38	\$35	\$35	\$35	\$143	\$38	\$35	\$35	\$35	\$143	\$200
FCF	(\$129)	\$276	\$777	\$3,220	\$957	\$1,410	\$1,742	\$1,735	\$5,844	\$1,025	\$1,798	\$1,906	\$2,076	\$6,805	\$8,512
% revenue	(2%)	4%	8%	20%	16%	21%	26%	24%	22%	15%	25%	25%	25%	23%	26%
Segment Revenues															
DT Revenue	\$1,714	\$1,999	\$2,327	\$2,491	\$701	\$680	\$612	\$551	\$2,544	\$508	\$467	\$481	\$495	\$1,951	\$1,862
AMD DT ASP (\$)	\$138	\$123	\$145	\$167	\$200	\$200	\$200	\$200	\$200	\$190	\$190	\$190	\$190	\$190	\$190
AMD DT Units (K)	12,448	16,273	16,037	14,937	3,505	3,400	3,060	2,754	12,719	2,671	2,458	2,531	2,607	10,268	9,799
DT TAM (K units)	92,984	92,186	83,739	85,771	19,278	17,864	20,011	23,340	80,493	18,451	17,674	19,877	22,565	78,567	78,567
AMD Share	13%	18%	19%	17%	18%	19%	15%	12%	16%	14%	14%	13%	12%	13%	12%
Mobile Revenue	\$860	\$1,392	\$2,863	\$4,338	\$1,465	\$1,354	\$1,381	\$1,381	\$5,581	\$1,308	\$1,203	\$1,323	\$1,429	\$5,263	\$5,552
AMD Mobile ASP (\$)	\$47	\$53	\$62	\$78	\$111	\$110	\$110	\$110	\$110	\$112	\$112	\$112	\$112	\$112	\$112
AMD Mobile Units (K)	18,438	26,350	46,142	55,274	13,235	12,308	12,554	12,554	50,651	11,675	10,741	11,816	12,761	46,993	49,567
Mobile TAM (K units)	183,520	182,052	244,208	272,132	57,556	58,037	54,763	53,564	223,920	52,855	54,163	54,091	54,347	215,456	221,920
AMD Share	10%	14%	19%	20%	23%	21%	23%	23%	23%	22%	20%	22%	23%	22%	22%
GPU Revenue (UBSe)	\$1,864	\$1,318	\$1,243	\$2,503	\$636	\$800	\$840	\$952	\$3,228	\$700	\$880	\$924	\$1,047	\$3,550	\$3,657
Gaming GPU Revenue(UBSe)	\$1,308	\$842	\$870	\$1,839	\$556	\$700	\$730	\$842	\$2,828	\$612	\$770	\$809	\$932	\$3,122	\$3,187
DC GPU Revenue (UBSe)	\$140	\$210	\$142	\$380	\$80	\$100	\$110	\$110	\$400	\$88	\$110	\$115	\$115	\$428	\$470
Computing and Graphics	\$4,306	\$4,709	\$6,433	\$9,332	\$2,802	\$2,834	\$2,833	\$2,883	\$11,352	\$2,515	\$2,550	\$2,728	\$2,971	\$10,764	\$11,070
Q/Q Growth					8%	1%	(0%)	2%		(13%)	1%	7%	9%		
Y/Y Growth	45%	9%	37%	45%	33%	26%	18%	12%	22%	(10%)	(10%)	(4%)	3%	(5%)	3%
Server Revenue (UBSe)	\$319	\$900	\$1,621	\$3,508	\$1,251	\$1,378	\$1,538	\$1,717	\$5,884	\$1,889	\$2,059	\$2,244	\$2,446	\$8,637	\$11,153
AMD Server ASP (\$)	\$558	\$736	\$783	\$925	\$1,024	\$1,025	\$1,050	\$1,075	\$1,045	\$1,085	\$1,085	\$1,085	\$1,085	\$1,085	\$1,085
AMD Server Units (K)	572	1,223	2,072	3,794	1,222	1,344	1,465	1,597	5,628	1,741	1,897	2,068	2,254	7,961	10,280
Server TAM (K units)	31,248	31,183	35,342	37,734	10,008	10,060	9,675	10,284	40,027	10,096	11,051	11,121	11,529	43,797	43,797
AMD Share	2%	4%	6%	10%	12%	13%	15%	16%	14%	17%	17%	19%	20%	18%	23%
Semicustom Revenue	\$1,685	\$950	\$1,568	\$3,401	\$1,175	\$1,200	\$1,225	\$1,250	\$4,850	\$1,275	\$1,300	\$1,325	\$1,350	\$5,250	\$4,475
Embedded	\$191	\$153	\$140	\$192	\$100	\$100	\$100	\$100	\$400	\$100	\$100	\$100	\$100	\$400	\$400
Other (IP)	\$160	\$20	--	--	--	--	--	--	--	--	--	--	--	--	--
Enterprise/Embedded	\$2,355	\$2,023	\$3,330	\$7,101	\$2,526	\$2,678	\$2,863	\$3,067	\$11,134	\$3,264	\$3,459	\$3,669	\$3,896	\$14,287	\$16,028
Q/Q Growth	3%	(14%)	65%	113%	13%	6%	7%	7%		6%	6%	6%	6%		
Y/Y Growth					88%	67%	50%	37%	57%	29%	29%	28%	27%	28%	12%
XLNX	--	--	--	--	\$559	\$1,062	\$1,115	\$1,138	\$3,874	\$1,183	\$1,230	\$1,267	\$1,305	\$4,986	\$5,907
Q/Q Growth					90%	5%	2%			112%	16%	14%	15%	29%	18%
Y/Y Growth															

Source: Company reports, UBS estimates



Semis in Big Picture

Semis Industry Forecasts

Memory

PC

Server

Smartphone

Autos

Semi Cap Equipment

Company Summaries

AMAT: Applied Materials

Investment Thesis/Risks

Our thesis	AMAT's customer exposure is the most diversified in all of SPE, a clear positive. Also, it continues to ride a strong wave of both secular and cyclical underpinnings to WFE. We believe AMAT remains well positioned as the company leverages its broad portfolio for both processes and materials to enable technology scaling roadmaps. We do like where AMAT sits strategically as we think dollars will ultimately shift to films companies like AMAT and LRCX - especially as logic adopts GAA/c-FETs and DRAM goes 3D – but we have long felt that WFE peaks out in late '22 with a potentially significant contraction in '23 and '24 making it hard to be bullish at this time.
Risks to our thesis	On the downside, AMAT is also relatively more exposed to how we see US/China trade restrictions transpiring through '22 and '23. On the upside, government subsidies in the US and Europe may support more elevated WFE intensity than economics would otherwise support. Chipmakers are also very profitable which provides downside support for WFE. AMAT has invested very heavily and is well positioned to gain share on the other side of this cycle.

Source: UBS estimates

UBS vs Street	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	2024	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)															
UBS (New)	\$ 14,608	\$ 17,202	\$ 23,063	\$ 6,271	\$ 6,245	\$ 6,350	\$ 6,555	\$ 25,421	\$ 27,678	\$ 24,385	\$ 15,017	\$ 18,202	\$ 24,172	\$ 26,454	\$ 26,635
UBS (Old)						\$ 6,350	\$ 6,555	\$ 25,421	\$ 27,678	\$ 24,385				\$ 26,454	\$ 26,635
Consensus						\$ 6,266	\$ 6,575	\$ 25,358	\$ 28,341	\$ 28,254				\$ 26,062	\$ 28,248
Delta						1.3%	(0.3%)	0.3%	(2.3%)	(13.7%)				1.5%	(5.7%)
EPS (Non-GAAP)															
UBS (New)	\$ 3.04	\$ 4.16	\$ 6.84	\$ 1.89	\$ 1.85	\$ 1.85	\$ 1.96	\$ 7.55	\$ 8.46	\$ 7.08	\$ 3.21	\$ 4.58	\$ 7.35	\$ 7.97	\$ 7.99
UBS (Old)						\$ 1.85	\$ 1.96	\$ 7.55	\$ 8.46	\$ 7.08				\$ 7.97	\$ 7.99
Consensus						\$ 1.78	\$ 1.94	\$ 7.47	\$ 8.77	\$ 8.83				\$ 7.71	\$ 8.75
Delta						3.8%	0.9%	1.2%	(3.5%)	(19.8%)				3.4%	(8.7%)

Source: Company reports, UBS estimates

AMAT: Model Summary

Applied Materials, Inc. (AMAT) - Key Metrics (in \$MM except EPS)												FISCAL YEAR SUMMARY							
	C2018A	C2019A	C2020A	C2021A	FQ2A CQ1A	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	F2017A	F2018A	F2019A	F2020A	F2021A	F2022E	F2023E		
Revenue	\$16,802	\$15,017	\$18,202	\$24,172	\$6,245	\$6,350	\$6,555	\$7,304	\$26,454	\$26,635	\$14,537	\$17,253	\$14,608	\$17,202	\$23,063	\$25,421	\$27,678		
Y/Y Growth	9%	(11%)	21%	33%	12%	2%	7%	16%	9%	1%	34%	19%	(15%)	18%	34%	10%	9%		
Gross Margin	45.9%	44.1%	45.3%	47.8%	47.0%	46.0%	46.5%	47.5%	46.8%	46.9%	46.1%	46.3%	44.0%	45.1%	47.5%	46.7%	47.1%		
Opex	\$3,029	\$3,045	\$3,297	\$3,740	\$1,021	\$1,063	\$1,093	\$1,163	\$4,340	\$4,687	\$2,476	\$2,784	\$2,777	\$2,968	\$3,346	\$3,809	\$4,380		
Y/Y Growth	19%	1%	8%	13%	14%	13%	19%	19%	16%	8%	6%	12%	(0%)	7%	13%	14%	15%		
Operating Margin	27.8%	23.8%	27.2%	32.3%	30.6%	29.3%	29.8%	31.6%	30.4%	29.3%	27.9%	29.0%	23.5%	26.3%	31.7%	30.3%	30.1%		
Non-GAAP EPS	\$4.20	\$3.21	\$4.58	\$7.35	\$1.85	\$1.85	\$1.96	\$2.31	\$7.97	\$7.99	\$3.25	\$4.45	\$3.04	\$4.16	\$6.84	\$7.55	\$8.46		
FCF																			
CFFO	\$3,155	\$3,400	\$4,238	\$6,679	\$415	\$1,226	\$1,586	\$2,407	\$5,635	\$8,525	\$3,609	\$3,787	\$3,247	\$3,804	\$5,442	\$5,885	\$8,740		
Capex	\$552	\$410	\$441	\$691	\$210	\$191	\$197	\$219	\$816	\$799	\$345	\$622	\$441	\$422	\$668	\$741	\$830		
FCF % revenue	\$2,603	\$2,990	\$3,797	\$5,988	\$205	\$1,036	\$1,389	\$2,188	\$4,818	\$7,726	\$3,264	\$3,165	\$2,806	\$3,382	\$4,774	\$5,144	\$7,910		
Segment Revenue																			
Semi Systems	\$10,226	\$9,573	\$12,106	\$17,300	\$4,458	\$4,565	\$4,650	\$5,350	\$19,023	\$18,500	\$9,517	\$10,805	\$9,027	\$11,367	\$16,286	\$18,240	\$19,600		
Y/Y Growth	0%	(6%)	26%	43%	12%	2%	8%	17%	10%	(3%)	38%	14%	(16%)	26%	43%	12%	7%		
Applied Global Service	\$3,838	\$3,889	\$4,313	\$5,178	\$1,383	\$1,450	\$1,550	\$1,574	\$5,957	\$6,590	\$3,017	\$3,756	\$3,854	\$4,155	\$5,013	\$5,703	\$6,558		
Y/Y Growth	19%	1%	11%	20%	15%	13%	13%	19%	15%	11%	15%	24%	3%	8%	21%	14%	15%		
Display & Adjacent Markets	\$2,669	\$1,476	\$1,686	\$1,589	\$381	\$310	\$325	\$350	\$1,366	\$1,425	\$1,900	\$2,617	\$1,651	\$1,607	\$1,634	\$1,382	\$1,400		
Y/Y Growth	38%	(45%)	14%	(6%)	2%	(28%)	(22%)	(4%)	(14%)	4%	66%	38%	(37%)	(3%)	2%	(15%)	1%		
Other	\$88	\$79	\$97	\$105	\$23	\$25	\$30	\$30	\$108	\$120	\$103	\$87	\$83	\$73	\$130	\$96	\$120		
Y/Y Growth	(7%)	(10%)	23%	8%	(28%)	--	--	67%	3%	11%	(44%)	(16%)	(5%)	(12%)	78%	(26%)	25%		
Segment Operating Income																			
Semi Systems	\$3,270	\$2,769	\$4,134	\$6,859	\$1,656	\$1,666	\$1,721	\$2,087	\$7,129	\$7,175	\$3,173	\$3,634	\$2,475	\$3,778	\$6,362	\$6,821	\$7,647		
Y/Y Growth	(6%)	(15%)	49%	66%	6%	(7%)	(1%)	17%	4%	1%	76%	15%	(32%)	53%	68%	7%	12%		
Applied Global Service	\$1,133	\$1,094	\$1,197	\$1,580	\$422	\$464	\$465	\$456	\$1,807	\$1,894	\$817	\$1,102	\$1,101	\$1,135	\$1,517	\$1,754	\$1,885		
Y/Y Growth	27%	(3%)	9%	32%	18%	18%	9%	13%	14%	5%	18%	35%	(0%)	3%	34%	16%	7%		
Display & Adjacent Markets	\$693	\$223	\$338	\$329	\$82	\$56	\$59	\$63	\$259	\$257	\$505	\$679	\$297	\$304	\$327	\$273	\$252		
Y/Y Growth	41%	(68%)	52%	(3%)	24%	(44%)	(32%)	(18%)	(21%)	(1%)	117%	34%	(56%)	2%	8%	(16%)	(8%)		
Other	(\$424)	(\$516)	(\$712)	(\$957)	(\$247)	(\$328)	(\$289)	(\$300)	(\$1,164)	(\$1,523)	(\$445)	(\$422)	(\$446)	(\$688)	(\$884)	(\$1,137)	(\$1,448)		

Source: Company reports, UBS estimates

AVGO: Broadcom

Investment Thesis/Risks

Our thesis	We see AVGO as the most attractive compounder in semis for income investors and we model the dividend to grow again through F2023E. The company is exposed to fast growing markets with very strong franchise in each of its end markets. It also benefits from scale especially post the VMW deal which will offset some revenue cyclical at the peak of the chip cycle and result is more stability going forward. Though we are at peak cycle, AVGO should be able to maintain lead times better than nearly every other peer given its strong franchises where there is no replacement product. This should provide downside protection with respect to the cycle. The wireless business comes with the most questions and even there, AVGO should continue to expand content 5-10%/yr for the foreseeable future.
Risks to our thesis	AVGO does not plan to work down lead times much if any which should help its shipments more closely match consumption. To some degree, this is muting growth in F2022 but should also help to mute the inevitable correction on the other side of the cycle. The primary risk for the stock is that it gets caught in the downcycle just like peers and its lead times provide little protection. In addition, the deal with VMWare may not be realized or turn out to be not as accretive as we expect.

Source: UBS estimates

UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	2024	CY2019	CY2020	CY2021	CY2022	CY2023
Revenue (\$MM)															
UBS (new)	\$22,597	\$23,888	\$27,450	\$7,706	\$8,103	\$8,428	\$8,792	\$33,029	\$34,971	\$32,869	\$22,666	\$24,685	\$28,501	\$33,944	\$34,933
UBS (old)						\$8,428	\$8,792	\$33,029	\$34,971	\$32,869				\$33,944	\$34,933
Consensus						\$8,406	\$8,749	\$32,964	\$34,990	\$35,815				\$33,996	\$35,246
Delta						0.3%	0.5%	0.2%	(0.1%)	(8.2%)				(0.2%)	(0.9%)
EPS (non-GAAP)															
UBS (new)	\$21.30	\$22.15	\$28.00	\$8.39	\$9.07	\$9.55	\$10.00	\$37.00	\$39.51	\$36.32	\$21.01	\$23.50	\$29.78	\$38.42	\$39.51
UBS (old)						\$9.55	\$10.00	\$37.00	\$39.51	\$36.32				\$38.42	\$39.51
Consensus						\$9.56	\$10.04	\$37.06	\$40.48	\$42.13				\$38.71	\$41.04
Delta						(0.1%)	(0.4%)	(0.2%)	(2.4%)	(13.8%)				(0.8%)	(3.7%)

Source: Company reports, UBS estimates

AVGO: Model Summary

Broadcom (AVGO) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020A	C2021	FQ2A CQ1A	Estimates			C2022E	C2023E	FISCAL YEAR SUMMARY													
							FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E			F2017A		F2018A		F2019A		F2020A		F2021A		F2022E		F2023E	
												F2017A	F2018A	F2019A	F2020A	F2021A	F2022E	F2023E							
Revenue	\$18,824	\$21,310	\$22,666	\$24,685	\$28,501	\$8,103	\$8,428	\$8,792	\$8,621	\$33,944	\$34,933	\$17,636	\$24,226	\$22,597	\$23,888	\$27,450	\$33,029	\$34,971							
Y/Y Growth	21%	13%	6%	9%	15%	23%	24%	19%	12%	19%	3%	33%	37%	(7%)	6%	15%	20%	6%							
Gross Profit (Non-GAAP)	\$12,001	\$14,610	\$16,199	\$18,151	\$21,388	\$6,186	\$6,405	\$6,594	\$6,552	\$25,737	\$26,648	\$11,137	\$16,657	\$16,055	\$17,552	\$20,443	\$25,006	\$26,591							
Gross Margin	63.8%	68.6%	71.5%	73.5%	75.0%	76.3%	76.0%	75.0%	76.0%	75.8%	76.3%	63.1%	68.8%	71.0%	73.5%	74.5%	75.7%	76.0%							
R&D	\$2,705	\$3,010	\$3,230	\$3,526	\$3,708	\$1,000	\$1,000	\$950	\$966	\$3,916	\$4,034	\$2,650	\$3,617	\$3,159	\$3,535	\$3,652	\$3,888	\$4,005							
SG&A	\$520	\$695	\$1,008	\$990	\$892	\$247	\$245	\$245	\$234	\$971	\$1,000	\$464	\$1,866	\$967	\$1,078	\$879	\$964	\$993							
Opx (Non-GAAP)	\$3,225	\$3,705	\$4,238	\$4,516	\$4,600	\$1,247	\$1,245	\$1,195	\$1,200	\$4,887	\$5,034	\$3,126	\$3,507	\$4,126	\$4,613	\$4,531	\$4,852	\$4,998							
Y/Y Growth	1%	15%	14%	7%	2%	8%	9%	5%	3%	6%	3%	15%	12%	18%	12%	(2%)	7%	3%							
Operating Income (Non-GAAP)	\$8,776	\$10,905	\$11,961	\$13,635	\$16,788	\$4,939	\$5,160	\$5,399	\$5,352	\$20,850	\$21,615	\$8,023	\$11,174	\$11,929	\$12,939	\$15,912	\$20,154	\$21,594							
Operating Margin	46.6%	51.2%	52.8%	55.2%	58.9%	61.0%	61.2%	61.4%	62.1%	61.4%	61.9%	45.4%	46.1%	52.8%	54.2%	58.0%	61.0%	61.7%							
Non-GAAP EPS	\$17.50	\$21.26	\$21.01	\$23.50	\$29.78	\$9.07	\$9.55	\$10.00	\$9.80	\$38.42	\$39.51	\$16.01	\$20.80	\$21.30	\$22.15	\$28.00	\$37.00	\$39.51							
Free Cash Flow																									
CFFO	\$6,883	\$9,327	\$9,887	\$12,852	\$14,137	\$4,243	\$5,339	\$4,421	\$4,497	\$18,500	\$17,612	\$6,551	\$8,880	\$9,697	\$12,061	\$13,764	\$17,489	\$17,485							
Capex	\$964	\$514	\$441	\$469	\$430	\$85	\$126	\$132	\$138	\$481	\$707	\$1,069	\$635	\$432	\$463	\$443	\$444	\$665							
FCF	\$5,919	\$8,813	\$9,446	\$12,383	\$13,707	\$4,158	\$5,212	\$4,289	\$4,359	\$18,019	\$16,905	\$5,482	\$8,245	\$9,265	\$11,598	\$13,321	\$17,045	\$16,821							
% revenue	31%	41%	42%	50%	48%	51%	62%	49%	51%	53%	48%	31%	34%	41%	49%	49%	52%	48%							
Segment Revenue (New Segments from FQ1:19)																									
Wireless Comm	\$6,439	\$5,638	\$5,440	\$5,641	\$6,908	\$1,739	\$1,739	\$2,174	\$1,891	\$7,543	\$7,648	\$5,404	\$6,490	\$5,507	\$4,969	\$6,853	\$7,670	\$7,632							
Q/Q Growth						(14%)	--	25%	(13%)			45%	20%	(15%)	(10%)	38%	12%	(0%)							
Y/Y Growth	49%	(12%)	(4%)	4%	22%	6%	22%	19%	(6%)	9%	1%														
Networking						\$6,035	\$7,173	\$2,221	\$2,350																
Broadband						\$2,836	\$3,561	\$1,076	\$1,110																
Other Wired						\$295																			
Wired Infrastructure	\$8,340	\$8,942	\$9,059	\$9,166	\$10,734	\$3,297	\$3,460	\$3,425	\$3,528	\$13,710	\$14,037	\$8,549	\$8,675	\$8,895	\$9,312	\$10,083	\$12,993	\$14,218							
Q/Q Growth						17%	5%	(1%)	3%			30%	1%	3%	5%	8%	29%	9%							
Y/Y Growth	1%	7%	1%	1%	17%	37%	27%	23%	26%	28%	2%														
Industrial & Automotive	\$962	\$1,018	\$944	\$606	\$838	\$254	\$254	\$241	\$244	\$993	\$1,026	\$884	\$1,011	\$986	\$626	\$792	\$992	\$1,020							
Q/Q Growth						5%	--	(5%)	1%																
Y/Y Growth	40%	6%	(7%)	(36%)	38%	32%	24%	22%	0%	18%	3%														
Enterprise Storage	\$3,083	\$4,751	\$3,283	\$3,696	\$2,868	\$939	\$1,080	\$1,047	\$1,006	\$4,072	\$4,229	\$2,799	\$4,672	\$3,589	\$3,871	\$2,656	\$3,867	\$4,197							
Q/Q Growth						17%	15%	(3%)	(4%)			22%	67%	(23%)	8%	(31%)	46%	9%							
Y/Y Growth	33%	54%	(31%)	13%	(22%)	62%	60%	28%	26%	42%	4%														
Total Semiconductor Solutions	\$18,824	\$20,349	\$17,190	\$17,984	\$21,348	\$6,229	\$6,533	\$6,888	\$6,668	\$26,318	\$26,941	\$17,636	\$24,226	\$17,373	\$17,267	\$20,383	\$25,522	\$27,067							
Q/Q Growth						6%	5%	5%	(3%)			33%	37%	NA	(1%)	18%	25%	6%							
Y/Y Growth						29%	30%	22%	14%	23%	2%														
Brocade						\$1,537	\$1,494	\$1,640	\$437	\$437	\$437	\$472	\$1,782	\$1,924		\$1,750	\$1,467	\$1,617	\$1,747	\$1,887					
Q/Q Growth						NA	(3%)	10%	16%	4%	6%	8%	9%	8%											
Y/Y Growth																(16%)	10%	8%	8%						
SYMC						\$400	\$1,631	\$1,733	\$450	\$475	\$475	\$475	\$1,875	\$1,900		\$1,611	\$1,715	\$1,838	\$1,900						
Q/Q Growth						NA		6%	(5%)	18%	14%	8%	8%	1%											
Y/Y Growth																	6%	7%	3%						
CA						\$3,487	\$3,575	\$3,780	\$987	\$984	\$992	\$1,006	\$3,969	\$4,168		\$3,410	\$3,543	\$3,735	\$3,921	\$4,117					
Q/Q Growth						NA	3%	6%	5%	5%	5%	5%	5%	5%											
Y/Y Growth																4%	5%	5%	5%						
Total Infrastructure Software						\$5,424	\$6,701	\$7,153	\$1,874	\$1,896	\$1,904	\$1,953	\$7,626	\$7,992		\$5,160	\$6,621	\$7,067	\$7,506	\$7,904					
Q/Q Growth						NA	24%	7%	5%	8%	7%	7%	7%	5%											
Y/Y Growth																NA	28%	7%	6%	5%					

Source: Company reports, UBS estimates



ENTG: Entegris

Investment Thesis/Risks

Our thesis	Much like many of the SPE stocks, ENTG remains positively levered to increasing dollar intensity as more varied chip designs are pushing to the leading edge. At the same time, it is also levered to demand for lagging edge capacity – a trend which helps ENTG and should have legs as large segments like autos and broad industrial applications look to secure capacity on a longer-term basis versus the traditional just-in-time transactional approach. Lastly, even in the inevitable cyclical correction, it is hard to see a significant Y/Y decline in revs given a more recurring aspect to its high purity consumables than most other business models in semis. All of these factors make ENTG unique among the SMID tech/industrial investment landscape. Lastly, the deal with CMC adds critical and highly complementary semiconductor materials to ENTG's core platform, though it does add a fairly significant amount of debt at a challenging time in the semis cycle.
Risks to our thesis	Secular trends are clear, but the broader debate in our view revolves around cyclical sustainability and therefore the multiple with which to capitalize out-year EPS and CF. While we believe long-term ENTG's competitive positioning continues to strengthen and content expansions would serve as catalysts for above-market growth, valuation versus a strong peer group keeps us on the sidelines. ENTG more often than not is a premium grower and we could see more upside on rev growth given solid execution track record and it could very well spin its capacity into further accretive deals. On the flip side, our profitability ests could face cuts on intensified competition and broad cyclical concerns. The semiconductor industry revenues have historically been correlated to global GDP. From a macro standpoint, a deep recession with demand destruction for ENTG end customers is a potential downside risk.

Source: UBS estimates

UBS vs Street

	Actual 2019	Actual 2020	Actual 2021	Actual 2022/1F	Estimate 2022/2F	Estimate 2022/3F	Estimate 2022/4F	Estimate 2022	Estimate 2023	CY2019	CY2020	CY2021	CY2022	CY2023	CY2024
Revenues (\$MM)															
UBS	\$ 1,591	\$ 1,859	\$ 2,299	\$650	\$674	\$687	\$722	\$ 2,733	\$ 3,088	\$ 1,591	\$ 1,859	\$ 2,299	\$ 2,733	\$ 3,088	\$ 2,938
UBS (old)					\$674	\$687	\$722	\$ 2,733	\$ 3,088				\$2,733	\$ 3,088	\$ 2,938
Consensus					\$667	\$686	\$711	\$ 2,715	\$ 2,992				\$2,715	\$ 2,992	\$ 3,209
Delta					1.0%	0.1%	1.5%	0.7%	3.2%				0.7%	3.2%	(8.5%)
EPS															
UBS (non-GAAP)	\$ 1.93	\$ 2.54	\$ 3.44	\$ 1.06	\$ 1.06	\$ 1.06	\$ 1.17	\$ 4.35	\$ 5.10	\$ 1.93	\$ 2.54	\$ 3.44	\$ 4.35	\$ 5.10	\$ 4.57
UBS (non-GAAP) (old)					\$ 1.06	\$ 1.06	\$ 1.17	\$ 4.35	\$ 5.10				\$4.35	\$ 5.10	\$ 4.57
Consensus (non-GAAP)					\$ 1.05	\$ 1.08	\$ 1.10	\$ 4.29	\$ 4.91				\$4.29	\$ 4.91	\$ 4.99
Delta					0.7%	(1.3%)	6.4%	1.5%	3.9%				1.6%	3.9%	(8.3%)

Source: Company reports, UBS estimates

ENTG: Model Summary

Entegris (ENTG) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020E	C2021A	FQ1A CQ1A	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	C2022E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	C2023E	FISCAL YEAR SUMMARY					
																F2018A	F2019A	F2020A	F2021A	F2022E	F2023E
Revenue (\$MM)	\$1,343	\$1,550	\$1,591	\$1,859	\$2,299	\$650	\$674	\$687	\$722	\$2,733	\$723	\$769	\$790	\$806	\$3,088	\$1,550	\$1,591	\$1,859	\$2,299	\$2,733	\$3,088
Y/Y Growth	14%	15%	3%	17%	24%	27%	18%	19%	14%	19%	11%	14%	15%	12%	13%	15%	3%	17%	24%	19%	13%
Gross Margin	45.8%	46.9%	45.3%	45.7%	46.1%	47.7%	47.5%	47.1%	47.6%	47.5%	47.5%	47.5%	47.5%	47.5%	47.5%	46.9%	45.3%	45.7%	46.1%	47.5%	47.5%
Opex	\$316	\$356	\$359	\$390	\$451	\$128	\$135	\$137	\$139	\$539	\$141	\$145	\$147	\$151	\$584	\$356	\$359	\$390	\$451	\$539	\$584
Y/Y Growth	3%	13%	1%	9%	16%	19%	19%	23%	17%	19%	11%	7%	7%	9%	8%	13%	1%	9%	16%	19%	8%
Operating Margin	22.3%	23.9%	22.7%	24.7%	26.5%	28.1%	27.5%	27.2%	28.4%	27.8%	28.0%	28.6%	28.9%	28.8%	28.6%	23.9%	22.7%	24.7%	26.5%	27.8%	28.6%
Non-GAAP EPS	\$1.44	\$1.89	\$1.93	\$2.54	\$3.44	\$1.06	\$1.06	\$1.06	\$1.17	\$4.35	\$1.16	\$1.27	\$1.32	\$1.34	\$5.10	\$1.89	\$1.93	\$2.54	\$3.44	\$4.35	\$5.10
Cash Flow																					
CFFO	\$293	\$313	\$382	\$447	\$404	\$64	\$114	\$169	\$161	\$509	\$198	\$157	\$198	\$205	\$759	\$313	\$382	\$447	\$404	\$509	\$759
Capex	\$94	\$110	\$112	\$132	\$211	\$84	\$135	\$137	\$144	\$501	\$108	\$115	\$119	\$121	\$463	\$110	\$112	\$132	\$211	\$501	\$463
FCF	\$200	\$202	\$270	\$315	\$193	(\$21)	(\$21)	\$32	\$17	\$8	\$90	\$42	\$79	\$84	\$295	\$202	\$270	\$315	\$193	\$8	\$295
% revenue	14.9%	13.1%	17.0%	16.9%	8.4%	-3.2%	-3.1%	4.7%	2.3%	0.3%	12.4%	5.5%	10.0%	10.5%	9.6%	13.1%	17.0%	16.9%	8.4%	0.3%	9.6%
Y/Y Growth	40%	1%	33%	17%	-39%	-311%	-152%	-68%	-57%	-96%	-535%	-304%	147%	402%	3796%	1%	33%	17%	-39%	-96%	3796%
Segment Revenue (\$MM)																					
Specialty Chemicals and Engineered																					
Materials	\$485	\$530	\$527	\$610	\$711	\$196	\$202	\$204	\$213	\$816	\$215	\$222	\$222	\$233	\$890	\$530	\$527	\$610	\$711	\$816	\$890
Y/Y Growth	13%	9%	-1%	16%	17%	18%	12%	16%	13%	15%	9%	9%	8%	9%	9%	9%	-1%	16%	17%	15%	9%
Microcontamination Control	\$437	\$554	\$634	\$742	\$919	\$267	\$285	\$294	\$317	\$1,163	\$317	\$349	\$360	\$367	\$1,393	\$554	\$634	\$742	\$919	\$1,163	\$1,393
Y/Y Growth	20%	27%	14%	17%	24%	29%	25%	30%	23%	27%	19%	22%	22%	16%	20%	27%	14%	17%	24%	27%	20%
Advanced Materials Handling	\$445	\$493	\$458	\$539	\$705	\$198	\$198	\$200	\$204	\$800	\$202	\$210	\$221	\$218	\$851	\$493	\$458	\$539	\$705	\$800	\$851
Y/Y Growth	16%	11%	-7%	18%	31%	33%	15%	7%	3%	14%	2%	6%	10%	7%	6%	11%	-7%	18%	31%	14%	6%

Source: Company reports, UBS estimates

INTC: Intel Corp.

Investment Thesis/Risks

Our thesis	We remain strong believers that decoupling the product and process groups and roadmaps will enable INTC to accelerate its manufacturing roadmap such that it can "catch" TSMC in terms of process density by its 20a and 18a nodes in 2025/2026. This should also allow it to tap into a very big wedge of foundry opportunity from customers such as QCOM, NVDA, and even AAPL. At the same time, by leveraging foundries to a greater degree, it should help to accelerate the product roadmap. INTC also has the most architecturally diverse array of offering across the compute landscape (GPUs – Ponte Vecchio/Arc, FPGAs, IPUs, and ASIC based offerings). However, even inclusive of government subsidies, we are troubled by the amount of capex the company will be spending to build out its foundry business with very uncertain and long tailed ROI. In the meantime, valuation remains a question mark given how low FCF will be over the next few years during this expansion, while PCs are still nearly 50% of revenue and consumer demand is rapidly weakening.
Risks to our thesis	If we are right about the product roadmap, the stock could conceivably look through this multi-year period where FCF is highly constrained by capex and power higher if PCs were to remain strong. On the other hand, building a foundry business is very challenging and it is to some degree mortgaging the future w/this endeavor. Lastly, as NVDA expands into CPU, this could prove even more of a competitive threat by taking existing INTC workloads rather than just capturing incremental workload from INTC. AMD remains a threat as well, though INTC's partnership w/TSMC should start to nullify this threat and ARM might be an even bigger threat than AMD.

Source: UBS estimates

UBS vs Street

	Actual 2019	Actual 2020	Actual 2021	Actual 2022/1F	Estimate 2022/2F	Estimate 2022/3F	Estimate 2022/4F	Estimate 2022	Estimate 2023	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)														
UBS	\$71,965	\$77,867	\$74,718	\$18,353	\$18,212	\$19,179	\$20,280	\$76,023	\$80,802	\$71,965	\$77,867	\$74,718	\$76,023	\$80,802
UBS Old					\$18,212	\$19,179	\$20,280	\$76,023	\$80,802				\$76,023	\$80,802
Consensus					\$17,974	\$18,896	\$19,784	\$75,008	\$77,525				\$75,008	\$77,525
Delta					1.3%	1.5%	2.5%	1.4%	4.2%				1.4%	4.2%
EPS														
EPS	\$4.87	\$5.30	\$5.47	\$0.87	\$0.74	\$0.92	\$1.05	\$3.58	\$3.73	\$4.87	\$5.30	\$5.47	\$3.58	\$3.73
UBS (Non-GAAP)					\$0.74	\$0.92	\$1.05	\$3.58	\$3.73				\$3.58	\$3.73
UBS (Non-GAAP) Old					\$0.74	\$0.92	\$1.05	\$3.58	\$3.73				\$3.58	\$3.73
Consensus (Non-GAAP)					\$0.70	\$0.90	\$0.99	\$3.46	\$3.50				\$3.46	\$3.50
Delta					5.2%	2.3%	6.7%	3.7%	6.6%				3.7%	6.6%

Source: Company reports, UBS estimates

INTC: Model Summary

Intel (INTC) - Key Metrics (in \$MM except EPS and units)	F2018A C2018A	F2019A C2019A	F2020A C2020A	F2021A C2021A	FQ1A CQ1A	Estimates				F2022E C2022E	F2023E C2023E	F2024E C2024E
						FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E				
Revenue (GAAP) (-) NSG	70,848	71,965	77,867	79,024	18,353	18,212	19,179	20,280	76,023	80,802	87,630	--
Revenue (Non GAAP) Y/Y Growth	\$70,848 13%	\$71,965 2%	\$77,867 8%	\$74,718 (4%)	\$18,353 (1%)	\$18,212 (2%)	\$19,179 6%	\$20,280 4%	\$76,023 2%	\$80,802 6%	\$87,630 8%	
Gross Profit (Non -GAAP)	44,842	43,264	44,823	43,103	9,745	9,288	9,935	10,545	39,513	41,863	46,444	
Gross Margin	63.3%	60.1%	57.6%	57.7%	53.1%	51.0%	51.8%	52.0%	52.0%	51.8%	53.0%	
R&D (Non-GAAP)	13,543	13,362	13,556	15,190	4,362	4,580	4,443	4,443	17,827	18,771	20,371	
MG&A (Non-GAAP)	6,750	6,150	6,180	6,543	1,752	1,840	1,784	1,784	7,160	7,388	8,038	
Other	259	--	(155)	(835)	(610)	--	--	--	(610)	--	--	
Total Opex (Non-GAAP) Y/Y Growth	\$20,552 0%	\$19,512 (5%)	\$19,581 0%	\$20,898 7%	\$5,504 16%	\$5,887 15%	\$5,666 8%	\$5,634 (2%)	\$22,691 9%	\$23,795 5%	\$25,845 9%	
Operating Income (Non-GAAP)	24,290	23,752	25,292	22,205	4,241	3,401	4,268	4,911	16,822	18,068	20,598	
Operating Margin	34.3%	33.0%	32.5%	29.7%	23.1%	18.7%	22.3%	24.2%	22.1%	22.4%	23.5%	
Non-GAAP EPS	\$4.58	\$4.87	\$5.30	\$5.47	\$0.87	\$0.74	\$0.92	\$1.05	\$3.58	\$3.73	\$4.25	
Free Cash Flow												
CFFO	29,432	33,145	35,384	29,991	5,891	1,302	9,088	9,998	26,280	30,907	35,641	
Capex	15,181	16,213	14,259	18,733	4,797	7,000	9,000	9,000	29,797	31,000	33,200	
FCF	\$14,251	\$16,932	\$21,125	\$11,258	\$1,094	(\$4,698)	\$1,088	\$1,998	(\$517)	(\$93)	\$2,441	
% of revenue	20%	24%	27%	15%	6%	(26%)	6%	10%	(1%)	(0%)	3%	
Y/Y Growth	38%	19%	25%	(47%)	(31%)	(191%)	(82%)	(247%)	(105%)	(82%)		

Source: Company reports, UBS estimates

INTC: Model Summary

Intel (INTC) - Key Metrics (in \$MM except EPS and units)	F2018A C2018A	F2019A C2019A	F2020A C2020A	F2021A C2021A	FQ1A CQ1A	Estimates				F2022E C2022E	F2023E C2023E	F2024E C2024E
						FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E				
Product Revenue												
Client Computing (CCG)	\$37,938	\$40,535	\$41,067	\$9,294	\$9,176	\$9,698	\$10,251	\$38,419	\$38,208	\$37,554		
Datacenter and AI (DCAI)	\$21,696	\$23,413	\$22,691	\$6,034	\$5,913	\$6,209	\$6,582	\$24,738	\$26,925	\$31,063		
Network and Edge (NEX)	\$6,829	\$7,132	\$7,976	\$2,213	\$2,257	\$2,325	\$2,395	\$9,190	\$10,576	\$12,163		
Accelerated Computing Systems and Graphics (AXG)	\$606	\$651	\$774	\$219	\$232	\$260	\$291	\$1,002	\$1,559	\$2,631		
Mobileye	\$879	\$967	\$1,386	\$394	\$418	\$468	\$524	\$1,803	\$2,326	\$2,826		
Intel Foundry Services (IFS)	\$461	\$715	\$786	\$283	\$300	\$303	\$321	\$1,207	\$1,545	\$1,728		
All Other	\$4,150	\$5,091	\$5,019	\$67	\$67	\$67	\$67	\$268	\$268	\$268		
Operating Margins												
Client Computing (CCG)	43%	39%	38%	30%	--	--	--	--	--	--	--	--
Datacenter and AI (DCAI)	46%	47%	37%	28%	--	--	--	--	--	--	--	--
Network and Edge (NEX)	25%	12%	21%	17%	--	--	--	--	--	--	--	--
Accelerated Computing Systems and Graphics (AXG)	(58%)	(62%)	(156%)	(178%)	--	--	--	--	--	--	--	--
Mobileye	36%	33%	40%	38%	--	--	--	--	--	--	--	--
Intel Foundry Services (IFS)	(46%)	6%	(3%)	(11%)	--	--	--	--	--	--	--	--
All Other	(134%)	(79%)	(114%)	(396%)	--	--	--	--	--	--	--	--
Q/Q Growth (Top Segment Level)												
Client Computing (CCG)	--	--	--	(10%)	(1%)	6%	6%	--	--	--	--	--
Datacenter and AI (DCAI)	--	--	--	(6%)	(2%)	5%	6%	--	--	--	--	--
Network and Edge (NEX)	--	--	--	6%	2%	3%	3%	--	--	--	--	--
Accelerated Computing Systems and Graphics (AXG)	--	--	--	(11%)	6%	12%	12%	--	--	--	--	--
Mobileye	--	--	--	11%	6%	12%	12%	--	--	--	--	--
Intel Foundry Services (IFS)	--	--	--	16%	6%	1%	6%	--	--	--	--	--
All Other	--	--	--	(94%)	--	--	--	--	--	--	--	--
Y/Y Growth (Top Segment Level)												
Client Computing (CCG)	--	7%	1%	(13%)	(11%)	(1%)	(1%)	(6%)	(1%)	(2%)		
Datacenter and AI (DCAI)	--	8%	(3%)	22%	7%	7%	2%	9%	9%	15%		
Network and Edge (NEX)	--	4%	12%	23%	7%	17%	15%	15%	15%	15%		
Accelerated Computing Systems and Graphics (AXG)	--	7%	19%	21%	31%	52%	19%	30%	56%	69%		
Mobileye	--	10%	43%	5%	28%	43%	47%	30%	29%	21%		
Intel Foundry Services (IFS)	--	55%	10%	175%	14%	74%	31%	54%	28%	12%		
All Other	--	23%	(1%)	(96%)	(94%)	(94%)	(94%)	(95%)	--	--		

Source: Company reports, UBS estimates

KLAC: KLA Corp

Investment Thesis/Risks

Our thesis	KLAC remains levered to foundry/logic spending and the stock has ridden a wave of the spending mix shifting significantly in that direction over the past few years. To that end, its WFE share has finally started to inflect higher as we would expect given how the mix has skewed in its favor. Going forward, however, we believe that WFE is peaking later this year with a potentially significant correction in '23 and maybe even '24. The stock has held up much better than peers due to the aforementioned mix shift, but it is highly vulnerable to what seems like an inevitable pullback in foundry spending. We like KLAC's non-semis business (other than flat panel) but do not believe it adds much premium to the growth rate for the company. Valuation is not challenging and fundamentals tend to be a bit more defensive than peers, but the risk on the foundry side keeps us Neutral.
Risks to our thesis	INTC is embarking on a very strong capex cycle and KLAC has historically been highly levered to this customer. Further, it is starting to drive a more balanced customer profile as it has gained some improved exposure to the memory vertical. The geopolitical situation with China remains a risk for all SPE makers as we expect the US to broaden its restrictions on chip equipment exports into China.

Source: UBS estimates

UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023/1F	2023/2F	2023/3F	2023/4F	2023	2024	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)																			
UBS (New)	\$ 4,569	\$ 5,806	\$ 6,919	\$ 2,084	\$ 2,353	\$ 2,289	\$ 2,468	\$ 9,193	\$ 2,535	\$ 2,580	\$ 2,537	\$ 2,498	\$ 10,150	\$ 9,589	\$ 5,279	\$ 6,073	\$ 8,166	\$ 9,871	\$ 9,830
UBS (Old)							\$ 2,468	\$ 9,193	\$ 2,535	\$ 2,580	\$ 2,537	\$ 2,498	\$ 10,150	\$ 9,589				\$ 9,871	\$ 9,830
Consensus							\$ 2,428	\$ 9,153	\$ 2,526	\$ 2,647	\$ 2,611	\$ 2,617	\$ 10,401	\$ 10,416				\$ 9,889	\$ 10,341
Delta							1.6%	0.4%	0.4%	(2.5%)	(2.9%)	(4.5%)	(2.4%)	(7.9%)				(0.2%)	(4.9%)
EPS (Non-GAAP)																			
UBS (New)	\$ 8.46	\$ 10.35	\$ 14.55	\$ 4.64	\$ 5.59	\$ 5.13	\$ 5.76	\$ 21.10	\$ 6.01	\$ 6.21	\$ 5.97	\$ 5.73	\$ 23.92	\$ 21.31	\$ 8.73	\$ 11.48	\$ 18.52	\$ 23.10	\$ 22.25
UBS (Old)							\$ 5.76	\$ 21.10	\$ 6.01	\$ 6.21	\$ 5.97	\$ 5.73	\$ 23.92	\$ 21.31				\$ 23.10	\$ 22.25
Consensus							\$ 5.50	\$ 20.86	\$ 5.83	\$ 6.32	\$ 6.05	\$ 6.01	\$ 24.22	\$ 24.19				\$ 22.78	\$ 23.90
Delta							4.7%	1.1%	2.9%	(1.7%)	(1.3%)	(4.7%)	(1.2%)	(11.9%)				1.4%	(6.9%)

Source: Company reports, UBS estimates

KLAC: Model Summary

KLA Corporation (KLAC) - Key Metrics (in \$MM except EPS)	C2018A	C2019A	C2020E	C2021A	Estimates				C2022E	C2023E	C2024E	FISCAL YEAR SUMMARY							
					FQ3A CQ1A	FQ4:22E CQ2E	FQ1E CQ3E	FQ2E CQ4E				F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E	F2024E
Systems	\$3,320	\$3,913	\$4,510	\$6,382	\$1,801	\$1,960	\$2,015	\$2,055	\$7,831	\$7,585	\$6,820	\$2,704	\$3,161	\$3,392	\$4,329	\$5,240	\$7,286	\$8,010	\$7,235
Y/Y Growth	11%	18%	15%	42%	31%	32%	24%	8%	23%	(3%)	(10%)	20%	17%	7%	28%	21%	39%	10%	(10%)
Services	\$985	\$1,365	\$1,563	\$1,783	\$488	\$508	\$520	\$525	\$2,041	\$2,245	\$2,423	\$776	\$876	\$1,177	\$1,478	\$1,678	\$1,906	\$2,140	\$2,354
Y/Y Growth	21%	39%	15%	14%	14%	14%	15%	15%	14%	10%	8%	6%	13%	34%	26%	14%	14%	12%	10%
Revenue	\$4,304	\$5,279	\$6,073	\$8,166	\$2,289	\$2,468	\$2,535	\$2,580	\$9,871	\$9,830	\$9,243	\$3,480	\$4,037	\$4,569	\$5,806	\$6,919	\$9,193	\$10,150	\$9,589
Y/Y Growth	13%	23%	15%	34%	27%	28%	22%	10%	21%	(0%)	(6%)	17%	16%	13%	27%	19%	33%	10%	(6%)
Gross Margin	64.4%	60.2%	61.4%	62.8%	62.9%	63.0%	63.0%	63.0%	63.0%	62.4%	62.2%	63.1%	64.3%	61.8%	60.8%	62.2%	63.0%	62.8%	62.1%
Opex	\$1,064	\$1,449	\$1,515	\$1,724	\$484	\$526	\$536	\$547	\$2,093	\$2,321	\$2,274	\$902	\$1,040	\$1,219	\$1,598	\$1,597	\$1,908	\$2,219	\$2,353
Y/Y Growth	9%	36%	5%	14%	19%	25%	24%	18%	21%	11%	(2%)	8%	15%	17%	31%	(0%)	19%	16%	6%
Operating Margin	39.7%	32.7%	36.4%	41.7%	41.7%	41.7%	41.9%	41.8%	41.8%	38.8%	37.6%	37.2%	38.5%	35.1%	33.2%	39.1%	42.2%	41.0%	37.6%
Non-GAAP EPS	\$9.14	\$8.73	\$11.48	\$18.52	\$5.13	\$5.76	\$6.01	\$6.21	\$23.10	\$22.25	\$20.85	\$5.94	\$8.00	\$8.46	\$10.35	\$14.55	\$21.10	\$23.92	\$21.31
Free Cash Flow																			
CFFO	\$1,390	\$1,373	\$1,968	\$2,786	\$819	\$781	\$637	\$870	\$3,107	\$3,611	\$3,261	\$1,080	\$1,229	\$1,153	\$1,779	\$2,185	\$3,275	\$3,339	\$3,269
Capex	\$87	\$149	\$200	\$250	\$100	\$49	\$51	\$52	\$252	\$197	\$185	\$39	\$67	\$130	\$153	\$232	\$284	\$203	\$192
FCF	\$1,303	\$1,224	\$1,768	\$2,536	\$719	\$732	\$586	\$818	\$2,855	\$3,415	\$3,076	\$1,041	\$1,162	\$1,022	\$1,626	\$1,953	\$2,991	\$3,136	\$3,077
% revenue	30.3%	23.2%	29.1%	31.1%	31.4%	29.7%	23.1%	31.7%	28.9%	34.7%	33.3%	29.9%	28.8%	22.4%	28.0%	28.2%	32.5%	30.9%	32.1%
Segment Revenue																			
Total Systems Revenue	\$3,320	\$3,913	\$4,510	\$6,382	\$1,801	\$1,960	\$2,015	\$2,055	\$7,831	\$7,585	\$6,820	\$2,704	\$3,161	\$3,392	\$4,329	\$5,240	\$7,286	\$8,010	\$7,235
Process control	\$3,320	\$3,144	\$3,518	\$5,224	\$1,530	\$1,600	\$1,650	\$1,700	\$6,480	\$6,250	\$5,500	\$2,704	\$3,161	\$3,099	\$3,359	\$4,168	\$6,071	\$6,600	\$5,900
Spec semis		\$171	\$298	\$356	\$106	\$120	\$120	\$120	\$466	\$433	\$429			\$53	\$270	\$304	\$423	\$465	\$435
FPD+PCB		\$375	\$485	\$585	\$123	\$180	\$180	\$170	\$653	\$642	\$631			\$126	\$497	\$563	\$562	\$685	\$640
Other		\$159	\$210	\$218	\$42	\$60	\$65	\$65	\$232	\$260	\$260			\$50	\$203	\$206	\$260	\$260	\$260
Total Service Revenue	\$985	\$1,365	\$1,563	\$1,783	\$488	\$508	\$520	\$525	\$2,041	\$2,245	\$2,423	\$776	\$876	\$1,177	\$1,478	\$1,678	\$1,906	\$2,140	\$2,354

Source: Company reports, UBS estimates

LRCX: Lam Research

Investment Thesis/Risks

Our thesis	We are structural bulls on memory as we believe memory revenue dollars will outgrow non-memory over time – this should ultimately result in LRCX out-growing peers. Within memory, LRCX is more levered to NAND where meaningful consolidation has yet to really happen meaning that LRCX will benefit from continued over-investment by NAND producers – especially if YMTC's success continues to grow. The stock has been trading at a discount to peers due to fears around a correction in memory spending, but if we enter a recession, foundry will not be immune and we do not think it is sustainable that WFE can remain so skewed to foundry. Ergo, LRCX is fundamentally under-earning relative to peers and trades at a discount as well. LRCX also has strong elements of a "recurring" revenue model given the "stickiness" of its NAND business combined w/the strength of its service business as its equipment essentially "eats" itself.
Risks to our thesis	We see overall WFE declining in '23 and potentially '24 as well as the chip industry moves into a downturn – it will be hard for LRCX to escape such a cycle. Leverage to NAND could ultimately work the other way if the sector can drive more significant consolidation and more rational capex. The geopolitical situation with China remains a risk for all SPE makers as we expect the US to broaden its restrictions on chip equipment exports into China.

Source: UBS estimates

UBS vs Street

	FY2019	FY2020	FY2021	2022/1F	2022/2F	2022/3F	2022/4F	FY2022	2023/1F	2023/2F	2023/3F	2023/4F	FY2023	FY2024	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)																			
UBS	\$ 9,654	\$ 10,045	\$ 14,626	\$ 4,304	\$ 4,227	\$ 4,060	\$ 4,200	\$ 16,791	\$ 4,350	\$ 4,550	\$ 4,850	\$ 5,000	\$ 18,750	\$ 19,100	\$ 9,549	\$ 11,929	\$ 16,524	\$ 17,160	\$ 19,350
UBS (Old)							\$ 4,200	\$ 16,791	\$ 4,350	\$ 4,550	\$ 4,850	\$ 5,000	\$ 18,750	\$ 19,100				\$ 17,160	\$ 19,350
Consensus							\$ 4,212	\$ 12,743	\$ 4,647	\$ 5,068	\$ 4,918	\$ 4,931	\$ 19,563	\$ 19,456				\$ 17,987	\$ 19,487
Delta							(0.3%)	31.8%	(6.4%)	(10.2%)	(1.4%)	1.4%	(4.2%)	(1.8%)				(4.6%)	(0.7%)
EPS (Non-GAAP)																			
UBS	\$ 14.55	\$ 15.94	\$ 27.25	\$ 8.36	\$ 8.53	\$ 7.40	\$ 7.28	\$ 31.58	\$ 7.46	\$ 8.23	\$ 9.40	\$ 9.98	\$ 35.02	\$ 37.78	\$ 14.51	\$ 20.47	\$ 32.47	\$ 30.37	\$ 37.82
UBS (Old)							\$ 7.28	\$ 31.58	\$ 7.46	\$ 8.23	\$ 9.40	\$ 9.98	\$ 35.02	\$ 37.78				\$ 30.37	\$ 37.82
Consensus							\$ 7.35	\$ 24.24	\$ 8.84	\$ 10.15	\$ 9.53	\$ 9.62	\$ 38.14	\$ 39.16				\$ 33.74	\$ 38.28
Delta							(1.0%)	30.3%	(15.6%)	(18.9%)	(1.4%)	3.8%	(8.2%)	(3.5%)				(10.0%)	(1.2%)

Source: Company reports, UBS estimates

LRCX: Model Summary

Lam Research Corporation (LRCX) - Key Metrics (in \$MM except EPS)	C2018A	C2019A	C2020	C2021A	FQ3A CQ1A	FQ4:22E CQ2E	FQ1E CQ3E	FQ2E CQ4E	C2022E	C2023E	C2024E	FISCAL YEAR SUMMARY					
													F2018A	F2019A	F2020A	F2021A	F2022E
Systems	\$7,842	\$6,295	\$7,968	\$10,974	\$2,651	\$2,750	\$2,850	\$2,975	\$11,226	\$12,300	\$11,050	\$8,268	\$6,452	\$6,626	\$9,765	\$11,066	\$12,275
Y/Y Growth	13%	(20%)	27%	38%	4%	(1%)	(3%)	9%	2%	10%	(10%)	48%	(22%)	3%	47%	13%	11%
Services	\$3,029	\$3,254	\$3,960	\$5,550	\$1,410	\$1,450	\$1,500	\$1,575	\$5,935	\$7,050	\$7,750	\$2,809	\$3,202	\$3,419	\$4,861	\$5,726	\$6,475
Y/Y Growth	16%	7%	22%	40%	8%	5%	9%	6%	7%	19%	10%	15%	14%	7%	42%	18%	13%
Total Revenue	\$10,871	\$9,549	\$11,929	\$16,524	\$4,060	\$4,200	\$4,350	\$4,550	\$17,160	\$19,350	\$18,800	\$11,077	\$9,654	\$10,045	\$14,626	\$16,791	\$18,750
Y/Y Growth	14%	(12%)	25%	39%	6%	1%	1%	8%	4%	13%	(3%)	38%	(13%)	4%	46%	15%	12%
Gross Margin	46.9%	45.5%	46.7%	46.4%	44.7%	44.5%	45.0%	45.5%	44.9%	46.1%	45.9%	47.4%	45.9%	45.9%	46.7%	45.5%	45.9%
Opex	\$1,872	\$1,850	\$2,066	\$2,354	\$621	\$650	\$710	\$716	\$2,697	\$2,837	\$2,741	\$1,868	\$1,829	\$1,891	\$2,227	\$2,485	\$2,856
Y/Y Growth	7%	(1%)	12%	14%	10%	13%	21%	14%	15%	5%	(3%)	15%	(2%)	3%	18%	12%	15%
Operating Margin	29.6%	26.2%	29.4%	32.2%	29.4%	29.0%	28.7%	29.8%	29.2%	31.5%	31.3%	30.5%	27.0%	27.1%	31.3%	30.7%	30.7%
Non-GAAP EPS	\$17.34	\$14.51	\$20.47	\$32.47	\$7.40	\$7.28	\$7.46	\$8.23	\$30.37	\$37.82	\$38.08	\$17.87	\$14.55	\$15.94	\$27.25	\$31.58	\$35.02
Free Cash Flow																	
CFFO	\$3,131	\$2,585	\$2,342	\$4,499	\$758	\$977	\$971	\$1,025	\$3,731	\$5,129	\$5,205	\$2,656	\$3,176	\$2,126	\$3,588	\$3,633	\$4,357
Capex	\$291	\$243	\$257	\$469	\$145	\$126	\$109	\$114	\$494	\$484	\$470	\$273	\$303	\$203	\$349	\$546	\$469
FCF	\$2,841	\$2,343	\$2,085	\$4,030	\$612	\$851	\$862	\$911	\$3,237	\$4,645	\$4,735	\$2,382	\$2,873	\$1,923	\$3,239	\$3,086	\$3,888
% revenue	26.1%	24.5%	17.5%	24.4%	15.1%	20.3%	19.8%	20.0%	18.9%	24.0%	25.2%	21.5%	29.8%	19.1%	22.1%	18.4%	20.7%
System Revenue Segments (shipments before Jun 2018)																	
DRAM	NA	\$1,273	\$1,362	\$1,819		\$716											
Y/Y Growth	NA	NA	7%	33%	101%												
NAND	NA	\$2,498	\$3,513	\$4,851		\$1,034											
Y/Y Growth	NA	NA	41%	38%	(15%)												
Memory	NA	\$3,771	\$4,875	\$6,670		\$1,750											
Y/Y Growth	NA	NA	29%	37%	11%												
Foundry	NA	\$1,767	\$2,425	\$3,337		\$557											
Y/Y Growth	NA	NA	37%	38%	(29%)												
IDM / Logic	NA	\$758	\$668	\$967		\$345											
Y/Y Growth	NA	NA	(12%)	45%	93%												

Source: Company reports, UBS estimates

MCHP: Microchip Technology Incorporated

Investment Thesis/Risks

Our thesis	We have very much entered the inventory build phase of the cycle and lead times are beginning to come down for MCHP's core products (MCUs), but inventories are well below norm and demand remains relatively strong even as supply is improving. MCHP benefited less than some peers in terms of pricing on the upside and its consistent MCU share gains have staying power while the stock trades at a material discount to TXN. We also like the flexible manufacturing model and strong growth in capital return – which has historically led to multiple expansion.
Risks to our thesis	Lead times could compress faster than we expect, and stock reaction to lead time compression & supply/demand in C23 remains a risk. Furthermore, Analog remains linked to macro.

Source: UBS estimates

UBS vs Street

	F2019	F2020	F2021	F2022	2023/1F	2023/2F	2023/3F	2023/4F	F2023	F2024		CY2019	CY2020	CY2021	CY2022	CY2023	CY2024
Revenues (\$MM)																	
UBS (new)	\$5,350	\$5,274	\$5,438	\$6,821	\$1,955	\$1,962	\$1,969	\$1,969	\$7,854	\$8,410		\$5,278	\$5,298	\$6,444	\$7,729	\$8,195	\$8,555
UBS (old)					\$1,955	\$1,962	\$1,969	\$1,969	\$7,854	\$8,410		\$5,278	\$5,298	\$6,444	\$7,729	\$8,195	\$8,555
Consensus					\$1,948	\$1,970	\$1,984	\$1,980	\$7,882	\$8,246					\$7,623	\$8,030	\$8,389
Delta					0.4%	(0.4%)	(0.8%)	(0.6%)	(0.4%)	2.0%					1.4%	2.1%	2.0%
EPS (non-GAAP)																	
UBS (new)	\$3.11	\$2.81	\$3.30	\$4.61	\$1.33	\$1.33	\$1.34	\$1.35	\$5.35	\$5.93		\$2.82	\$3.09	\$4.19	\$5.35	\$5.72	\$6.17
UBS (old)					\$1.33	\$1.33	\$1.34	\$1.35	\$5.35	\$5.93		\$2.82	\$3.09	\$4.19	\$5.35	\$5.72	\$6.17
Consensus					\$1.33	\$1.35	\$1.36	\$1.35	\$5.39	\$5.69					\$5.19	\$5.53	\$5.77
Delta					(0.1%)	(1.4%)	(0.9%)	(0.3%)	(0.7%)	4.3%					3.2%	3.5%	7.0%

Source: Company reports, UBS estimates

MCHP: Model Summary

Microchip (MCHP) - Key Metrics (in \$MM except EPS)	C2018A	C2019A	C2020A	C2021A	FQ4:22A CQ1A	Estimates			C2022E	C2023E	FISCAL YEAR SUMMARY						
						FQ1E CQ2E	FQ2E CQ3E	FQ3E CQ4E			F2018A	F2019A	F2020A	F2021A	F2022A	F2023E	F2024E
Revenue	\$5,022	\$5,278	\$5,298	\$6,444	\$1,844	\$1,955	\$1,962	\$1,969	\$7,729	\$8,195	\$3,981	\$5,350	\$5,274	\$5,438	\$6,821	\$7,854	\$8,410
Y/Y Growth	29%	5%	0%	22%	26%	25%	19%	12%	20%	6%	17%	34%	(1%)	3%	25%	15%	7%
Gross Profit	\$3,110	\$3,271	\$3,296	\$4,196	\$1,228	\$1,304	\$1,320	\$1,329	\$5,181	\$5,565	\$2,434	\$3,315	\$3,266	\$3,414	\$4,484	\$5,286	\$5,717
Gross Margin	61.9%	62.0%	62.2%	65.1%	66.6%	66.7%	67.3%	67.5%	67.0%	67.9%	61.1%	62.0%	61.9%	62.8%	65.7%	67.3%	68.0%
R&D (Non-GAAP)	\$680	\$789	\$740	\$855	\$237	\$246	\$251	\$252	\$986	\$1,049	\$487	\$753	\$795	\$739	\$890	\$1,001	\$1,076
SG&A (Non-GAAP)	\$532	\$577	\$514	\$604	\$166	\$180	\$186	\$187	\$720	\$795	\$405	\$579	\$564	\$521	\$628	\$744	\$816
OpeX (Non-GAAP)	\$1,211	\$1,365	\$1,253	\$1,459	\$404	\$426	\$437	\$439	\$1,706	\$1,844	\$892	\$1,332	\$1,359	\$1,260	\$1,519	\$1,746	\$1,892
Y/Y Growth	37%	13%	(8%)	16%	17%	18%	16%	16%	17%	8%	(2%)	49%	2%	(7%)	21%	15%	8%
Operating Income	\$1,899	\$1,906	\$2,043	\$2,737	\$825	\$878	\$883	\$890	\$3,475	\$3,721	\$1,542	\$1,983	\$1,907	\$2,154	\$2,965	\$3,540	\$3,824
Operating Margin	37.8%	36.1%	38.6%	42.5%	44.7%	44.9%	45.0%	45.2%	45.0%	45.4%	38.7%	37.1%	36.2%	39.6%	43.5%	45.1%	45.5%
Non-GAAP EPS	\$3.07	\$2.82	\$3.09	\$4.19	\$1.35	\$1.33	\$1.33	\$1.34	\$5.35	\$5.72	\$2.72	\$3.11	\$2.81	\$3.30	\$4.61	\$5.35	\$5.93
Free Cash Flow																	
CFFO	\$1,631	\$1,576	\$1,839	\$2,544	\$748	\$410	\$777	\$794	\$2,728	\$3,321	\$1,420	\$1,675	\$1,544	\$1,917	\$2,843	\$2,733	\$3,462
Capex	\$247	\$96	\$49	\$311	\$115	\$125	\$125	\$125	\$490	\$440	\$207	\$229	\$68	\$93	\$370	\$500	\$420
FCF	\$1,384	\$1,480	\$1,790	\$2,233	\$633	\$285	\$652	\$669	\$2,238	\$2,881	\$1,213	\$1,446	\$1,476	\$1,824	\$2,473	\$2,233	\$3,041
% revenue	28%	28%	34%	35%	34%	15%	33%	34%	29%	35%	30%	27%	28%	34%	36%	28%	36%
Y/Y Growth	14%	7%	21%	25%	61%	(48%)	22%	(12%)	0%	29%	23%	19%	2%	24%	36%	(10%)	36%
Segment Revenue																	
Microcontrollers (MCU)	\$2,875	\$2,796	\$2,872	\$3,584	\$1,046	\$1,115	\$1,115	\$1,126	\$4,403	\$4,592	\$2,619	\$2,922	\$2,818	\$2,961	\$3,815	\$4,449	\$4,752
Q/Q Growth						8%	7%	--	1%								
Y/Y Growth	13%	(3%)	3%	25%	28%	24%	25%	16%	23%	4%	22%	12%	(4%)	5%	29%	17%	7%
Analog	\$1,390	\$1,527	\$1,472	\$1,839	\$516	\$552	\$557	\$552	\$2,176	\$2,409	\$952	\$1,531	\$1,511	\$1,520	\$1,939	\$2,245	\$2,451
Q/Q Growth	48%	10%	(4%)	25%	24%	28%	14%	10%	18%	11%	7%	61%	(1%)	1%	28%	16%	9%
LMO+FPGA	\$757	\$955	\$954	\$1,021	\$283	\$288	\$289	\$291	\$1,151	\$1,194	\$897	\$945	\$945	\$958	\$1,067	\$1,160	\$1,207
Q/Q Growth	90%	26%	(0%)	7%	19%	23%	9%	2%	13%	4%	119%	5%	--	1%	11%	9%	4%

Source: Company reports, UBS estimates

MU: Micron Technology, Inc.

Investment Thesis/Risks

Our thesis	We are structural bulls on Memory and on MU in particular as DRAM demand remains levered to markets such as Cloud Computing, 5G, Autos all of which have a long runway of growth. Investors most often focus on the supply side in memory because it can be tracked more easily via reported capex from the chip companies and supply growth should be very limited in '23 given rapid pullback in capex across the industry, combined with technology hiccups at Samsung. Returns in NAND should remain far below DRAM for a long time, and we like that MU remains under-levered to NAND as it represents only ~20-25% of revenue. Having said that, MU is also a clear technology leader in NAND as well. MU's technology leadership and supply constraints across the industry should drive sustained gross margin and prevent a big correction in DRAM pricing in '23 even as consumer demand softens. As fundamentals and cycles prove to be more durable, there is a significant re-rating potential.
Risks to our thesis	DRAM pricing decline may last longer than we are estimating based on supply and demand balance. Supply constraints and inventory/demand correction may also cap Q/Q bit growth in C2H:22E. In addition, MU looks challenged to grow DRAM bits in F2023 given the significant near-term pullback in its shipments. Also, NAND remains a drag on margins until MU can build more scale.

Source: UBS estimates

UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023/1F	2023/2F	2023/3F	2023/4F	2023	2024	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)																				
UBS (New)	\$23,406	\$21,435	\$27,705	\$7,687	\$7,786	\$8,642	\$7,202	\$31,317	\$6,433	\$6,343	\$7,315	\$8,718	\$28,809	\$41,699	\$31,501	\$20,637	\$22,064	\$29,619	\$30,063	\$31,480
UBS (Old)								\$7,202	\$31,317	\$6,433	\$6,343	\$7,315	\$8,718	\$28,809	\$41,699				\$30,063	\$31,480
Consensus								\$7,413	\$31,528	\$6,780	\$6,837	\$7,406	\$8,127	\$29,150	\$33,634				\$30,621	\$30,570
Delta								(2.9%)	(0.7%)	(5.1%)	(7.2%)	(1.2%)	7.3%	(1.2%)	24.0%				(1.8%)	3.0%
EPS																				
UBS (New)	\$6.36	\$2.83	\$6.07	\$2.16	\$2.14	\$2.59	\$1.57	\$8.46	\$1.07	\$1.00	\$1.50	\$2.36	\$5.90	\$15.04	\$12.47	\$3.81	\$3.14	\$7.45	\$7.36	\$7.56
UBS (Old)								\$1.57	\$8.46	\$1.07	\$1.00	\$1.50	\$2.36	\$5.90	\$15.04				\$7.36	\$7.56
Consensus								\$1.71	\$8.60	\$1.42	\$1.42	\$1.68	\$1.99	\$6.52	\$8.96				\$7.86	\$7.18
Delta								(8.2%)	(1.6%)	(24.9%)	(29.6%)	(10.9%)	18.5%	(9.5%)	67.9%				(6.4%)	5.3%

Source: Company reports, UBS estimates

MU: Model Summary

Micron (MU): Key Metrics	C2017A	C2018A	C2019A	C2020A	C2021A	FQ2 CQ1	FQ3 CQ2	Estimates FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY						
												F2018	F2019	F2020	F2021	F2022E	F2023E	F2024E
												\$30,391	\$23,406	\$21,435	\$27,705	\$31,317	\$28,809	\$41,699
Revenue	\$23,155	\$31,501	\$20,637	\$22,064	\$29,619	\$7,786	\$8,642	\$7,202	\$6,433	\$30,063	\$31,480	50%	(23%)	(8%)	29%	13%	(8%)	45%
Y/Y Growth	78%	36%	(34%)	7%	34%	25%	16%	(13%)	(16%)	1%	5%							
Gross Profit (Non-GAAP)	\$11,376	\$18,895	\$7,708	\$7,097	\$12,819	\$3,724	\$4,097	\$3,029	\$2,393	\$13,243	\$13,451	\$17,994	\$10,973	\$6,718	\$10,987	\$14,466	\$11,501	\$22,291
Gross Margin	49.1%	60.0%	37.4%	32.2%	43.3%	47.8%	47.4%	42.1%	37.2%	44.1%	42.7%	59.2%	46.9%	31.3%	39.7%	46.2%	39.9%	53.5%
R&D Expenses (Non-GAAP) ex SBC	1,746	2,241	2,376	2,515	2,602	748	728	790	790	3,056	3,240	2,086	2,344	2,513	2,551	2,940	3,200	3,460
SG&A Expenses (Non-GAAP) ex SBC	697	767	752	776	833	233	231	260	260	984	1,120	752	751	778	796	948	1,080	1,330
Other & Restructuring (Non-GAAP)	53	(84)	72	15	578	81	-	--	--	81	--	(85)	77	8	616	51	--	--
Total Opex (Non GAAP)	\$2,496	\$2,924	\$3,200	\$3,299	\$3,400	\$974	\$953	\$1,050	\$1,050	\$4,027	\$4,360	\$2,753	\$3,172	\$3,299	\$3,320	\$3,868	\$4,280	\$4,790
Y/Y Growth	15%	17%	9%	3%	3%	22%	16%	18%	18%	18%	8%	11%	15%	4%	1%	17%	11%	12%
Operating Income (Non-GAAP)	\$8,880	\$15,971	\$4,508	\$3,798	\$9,419	\$2,750	\$3,144	\$1,979	\$1,343	\$9,216	\$9,091	\$15,241	\$7,801	\$3,419	\$7,667	\$10,598	\$7,221	\$17,501
Operating Margin	38.4%	50.7%	21.8%	17.2%	31.8%	35.3%	36.4%	27.5%	20.9%	30.7%	28.9%	50.1%	33.3%	16.0%	27.7%	33.8%	25.1%	42.0%
Non-GAAP EPS	\$7.00	\$12.48	\$3.81	\$3.14	\$7.45	\$2.14	\$2.59	\$1.57	\$1.07	\$7.36	\$7.56	\$11.96	\$6.36	\$2.83	\$6.07	\$8.46	\$5.90	\$15.04
Free Cash Flow																		
CFFO	10,651	18,574	10,390	8,262	14,409	3,628	3,838	5,730	3,177	16,373	17,312	17,400	13,189	8,306	12,438	17,134	14,968	22,941
Capex	5,426	9,623	9,023	9,018	10,557	2,611	2,578	3,400	2,000	10,589	10,000	8,879	9,780	8,223	10,030	11,854	9,000	13,250
FCF	\$5,225	\$8,951	\$1,367	(\$756)	\$4,077	\$1,017	\$1,260	\$2,330	\$1,177	\$5,784	\$7,312	\$8,521	\$3,409	\$83	\$2,588	\$5,280	\$5,968	\$9,691
% revenue	23%	28%	7%	(3%)	14%	13%	15%	32%	18%	19%	23%	28%	15%	0%	9%	17%	21%	23%
Product Revenue																		
Total DRAM Revenue	\$16,072	\$23,635	\$14,420	\$15,097	\$21,570	\$5,719	\$6,271	\$5,232	\$4,622	\$21,844	\$23,570	\$22,610	\$16,807	\$14,509	\$20,039	\$22,809	\$21,126	\$31,830
Unit Shipment (1MM GBe)	2,604	2,923	3,456	4,384	5,348	1,411	1,566	1,347	1,279	5,603	6,170	2,893	3,173	4,173	5,263	5,630	5,741	7,309
Q/Q						8%	11%	(14.0%)	(5%)									
Y/Y		12%	18%	27%		22%	8%	17%	(3%)	(2%)	5%	10%						
ASP/GB	\$6.17	\$8.09	\$4.17	\$3.44		\$4.03	\$4.05	\$4.00	\$3.88	\$3.61	\$3.90	\$7.82	\$5.30	\$3.23	\$3.81	\$4.05	\$3.68	\$4.35
Q/Q						(5%)	(1%)	(3.0%)	(7%)									
Y/Y		31%	(48%)	(17%)		17%												
Cost/GB	\$2.71	\$2.55	\$2.25	\$2.14		\$1.96	\$1.87	\$1.87	\$1.99	\$2.03	\$1.93	\$2.55	\$2.29	\$2.20	\$1.99	\$1.91	\$1.91	\$1.67
Q/Q						(3%)	0%	6%	2%									
Y/Y		(6%)	(12%)	(5%)		(8%)												(12%)
Total NAND Revenue	\$6,206	\$6,537	\$5,141	\$6,284	\$7,312	\$1,957	\$2,288	\$1,864	\$1,700	\$7,809	\$7,508	\$6,508	\$5,381	\$6,131	\$7,008	\$7,987	\$7,280	\$9,474
Bit shipments (MM GBe)	24,740	33,551	47,000	56,811	71,732	18,145	21,408	17,982	17,083	74,619	90,835	29,927	43,703	54,202	69,650	75,753	82,555	110,920
Q/Q						(0%)	18%	(16.0%)	(5%)									
Y/Y		36%	40%	21%		26%	4%	20%	(2%)	(6%)	4%	22%						
ASP/GB	\$0.25	\$0.19	\$0.11	\$0.11		\$0.11	\$0.11	\$0.10	\$0.10	\$0.10	\$0.10	\$0.22	\$0.12	\$0.11	\$0.10	\$0.11	\$0.09	\$0.09
Q/Q						5%	(1%)	(3%)	(4%)									
Y/Y		(22%)	(44%)	1%	(8%)		\$0.07	\$0.07	\$0.08	\$0.08	\$0.08	(15%)	(43%)	(8%)	(11%)	5%	(16%)	(3%)
Cost/GB	\$0.17	\$0.12	\$0.09	\$0.09		\$0.08						\$0.17	\$0.09	\$0.09	\$0.08	\$0.07	\$0.07	\$0.06
Q/Q																		
Y/Y		(26%)	(27%)	(1%)	(10%)													(16%)
Total NOR Revenue	\$959	\$1,033	\$1,089	\$584	\$638	\$85	\$58	\$81	\$86	\$310	\$302	\$1,068	\$1,144	\$694	\$559	\$421	\$304	\$296
All Other	\$100	\$100	\$100	\$100	\$100	\$25	\$25	\$25	\$25	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100

Source: Company reports, UBS estimates



MRVL: Marvell Technology Group Ltd.

Investment Thesis/Risks

Our thesis	Post IPHI and Innovium acquisition, MRVL is now one of the better cloud stories in the market with relatively little competition for its merchant products and very unique custom ASIC capabilities amid a flurry of activity from hyperscalers. Beyond near and even medium term demand strength from cloud/5G, the longer-term product roadmap is starting to benefit from 5nm R&D investments that mgmt undertook during the CAVM deal as new cloud wins add visibility out into 2024/2025 after 5G will have largely played out. In this timeframe, the auto segment should also be a much larger revenue contributor as cars become computers on wheels and MRVL is the standard for auto Ethernet. The company raised its long-term revenue growth rate from 14% mid-pt to 17.5% midpt, one of - if not the - most ambitious growth targets for any company in the broader semis universe. MRVL has also been one of the most constrained on the supply side, meaning that more substrate and wafer availability could open some upside for the model and unless data center weakens materially, the backlog seems to offer more protection on the downside than many peers across semis.
Risks to our thesis	The company has built through M&A and stock compensation relative to EBIT is one of the highest in all of semis. Also, the custom ASIC business can be risky unless MRVL chooses the right partners and projects to pursue. Lastly, the stock may not be able to escape the inevitable downcycle that we see starting to materialize in '23E especially if data center demand were to materially weaken.

Source: UBS estimates

UBS vs Street

	F2019	F2020	F2021	F2022	2023/1F	2023/2F	2023/3F	2023/4F	F2023	F2024		CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)																	
UBS (new)	\$2,866	\$2,699	\$2,969	\$4,462	\$1,447	\$1,514	\$1,592	\$1,675	\$6,228	\$7,389		\$2,866	\$2,699	\$2,969	\$4,462	\$6,228	\$7,389
UBS (old)						\$1,514	\$1,592	\$1,675	\$6,228	\$7,389						\$6,228	\$7,389
Consensus						\$1,517	\$1,580	\$1,638	\$6,182	\$7,268						\$6,182	\$7,268
Delta						(0.2%)	0.8%	2.3%	0.7%	1.7%						0.7%	1.7%
EPS (non-GAAP)																	
UBS (new)	\$1.19	\$0.66	\$0.92	\$1.58	\$0.52	\$0.56	\$0.62	\$0.67	\$2.38	\$3.14		\$1.19	\$0.66	\$0.92	\$1.58	\$2.38	\$3.14
UBS (old)						\$0.56	\$0.62	\$0.67	\$2.38	\$3.14						\$2.38	\$3.14
Consensus						\$0.56	\$0.60	\$0.64	\$2.33	\$2.94						\$2.33	\$2.94
Delta						(0.6%)	3.0%	4.8%	2.0%	7.1%						2.0%	7.1%

Source: Company reports, UBS estimates

MRVL: Model Summary

Marvell (MRVL) - Key Metrics (in \$MM except EPS)	F2019A C2018A	F2020A C2019A	F2021A C2020A	F2022A C2021A	FQ1A CQ1A	Estimates FQ2E CQ2E	FQ3E CQ3E	FQ4:23E CQ4E	F2023E C2022E	F2024E C2023E	F2025E C2024E
Revenue	\$2,866	\$2,699	\$2,969	\$4,462	\$1,447	\$1,514	\$1,592	\$1,675	\$6,228	\$7,389	\$8,514
Y/Y Growth	19%	-6%	10%	50%	74%	41%	31%	25%	40%	19%	15%
Gross Margin	63.9%	63.3%	63.3%	64.9%	65.5%	65.3%	65.2%	65.2%	65.3%	65.5%	65.5%
Opex	\$1,041	\$1,164	\$1,160	\$1,433	\$435	\$435	\$445	\$455	\$1,771	\$1,875	\$2,000
Y/Y Growth	22%	12%	0%	24%	42%	19%	20%	17%	24%	6%	7%
Operating Margin	27.6%	20.2%	24.2%	32.8%	35.4%	36.5%	37.2%	38.0%	36.8%	40.1%	42.0%
Non-GAAP EPS	\$1.19	\$0.66	\$0.92	\$1.58	\$0.52	\$0.56	\$0.62	\$0.67	\$2.38	\$3.14	\$3.80
Free Cash Flow											
CFFO	\$597	\$360	\$817	\$819	\$195	\$321	\$434	\$562	\$1,502	\$2,805	\$3,243
Capex	\$76	\$85	\$107	\$169	\$37	\$45	\$48	\$50	\$180	\$222	\$255
FCF	\$521	\$276	\$710	\$650	\$158	\$275	\$387	\$511	\$1,322	\$2,584	\$2,988
% revenue	18.2%	10.2%	23.9%	14.6%	10.9%	18.2%	24.3%	30.5%	21.2%	35.0%	35.1%
Y/Y Growth	-4%	-47%	158%	-9%	-549%	45%	106%	66%	103%	95%	16%
Segment Revenue											
Data Center			\$1,041	\$1,785	\$641	\$653	\$699	\$748	\$2,741	\$3,560	\$4,437
Y/Y Growth				71%	131%	51%	40%	30%	54%	30%	25%
Carrier Infrastructure			\$600	\$820	\$252	\$275	\$286	\$297	\$1,109	\$1,249	\$1,386
Y/Y Growth				37%	50%	40%	33%	23%	35%	13%	11%
Enterprise Networking			\$636	\$908	\$287	\$327	\$343	\$360	\$1,317	\$1,477	\$1,516
Y/Y Growth				43%	64%	47%	39%	37%	45%	12%	3%
Automotive/Industrial			\$118	\$250	\$89	\$93	\$97	\$100	\$379	\$466	\$546
Y/Y Growth				112%	94%	62%	45%	26%	52%	23%	17%
Consumer			\$575	\$700	\$179	\$166	\$168	\$169	\$682	\$638	\$628
Y/Y Growth				22%	7%	0%	-8%	-9%	-3%	-6%	-1%

Source: Company reports, UBS estimates

NVDA: Nvidia Corporation

Investment Thesis/Risks

Our thesis	We view NVDA as a core holding for any growth portfolio. We think NVDA is best positioned to address the broadest set of workloads in the competition as NVDA's GPUs combined with their software horsepower are still very much the most dominant spot amid the proliferation of heterogeneous compute architectures in the cloud. AI workloads continue to rapidly broaden into mainstream verticals of the global economy and this creates a large wedge of opportunity as compute demand for these workloads significantly outstrips supply, creating a very long runway for the data center business. On top of all of these, we believe that the Omniverse platform, spurred by the multi-year secular catalysts of Metaverse, will usher in the next wave of significant TAM expansion given its very broad application spectrum. Gaming represents near-term risk, but the stock is reflecting much of this at current levels.
Risks to our thesis	Gaming's seasonal and channel headwinds could be worse than we are expecting down the road as it eventually sets up for what are likely to be a few sub-seasonal quarters as the gaming channel becomes more balanced. AMD is catching up with NVDA on the GPU architecture technology and there could be a big risk of migration of gamers from NVDA's GPUs to AMD's, while INTC's new discrete GPUs will also intensify the competition. In addition, China's crackdown on cryptocurrency mining will significantly decrease the customer base as well as the TAM in that market. Lastly, the Omniverse platform may not be able to grow its installed base of customers as soon and fast as we are expecting.

Source: UBS estimates

UBS vs Street

	FY 2019	FY 2020	FY 2021	FY 2022	2023/1F	2023/2F	2023/3F	2023/4F	FY 2023	FY 2024	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	CY2024
Revenues (\$MM)																	
UBS (New)	\$ 11,716	\$ 10,918	\$ 16,675	\$ 26,914	\$ 8,288	\$ 8,135	\$ 8,607	\$ 8,570	\$ 33,600	\$ 38,886	\$ 11,716	\$ 10,918	\$ 16,675	\$ 26,914	\$ 33,600	\$ 38,886	\$ 45,765
UBS (Old)																	
Consensus																	
Delta																	
EPS																	
UBS (non-GAAP) (New)	\$ 1.66	\$ 1.45	\$ 2.50	\$ 4.44	\$ 1.36	\$ 1.31	\$ 1.42	\$ 1.41	\$ 5.50	\$ 6.83	\$ 1.66	\$ 1.45	\$ 2.50	\$ 4.44	\$ 5.50	\$ 6.83	\$ 8.22
UBS (non-GAAP) (Old)																	
Consensus (non-GAAP)																	
Delta																	

Source: Company reports, UBS estimates

NVDA: Model Summary

NVIDIA (NVDA) - Key Metrics (in \$MM except EPS)	CY2017 F2018	CY2018 F2019	CY2019 F2020	CY2020 F2021	CY2021A F2022A	CQ1:22A FQ1:23A	Estimates		CY2022E F2023E	CQ1:23E FQ1:24E	CQ2:23E FQ2:24E	CQ3:23E FQ3:24E	CQ4:23E FQ4:24E	CY2023E F2024E	
							CQ2:22E FQ2:23E	CQ3:22E FQ3:23E	CQ4:22E FQ4:23E						
Revenue	\$9,714	\$11,716	\$10,918	\$16,675	\$26,914	\$8,288	\$8,135	\$8,607	\$8,570	\$33,600	\$8,739	\$9,414	\$10,186	\$10,547	\$38,886
Y/Y Growth	41%	21%	(7%)	53%	61%	46%	25%	21%	12%	25%	5%	16%	18%	23%	16%
Gross Profit (Non GAAP)	\$5,844	\$7,233	\$6,822	\$10,948	\$17,968	\$5,563	\$5,459	\$5,767	\$5,742	\$22,530	\$5,855	\$6,448	\$7,028	\$7,298	\$26,630
Gross Margin	60.2%	61.7%	62.5%	65.7%	66.8%	67.1%	67.1%	67.0%	67.0%	67.1%	67.0%	68.5%	69.0%	69.2%	68.5%
R&D (Non-GAAP)	1,578	2,038	2,288	3,066	3,969	1,234	1,285	1,285	1,295	5,099	1,300	1,310	1,350	1,390	5,350
SG&A (Non-GAAP)	665	799	828	1,489	1,600	436	465	475	480	1,856	490	500	525	550	2,065
Non GAAP Adjustments	(15)	(12)	(29)	(411)	(292)	1,415	160	160	160	1,895	160	160	160	160	640
Operating Expenses (Non-GAAP)	\$2,228	\$2,825	\$3,087	\$4,144	\$5,277	\$1,608	\$1,750	\$1,760	\$1,775	\$6,893	\$1,790	\$1,810	\$1,875	\$1,940	\$7,415
Y/Y Growth	19%	27%	9%	34%	27%	35%	38%	28%	23%	31%	11%	3%	7%	9%	8%
Operating Income (Non GAAP)	\$3,616	\$4,408	\$3,735	\$6,804	\$12,691	\$3,955	\$3,709	\$4,007	\$3,967	\$15,637	\$4,065	\$4,638	\$5,153	\$5,358	\$19,215
Operating Margin	37.2%	37.6%	34.2%	40.8%	47.2%	47.7%	45.6%	46.6%	46.3%	46.5%	46.5%	49.3%	50.6%	50.8%	49.4%
GAAP EPS (incl. SBC)	\$1.20	\$1.66	\$1.13	\$1.73	\$3.85	\$0.64	\$0.94	\$1.04	\$1.03	\$3.65	\$1.05	\$1.25	\$1.43	\$1.50	\$5.22
Non-GAAP EPS (incl. SBC)	\$1.08	\$1.39	\$1.12	\$1.95	\$3.65	\$1.15	\$1.08	\$1.19	\$1.17	\$4.59	\$1.20	\$1.40	\$1.58	\$1.65	\$5.82
Non-GAAP EPS (excl. SBC)	\$1.23	\$1.66	\$1.45	\$2.50	\$4.44	\$1.36	\$1.31	\$1.42	\$1.41	\$5.50	\$1.44	\$1.65	\$1.83	\$1.91	\$6.83
Reported SBC (\$M)	\$390	\$557	\$845	\$1,398	\$2,043	\$578	\$665	\$678	\$692	\$2,613	\$706	\$720	\$734	\$749	\$2,909
Free Cash Flow															
CFFO	3,500	3,744	4,761	5,822	9,108	1,731	3,800	3,630	4,152	13,313	3,855	4,049	4,433	4,894	17,231
Capex	(593)	(600)	(488)	(1,128)	(975)	(361)	(447)	(430)	(428)	(1,667)	(350)	(377)	(407)	(422)	(1,555)
FCF	\$2,907	\$3,144	\$4,273	\$4,694	\$8,133	\$1,370	\$3,352	\$3,200	\$3,724	\$11,646	\$3,506	\$3,672	\$4,026	\$4,472	\$15,676
% of revenue	45%	45%	39%	28%	30%	17%	41%	37%	43%	35%	40%	39%	40%	42%	40%

Source: Company reports, UBS estimates

NVDA: Model Summary

NVIDIA (NVDA) - Key Metrics (in \$MM except EPS)	CY2017 F2018	CY2018 F2019	CY2019 F2020	CY2020 F2021	CY2021A F2022A	CQ1:22A FQ1:23A	Estimates CQ2:22E FQ2:23E	CQ3:22E FQ3:23E	CQ4:22E FQ4:23E	CY2022E F2023E	CQ1:23E FQ1:24E	CQ2:23E FQ2:24E	CQ3:23E FQ3:24E	CQ4:23E FQ4:24E	CY2023E F2024E
Product Revenue															
Nintendo Switch Revenue	\$866	\$785	\$752	\$918	\$706	\$103	\$122	\$252	\$129	\$605	\$95	\$102	\$205	\$110	\$512
Units (in MM)	14.82	17.42	19.92	27.38	23.67	4.56	3.24	4.20	9.13	21.13	3.43	3.11	3.46	7.43	17.43
ASP (in \$)	\$59	\$48	\$38	\$33	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30
Gaming ex-Switch	\$4,647	\$5,461	\$4,766	\$6,841	\$11,756	\$3,517	\$2,955	\$2,979	\$2,779	\$12,231	\$2,668	\$2,853	\$3,194	\$3,289	\$12,004
Q/Q Growth						8%	(16%)	1%	(7%)		(4%)	7%	12%	3%	
Y/Y Growth	19%	18%	(13%)	44%	72%	34%	0%	2%	(15%)	4%	(24%)	(3%)	7%	18%	(2%)
Total Gaming	\$5,513	\$6,246	\$5,518	\$7,759	\$12,462	\$3,620	\$3,077	\$3,231	\$2,908	\$12,836	\$2,762	\$2,956	\$3,399	\$3,399	\$12,516
Q/Q Growth						6%	(15%)	5%	(10%)		(5%)	7%	15%	--	--
Y/Y Growth	36%	13%	(12%)	41%	61%	31%	1%	0%	(15%)	3%	(24%)	(4%)	5%	17%	(2%)
Gross Margins (UBS Est.)	55%	56%	57%	59%	59%	59%	57%	56%	54%	56%	50%	55%	59%	59%	56%
Professional Visualization	\$933	\$1,130	\$1,212	\$1,053	\$2,111	\$622	\$653	\$692	\$771	\$2,739	\$694	\$792	\$855	\$872	\$3,213
Q/Q Growth						(3%)	5%	6%	11%		(10%)	14%	8%	2%	
Y/Y Growth	12%	21%	7%	(13%)	100%	67%	26%	20%	20%	30%	12%	21%	23%	13%	17%
Gross Margins (UBS Est.)	77%	72%	74%	69%	68%	68%	68%	70%	70%	69%	70%	70%	70%	70%	70%
DC compute (excl. MLNX)	\$1,932	\$2,932	\$2,983	\$5,029	\$8,268	\$3,050	\$3,325	\$3,524	\$3,630	\$13,528	\$3,920	\$4,234	\$4,445	\$4,712	\$17,311
Q/Q Growth	--	--	--	--	--	15%	9%	6%	3%	--	8%	8%	5%	6%	--
Y/Y Growth	133%	52%	2%	69%	64%	103%	94%	48%	36%	64%	29%	27%	26%	30%	28%
Gross Margins (UBS Est.)	82%	79%	76%	77%	80%	78%	77%	77%	77%	77%	78%	78%	78%	78%	78%
Networking (MLNX)	--	\$1,089	\$1,330	\$1,668	\$2,275	\$700	\$763	\$824	\$906	\$3,193	\$988	\$1,037	\$1,069	\$1,122	\$4,216
Q/Q Growth	--	--	--	--	--	17%	9%	8%	10%	--	9%	5%	3%	5%	--
Y/Y Growth	NA	NA	22%	25%	36%	33%	27%	50%	51%	40%	41%	36%	30%	24%	32%
Total Data Center (Incl MLNX)	\$1,932	\$2,932	\$2,983	\$6,696	\$10,613	\$3,750	\$4,088	\$4,348	\$4,536	\$16,722	\$4,908	\$5,271	\$5,514	\$5,834	\$21,527
Q/Q Growth						15%	9%	6%	4%		8%	7%	5%	6%	
Y/Y Growth	133%	52%	2%	124%	58%	83%	73%	48%	39%	58%	31%	29%	27%	29%	29%
Automotive	\$558	\$641	\$700	\$536	\$566	\$138	\$155	\$168	\$182	\$643	\$197	\$212	\$229	\$248	\$885
Q/Q Growth						10%	12%	9%	8%		8%	8%	8%	8%	
Y/Y Growth	15%	15%	9%	(23%)	6%	-10%	2%	25%	46%	14%	42%	37%	36%	36%	38%
Gross Margins (UBS Est.)	40%	45%	45%	41%	40%	40%	40%	40%	40%	40%	45%	45%	45%	45%	45%
OEM & IP	\$778	\$767	\$505	\$631	\$1,162	\$158	\$163	\$168	\$173	\$661	\$178	\$183	\$189	\$194	\$744
Q/Q Growth						-18%	3%	3%	3%		3%	3%	3%	3%	
Y/Y Growth	11%	(1%)	(34%)	25%	84%	-52%	-60%	-28%	-10%	-43%	13%	13%	13%	13%	13%
Gross Margins (UBS Est.)	43%	43%	43%	41%	40%	30%	30%	30%	30%	30%	40%	40%	40%	40%	40%
Segment Revenues (New segment from FY2021)															
Graphic	NA	\$8,159	\$7,639	\$9,834	\$15,868	\$4,616	--	--	--	--	--	--	--	--	--
Q/Q Growth						4%	34%								
Y/Y Growth		NA	(6%)	29%	61%	--									
Operating Profits	\$3,417	\$3,267	\$4,612	\$8,492	--	--	--	--	--	--	--	--	--	--	--
Operating Margins	42%	43%	47%	54%	--	--	--	--	--	--	--	--	--	--	--
Compute & Network	NA	\$3,417	\$3,279	\$6,841	\$11,046	\$3,672	--	--	--	--	--	--	--	--	--
Q/Q Growth		NA	(4%)	109%	61%	66%									
Y/Y Growth		\$1,251	\$751	\$2,548	\$4,598	--	--	--	--	--	--	--	--	--	--
Operating Profits	37%	23%	37%	42%	--	--	--	--	--	--	--	--	--	--	--
Operating Margins															

Source: Company reports, UBS estimates

ON: ON Semiconductor

Investment Thesis/Risks

Our thesis	ON's updated financial targets GM 48%-50%, Op. Margin 31%-33% look achievable in context of mix shift to Auto/Industrial, upcoming manufacturing optimizations and more evidence of EV traction. In addition, ON has locked in pricing for C2022 and vast majority of C2023 revenue via LTSAs and NCNRs while SiC lends to a ~4x richer ASP mix in autos and remains on track, meaning it is hard to see a large ASP cliff in C2022/C2023. Furthermore, GM floor is now structurally higher as EFK could ultimately bias GMs sustainably higher (we think ~48-50%) in 2024/2025+ time frame. However, we see a flatter trajectory in 2023E as revenue growth/GM improvements tail off, weighing on the multiple in the near term.
Risks to our thesis	Onsemi has raised prices aggressively despite a heavy exposure to commodity Analog. The sustainability of this is an open question as demand softens, although EV ramp could cushion impact. Near term impact of Auto production although EV remains strong.

Source: UBS estimates

UBS vs Street

	F2019	F2020	F2021	2022/1F	2022/2F	2022/3F	2022/4F	F2022	F2023	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)														
UBS (new)	\$5,518	\$5,255	\$6,740	\$1,945	\$2,015	\$2,017	\$2,022	\$8,000	\$8,403	\$5,518	\$5,255	\$6,740	\$8,000	\$8,403
UBS (old)					\$2,015	\$2,017	\$2,022	\$8,000	\$8,403				\$8,000	\$8,403
Consensus					\$2,012	\$2,017	\$2,019	\$7,985	\$8,247				\$7,985	\$8,247
Delta					0.2%	0.0%	0.2%	0.2%	1.9%				0.2%	1.9%
EPS (non-GAAP)														
UBS (new)	\$1.49	\$0.85	\$2.95	\$1.22	\$1.26	\$1.19	\$1.19	\$4.86	\$4.93	\$1.49	\$0.85	\$2.95	\$4.86	\$4.93
UBS (old)					\$1.26	\$1.19	\$1.19	\$4.86	\$4.93				\$4.86	\$4.93
Consensus					\$1.25	\$1.22	\$1.19	\$4.88	\$4.87				\$4.88	\$4.87
Delta					0.8%	(2.2%)	(0.3%)	(0.5%)	1.4%				(0.5%)	1.4%

Source: Company reports, UBS estimates

ON: Model Summary

ONsemi (ON) - Key Metrics (in \$MM except EPS)	C2018A	C2019A	C2020E	C2021A	Estimates				C2022E	C2023E
					FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E		
Revenue	\$5,878	\$5,518	\$5,255	\$6,740	\$1,945	\$2,015	\$2,017	\$2,022	\$8,000	\$8,403
Y/Y Growth	6%	(6%)	(5%)	28%	31%	21%	16%	10%	19%	5%
Gross Profit	\$2,240	\$1,993	\$1,716	\$2,720	\$961	\$997	\$988	\$991	\$3,938	\$4,150
Gross Margin	38.1%	36.1%	32.7%	40.4%	49.4%	49.5%	49.0%	49.0%	49.2%	49.4%
R&D (Non-GAAP)	\$651	\$641	\$643	\$655	\$157	\$171	\$182	\$182	\$692	\$756
SG&A (Non-GAAP)	\$618	\$585	\$537	\$598	\$149	\$151	\$151	\$152	\$603	\$605
Opex (Non-GAAP)	\$1,257	\$1,215	\$1,179	\$1,242	\$303	\$317	\$328	\$329	\$1,277	\$1,341
Y/Y Growth	6%	(3%)	(3%)	5%	(7%)	1%	11%	7%	3%	5%
Operating Income	\$982	\$779	\$537	\$1,478	\$659	\$680	\$661	\$662	\$2,661	\$2,809
Operating Margin	16.7%	14.1%	10.2%	21.9%	33.9%	33.7%	32.7%	32.7%	33.3%	33.4%
Non-GAAP EPS	\$1.96	\$1.49	\$0.85	\$2.95	\$1.22	\$1.26	\$1.19	\$1.19	\$4.86	\$4.93
Free Cash Flow										
CFFO	\$1,274	\$695	\$884	\$1,782	\$479	\$581	\$812	\$647	\$2,518	\$2,456
Capex	\$515	\$535	\$384	\$445	\$174	\$242	\$242	\$243	\$900	\$1,008
FCF	\$759	\$160	\$501	\$1,337	\$305	\$340	\$570	\$404	\$1,618	\$1,448
% revenue	13%	3%	10%	20%	16%	17%	28%	20%	20%	17%
Y/Y Growth	7%	(79%)	213%	167%	115%	(11%)	60%	(12%)	21%	(11%)
Segment Revenue										
PSG	\$3,038	\$2,788	\$2,606	\$3,439	\$987	\$1,028	\$1,029	\$1,032	\$4,076	\$4,282
Q/Q Growth					3%	4%	0%	0%		
Y/Y Growth	8%	(8%)	(7%)	32%	32%	21%	15%	8%	19%	5%
ASG	\$2,071	\$1,972	\$1,910	\$2,400	\$689	\$718	\$718	\$720	\$2,845	\$2,989
Q/Q Growth					6%	4%	0%	0%		
Y/Y Growth	6%	(5%)	(3%)	26%	30%	18%	17%	11%	19%	5%
ISG	\$769	\$757	\$739	\$901	\$269	\$269	\$270	\$270	\$1,078	\$1,133
Q/Q Growth					10%	0%	0%	0%		
Y/Y Growth	(1%)	(2%)	(2%)	22%	32%	25%	14%	10%	20%	5%
End Market Revenue										
Auto	\$1,844	\$1,818	\$1,681	\$2,287	\$715	\$757	\$818	\$867	\$3,157	\$3,676
Q/Q Growth					11%	6%	8%	6%		
Y/Y Growth	11%	(1%)	(8%)	36%	39%	36%	42%	35%	38%	16%
Industrial	\$1,559	\$1,402	\$1,337	\$1,805	\$543	\$570	\$587	\$611	\$2,312	\$2,677
Q/Q Growth					4%	5%	3%	4%		
Y/Y Growth	9%	(10%)	(5%)	35%	47%	32%	23%	17%	28%	16%
Others (Computing, Consumer, Comms, etc)	--	\$2,271	\$2,215	\$2,651	\$687	\$687	\$612	\$544	\$2,531	\$2,049
Q/Q Growth					1%	--	(11%)	(11%)		
Y/Y Growth					15%	1%	(11%)	(20%)	(5%)	(19%)

Source: Company reports, UBS estimates



QRVO: Qorvo

Investment Thesis/Risks

Our thesis	QRVO should continue to benefit from RF content gain and expansion into new verticals, but the business remains lumpy given high exposure to China. IDP is cause for optimism as recent acquisitions have bolstered and diversified its exposure to growth areas like autos/EV charging, power management, IoT, autos connectivity, and new WiFi applications as it leverages its BAW expertise. Overall, operational execution remains strong but we find it hard to get excited from here given the tepid sentiment on smartphone market and supply issues.
Risks to our thesis	We may be overly concerned about QCOM's ability to take content from QRVO on its modem reference designs in China. We also may be under-estimating the remaining content growth for QRVO during the remainder of the 5G cycle. Lastly, we may be under-appreciating the breadth of its capabilities as it increasingly bundles SAW and BAW technologies into advanced solutions.

Source: UBS estimates

UBS vs Street

	Actual 2019	Actual 2020	Actual 2021	Estimate 2022	Estimate 2023/1F	Estimate 2023/2F	Estimate 2023/3F	Estimate 2023/4F	Estimate 2023	Estimate 2024	CALENDAR YEARS			
	CY2019	CY2020	CY2021	CY2022	CY2023						CY2019	CY2020	CY2021	CY2022
Revenues (\$MM)														
UBS	\$ 3,090	\$ 3,239	\$ 4,015	\$ 4,646	\$ 1,023	\$ 1,120	\$ 1,256	\$ 1,140	\$ 4,540	\$ 5,048	\$ 3,132	\$ 3,730	\$ 4,552	\$ 4,566 \$ 4,975
UBS (old)					\$ 1,023	\$ 1,120	\$ 1,256	\$ 1,140	\$ 4,540	\$ 5,048				\$ 4,566 \$ 4,975
Consensus					\$ 1,024	\$ 1,155	\$ 1,218	\$ 1,136	\$ 4,533	\$ 5,037				\$ 4,564 \$ 4,936
Delta					(0.1%)	(3.0%)	3.1%	0.4%	0.2%	0.2%				0.0% 0.8%
EPS														
UBS (non-GAAP)	\$ 5.77	\$ 6.31	\$ 9.74	\$ 12.36	\$ 2.12	\$ 2.62	\$ 3.32	\$ 2.81	\$ 10.87	\$ 13.13	\$ 5.96	\$ 8.59	\$ 11.98	\$ 11.19 \$ 12.88
UBS (non-GAAP) (old)					\$ 2.12	\$ 2.62	\$ 3.32	\$ 2.81	\$ 10.87	\$ 13.13				\$ 11.19 \$ 12.88
Consensus (non-GAAP)					\$ 2.11	\$ 2.69	\$ 3.05	\$ 2.69	\$ 10.55	\$ 12.78				\$ 10.97 \$ 12.38
Delta					0.4%	(2.4%)	9.0%	4.2%	3.1%	2.8%				2.0% 4.0%

Source: Company reports, UBS estimates

QRVO: Model Summary

Qorvo, Inc. (QRVO) - Key Metrics (in \$MM except EPS and units)	Estimates										FISCAL YEAR SUMMARY					
	C2018A	C2019A	C2020A	C2021A	FQ4:22A CQ1A	FQ1E CQ2E	FQ2E CQ3E	FQ3E CQ4E	C2022E	C2023E	F2018A	F2019A	F2020A	F2021A	F2022E	F2023E
Revenue	\$3,075	\$3,132	\$3,730	\$4,552	\$1,166	\$1,023	\$1,120	\$1,256	\$4,566	\$4,975	\$2,974	\$3,090	\$3,239	\$4,015	\$4,646	\$4,540
Y/Y Growth	4%	2%	19%	22%	9%	(8%)	(11%)	13%	0%	9%	(2%)	4%	5%	24%	16%	(2%)
Gross Profit	\$1,457	\$1,489	\$1,917	\$2,391	\$606	\$512	\$571	\$653	\$2,342	\$2,587	\$1,415	\$1,466	\$1,552	\$2,091	\$2,433	\$2,329
Gross Margin	47.4%	47.5%	51.4%	52.5%	52.0%	50.0%	51.0%	52.0%	51.3%	52.0%	47.6%	47.5%	47.9%	52.1%	52.4%	51.3%
R&D (Non-GAAP)	\$422	\$444	\$519	\$578	\$150	\$160	\$160	\$160	\$630	\$658	\$422	\$423	\$458	\$537	\$589	\$640
SG&A (Non-GAAP)	\$213	\$227	\$254	\$281	\$79	\$85	\$85	\$86	\$335	\$361	\$208	\$217	\$233	\$262	\$292	\$344
Opex (Non-GAAP)	\$635	\$671	\$773	\$859	\$229	\$245	\$245	\$246	\$965	\$1,019	\$630	\$640	\$691	\$799	\$881	\$984
Y/Y Growth	(0%)	6%	15%	11%	10%	14%	10%	15%	12%	6%	(5%)	2%	8%	16%	10%	12%
Operating Income	\$822	\$818	\$1,144	\$1,532	\$377	\$267	\$326	\$407	\$1,377	\$1,568	\$785	\$826	\$861	\$1,292	\$1,552	\$1,345
Operating Margin	26.7%	26.1%	30.7%	33.6%	32.3%	26.1%	29.1%	32.4%	30.2%	31.5%	26.4%	26.7%	26.6%	32.2%	33.4%	29.6%
Non-GAAP EPS	\$5.62	\$5.96	\$8.59	\$11.98	\$3.12	\$2.12	\$2.62	\$3.32	\$11.19	\$12.88	\$5.14	\$5.77	\$6.31	\$9.74	\$12.36	\$10.87
Free Cash Flow																
CFFO	\$882	\$919	\$1,113	\$1,106	\$346	\$423	\$296	\$355	\$1,420	\$1,613	\$853	\$810	\$946	\$1,302	\$1,049	\$1,572
Capex	\$218	\$164	\$145	\$241	\$51	\$51	\$67	\$75	\$244	\$375	\$270	\$221	\$164	\$187	\$214	\$262
FCF	\$664	\$754	\$969	\$866	\$295	\$372	\$229	\$279	\$1,176	\$1,238	\$583	\$589	\$782	\$1,115	\$836	\$1,310
% revenue	22%	24%	26%	19%	25%	36%	20%	22%	26%	25%	20%	19%	24%	28%	18%	29%
Y/Y Growth	52%	14%	28%	(11%)	(9%)	35%	16%	320%	36%	5%	160%	1%	33%	43%	(25%)	57%
Segment Revenue																
AAPL Revenue	\$928	\$1,102	\$1,100	\$1,577	\$350	\$346	\$487	\$498	\$1,680	\$1,744	\$1,068	\$980	\$1,060	\$1,224	\$1,609	\$1,693
Units (in MM)	204	193	196	233	55	45	52	82	234	235	217	196	187	215	232	234
Blended Content (in \$)	\$4.5	\$5.7	\$5.6	\$6.8	\$7.0	\$7.0	\$7.3	\$7.3	\$7.2	\$7.4	\$4.9	\$5.0	\$5.7	\$5.7	\$6.9	\$7.2
Y/Y Growth	(16%)	19%	(0%)	43%	10%	9%	6%	3%	7%	4%	4%	(8%)	8%	15%	31%	5%
% total QRVO revenue	30%	35%	29%	35%	30%	34%	43%	40%	37%	35%	36%	32%	33%	30%	35%	37%
Samsung Revenue	\$168	\$252	\$272	\$277	\$130	\$88	\$93	\$89	\$398	\$431	\$196	\$163	\$280	\$254	\$345	\$366
Units (in MM)	290	295	251	271	74	70	74	71	289	300	314	284	281	269	269	293
Blended Content (in \$)	\$0.6	\$0.9	\$1.1	\$1.0	\$1.8	\$1.3	\$1.3	\$1.3	\$1.4	\$1.4	\$0.6	\$0.6	\$1.0	\$0.9	\$1.3	\$1.3
Y/Y Growth	(10%)	50%	8%	2%	113%	54%	22%	7%	44%	8%	(7%)	(17%)	72%	(9%)	36%	6%
% total QRVO revenue	5%	8%	7%	6%	11%	9%	8%	7%	9%	9%	7%	5%	9%	6%	7%	8%
Huawei Revenue	\$380	\$263	\$69	\$5	\$1	\$1	\$0	--	\$2	--	\$284	\$416	\$181	\$46	\$5	\$1
Units (in MM)	206	241	189	38	4	2	1	--	7	--	158	226	231	155	27	3
Blended Content (in \$)	\$1.8	\$1.1	\$0.4	\$0.1	\$0.3	\$0.3	\$0.2	\$0.2	\$0.3	--	\$1.8	\$1.8	\$0.8	\$0.3	\$0.2	\$0.3
Y/Y Growth	44%	(31%)	(74%)	(92%)	(15%)	(60%)	(77%)	(100%)	(62%)	(100%)	(12%)	46%	(57%)	(74%)	(89%)	(85%)
% total QRVO revenue	12%	8%	2%	0%	0%	0%	0%	--	0%	--	10%	13%	6%	1%	0%	0%
China ex-Huawei	\$731	\$668	\$1,164	\$1,621	\$384	\$288	\$237	\$369	\$1,278	\$1,478	\$632	\$639	\$876	\$1,332	\$1,577	\$1,255
Y/Y Growth	13%	(9%)	74%	39%	(10%)	(37%)	(48%)	31%	(21%)	16%	(24%)	1%	37%	52%	18%	(20%)
% total QRVO revenue	24%	21%	31%	36%	33%	28%	21%	29%	28%	30%	21%	21%	27%	33%	34%	28%
Other ex-Apple, Samsung and Huawei	\$731	\$668	\$1,164	\$1,621	\$384	\$288	\$237	\$369	\$1,278	\$1,478	\$632	\$639	\$876	\$1,332	\$1,577	\$1,255
Y/Y Growth	13%	(9%)	74%	39%	(10%)	(37%)	(48%)	31%	(21%)	16%	(24%)	1%	37%	52%	18%	(20%)
% total QRVO revenue	24%	21%	31%	36%	33%	28%	21%	29%	28%	30%	21%	21%	27%	33%	34%	28%
Mobile Products	\$2,207	\$2,284	\$2,605	\$3,479	\$865	\$722	\$816	\$955	\$3,358	\$3,653	\$2,180	\$2,198	\$2,397	\$2,857	\$3,536	\$3,315
Q/Q Growth					2%	(17%)	13%	17%			(9%)	1%	9%	19%	24%	(6%)
Y/Y Growth	0%	4%	14%	34%	7%	(14%)	(17%)	13%	(3%)	9%	(9%)	1%	9%	19%	24%	(6%)
Industrial and Defense Products	\$867	\$848	\$1,126	\$1,073	\$301	\$301	\$304	\$301	\$1,208	\$1,322	\$789	\$893	\$842	\$1,159	\$1,109	\$1,226
Q/Q Growth	16%	(2%)	33%	(5%)	14%	10%	13%	13%	13%	9%	22%	13%	(6%)	38%	(4%)	10%

Source: Company reports, UBS estimates

QCOM: Qualcomm

Investment Thesis/Risks

Our thesis	~70% of revenue is still directly tied to the smartphone market (modem/chipset revenue and licensing) and QCOM has reaped most of the benefit from blended content gains as Huawei units have shifted to other OEMs. AAPL is also going away over the longer-term, though if AAPL remains reliant on QCOM's modems in C2023, it is possible that QCOM could extract additional concessions from AAPL that would better "bridge" revenue and EPS into the 2025/2026 timeframe where other verticals (autos, etc.) should start to drive revenue growth. These new verticals leverage the R&D that it has already sunk into its mobile business which argues for strong and sustainable margins. One of the most exciting greenfield opportunities for QCOM is China adopting mmWave - especially as QCOM has just gained large amounts of share in the premium tier at Chinese OEMs - the problem is that this still seems several years out given macro issues and the delays in key trials. In the meantime, it is hard for us to build a compelling investment case over the next 12mos.
Risks to our thesis	Mix shifts within 5G could turn out much worse than expected. Looming AAPL modem loss impact might be much more significant than we are modeling. On the flipside, there could be future content opportunities with AAPL that are unaccounted for in QCOM's updated LT financial model and QCOM could extract additional content from AAPL if iPhone remains reliant on QCOM's modems for the Fall 2023 launch.

Source: UBS estimates

UBS vs Street

	FY2019	FY2020	FY2021	2022/1F	2022/2F	2022/3F	2022/4F	FY2022	FY2023	FY2024	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)																
UBSe	\$ 19,532	\$ 23,532	\$ 33,566	\$ 10,705	\$ 11,164	\$ 10,959	\$ 12,352	\$ 45,180	\$ 48,608	\$ 48,465	\$ 21,506	\$ 19,767	\$ 26,690	\$ 36,036	\$ 46,833	\$ 48,492
UBS (Old)						\$ 10,959	\$ 12,352	\$ 45,180	\$ 48,608	\$ 48,465					\$ 46,833	\$ 48,492
Consensus						\$ 10,834	\$ 12,067	\$ 44,486	\$ 48,129	\$ 48,330					\$ 46,881	\$ 48,551
Delta						1.1%	2.4%	1.6%	1.0%	0.3%					-0.1%	-0.1%
EPS (Non GAAP)																
UBSe	\$ 3.54	\$ 4.19	\$ 8.54	\$ 3.23	\$ 3.21	\$ 2.91	\$ 3.35	\$ 12.69	\$ 11.98	\$ 12.03	\$ 3.91	\$ 3.34	\$ 5.37	\$ 9.60	\$ 12.53	\$ 12.00
UBS (Old)						\$ 2.91	\$ 3.35	\$ 12.69	\$ 11.98	\$ 12.03					\$ 12.53	\$ 12.00
Consensus						\$ 2.89	\$ 3.33	\$ 12.59	\$ 13.22	\$ 13.17					\$ 13.10	\$ 13.32
Delta						0.7%	0.6%	0.8%	-9.4%	-8.6%					-4.4%	-9.9%

Source: Company reports, UBS estimates

QCOM: Model Summary

Qualcomm (QCOM) - Key Metrics (in \$MM except EPS and units)	C2017A	C2018A	C2019A	C2020A	C2021A	FQ2A CQ1A	Estimates FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E		FISCAL YEAR SUMMARY							
								FQ4:22E CQ3E	FQ1E CQ4E				F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E	F2024E
Revenue	\$22,360	\$21,506	\$19,767	\$26,690	\$36,036	\$11,164	\$10,959	\$12,352	\$12,358	\$46,833	\$48,492		\$22,291	\$22,732	\$24,273	\$23,532	\$33,566	\$45,180	\$48,608	\$48,465
Y/Y Growth	(6%)	(4%)	(8%)	35%	35%	41%	36%	32%	15%	30%	4%		(5%)	2%	7%	(3%)	43%	35%	8%	(0%)
Gross Profit (Non-GAAP)	\$13,882	\$12,279	\$11,535	\$14,521	\$21,124	\$6,564	\$6,305	\$7,027	\$6,733	\$26,629	\$27,290		\$14,021	\$13,039	\$11,246	\$12,749	\$19,484	\$26,346	\$26,995	\$28,304
Gross Margin	62.1%	57.1%	58.4%	54.4%	58.6%	58.8%	57.5%	56.9%	54.5%	56.9%	56.3%		62.9%	57.4%	57.6%	54.2%	58.0%	58.3%	55.5%	58.4%
R&D	\$4,982	\$4,874	\$4,756	\$5,252	\$6,064	\$1,678	\$1,800	\$1,950	\$2,009	\$7,437	\$8,779		\$4,845	\$5,025	\$4,670	\$5,097	\$5,870	\$6,974	\$8,505	\$9,664
SG&A	\$2,242	\$2,232	\$1,871	\$1,701	\$1,889	\$512	\$540	\$551	\$567	\$2,170	\$2,480		\$2,080	\$2,393	\$1,876	\$1,720	\$1,844	\$2,075	\$2,402	\$2,730
Opex (Non-GAAP)	\$7,224	\$7,106	\$6,627	\$6,953	\$7,953	\$2,190	\$2,340	\$2,501	\$2,576	\$9,607	\$11,259		\$6,925	\$7,418	\$6,546	\$6,817	\$7,714	\$9,049	\$10,908	\$12,394
Y/Y Growth	13%	(2%)	(7%)	5%	14%	16%	17%	23%	28%	21%	17%		7%	7%	(12%)	4%	13%	17%	21%	14%
Operating Income	\$6,658	\$5,173	\$4,908	\$7,568	\$13,171	\$4,374	\$3,965	\$4,526	\$4,157	\$17,022	\$16,031		\$7,096	\$5,621	\$4,700	\$5,932	\$11,770	\$17,297	\$16,087	\$15,910
Operating Margin	29.8%	24.1%	24.8%	28.4%	36.5%	39.2%	36.2%	36.6%	33.6%	36.3%	33.1%		31.8%	24.7%	24.1%	25.2%	35.1%	38.3%	33.1%	32.8%
Non-GAAP EPS	\$4.07	\$3.91	\$3.34	\$5.37	\$9.60	\$3.21	\$2.91	\$3.35	\$3.07	\$12.53	\$12.00		\$4.28	\$3.70	\$3.54	\$4.19	\$8.54	\$12.69	\$11.98	\$12.03
Free Cash Flow																				
CFFO	\$5,076	\$2,489	\$8,048	\$7,871	\$9,418	\$2,698	\$4,743	\$3,778	\$3,836	\$15,055	\$15,304		\$4,692	\$3,895	\$7,286	\$5,814	\$10,536	\$13,276	\$15,156	\$15,374
Capex	\$787	\$710	\$1,031	\$1,580	\$2,002	\$491	\$438	\$494	\$494	\$1,918	\$1,940		\$690	\$784	\$887	\$1,407	\$1,888	\$2,006	\$1,944	\$1,939
FCF	\$4,289	\$1,779	\$7,017	\$6,291	\$7,416	\$2,207	\$4,305	\$3,284	\$3,342	\$13,137	\$13,365		\$4,002	\$3,111	\$6,399	\$4,407	\$8,648	\$11,270	\$13,211	\$13,435
% revenue	19%	8%	35%	24%	21%	20%	39%	27%	27%	28%	28%		18%	14%	26%	19%	26%	25%	27%	28%
Y/Y Growth	(22%)	(59%)	294%	(10%)	18%	(9%)	50%	408%	127%	77%	2%		(42%)	(22%)	106%	(31%)	96%	30%	17%	2%

Source: Company reports, UBS estimates

QCOM: Model Summary

Qualcomm (QCOM) - Key Metrics (in \$MM except EPS and units)	C2017A	C2018A	C2019A	C2020A	C2021A	FQ2A CQ1A	Estimates FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E		FISCAL YEAR SUMMARY												
													F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E	F2024E					
Segment Revenue																									
MSM Chipset Revenue	\$12,689	\$11,975	\$9,149	\$12,327	\$18,597	\$6,325	\$6,110	\$6,980	\$7,182	\$26,597	\$26,038		\$12,279	\$12,607	\$9,641	\$10,462	\$16,830	\$25,397	\$26,760	\$23,912					
Unit (in MM)	838	804	618	651	905	255	234	262	276	1,027	1,045		843	855	649	576	876	1,011	1,057	970					
ASP (in \$)	\$15	\$15	\$15	\$19	\$21	\$25	\$26	\$27	\$26	\$26	\$25		\$15	\$15	\$15	\$18	\$19	\$25	\$25	\$25					
RFFE	\$1,240	\$1,200	\$1,641	\$3,010	\$4,229	\$1,160	\$1,072	\$1,423	\$1,302	\$4,956	\$5,700		\$1,200	\$1,275	\$1,478	\$2,362	\$4,158	\$4,786	\$5,504	\$6,330					
Q/Q Growth						2%	(8%)	33%	(8%)				15%	6%	16%	60%	76%	15%	15%	15%					
Y/Y Growth	15%	(3%)	37%	83%	40%	28%	12%	15%	15%	17%	15%		15%	6%	16%	60%	76%	15%	15%	15%					
Other (auto, IoT, compute, networking)	\$3,100	\$3,195	\$3,747	\$4,071	\$6,516	\$2,063	\$2,204	\$2,268	\$2,149	\$8,684	\$10,478		\$3,000	\$3,400	\$3,545	\$3,662	\$6,040	\$8,267	\$10,064	\$12,023					
Auto						\$709	\$1,028	\$339	\$359	\$350	\$348		\$1,882		\$640	\$638	\$984	\$1,304	\$1,774	\$2,324					
IoT						\$3,362	\$5,488	\$1,724	\$1,845	\$1,918	\$1,801		\$7,288		\$2,728	\$3,024	\$5,056	\$6,963	\$8,290	\$9,699					
CDMA Technologies (QCT)	\$17,029	\$16,370	\$14,544	\$19,408	\$29,333	\$9,548	\$9,386	\$10,671	\$10,633	\$40,238	\$42,215		\$16,479	\$17,282	\$14,665	\$16,493	\$27,019	\$38,452	\$42,328	\$42,265					
Q/Q Growth						8%	(2%)	14%	(0%)				7%	5%	(15%)	12%	64%	42%	10%	(0%)					
Y/Y Growth	10%	(4%)	(11%)	33%	51%	52%	45%	38%	20%	37%	5%														
QTL Revs Ex AAPL, Huawei						\$2,876	\$3,502	\$3,392	\$4,298	\$1,117	\$1,202		\$1,259	\$1,067	\$4,645	\$4,397									
TRDS Revenue ex AAPL, Huawei						\$168,909	\$114,317	\$152,685	\$37,770	\$40,742	\$42,924		\$49,707	\$171,144	\$177,583										
Nominal Royalty Rate						3%	3%	3%	2%				1%	2%	3%	3%	\$160,975	\$164,371	\$164,161	\$132,607	\$135,091	\$162,591	\$177,767	\$174,467	
Huawei						\$750	\$300	\$459	\$266	\$23	\$11		\$6	--	\$40	--	--	\$450	\$239	\$455	\$71	--	--		
Huawei Revenue								\$17,145	\$9,546	\$1,000	\$490		\$257	--	\$1,747	--		\$38,284	\$14,971	\$3,087	--	--	--		
Nominal Royalty Rate								3%	3%	2%	2%		2%	2%				1%	3%	2%					
AAPL						--	\$1,164	\$1,541	\$1,864	\$440	\$360		\$416	\$658	\$1,874	\$1,880	--	--	\$628	\$1,437	\$1,840	\$1,880	\$1,880	\$1,880	
Unit (in MM)						146	193	233	55	45	52		82	234	235			79	180	230	235	235	235		
ASP (in \$)						\$8	\$8	\$8	\$8	\$8	\$8		\$8	\$8	\$8			\$8	\$8	\$8	\$8	\$8	\$8		
Technology Licensing (QTL)	\$5,933	\$4,881	\$4,975	\$5,284	\$6,479	\$1,580	\$1,573	\$1,681	\$1,725	\$6,559	\$6,277		\$6,445	\$5,162	\$4,589	\$5,028	\$6,321	\$6,652	\$6,281	\$6,200					
Q/Q Growth						(25%)	(18%)	2%	6%	23%	(2%)		6%	8%	(5%)	1%	(4%)	(16%)	(20%)	(11%)	10%	26%	5%	(6%)	(1%)
Y/Y Growth																									
Segment EBT																									
CCT Expenses	\$14,051	\$13,761	\$12,520	\$15,204	\$20,376	\$6,208	\$6,382	\$7,150	\$7,337	\$27,077	\$29,129		\$13,732	\$14,316	\$12,522	\$13,729	\$19,257	\$25,473	\$29,206	\$29,163					
Y/Y Growth	4%	(2%)	(9%)	21%	34%	32%	36%	36%	28%	33%	8%		1%	4%	(13%)	10%	40%	32%	15%	(0%)					
CCT EBT	\$2,978	\$2,609	\$2,024	\$4,204	\$8,957	\$3,340	\$3,003	\$3,521	\$3,296	\$13,161	\$13,087		\$2,747	\$2,966	\$2,143	\$2,764	\$7,762	\$12,979	\$13,122	\$13,102					
% segment revenue	17%	16%	14%	22%	31%	35%	32%	33%	31%	33%	31%		17%	17%	15%	17%	29%	34%	31%	31%					
QTL Expenses	\$1,404	\$1,653	\$1,594	\$1,590	\$1,715	\$426	\$456	\$420	\$483	\$1,786	\$1,815		\$1,271	\$1,637	\$1,635	\$1,587	\$1,693	\$1,715	\$1,816	\$1,792					
Y/Y Growth	22%	18%	(4%)	(0%)	8%	1%	5%	(5%)	17%	4%	2%		12%	29%	(0%)	(3%)	7%	1%	6%	(1%)					
QTL EBT	\$4,529	\$3,228	\$3,381	\$3,694	\$4,764	\$1,154	\$1,117	\$1,261	\$1,242	\$4,774	\$4,461		\$5,174	\$3,525	\$2,954	\$3,441	\$4,628	\$4,938	\$4,464	\$4,408					
% segment revenue	76%	66%	68%	70%	74%	73%	71%	75%	72%	73%	71%		80%	68%	64%	68%	73%	74%	71%	71%					

Source: Company reports, UBS estimates

STX: Seagate

Investment Thesis/Risks

Our thesis	We see the HDD business at a structural inflection yielding more stable supply/demand dynamics and expanding cross cycle margins - much like what we have seen happen in DRAM over the past several years - while near-term cyclical dynamics also skew positive. We expect STX to benefit from structural changes under way in the HDD segment. The ramp of high-capacity nearline applications is mixing demand to cloud and these customers increasingly spend on different cadences depending on their technology initiatives. Additionally, the significant growth in data storage requirements has led these customers to engage in more longer-term supply/pricing arrangements while recent storage-driven blockchains have reduced channel inventory. Lastly, new technologies like HAMR will likely keep alternative solutions like NAND at bay for these high capacity applications for many years to come. Combined with strong opex discipline, this should allow STX to sustain OpM well above prior peak levels from the past few years.
Risks to our thesis	In the near-term, COVID costs are expected to continue throughout F22, there are risks of slowing demand where semiconductor supply concerns (beyond the HDD segment) could ease, cloud customers could potentially see cyclical slowdown, and pent-up demand from enterprise could fade. Longer-term, the downside scenario could be possible based on: (1) lower growth in the mass capacity drives; (2) higher decline in legacy segments; (3) gross margin pressure on lower shipments; and (4) fewer opportunities to reduce opex.

Source: UBS estimates

UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	2024	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)															
UBS	\$ 10,391	\$ 10,509	\$ 10,681	\$3,115	\$3,116	\$2,802	\$2,802	\$ 11,835	\$ 12,620	\$ 12,639	\$ 9,958	\$ 10,172	\$ 11,975	\$ 12,100	\$ 12,392
UBS (old)								\$ 2,802	\$ 11,835	\$ 12,620	\$ 12,639			\$ 12,100	\$ 12,392
Consensus								\$ 2,807	\$ 9,038	\$ 12,318	\$ 12,586			\$ 11,896	\$ 12,276
Delta								(0.2%)	30.9%	2.5%	0.4%			1.7%	0.9%
EPS															
UBS (non-GAAP)	\$ 4.80	\$ 4.96	\$ 5.70	\$ 2.35	\$ 2.41	\$ 1.81	\$ 1.91	\$ 8.50	\$ 9.76	\$ 10.04	\$ 4.07	\$ 4.80	\$ 8.25	\$ 8.83	\$ 9.51
UBS (non-GAAP) (old)								\$ 1.91	\$ 8.50	\$ 9.76	\$ 10.04			\$ 8.83	\$ 9.51
Consensus (non-GAAP)								\$ 1.91	\$ 6.67	\$ 9.30	\$ 9.61			\$ 8.60	\$ 9.24
Delta								0.2%	27.5%	5.0%	4.4%			2.7%	2.9%

Source: Company reports, UBS estimates

STX: Model Summary

Seagate (STX) - Key Metrics (in \$MM except EPS)	C2019A	C2020	C2021A	Estimates					C2022E	C2023E	FISCAL YEAR SUMMARY			
				FQ3E CQ1E	FQ4:22E CQ2E	FQ1E CQ3E	FQ2E CQ4E	F2020A			F2020A	F2021A	F2022E	F2023E
Revenue (\$MM)	\$9,958	\$10,172	\$11,975	\$2,802	\$2,802	\$3,078	\$3,418	\$12,100	\$12,392	\$10,509	\$10,681	\$11,835	\$12,620	
Y/Y Growth	-12%	2%	18%	3%	-7%	-1%	10%	1%	2%	1%	2%	11%	7%	
Gross Margin	27.2%	27.2%	29.8%	29.2%	30.4%	30.5%	30.5%	30.2%	30.6%	27.7%	27.7%	30.4%	30.5%	
Opex	\$1,408	\$1,292	\$1,351	\$345	\$350	\$345	\$348	\$1,388	\$1,446	\$1,362	\$1,314	\$1,371	\$1,405	
Y/Y Growth	-8%	-8%	5%	5%	1%	2%	3%	3%	4%	-6%	-4%	4%	2%	
Operating Margin	13.1%	14.5%	18.5%	16.8%	17.9%	19.3%	20.3%	18.7%	19.0%	14.7%	15.4%	18.8%	19.4%	
Non-GAAP EPS	\$4.07	\$4.80	\$8.25	\$1.81	\$1.91	\$2.33	\$2.79	\$8.83	\$9.51	\$4.96	\$5.64	\$8.50	\$9.76	
Cash Flow														
CFFO	\$1,822	\$1,548	\$1,873	\$460	\$666	\$614	\$623	\$2,362	\$2,631	\$1,714	\$1,626	\$2,143	\$2,591	
Capex	\$639	\$514	\$440	\$97	\$160	\$121	\$151	\$529	\$574	\$585	\$498	\$469	\$563	
FCF	\$1,183	\$1,034	\$1,433	\$363	\$506	\$492	\$472	\$1,833	\$2,057	\$1,129	\$1,128	\$1,674	\$2,028	
% revenue	11.9%	10.2%	12.0%	13.0%	18.1%	16.0%	13.8%	15.1%	16.6%	10.7%	10.6%	14.1%	16.1%	
Product Revenue (\$MM)														
HDD REVENUE	\$9,200	\$9,409	\$10,916	\$2,565	\$2,567	\$2,793	\$3,085	\$11,011	\$11,163	\$9,719	\$9,792	\$10,818	\$11,468	
Y/Y Growth	-13%	2%	16%	3%	-6%	-2%	9%	1%	1%	1%	1%	10%	6%	
HDD Shipment in Exabytes	366	481	614	154	156	179	205	694	843	442	536	633	792	
Y/Y Growth	0%	31%	28%	10%	2%	12%	25%	13%	22%	27%	21%	18%	25%	
Price\$MM/EB	\$25	\$20	\$18	\$17	\$16	\$16	\$15	\$16	\$13	\$22	\$18	\$17	\$14	
Y/Y Growth	-13%	-22%	-9%	-7%	-8%	-13%	-13%	-11%	-17%	-21%	-17%	-6%	-15%	
Enterprise Data Solutions, SSD & Other	\$759	\$762	\$1,059	\$237	\$235	\$285	\$333	\$1,089	\$1,229	\$790	\$889	\$1,017	\$1,152	
Y/Y Growth	-7%	0%	39%	0%	-15%	13%	13%	3%	13%	2%	13%	14%	13%	

Source: Company reports, UBS estimates

SWKS: Skyworks Solutions

Investment Thesis/Risks

Our thesis	Our investment thesis is based on the fact that SWKS is a trusted supplier to AAPL and continues to ride wireless content proliferation across an expanding category of devices. SWKS' iPhone content growth has accelerated over the past 12 months, now growing >20% Y/Y. Beyond this iPhone catalyst, in the Broad Markets IoT business, 5G is catalyzing devices of all sorts to move beyond just WiFi and Bluetooth to also start including more cellular connectivity – which works right to SWKS wheelhouse for that business and the SLAB assets should allow SWKS to expand its connectivity solutions more broadly into the autos segment. However, several of the BM businesses are fabless and supply constraints are more acute for them.
Risks to our thesis	Content gain in the next iPhone series launch may not be as good as we are expecting. The iPhone sell through may fall way short of where the supply chain is tracking to on builds. Over time, AAPL may invest more in building more significant internal RF capabilities – which would weigh on SWKS stock. Lastly, tighter supply and higher logistics costs could last longer and weigh on GM more severely.

Source: UBS estimates

UBS vs Street

	Actual 2019	Actual 2020	Actual 2021	Actual 2022/1F	Actual 2022/2F	Estimate 2022/3F	Estimate 2022/4F	Estimate 2022	Estimate 2023/1F	Estimate 2023/2F	Estimate 2023/3F	Estimate 2023/4F	Estimate 2023	CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)																		
UBS (New)	\$ 3,377	\$ 3,356	\$ 5,109	\$ 1,510	\$ 1,336	\$ 1,229	\$ 1,437	\$ 5,511	\$ 1,564	\$ 1,393	\$ 1,265	\$ 1,519	\$ 5,741	\$ 3,301	\$ 3,970	\$ 5,110	\$ 5,565	\$ 5,896
UBS (Old)						\$ 1,229	\$ 1,437	\$ 5,511	\$ 1,564	\$ 1,393	\$ 1,265	\$ 1,519	\$ 5,741				\$ 5,565	\$ 5,896
Consensus						\$ 1,226	\$ 1,440	\$ 5,513	\$ 1,576	\$ 1,405	\$ 1,385	\$ 1,573	\$ 5,939				\$ 5,578	\$ 6,089
Delta						0.2%	(0.3%)	(0.0%)	(0.8%)	(0.8%)	(8.7%)	(3.5%)	(3.3%)				(0.2%)	(3.2%)
EPS																		
UBS (non-GAAP) (New)	\$ 6.17	\$ 6.13	\$ 10.50	\$ 3.14	\$ 2.63	\$ 2.36	\$ 3.04	\$ 11.17	\$ 3.43	\$ 2.88	\$ 2.53	\$ 3.29	\$ 12.14	\$ 6.02	\$ 7.80	\$ 10.28	\$ 11.45	\$ 12.61
UBS (non-GAAP) (Old)						\$ 2.36	\$ 3.04	\$ 11.17	\$ 3.43	\$ 2.88	\$ 2.53	\$ 3.29	\$ 12.14				\$ 11.45	\$ 12.61
Consensus (non-GAAP)						\$ 2.35	\$ 2.97	\$ 11.10	\$ 3.33	\$ 2.82	\$ 2.77	\$ 3.31	\$ 12.24				\$ 11.29	\$ 12.64
Delta						0.2%	2.1%	0.6%	2.9%	2.2%	(8.8%)	(0.5%)	(0.8%)				1.5%	(0.2%)

Source: Company reports, UBS estimates

SWKS: Model Summary

Skyworks Solutions, Inc. (SWKS) - Key Metrics (in \$MM except EPS and units)	Estimates															FISCAL YEAR SUMMARY						
	FQ2A					FQ3E			FQ4:22E			FQ1E			C2022E					C2023E		
	C2017A	C2018A	C2019A	C2020A	C2021A	CQ1A	CQ2E	CQ3E	CQ4E	C2022E	C2023E	F2017A	F2018A	F2019A	F2020A	F2021A	F2022E	F2023E				
Revenue	\$3,789	\$3,788	\$3,301	\$3,970	\$5,110	\$1,336	\$1,229	\$1,437	\$1,564	\$5,565	\$5,896	\$3,651	\$3,868	\$3,377	\$3,356	\$5,109	\$5,511	\$5,741				
Y/Y Growth	16%	(0%)	(13%)	20%	29%	14%	10%	10%	4%	9%	6%	11%	6%	(13%)	(1%)	52%	8%	4%				
Gross profit (Non-GAAP)	\$1,929	\$1,929	\$1,663	\$2,006	\$2,601	\$683	\$627	\$740	\$806	\$2,855	\$3,014	\$1,855	\$1,975	\$1,709	\$1,684	\$2,599	\$2,823	\$2,940				
Gross Margin	50.9%	50.9%	50.4%	50.5%	50.9%	51.2%	51.0%	51.5%	51.5%	51.3%	51.1%	50.8%	51.1%	50.6%	50.2%	50.9%	51.2%	51.2%				
R&D (Non-GAAP)	\$333	\$372	\$379	\$404	\$478	\$133	\$134	\$138	\$138	\$543	\$583	\$320	\$362	\$383	\$395	\$447	\$538	\$573				
SG&A (Non-GAAP)	\$164	\$165	\$159	\$167	\$206	\$59	\$57	\$60	\$61	\$237	\$255	\$165	\$163	\$161	\$160	\$199	\$231	\$252				
Total Opex (Non-GAAP)	\$490	\$537	\$538	\$570	\$684	\$192	\$191	\$198	\$199	\$780	\$838	\$476	\$525	\$543	\$555	\$646	\$769	\$825				
Y/Y Growth	12%	10%	0%	6%	20%	24%	18%	10%	6%	14%	7%	10%	10%	3%	2%	16%	19%	7%				
Operating Income (Non-GAAP)	\$1,439	\$1,392	\$1,125	\$1,436	\$1,917	\$491	\$436	\$542	\$607	\$2,075	\$2,176	\$1,379	\$1,450	\$1,166	\$1,129	\$1,953	\$2,054	\$2,115				
Operating Margin	38.0%	36.7%	34.1%	36.2%	37.5%	36.8%	35.5%	37.7%	38.8%	37.3%	36.9%	37.8%	37.5%	34.5%	33.7%	38.2%	37.3%	36.8%				
Non-GAAP EPS	\$6.83	\$7.05	\$6.02	\$7.80	\$10.28	\$2.63	\$2.36	\$3.04	\$3.43	\$11.45	\$12.61	\$6.44	\$7.22	\$6.17	\$6.13	\$10.50	\$11.17	\$12.14				
Free Cash Flow																						
CFFO	\$1,336	\$1,449	\$1,217	\$1,291	\$1,869	\$393	\$648	\$436	\$614	\$2,091	\$2,414	\$1,471	\$1,261	\$1,367	\$1,205	\$1,772	\$2,059	\$2,514				
Capex	\$281	\$524	\$380	\$397	\$622	\$127	\$172	\$287	\$188	\$774	\$707	\$303	\$422	\$398	\$389	\$688	\$689					
FCF	\$1,055	\$925	\$837	\$894	\$1,247	\$266	\$476	\$148	\$426	\$1,317	\$1,706	\$1,168	\$838	\$969	\$815	\$1,133	\$1,371	\$1,825				
% revenue	28%	24%	25%	23%	24%	20%	39%	10%	27%	24%	29%	32%	22%	29%	24%	22%	25%	32%				
Segment Revenue																						
AAPL Revenue	\$1,541	\$1,781	\$1,805	\$2,373	\$2,830	\$718	\$587	\$916	\$964	\$3,185	\$3,502	\$1,425	\$1,782	\$1,752	\$1,879	\$2,992	\$3,122	\$3,395				
Units (in MM)	216	204	193	196	233	55	45	52	82	234	235	217	218	187	186	230	235	235				
Blended Content (in \$)	\$7.1	\$8.7	\$9.4	\$12.1	\$12.1	\$17.5	\$10.5	\$13.5	\$13.8	\$13.6	\$14.9	\$6.6	\$8.2	\$9.4	\$10.1	\$13.0	\$13.3	\$14.4				
Samsung Revenue	\$468	\$380	\$207	\$216	\$456	\$170	\$224	\$130	\$89	\$612	\$375	\$438	\$443	\$207	\$222	\$367	\$655	\$375				
Units (in MM)	316	290	295	253	271	74	70	74	71	289	300	317	295	295	261	263	287	300				
Blended Content (in \$)	\$1.5	\$1.3	\$0.7	\$0.9	\$1.7	\$2.3	\$3.2	\$1.8	\$1.3	\$2.1	\$1.3	\$1.4	\$1.5	\$0.7	\$0.8	\$1.4	\$2.3	\$1.3				
Huawei Revenue	\$306	\$248	\$191	\$142	\$8	\$6	\$3	\$1	--	\$10	--	\$365	\$249	\$242	\$170	\$0	\$18	--				
Units (in MM)	158	207	241	189	38	4	2	1	--	7	--	151	193	245	213	65	12	--				
Blended Content (in \$)	\$1.9	\$1.2	\$0.8	\$0.8	\$0.2	\$1.6	\$1.4	\$1.2	\$1.6	\$1.5	\$1.5	\$2.4	\$1.3	\$1.0	\$0.8	\$0.0	\$1.5	--				
Total non-AAPL/Huawei/Samsung	\$499	\$313	\$32	\$158	\$232	(\$82)	(\$66)	(\$135)	(\$13)	(\$296)	(\$257)	\$540	\$332	\$90	\$88	\$316	(\$289)	(\$239)				
Mobile	\$2,815	\$2,721	\$2,235	\$2,889	\$3,525	\$813	\$748	\$912	\$1,040	\$3,512	\$3,619	\$2,706	\$2,806	\$2,290	\$2,359	\$3,675	\$3,506	\$3,531				
Q/Q Growth						(21%)	(8%)	22%	14%			(0%)	3%	29%	4%	(18%)	3%	56%	(5%)	1%		
Y/Y Growth	37%	(3%)	(18%)	29%	22%	3%	(3%)	(2%)	1%	(0%)	3%	29%	4%	(18%)	3%	56%	(5%)	1%				
Broad Markets	\$948	\$1,067	\$1,066	\$1,081	\$1,585	\$523	\$481	\$524	\$524	\$2,053	\$2,276	\$945	\$1,036	\$1,087	\$997	\$1,434	\$2,006	\$2,211				
Q/Q Growth	12%	13%	(0%)	1%	47%	36%	40%	38%	10%	30%	11%	17%	10%	5%	(8%)	44%	40%	10%				
Y/Y Growth																						

TER: Teradyne

Investment Thesis/Risks

Our thesis	TER is one of the few stocks in the sector that has seen material cuts to EPS estimates, largely due to this being a down year for AAPL. The company is not immune to a cyclical correction, but this creates a low base off which to grow as AAPL turns back "on" over 2023 and 2024. Additionally, chipmakers are also splitting what would have been previously done in a single chip up into multiple chips - very positive for a capacity/unit driven story like TER. The slowdown in Moore's Law is causing the industry to have to spend more on test and the rise of AI and 5G is driving a big inflection in demand for compute (a dynamic we have written about extensively in the past) and this compute must be tested. We are bullish on Teradyne's share gain opportunity in these markets as it has historically had a weak position in testing x86 compute (AMD/INTC) but a big piece of this new compute will be met by new non x86 architectures for which Teradyne seems well positioned to capture. The Industrial Automation business has been more of a mixed bag as Teradyne invests aggressively, but it has a strong franchise, the opportunity pool is very deep given the increased penetration of robotics in a host of growing verticals, and the business adds some optionality in terms of valuation.
Risks to our thesis	We may be over-playing the relationship between front-end WFE and back-end tester demand given some capital intensity inflation due to EUV that is disproportionately benefiting the front-end WFE sector. We also may be over-playing TER's ability to win new ARM-based designs and our work around demand from AAPL and the idea that iPhone related tester demand has already corrected could be off. The sharp recovery in EPS we are expecting in 2023E could happen sooner if AAPL comes back earlier and ARM compute designs become broader much earlier than expected.

Source: UBS estimates

UBS vs Street

	FY 2019	FY 2020	FY 2021	2022/1F	2022/2F	2022/3F	2022/4F	FY 2022	FY 2023	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)													
UBS (New)	\$2,295	\$3,121	\$3,703	\$755	\$873	\$900	\$938	\$3,465	\$4,885	\$3,121	\$3,703	\$3,465	\$4,885
UBS (Old)					\$873	\$900	\$938	\$3,465	\$4,885			\$3,465	\$4,885
Consensus					\$829	\$893	\$942	\$3,419	\$4,127			\$3,419	\$4,127
Delta					5.2%	0.8%	(0.5%)	1.3%	18.4%			1.3%	18.4%
EPS (non-GAAP, adjusted)													
UBS (New)	\$2.75	\$4.59	\$5.97	\$0.98	\$1.23	\$1.25	\$1.34	\$4.79	\$8.17	\$4.59	\$5.97	\$4.79	\$8.17
UBS (Old)					\$1.23	\$1.25	\$1.34	\$4.79	\$8.17			\$4.79	\$8.17
Consensus					\$1.14	\$1.29	\$1.40	\$4.80	\$6.51			\$4.80	\$6.51
Delta					7.7%	(2.8%)	(3.7%)	(0.3%)	25.5%			(0.3%)	25.5%

Source: Company reports, UBS estimates

TER: Model Summary

Teradyne (TER): Key Metrics (in \$MM except EPS)	F2018A C2018A	F2019A C2019A	F2020A C2020A	F2021A C2021A	FQ1A CQ1A	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2023E C2023E
Revenue	\$2,101	\$2,295	\$3,121	\$3,703	\$755	\$873	\$900	\$938	\$3,465	\$1,175	\$1,365	\$1,180	\$1,165	\$4,885
Y/Y Growth	(2%)	9%	36%	19%	(3%)	(20%)	(5%)	6%	(6%)	56%	56%	31%	24%	41%
Gross Profit	\$1,225	\$1,352	\$1,788	\$2,207	\$455	\$528	\$545	\$567	\$2,094	\$693	\$805	\$702	\$699	\$2,900
Gross Margin	58.3%	58.9%	57.3%	59.6%	60.2%	60.5%	60.5%	60.5%	60.4%	59.0%	59.0%	59.5%	60.0%	59.4%
R&D	\$302	\$323	\$375	\$428	\$108	\$118	\$126	\$128	\$480	\$132	\$137	\$145	\$149	\$564
SG&A	\$391	\$437	\$465	\$548	\$140	\$151	\$158	\$160	\$609	\$161	\$166	\$176	\$176	\$678
OpeX (Non-GAAP)	\$692	\$760	\$840	\$975	\$248	\$269	\$283	\$288	\$1,089	\$293	\$303	\$321	\$325	\$1,242
Y/Y Growth	6%	10%	11%	16%	8%	7%	17%	14%	12%	18%	13%	13%	13%	14%
Operating Income (Non-GAAP)	\$528	\$582	\$946	\$1,231	\$207	\$257	\$259	\$277	\$998	\$399	\$501	\$380	\$373	\$1,652
Operating Margin	25.1%	25.4%	30.3%	33.3%	27.4%	29.5%	28.8%	29.5%	28.8%	33.9%	36.7%	32.2%	32.0%	33.8%
Non-GAAP EPS (incl. SBC)	\$2.37	\$2.75	\$4.59	\$5.97	\$0.98	\$1.23	\$1.25	\$1.34	\$4.79	\$1.95	\$2.48	\$1.89	\$1.85	\$8.17
Free Cash Flow														
CFFO	\$477	\$564	\$869	\$1,098	\$7	\$228	\$292	\$305	\$830	\$173	\$324	\$466	\$350	\$1,313
Capex	\$106	\$135	\$185	\$132	\$44	\$51	\$52	\$55	\$202	\$47	\$55	\$47	\$47	\$195
FCF	\$370	\$429	\$684	\$966	(\$37)	\$178	\$239	\$250	\$628	\$126	\$269	\$419	\$303	\$1,118
% revenue	18%	19%	22%	26%	(5%)	20%	27%	27%	18%	11%	20%	36%	26%	23%
Segment Information														
SOC test	\$1,219	\$1,286	\$1,877	\$2,247	\$387	\$460	\$480	\$510	\$1,837	\$750	\$900	\$675	\$665	\$2,990
Y/Y Growth	(17%)	6%	46%	20%	(8%)	(38%)	(17%)	0%	(18%)	94%	96%	41%	30%	63%
Q/Q Growth					(24%)	19%	4%	6%		47%	20%	(25%)	(1%)	
TAM	\$2,900	\$3,300	\$3,450	\$4,800					\$5,000	37%				\$6,100
share	42%	39%	54%	47%										49%
Memory test	\$273	\$266	\$382	\$396	\$96	\$105	\$103	\$105	\$408	\$105	\$105	\$100	\$100	\$410
Y/Y Growth	45%	(3%)	44%	4%	(11%)	14%	(9%)	28%	3%	10%	--	(2%)	(5%)	0%
Q/Q Growth					16%	10%	(2%)	2%		--	--	(5%)	--	
TAM	\$950	\$650	\$900	\$1,000					\$1,000					\$900
share	29%	41%	42%	40%					41%					46%
Total Semi Test	\$1,492	\$1,552	\$2,260	\$2,642	\$482	\$565	\$583	\$615	\$2,245	\$855	\$1,005	\$775	\$765	\$3,400
Y/Y Growth	(10%)	4%	46%	17%	(9%)	(32%)	(15%)	4%	(15%)	77%	78%	33%	24%	51%
Q/Q Growth					(19%)	17%	3%	6%		39%	18%	(23%)	(1%)	
System Test	\$216	\$288	\$410	\$468	\$119	\$120	\$115	\$115	\$469	\$125	\$130	\$135	\$135	\$525
Y/Y Growth	13%	33%	42%	14%	(11%)	14%	12%	(10%)	0%	5%	8%	17%	17%	12%
Q/Q Growth					(7%)	1%	(4%)	--		9%	4%	4%	--	
Wireless Test	\$132	\$157	\$173	\$217	\$52	\$65	\$65	\$55	\$237	\$55	\$75	\$85	\$65	\$280
Y/Y Growth	18%	19%	10%	25%	26%	18%	(5%)	5%	9%	7%	15%	31%	18%	18%
Q/Q Growth					(2%)	26%	--	(15%)		--	36%	13%	(24%)	
Universal Robots	\$234	\$248	\$221	\$311	\$85	\$100	\$113	\$125	\$423					
MiR	\$27	\$50	\$45	\$64	\$17	\$22	\$25	\$27	\$91					
AutoGuide	\$4	\$2	\$13	\$1	\$1	\$1	\$1	\$1	\$2					
Total Industrial Automation	\$261	\$298	\$280	\$376	\$103	\$123	\$138	\$153	\$516	\$140	\$155	\$185	\$200	\$680
Y/Y Growth	55%	14%	(6%)	34%	29%	33%	51%	35%	37%	36%	27%	35%	31%	32%
Q/Q Growth					(8%)	19%	12%	11%		(8%)	11%	19%	8%	

Source: Company reports, UBS estimates



TXN: Texas Instruments

Investment Thesis/Risks

Our thesis	TI is the undisputed cost leader in Analog and maintains a tight control over its supply chain and these are both enduring advantages. However, we see a few shifts that are dampening its competitive edge: 1) Cost is no longer the only factor as M&A and new growth verticals such as Autos have had a moderating impact on ASP declines, allowing specialized competitors to lock in high value sockets, despite a higher cost structure. 2) TXN will face tougher competition from ADI+MXIM in Analog Power, with TXN having few options to challenge ADI in Data Converters. In MCU, despite improvement, TXN is being outcompeted. This could be the result of some under-investment in R&D given its focus on FCF/share. In fact, ADI+MXIM+MCHP have a combined revenue base comparable to TXN and yet TXN has invested ~\$4B less than this combination over the past 5 years and the gap shows no sign of slowing. Lastly, TXN faces a much heavier capex burden over the coming Qs and years and this will significantly mute FCF/share growth.
Risks to our thesis	We may be under-appreciating TXN's R&D efficiency and its Analog franchise in particular. We also may be over-estimating TXN's capex burden over the coming years. Also, the second phase of the cycle could last longer and push TXN's estimates much higher than we expect. We also may be over-playing the importance of TXN's lack of recent share repurchase activity as a harbinger for what is to come in terms of FCF pressure.

Source: UBS estimates

UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	CY2020	CY2021	CY2022	CY2023	CY2024
Revenues (\$MM)														
UBS (New)	\$ 14,383	\$ 14,461	\$ 18,344	\$ 4,905	\$ 4,800	\$ 5,168	\$ 5,039	\$ 19,912	\$ 20,264	\$ 3,329	\$ 18,344	\$ 19,912	\$ 20,264	\$ 17,532
UBS (Old)					\$ 4,800	\$ 5,168	\$ 5,039	\$ 19,912	\$ 20,264			\$ 19,912	\$ 20,264	\$ 17,532
Consensus					\$ 4,653	\$ 4,995	\$ 4,950	\$ 19,503	\$ 19,764			\$ 19,503	\$ 19,764	\$ 20,149
Delta					3.1%	3.5%	1.8%	2.1%	2.5%			2.1%	2.5%	(13.0%)
Non GAAP EPS														
UBS (New)	\$ 5.03	\$ 5.58	\$ 8.23	\$ 2.39	\$ 2.26	\$ 2.43	\$ 2.34	\$ 9.41	\$ 8.90	\$ 1.12	\$ 8.23	\$ 9.41	\$ 8.90	\$ 6.90
UBS (Old)					\$ 2.26	\$ 2.43	\$ 2.34	\$ 9.41	\$ 8.90			\$ 9.41	\$ 8.90	\$ 6.90
Consensus					\$ 2.13	\$ 2.26	\$ 2.19	\$ 8.94	\$ 8.83			\$ 8.94	\$ 8.83	\$ 8.64
Delta					6.3%	7.4%	6.5%	5.3%	0.8%			5.3%	0.8%	(20.2%)

Source: Company reports, UBS estimates

TXN: Model Summary

Texas Instruments (TXN) - Key Metrics (in \$MM except EPS)	F2017A C2017A	F2018A C2018A	F2019A C2019A	F2020A C2020A	F2021A C2021A	FQ1A CQ1A	Estimates	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
	\$14,961	\$15,784	\$14,383	\$14,461	\$18,344	\$4,905	\$4,800	\$5,168	\$5,039	\$19,912	\$20,264	
Revenue												
Y/Y Growth	12%	6%	(9%)	1%	27%	14%	5%	11%	4%	9%	2%	
Q/Q Growth						2%	(2%)	8%	(3%)			
Gross Profit	\$9,614	\$10,277	\$9,164	\$9,269	\$12,376	\$3,442	\$3,345	\$3,566	\$3,477	\$13,830	\$13,656	
Gross Margin	64.3%	65.1%	63.7%	64.1%	67.5%	70.2%	69.7%	69.0%	69.0%	69.5%	67.4%	
R&D	\$1,508	\$1,559	\$1,544	\$1,530	\$1,554	\$391	\$405	\$421	\$425	\$1,642	\$1,821	
SG&A	\$1,694	\$1,684	\$1,645	\$1,623	\$1,666	\$422	\$437	\$454	\$459	\$1,772	\$1,966	
Opex (Non-GAAP)	\$3,202	\$3,243	\$3,189	\$3,153	\$3,220	\$813	\$841	\$875	\$884	\$3,413	\$3,787	
Y/Y Growth	2%	1%	(2%)	(1%)	2%	0%	3%	9%	11%	6%	11%	
Operating Income (Non-GAAP)	\$6,412	\$7,034	\$5,975	\$6,116	\$9,156	\$2,629	\$2,504	\$2,691	\$2,593	\$10,417	\$9,870	
Operating Margin	42.9%	44.6%	41.5%	42.3%	49.9%	53.6%	52.2%	52.1%	51.5%	52.3%	48.7%	
Non-GAAP EPS	\$3.64	\$5.63	\$5.03	\$5.58	\$8.23	\$2.39	\$2.26	\$2.43	\$2.34	\$9.41	\$8.90	
Free Cash Flow												
CFFO	\$5,363	\$7,189	\$6,649	\$6,139	\$8,756	\$2,144	\$2,548	\$2,445	\$2,514	\$9,651	\$10,525	
Capex	\$695	\$1,131	\$847	\$649	\$2,462	\$443	\$672	\$724	\$665	\$2,504	\$3,698	
FCF	\$4,668	\$6,058	\$5,802	\$5,490	\$6,294	\$1,701	\$1,876	\$1,721	\$1,848	\$7,147	\$6,828	
% revenue	31%	38%	40%	38%	34%	35%	39%	33%	37%	36%	34%	
Y/Y Growth	14%	30%	(4%)	(5%)	15%	10%	8%	(11%)	72%	14%	(4%)	

Source: Company reports, UBS estimates

TXN: Model Summary

Texas Instruments (TXN) - Key Metrics (in \$MM except EPS)	F2017A C2017A	F2018A C2018A	F2019A C2019A	F2020A C2020A	F2021A C2021A	FQ1A CQ1A	Estimates FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
Segment Revenue											
Analog	\$9,900	\$10,801	\$10,223	\$10,886	\$14,050	\$3,816	\$3,740	\$4,076	\$4,035	\$15,667	\$16,119
Y/Y Growth	16%	9%	(5%)	6%	29%	16%	8%	15%	7%	12%	3%
Q/Q Growth						2%	(2%)	9%	(1%)		
TI Analog Market Share	18.7%	18.4%	19.0%	19.7%	19.0%	17.5%					
Embedded Processing	\$3,498	\$3,554	\$2,943	\$2,570	\$3,049	\$782	\$753	\$761	\$738	\$3,033	\$2,885
Y/Y Growth	16%	2%	(17%)	(13%)	19%	2%	(3%)	3%	(3%)	(1%)	(5%)
Q/Q Growth						2%	(4%)	1%	(3%)		
Other	\$1,563	\$1,429	\$1,217	\$1,005	\$1,245	\$307	\$307	\$332	\$265	\$1,211	\$1,260
Y/Y Growth	(14%)	(9%)	(15%)	(17%)	24%	27%	(9%)	(7%)	(14%)	(3%)	4%
Q/Q Growth						(1%)	--	8%	(20%)		
Segment Revenue Operating Profit											
Analog	\$4,468	\$5,109	\$4,477	\$4,912	\$7,393	\$2,150	\$2,057	\$2,283	\$2,260	\$8,749	\$8,971
Margin (%)	45%	47%	44%	45%	53%	56%	55%	56%	56%	56%	56%
Embedded Processing	\$1,143	\$1,205	\$907	\$743	\$1,174	\$315	\$290	\$297	\$280	\$1,182	\$1,060
Margin (%)	33%	34%	31%	29%	39%	40%	39%	39%	38%	39%	37%
Other	\$472	\$399	\$339	\$239	\$393	\$98	\$82	\$37	(\$23)	\$194	(\$162)
Margin (%)	30%	28%	28%	24%	32%	32%	27%	11%	(8%)	16%	(13%)
End Market Exposure											
Communications	\$1,795	\$1,736	\$1,590	\$1,213	\$1,101	\$313					
% of Sales	12%	11%	11%	8%	6%	6%					
Y/Y Growth	3%	(3%)	(8%)	(24%)	(9%)	10%					
Enterprise	\$898	\$1,105	\$780	\$876	\$1,101	\$273					
% of Sales	6%	7%	5%	6%	6%	6%					
Y/Y Growth	12%	23%	(29%)	12%	26%	35%					
Industrial	\$5,236	\$5,682	\$5,119	\$5,419	\$7,521	\$2,062					
% of Sales	35%	36%	36%	37%	41%	42%					
Y/Y Growth	19%	9%	(10%)	6%	39%	20%					
CE	\$3,740	\$3,630	\$3,275	\$3,833	\$4,403	\$1,012					
% of Sales	25%	23%	23%	27%	24%	21%					
Y/Y Growth	8%	(3%)	(10%)	17%	15%	(5%)					
Automotive	\$2,843	\$3,157	\$3,041	\$2,852	\$3,852	\$1,097					
% of Sales	19%	20%	21%	20%	21%	22%					
Y/Y Growth	18%	11%	(4%)	(6%)	35%	20%					
Other	\$449	\$474	\$579	\$268	\$367	\$148					
% of Sales	3%	3%	4%	2%	2%	3%					
Y/Y Growth	(16%)	6%	22%	(54%)	37%						

Source: Company reports, UBS estimates



WDC: Western Digital

Investment Thesis/Risks

Our thesis	We believe in WDC's potential in achieving structurally higher margins in HDD going forward as it continues to expand in nearline HDDs. However, we think this is more than offset by its NAND exposure (about half of its total revenue) where we see supply/demand balance worsening through C2023 with further market consolidation necessary to truly drive expanding cross-cycle margins. Current WDC valuation suggests that, to some degree, the market already agrees with our view on NAND as WDC's NAND business does not attract a sufficient valuation for its worth from the investors. There could be significant value that could be unlocked if the HDD and NAND businesses were split as suggested by activist investor Elliott Management, however we think there are significant logistical (legal, tax, etc.) impediments contained in the Flash Ventures agreements preventing the split from being executed eventually.
Risks to our thesis	WDC benefits from many of the same structural dynamics as STX on the HDD side, yet the stock trades at a large discount such that the NAND business is nearly being valued as a free call option. We are not bullish on the NAND sector, but if WDC can drive more sustained profitability in NAND and potentially even consolidate with the Kioxia JV, this would be a big positive for valuation. Lastly, the logistical impediments for the split may turn out to be not as significant as we think.

Source: UBS estimates

UBS vs Street

	Actual 2019	Actual 2020	Actual 2021	Actual 2022/1F	Actual 2022/2F	Actual 2022/3F	Estimate 2022	Estimate 2022	Estimate 2023/1F	Estimate 2023/2F	Estimate 2023/3F	Estimate 2023/4F	Estimate 2023	Estimate 2024	CALENDAR YEARS				
															CY2019	CY2020	CY2021	CY2022	CY2023
Revenues (\$MM)																			
UBS	\$ 16,569	\$ 16,736	\$ 16,922	\$ 5,051	\$ 4,833	\$ 4,381	\$ 4,604	\$ 18,869	\$ 5,344	\$ 5,875	\$ 5,803	\$ 5,406	\$ 22,428	\$ 20,196	\$ 15,582	\$ 16,327	\$ 18,941	\$ 20,204	\$ 21,712
UBS (old)							\$ 4,604	\$ 18,869	\$ 5,344	\$ 5,875	\$ 5,803	\$ 5,406	\$ 22,428	\$ 20,196				\$ 20,204	\$ 21,712
Consensus							\$ 4,590	\$ 18,855	\$ 4,961	\$ 5,224	\$ 4,913	\$ 4,960	\$ 20,058	\$ 20,651				\$ 19,155	\$ 20,428
Delta							0.3%	0.1%	7.7%	12.5%	18.1%	9.0%	11.8%	(2.2%)				5.5%	6.3%
EPS																			
UBS (non-GAAP)	\$ 4.82	\$ 3.03	\$ 4.51	\$ 2.49	\$ 2.30	\$ 1.65	\$ 1.75	\$ 8.18	\$ 2.22	\$ 3.24	\$ 3.41	\$ 2.73	\$ 11.59	\$ 2.92	\$ 1.30	\$ 3.41	\$ 7.96	\$ 8.85	\$ 9.25
UBS (non-GAAP) (old)							\$ 1.75	\$ 8.18	\$ 2.22	\$ 3.24	\$ 3.41	\$ 2.73	\$ 11.59	\$ 2.92				\$ 8.85	\$ 9.25
Consensus (non-GAAP)							\$ 1.75	\$ 8.19	\$ 2.16	\$ 2.42	\$ 2.15	\$ 2.07	\$ 8.80	\$ 8.91				\$ 7.98	\$ 8.73
Delta							(0.2%)	(0.1%)	2.8%	33.9%	58.2%	31.8%	31.8%	(67.3%)				11.0%	5.9%

Source: Company reports, UBS estimates

WDC: Model Summary

Western Digital (WDC) - Key Metrics (in \$MM except EPS)	C2018A	C2019A	C2020E	C2021A	FQ3A CQ1A	Estimates FQ4:22E CQ2E	FQ1E CQ3E	FQ2E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY					
											F2018A	F2019A	F2020A	F2021A	F2022E	F2023E
Revenue (\$MM)	\$19,391	\$15,582	\$16,327	\$18,941	\$4,381	\$4,604	\$5,344	\$5,875	\$20,204	\$21,712	\$20,647	\$16,569	\$16,736	\$16,922	\$18,869	\$22,428
Y/Y Growth	-3%	-20%	5%	16%	6%	-6%	6%	22%	7%	7%	8%	-20%	1%	1%	12%	19%
Gross Margin	38.7%	25.1%	27.4%	32.2%	31.7%	32.0%	31.3%	35.2%	32.7%	32.7%	42.5%	30.5%	26.9%	28.6%	32.9%	34.9%
Opex	\$3,228	\$2,996	\$2,855	\$3,024	\$740	\$780	\$800	\$820	\$3,140	\$3,410	\$3,354	\$3,022	\$2,983	\$2,926	\$3,022	\$3,320
YY Growth	-2%	-7%	-5%	6%	1%	-1%	5%	11%	4%	9%	2%	-10%	-1%	-2%	3%	10%
Operating Margin	22.1%	5.9%	9.9%	16.2%	14.8%	15.1%	16.4%	21.3%	17.2%	17.0%	26.2%	12.2%	9.1%	11.3%	16.8%	20.1%
Non-GAAP EPS	\$11.73	\$1.30	\$3.41	\$7.96	\$1.65	\$1.75	\$2.22	\$3.24	\$8.85	\$9.25	\$14.74	\$4.84	\$3.04	\$4.54	\$8.18	\$11.59
Cash Flow																
CFFO	\$3,064	\$883	\$1,102	\$2,297	\$398	\$249	(\$1,166)	\$765	\$245	\$3,610	\$4,205	\$1,547	\$824	\$1,898	\$1,834	\$2,198
Capex	\$900	\$565	\$918	\$1,087	\$290	\$550	\$374	\$411	\$1,625	\$1,520	\$809	\$757	\$647	\$1,124	\$1,379	\$1,570
FCF	\$2,164	\$318	\$184	\$1,210	\$108	(\$301)	(\$1,540)	\$354	(\$1,380)	\$2,090	\$3,396	\$790	\$177	\$774	\$455	\$628
% revenue	11%	2%	1%	6%	2%	-7%	-29%	6%	-7%	10%	16%	5%	1%	5%	2%	3%
Product Revenue (\$MM)																
HDD Revenue	\$9,948	\$8,996	\$7,916	\$9,237	\$2,138	\$2,196	\$2,534	\$2,762	\$9,630	\$9,567	\$10,698	\$8,746	\$8,967	\$8,216	\$9,108	\$10,036
Y/Y Growth	-3%	-10%	-12%	17%	9%	-12%	-1%	25%	4%	-1%	1%	-18%	3%	-8%	11%	10%
GM	31%	29%	27%	29%	28%	28%	28%	28%	28%	33%	32%	29%	29%	27%	29%	30%
NAND Revenue	\$9,443	\$6,586	\$8,411	\$9,704	\$2,243	\$2,408	\$2,810	\$3,113	\$10,574	\$12,144	\$9,949	\$7,823	\$7,769	\$8,706	\$9,761	\$12,392
Y/Y Growth	-3%	-30%	28%	15%	3%	0%	13%	19%	9%	15%	17%	-21%	-1%	12%	12%	27%
GM	46%	20%	28%	35%	36%	36%	34%	41%	37%	33%	42%	30%	27%	29%	33%	35%

Source: Company reports, UBS estimates

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Buy	FSR is > 6% above the MRA.	56%	32%
Neutral	FSR is between -6% and 6% of the MRA.	35%	28%
Sell	FSR is > 6% below the MRA.	8%	22%
Short-Term Rating	Definition	Coverage ³	IB Services ⁴
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 31 March 2022.

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Company Name	Reuters	12-month rating	Price	Price date
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Analog Devices Inc^{16,7}	ADI.O	Buy	US\$149.94	08 Jul 2022
Applied Materials Inc^{16,20}	AMAT.O	Neutral (CBE)	US\$91.19	08 Jul 2022
Broadcom Inc.¹⁶	AVGO.O	Buy	US\$498.69	08 Jul 2022
Entegris Inc¹⁶	ENTG.O	Neutral	US\$91.49	08 Jul 2022
Intel Corp.^{16,6,7}	INTC.O	Neutral	US\$37.99	08 Jul 2022
KLA Corporation¹⁶	KLAC.O	Neutral	US\$316.84	08 Jul 2022
LAM Research Corp¹⁶	LRCX.O	Buy	US\$415.12	08 Jul 2022
Marvell Technology Group¹⁶	MRVL.O	Buy	US\$46.99	08 Jul 2022
Microchip Technology Inc¹⁶	MCHP.O	Buy	US\$59.45	08 Jul 2022
Micron Technology Inc¹⁶	MU.O	Buy	US\$59.14	08 Jul 2022
NVIDIA Corp¹⁶	NVDA.O	Buy	US\$158.38	08 Jul 2022
Onsemi^{16,20}	ON.O	Neutral (CBE)	US\$53.47	08 Jul 2022
Qorvo Inc¹⁶	QRVO.O	Neutral	US\$99.41	08 Jul 2022
Qualcomm Inc.¹⁶	QCOM.O	Neutral	US\$136.01	08 Jul 2022
Seagate Technology Holdings PLC^{16,7}	STX.O	Buy	US\$74.87	08 Jul 2022
Skyworks Solutions Inc¹⁶	SWKS.O	Neutral	US\$97.87	08 Jul 2022
Teradyne Inc¹⁶	TER.O	Buy	US\$92.08	08 Jul 2022
Texas Instruments Inc¹⁶	TXN.O	Neutral	US\$155.53	08 Jul 2022
Western Digital Corp^{13,16}	WDC.O	Neutral	US\$45.24	08 Jul 2022

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