

# US Semiconductors and Semi Equipment

## *2022 Outlook: The Chartbook*

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# UBS Semis and Semi Equipment - Primary Stock Coverage

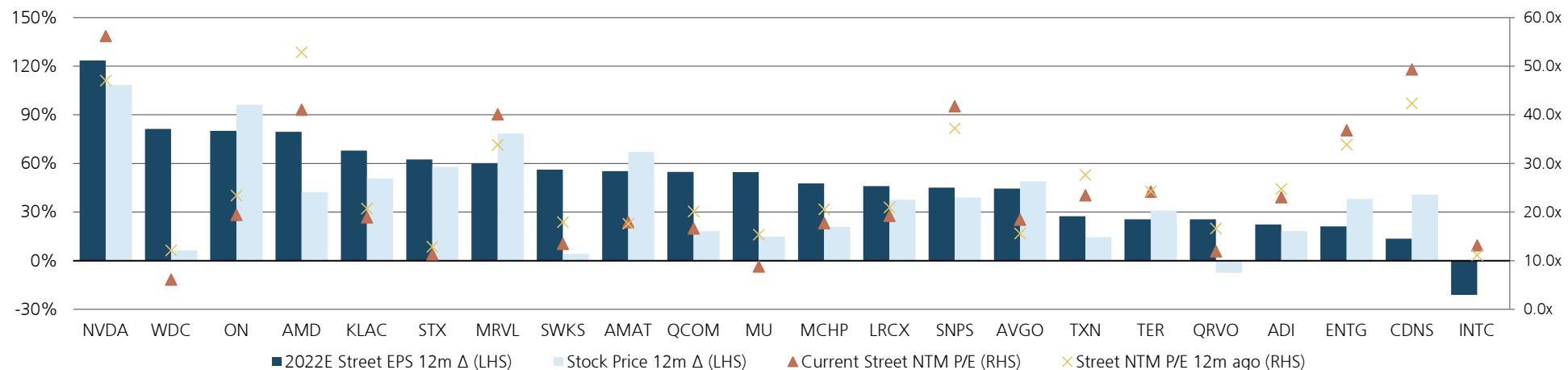
								2021E			2022E			2023E			2022			
Rating	Ticker	Company	Analyst	Mkt Cap, \$MM	Current Price	UBS Price Target	Upside / Downside	UBS EPS	Street EPS	Delta to Street	UBS EPS	Street EPS	Delta to Street	UBS EPS	Street EPS	Delta to Street	% Buy Rating	Short Int	12m Stock Price Δ	Street EPS Δ (Current vs 1 Year Ago)
Buy	ADI	Analog Devices	Pradeep Ramani	\$88,424	\$168	\$220	31%	\$6.76	\$6.77	(0%)	\$7.80	\$7.73	1%	\$8.69	\$8.76	(1%)	78%	1%	18%	22%
Buy	NVDA	Nvidia	Timothy Arcuri	\$692,975	\$277	\$350	26%	\$4.37	\$4.34	1%	\$5.59	\$5.17	8%	\$6.48	\$6.25	4%	81%	1%	108%	124%
Neutral	QRVO	Qorvo	Timothy Arcuri	\$16,110	\$146	\$180	23%	\$11.79	\$11.75	0%	\$12.69	\$13.04	(3%)	\$13.57	\$14.27	(5%)	56%	2%	-7%	25%
Buy	MU	Micron Technology	Timothy Arcuri	\$91,888	\$82	\$99	21%	\$7.43	\$7.38	1%	\$10.95	\$9.46	16%	\$13.88	\$11.51	21%	75%	2%	15%	55%
Neutral	SWKS	Skyworks Solutions	Timothy Arcuri	\$24,793	\$150	\$180	20%	\$10.27	\$10.25	0%	\$11.87	\$11.92	(0%)	\$12.99	\$13.22	(2%)	56%	2%	4%	56%
Neutral	INTC	Intel	Timothy Arcuri	\$201,723	\$50	\$58	17%	\$5.28	\$5.28	(0%)	\$3.30	\$3.64	(10%)	\$3.92	\$3.74	5%	27%	2%	0%	-21%
Buy	LRCX	Lam Research	Timothy Arcuri	\$93,079	\$661	\$765	16%	\$32.75	\$32.45	1%	\$40.00	\$36.36	10%	\$43.49	\$38.10	14%	59%	1%	38%	46%
Buy	TER	Teradyne	Timothy Arcuri	\$25,381	\$156	\$180	16%	\$5.87	\$5.90	(0%)	\$7.72	\$6.59	17%	\$7.91	\$7.62	4%	75%	2%	31%	26%
Neutral	ENTG	Entegris	Timothy Arcuri	\$17,590	\$130	\$148	14%	\$3.35	\$3.36	(0%)	\$3.91	\$3.92	(0%)	\$4.45	\$4.60	(3%)	62%	3%	38%	21%
Buy	MRVL	Marvell	Timothy Arcuri	\$71,023	\$84	\$95	13%	\$1.57	\$1.54	0%	\$2.29	\$2.22	3%	\$2.85	\$2.86	(0%)	87%	2%	78%	60%
Neutral	KLAC	KLA Corporation	Timothy Arcuri	\$58,450	\$386	\$435	13%	\$18.36	\$18.37	(0%)	\$22.20	\$21.76	2%	\$22.33	\$22.85	(2%)	59%	2%	51%	68%
Buy	SNPS	Synopsys	Pradeep Ramani	\$53,107	\$346	\$390	13%	\$7.73	\$7.71	0%	\$7.59	\$7.99	(5%)	\$9.60	\$9.38	2%	88%	1%	39%	45%
Neutral	WDC	Western Digital	Timothy Arcuri	\$17,420	\$56	\$62	11%	\$7.84	\$7.79	1%	\$7.86	\$8.57	(8%)	\$3.97	\$9.54	(58%)	67%	3%	6%	81%
Neutral	TXN	Texas Instruments	Timothy Arcuri	\$170,150	\$184	\$195	6%	\$7.83	\$7.93	(1%)	\$8.46	\$8.12	3%	\$8.53	\$8.81	(3%)	42%	2%	15%	27%
Neutral	QCOM	Qualcomm	Timothy Arcuri	\$197,870	\$177	\$185	5%	\$9.33	\$9.37	(0%)	\$10.27	\$11.13	(8%)	\$10.87	\$11.76	(8%)	68%	1%	18%	55%
Neutral	AMAT	Applied Materials	Timothy Arcuri	\$128,843	\$145	\$150	3%	\$7.37	\$7.33	1%	\$8.84	\$8.45	5%	\$8.64	\$8.87	(3%)	68%	1%	67%	55%
Buy	AVGO	Broadcom	Timothy Arcuri	\$266,316	\$645	\$665	3%	\$29.55	\$29.51	0%	\$33.72	\$33.99	(1%)	\$34.87	\$36.64	(5%)	84%	1%	49%	44%
Buy	STX	Seagate	Timothy Arcuri	\$23,406	\$105	\$105	(0%)	\$8.05	\$8.19	(2%)	\$8.55	\$8.70	(2%)	\$9.14	\$9.10	0%	39%	5%	58%	62%
Neutral	MCHP	Microchip	Pradeep Ramani	\$45,832	\$83	\$82	(1%)	\$4.15	\$4.16	(0%)	\$4.79	\$4.82	(1%)	\$4.91	\$5.11	(4%)	65%	2%	21%	48%
Neutral	CDNS	Cadence Design Systems	Pradeep Ramani	\$49,143	\$177	\$170	(4%)	\$3.28	\$3.26	1%	\$3.61	\$3.58	1%	\$3.99	\$3.99	0%	50%	1%	41%	14%
Neutral	ON	On Semiconductor	Pradeep Ramani	\$26,255	\$61	\$55	(10%)	\$2.81	\$2.80	0%	\$2.93	\$3.26	(10%)	\$3.22	\$3.50	(8%)	67%	5%	96%	80%
Neutral	AMD	Advanced Micro Devices	Timothy Arcuri	\$163,994	\$136	\$115	(15%)	\$2.65	\$2.64	0%	\$3.30	\$3.33	(1%)	\$3.94	\$4.12	(4%)	56%	6%	42%	79%

Source: Factset, UBS estimates

Prices as of 12/20/2021

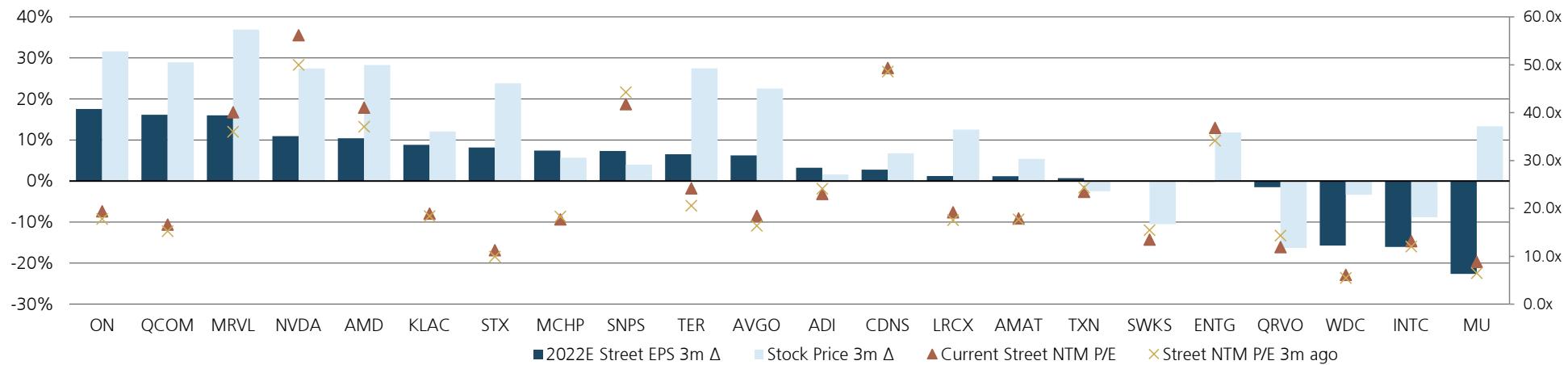
# Primary Stock Coverage: Street Estimates Change

## Stock Coverage – 12M Change



Source: Factset

## Stock Coverage – 3M Change



Source: Factset

# Primary Stock Coverage: Summary Thesis and Risks - Part 1

Ticker	Company	Analyst	Market Cap (Units: \$M)	Rating	Current Stock Price	UBS Target Price	Upside/Downside	Thesis/Risks
ADI	Analog Devices	Pradeep Ramani	\$88,424	Buy	\$168	\$220	31%	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 – that leave it well positioned for through-cycle growth. We see ADI as being well positioned to grow in multiple end markets as supply constraints gradually ease in 2022 and we view MXIN as a high quality R&D franchise that augments ADI's competitive position in Autos/Comms and ultimately opens up a degree of freedom to grow P&L in 2023. Beyond the numbers, when viewed via the lens of our decade's worth of Analog design experience, we see new growth verticals (Space, Autos, 5G) driving up demand for specialized Analog and playing to ADI's strength - a unique innovative culture + willingness to commit R&D \$ to drive growth. Buy, PT \$220.
								Risks to our thesis ADI is subject to macro cycles and remains supply constrained in the near term.
NVDA	Nvidia	Timothy Arcuri	\$692,975	Buy	\$277	\$350	26%	Our thesis  We view NVDA as a core holding for any growth portfolio. 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 in a hundreds of billions range given its very broad application spectrum.
								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. 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.
QRVO	Qorvo	Timothy Arcuri	\$16,110	Neutral	\$146	\$180	23%	Our thesis  The main near-term question for us is now whether Mobile business could come back in March Q after QRVO's recent disappointing guidance, which we believe is likely and has to do with QRVO's supply constraints and a tepid China market QRVO is more exposed to vs. SWKS. Meanwhile, operational execution remains strong so far (GM) and AAPL's modern internalization could pose a content gain opportunity as QRVO could regain the envelope tracker. In addition, QRVO is also expanding its TAM with new diversity path, ultra wide-band, touch and medical solutions. Lastly, China 5G infrastructure where QRVO has high exposure in IDP business has finally washed out and should start to improve.
								Risks to our thesis We may be overly concerned about QCOM's ability to take content from QRVO on its modern 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.
MU	Micron Technology	Timothy Arcuri	\$91,888	Buy	\$82	\$99	21%	Our thesis  We have a multi-year secular bull view on memory industry fundamentals and stock re-rating potential as Feb'22 Q is effectively the bottom in MU's financials and they should hockey stick higher from Feb to May and August Qs in 2022. Furthermore, as MU suggested, we believe the current "kiting" issues in PCs are transitory while cloud demand should also remain strong in 2022 – all of which argues for another strong year in 2022 and provides a favorable "up and to the right" trajectory for annual revenue/EPS. Lastly, we see significant potential for the stock to re-rate higher as DRAM cycles become shallower and shorter – an outcome that could transpire in '22 as investors see that this recent correction was much shorter and less severe than in the past.
								Risks to our thesis DRAM pricing decline may last longer than we are estimating based on supply and demand balance. Supply constraints may also cap Q/Q bit growth in November'22 Q and bits down in Feb'22 Q. In addition, FY2022 full year bit shipment for both DRAM/NAND may lag long-term CAGR. Lastly, from an M&A perspective, MU might be negatively impacted if WDC indeed merges with Kioxia in NAND where we already know MU missed out acquiring INTC's NAND business.
SWKS	Skyworks Solutions	Timothy Arcuri	\$24,793	Neutral	\$150	\$180	20%	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.
INTC	Intel	Timothy Arcuri	\$201,723	Neutral	\$50	\$58	17%	Our thesis  We remain strong believers that INTC will ultimately catch up in terms of the manufacturing and the relationship with TSMC is a big positive for the product roadmap. We also like INTC's diversified approach as it now architecturally covers the entire 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 a 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. We are also skeptical of the 10-12% LT CAGR and even so, much of this revenue seems parked in out in 2025/2026 and this seems too far out. Ergo, we are Neutral on INTC.
								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. On the other hand, building a foundry business is very challenging and the company 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 incremental workload. AMD remains a threat as well, though INTC's partnership with TSMC should start to nullify this threat.
LRCX	Lam Research	Timothy Arcuri	\$93,079	Buy	\$661	\$765	16%	Our thesis  We are structural bulls on memory as we believe memory revenue dollars will continue to outgrow non-memory over time. Within memory, LRCX is more levered to NAND where meaningful consolidation has yet to really happen, we continue to expect capex to remain very high relative to industry EBITDA, and we see the quarterly trajectory of WFE inflecting higher through '22. The nature of the NAND business also makes LRCX's installed base one of the "stickiest" in the sector as LRCX should continue to monetize the dominant share that it secured many years back during the initial planar-3D transition. LRCX should similarly benefit as other device types start to build more vertically. Lastly, LRCX has the fastest growing service business in the sector and if we valued this more in-line w/traditional "toll-taking" business models, this would imply a very low multiple for its equipment business.
								Risks to our thesis We see overall WFE starting to flatten off and potentially decline in '23 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: Factset, UBS estimates

Prices as of 12/20/2021

# Primary Stock Coverage: Summary Thesis and Risks - Part 2

Ticker	Company	Analyst	Market Cap (Units: \$M)	Rating	Current Stock Price	UBS Target Price	Upside/Downside	Thesis/Risks
TER	Teradyne	Timothy Arcuri	\$25,381	Buy	\$156	\$180	16%	Our thesis  TER has cyclical tailwinds that should last well into 2023 as investors may be under-estimating the size of its core SoC tester TAM for 2022. As chipmakers turn on recently installed manufacturing capacity and work down backlogs, these devices must be tested. Structurally, 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 gradual recovery in EPS we are expecting in 2023 and a big recovery in 2024 could happen sooner if ARM compute designs become broader much earlier than expected and TER is feasting on this structural shift.
ENTG	Entegris	Timothy Arcuri	\$17,590	Neutral	\$130	\$148	14%	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.
								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 its 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.
MRVL	Marvell	Timothy Arcuri	\$71,023	Buy	\$84	\$95	13%	Our thesis  Post IPHI and Innovium acquisition, MRVL becomes 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. Better supply is finally unlocking a new degree of freedom on the upside for the model and we expect the stock will act better when these delinquencies inflect lower and the story pivots to faster growth cloud.
								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 '23.
KLAC	KLA Corporation	Timothy Arcuri	\$58,450	Neutral	\$386	\$435	13%	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 expect memory revenue dollars to out-grow non-memory revenue dollars at the chip level which should start to move the mix back in the other direction – a headwind for KLAC's growth. We also believe that WFE will start to flatten off and peak as we move into 2H:22 and 2023 which will provide an additional headwind. We like the 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 but we simply view it as more of a defensive investment when the cycle starts to roll over and the WFE dollars mix away from capacity and toward technology – which is more of a 2H:22 or C2023 event.
								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. Its valuation versus peers and the broader market has also compressed recently, suggesting that the market may be starting to discount some of our concerns. 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.
SNPS	Synopsys	Pradeep Ramani	\$53,107	Buy	\$346	\$390	13%	Our thesis  We see a long runway for margin accretive growth due to: 1) multiple revenue growth vectors in Digital; 2) halo effect from new products (DSO.ai) in the near term; 3) operating leverage that should drive (in our view at least) mid-teens EPS growth. SNPS is executing in a strong market environment as it sees tailwinds from multiple long term growth vectors (large semis customers renewals, new products, hyperscalers, China, IP, Security business) all of which play to its strengths in core Digital. SNPS does not see a ceiling to margins as operating leverage and execution ultimately drive mid-teens EPS growth in its model.
								Risks to our thesis  We see EDA as a stable business model. However, hardware can be lumpy and EDA ultimately remains linked to Semi R&D that is far less cyclical than revenue, but timing and renewal rates could still be subject to cycles.
WDC	Western Digital	Timothy Arcuri	\$17,420	Neutral	\$56	\$62	11%	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 C2022/2023 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.
								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 the Kioxia JV, this would be a big positive for valuation.
TXN	Texas Instruments	Timothy Arcuri	\$170,150	Neutral	\$184	\$195	6%	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: Factset, UBS estimates

Prices as of 12/20/2021

# Primary Stock Coverage: Summary Thesis/Risks - Part 3

Ticker	Company	Analyst	Market Cap (Units: \$M)	Rating	Current Stock Price	UBS Target Price	Upside/Downside	Thesis/Risks
QCOM	Qualcomm	Timothy Arcuri	\$197,870	Neutral	\$177	\$185	5%	Our thesis QCOM has a myriad of new growth vectors, most of which leverage the R&D that it has already sunk into its mobile business which supports very strong and sustainable margins. QCOM's position in most of these markets though is nowhere near as dominant as it has been in mobile for the better part of 20 years making us question whether the market will reward the stock with a higher multiple. To us, the next driver for a big upside to its new financial model is now around the pace of mmWave proliferation – very rich content for QCOM and an area where it has a major technology advantage. It's hard though to pinpoint timing given its significant added expense and investment requirements for carriers plus the lack of a killer application. In the meantime, we do not see the stock re-rating and we remain Neutral.
								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 recently updated LT financial model.
AMAT	Applied Materials	Timothy Arcuri	\$128,843	Neutral	\$145	\$150	3%	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 very well positioned and should remain a share gainer as the company leverages its broad portfolio for both processes and materials to enable technology scaling roadmaps; but we feel that estimates already reflect much of this given where we see WFE for '22 and '23. We do like AMAT's leverage to emerging verticals like advanced packaging and 3D structures in logic and DRAM.
								Risks to our thesis WFE should continue to grow through '22, reaching ~\$100B/yr run-rate in 2H22. However, we expect spending to moderate from there as chipmakers digest all of the capacity addition and work down backlog. We also feel that long-term WFE intensity is more like 13.5-14% - far below the ~15.5-16% we are running at in 1H22. This suggests that the amount of equipment that will have been shipped through '22 is enough to accommodate ~35-40% more semiconductor revenue. This suggests a strong potential for digestion. AMAT is also relatively more exposed to how we see US/China trade restrictions transpiring through '22 and '23.
AVGO	Broadcom	Timothy Arcuri	\$266,316	Buy	\$645	\$665	3%	Our thesis We see AVGO as the most attractive compounding in semis for income investors and we model the dividend to grow again to ~\$17.50 for F2023. The company is exposed to fast growing markets with very strong franchise in each of its end markets. It also benefits from scale and is becoming more selective in M&A – a trend which investors should view favorably. While AVGO is growing ~2x what it considers its long-term growth rate, it should be able to maintain lead times in the 2H of this cycle 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. AVGO announced dividend increase and the new \$10B share repo program, while it will continue to look for M&A targets – we note that its hurdle rate has gone up and it is harder to find needle moving assets with a customer set that dovetails well with AVGO's core ~600 accounts. The primary risk for the stock is that it gets caught in the downcycle just like peers and its lead times provide little protection.
STX	Seagate	Timothy Arcuri	\$23,406	Buy	\$105	\$105	0%	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 underway 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 OpEx 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.
MCHP	Microchip	Pradeep Ramani	\$45,832	Neutral	\$83	\$82	-1%	Our thesis We see limited upside to street amid supply constraints. MCHP outsources manufacturing of 32 Bit MCU (by far the growth driver) and is heavily constrained, making it hard for MCHP to demonstrate a whole lot of MCU revenue upside (vs. already high expectations). We are still solidly mid-cycle (ISM>50). We see the cycle as still being strong enough for longer and although a stretched-out cycle improves near term set-up for the stock, we view MCHP as a defensive name that has consistently outperformed S&P/Analog much later in the cycle (ISM <50).
								Risks to our thesis Lead times could compress faster than we expect. Analog remains linked to macro.
CDNS	Cadence Design Systems	Pradeep Ramani	\$49,143	Neutral	\$177	\$170	-4%	Our thesis Design activity remains solid and revenue growth is accelerating with both contract volumes and pricing driving ACV uplift. Verification product cycle is only just ramping and this is a + for the stock. We expect CDNS' new CEO to continue to push into System Analysis and we think this could create a headwind for Op. leverage and FCF is only being guided flat y/y and we remain on the sidelines.
								Risks to our thesis The overall backdrop for R&D and EDA spend remains very strong and this could create upside risk to our thesis. On the downside, we see System Analysis push as taking a bite out of Op. margins and limit FCF.
ON	ON Semiconductor	Pradeep Ramani	\$26,255	Neutral	\$61	\$55	-10%	Our thesis ON delivered a strong set of results - a beat/raise (~-\$30MM/\$70MM vs. street), Dec Q GM guide 42%-44% well above Buyside expectations - that were somewhat eclipsed by the compelling evidence of EV traction. However, the call was largely consistent w/ Analyst day targets (not a whole lot incremental in terms of revenue) that are now increasingly baked in and we would wait for a better entry point. In an endorsement of ON's technology, multiple EV customers are signing take or pay long term supply agreements (LTSA) and co-investing in late stage R&D. EV revenue should cross over ADAS in late C2023 as it ramps to >20% of Autos. Relative to GMs, we think Dec Q is benefiting from pricing and we are only modeling ~42% GMs for C2022 but we see a path to a more gradual shift to structurally higher margins (>45%).
								Risks to our thesis Onsemi is raising prices aggressively despite a heavy exposure to commodity Analog. The sustainability of this is an open question, although EV ramp could cushion impact. Near term impact of Auto production although EV remains strong.
AMD	Advanced Micro Devices	Timothy Arcuri	\$163,994	Neutral	\$136	\$115	-15%	Our thesis We believe that AMD will gain ~400-500bps of total server CPU share this year and it could plausibly post similar gains in '22 before INTC rights the ship on the product roadmap in '23 with the recently inserted Emerald Rapids and Granite Rapids. However, the stock is pricing in very robust share gains even 3-4 years out. We think INTC is making significant progress on its node technology making it hard for us to underwrite a significant multiple on estimates this far out given what should be a narrower competitive window.
								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 AMD. Additionally, the XLNX deal – assuming it is approved by China - 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 12/20/2021

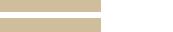
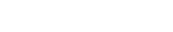
# Our Most Popular Research

## Top 10 Readership – Past 30 Days

#	Document Distribution Title	Document Publication Date	No. of External hits
1	NVIDIA Corp "UBS Evidence Lab Inside: Raise PT to \$350 And New Web 3.0..."	14-Nov-2021	
2	NVIDIA Corp "The Transformation To A Platform Company Continues" (Buy) Arcuri	17-Nov-2021	
3	UBS Global I/O Global Semiconductors and Semi Equipment "Quarterly WFE..."	23-Nov-2021	
4	Qualcomm Inc. "New Supply Helps Fill A Rich 5G Android Market" (Neutral) Arcuri	04-Nov-2021	
5	US Semiconductors and Semi Equipment "US/China Trade Update, MCHP, AMD,..."	07-Nov-2021	
6	US Semiconductors and Semi Equipment "NVDA and AMAT Earnings, QCOM A-Day,..."	14-Nov-2021	
7	Qualcomm Inc. "A-Day Highlights - mmWave The Next Debate" (Neutral) Arcuri	17-Nov-2021	
8	First Read: Advanced Micro Devices Inc "New Offerings Deepen Cloud Penetration"	08-Nov-2021	
9	Applied Materials Inc "Supply Constraints Bite, But Outlook Remains Solid"	19-Nov-2021	
#	US Semiconductors "Web 3.0: EDA Market Sizing Analysis" Ramani	14-Nov-2021	

Source: UBS

## Top 10 Readership – Past 15 Months

#	Document Distribution Title	Document Publication Date	No. of External hits
1	Intel Corp. "2021 Should Herald A Transformation, Catalyzed By..."	10-Nov-2020	
2	US Semiconductors "2021 Outlook; The "Momentum" Trade Is Waning, But..."	20-Dec-2020	
3	Initiation of Coverage: US Semiconductors "Peak Analog? And How to..."	12-Oct-2021	
4	Intel Corp. "Downgrade to Neutral, PT to \$58 On Capex Commentary" (Neutral)	22-Oct-2021	
5	NVIDIA Corp "Ampere – A "Game Changer" (Buy) Arcuri	01-Sep-2020	
6	Analog Devices Inc "The Specialized Analog Era Is Here. Initiate Buy." (Buy)	12-Oct-2021	
7	NVIDIA Corp "Strong Results And Guide; Buy Weakness And Don't Overthink It"	24-Feb-2021	
8	US Semiconductors and Semi Equipment "The Semis Chartbook: Our Latest..."	14-Jun-2021	
9	Micron Technology Inc "Investing For the Future Amid A Strong Cycle" (Buy)	01-Jul-2021	
#	NVIDIA Corp "Transformational ARM Deal Finally Announced; But Execution Is..."	15-Sep-2020	

Source: UBS

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## Section 1

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# Semiconductors – Big Picture

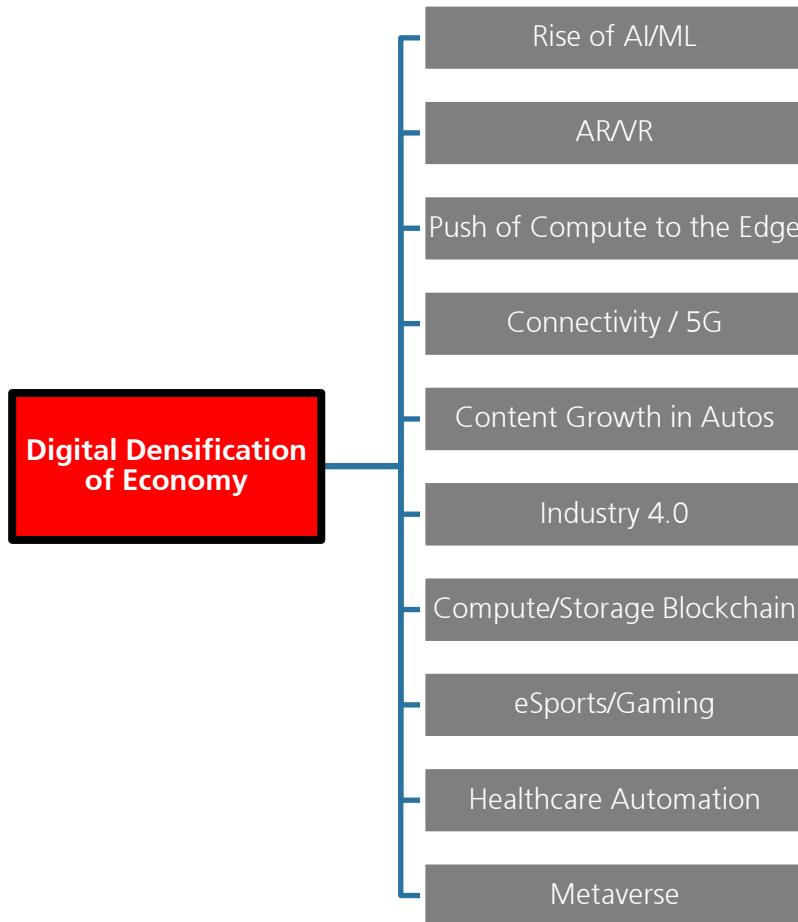
# Key Messages

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- Semis now a key industrial building block similar to oil; long-term demand backdrop remains favorable as digital densification of the global economy should continue to accelerate...
  - Semis have grown vs. GDP, but still "only" ~65bps (memory ~20bps) vs. oil ~230bps
- ...ISM has peaked, but is holding steady at high levels – overall, macro remains healthy...
- ...but the cycle is transitioning from inventory depletion to inventory build and inventory growth is about to cross over revenue growth
  - This will drive choppiness as lead times start to compress...
  - ...but as supply constraints lift, there is still upside to estimates...
  - ...stocks have still been reacting accordingly to revisions...
  - ...and inventory replenishment should last well into 2023
- ...Investors and particularly HFs are underweight, and Street estimates (ex memory) for 2H:22 are BELOW seasonal
  - So we are not worried quite yet about "the cycle" but "wall of worry" is growing as investor positioning has recently skewed to being under-weight
- Valuation is not overly concerning as semis+SPE trades at a discount to the S&P500
- We prefer compute and memory verticals; Buy (NVDA, AVGO, MRVL, MU, LRCX, STX, ADI, TER, SNPS)

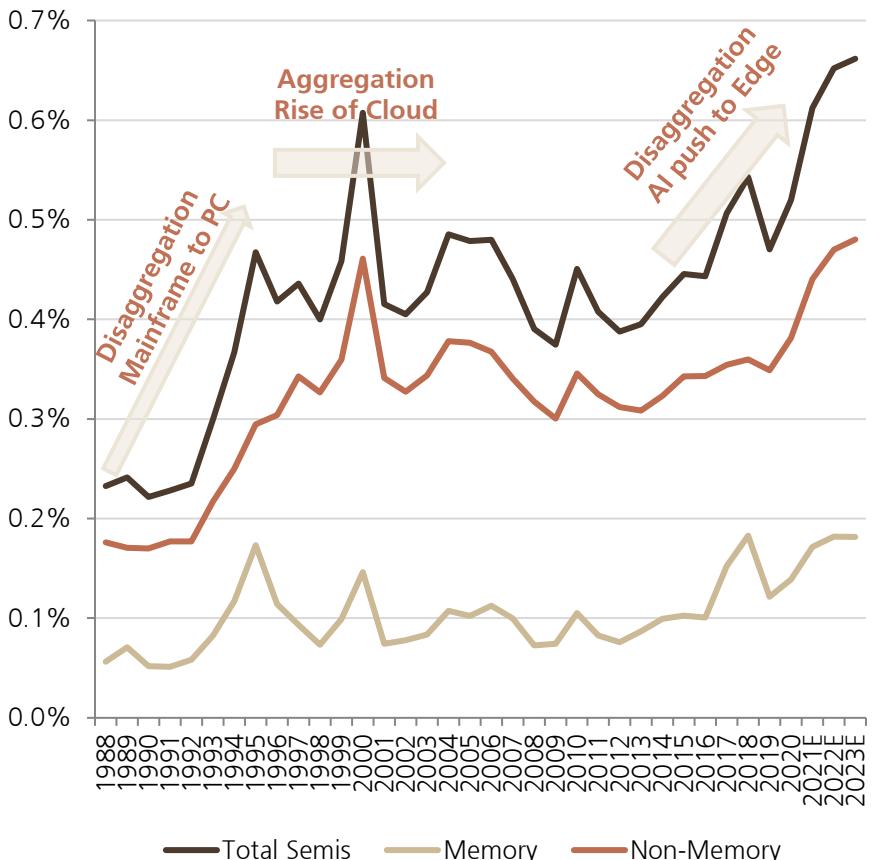
# Big Picture: Semis Long-term Secular Drivers

## Semis Secular Drivers



Source: UBS

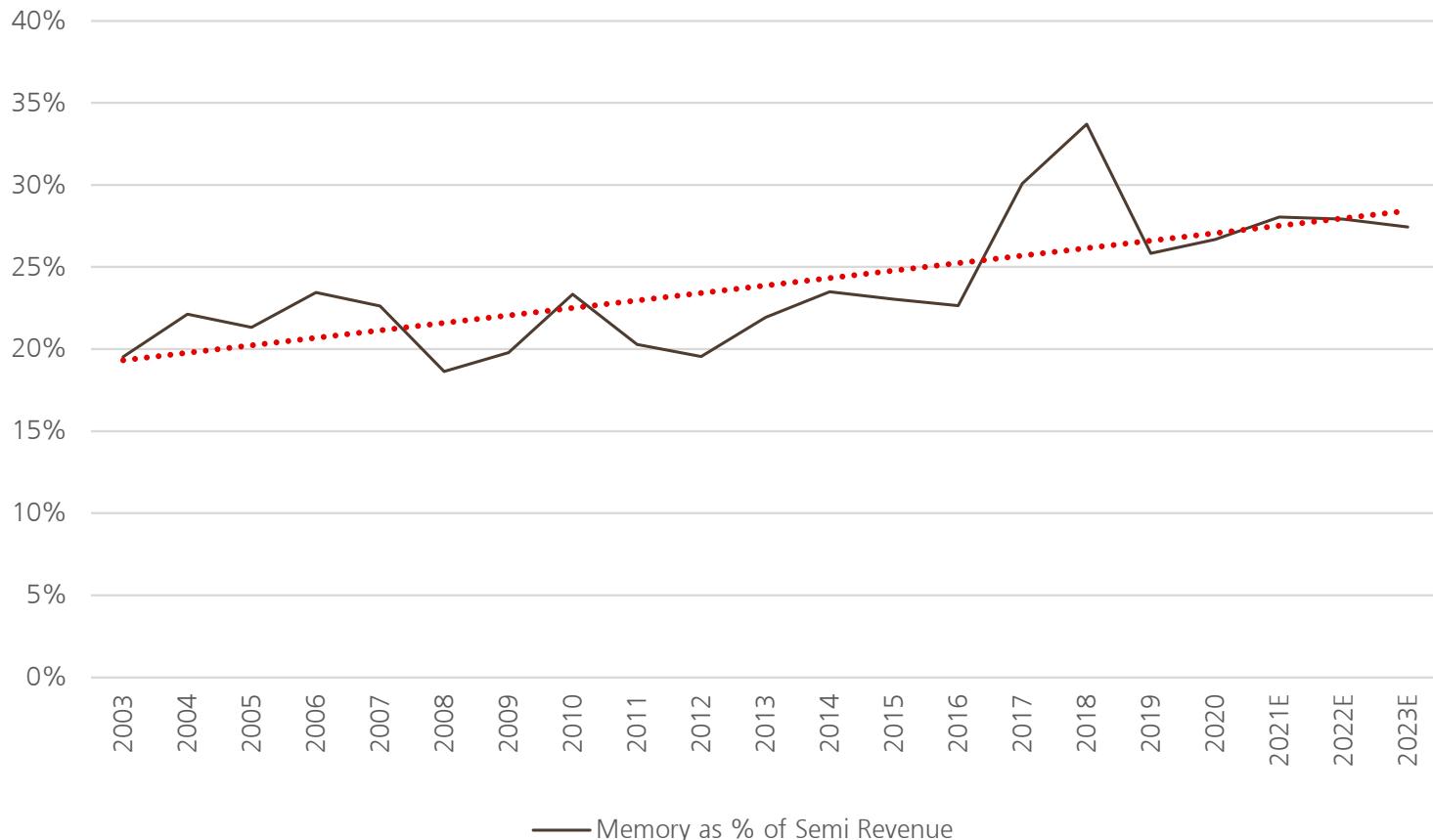
## Semis Revenue as % of Global GDP



Source: Factset, SIA, UBS

# Secular Growth in Memory

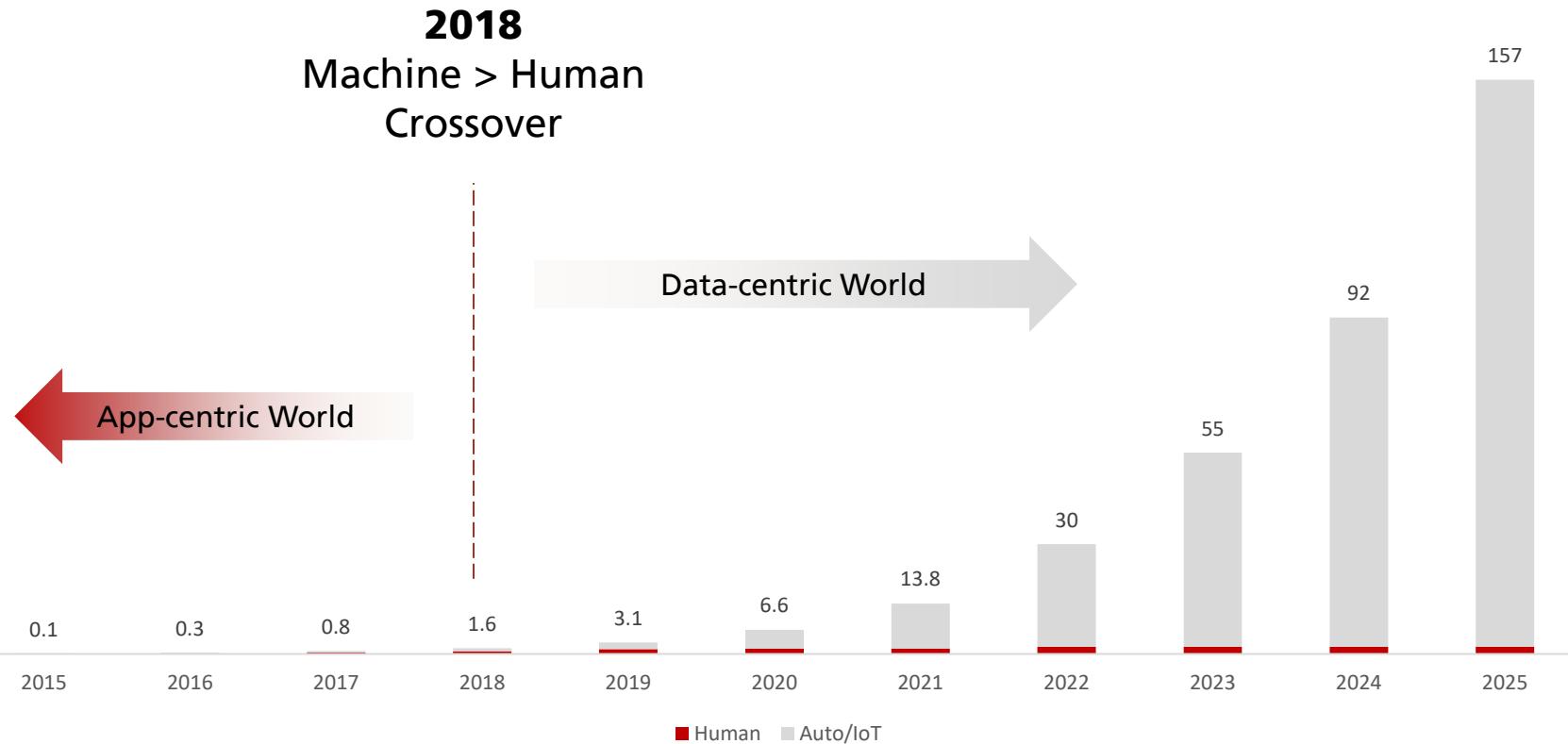
Memory Revs as % of Semi Revs – Premium Growth



Source: Factset, SIA, UBS estimates

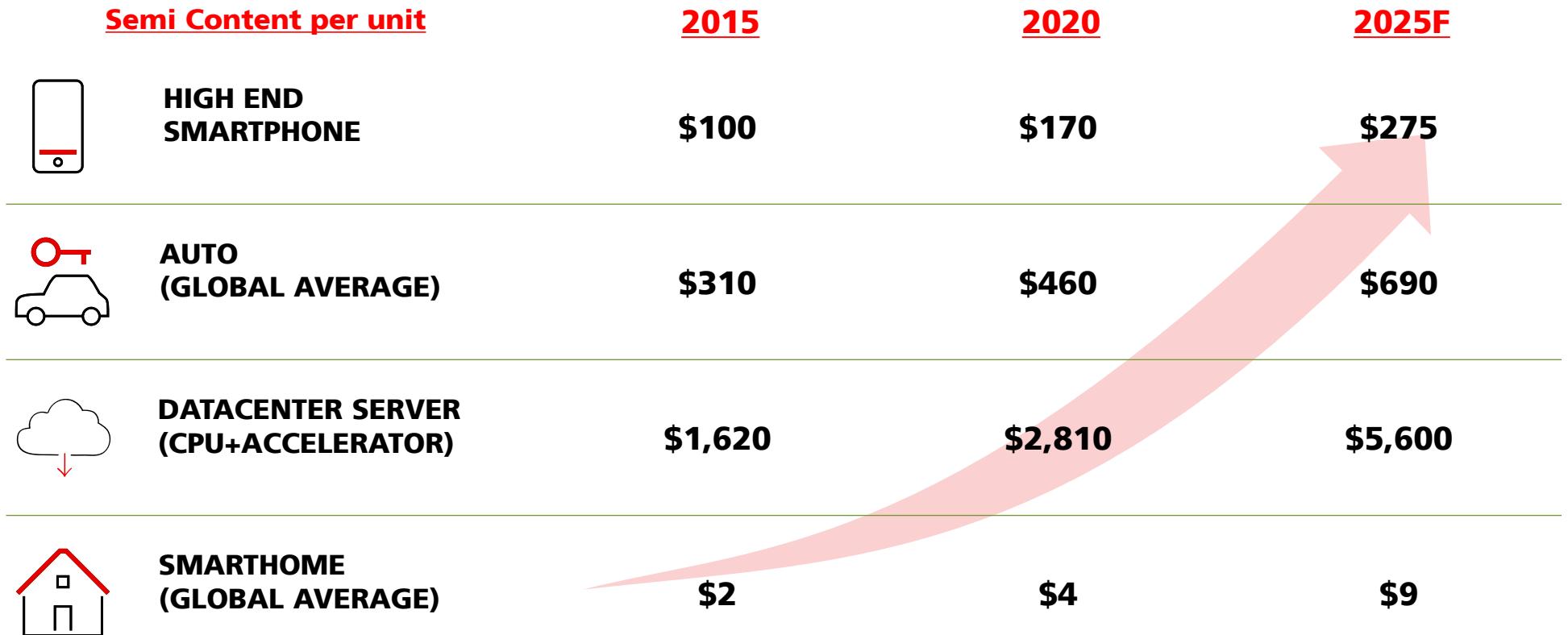
# Data has been mostly generated by machine since 2018

Data Generation by Category (ZB)



Source: Applied Materials, Sep 2021

# Silicon content growing as everything gets smarter



Source: Applied Materials, Sep 2021

# Semis outperform even when high ISM levels fall off slightly

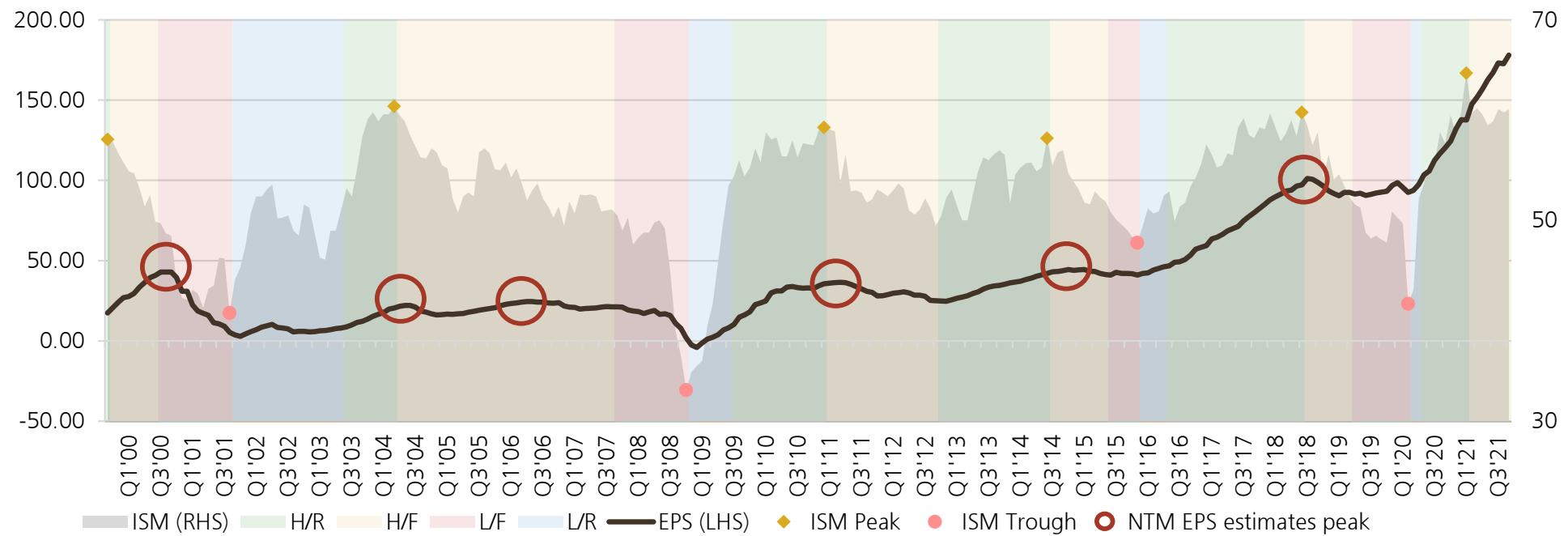
S&P 500 IGs Relative Returns, High ISM (>52.5), Annualized

Change in ISM	Falling					Rising				
	100 to -5	-5 to -3	-3 to -2	-2 to -1	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 5	5 to 100
Capital Goods	-3.2%	-3.5%	1.1%	0.2%	0.5%	-0.3%	5.2%	6.2%	4.5%	-1.9%
Com & Prof Svcs	5.6%	2.3%	0.9%	-14.1%	-7.3%	-11.1%	1.5%	-3.0%	-15.0%	-12.8%
Transportation	-2.4%	-1.7%	-7.0%	0.0%	0.9%	-6.0%	2.2%	6.9%	2.9%	9.4%
Autos & Comp	1.7%	-22.9%	-10.7%	5.8%	-9.7%	-1.9%	-4.5%	2.9%	-4.7%	10.8%
Cons Dur & App	-3.2%	-8.6%	-1.2%	1.8%	-13.0%	-3.1%	1.3%	2.0%	-8.3%	-3.3%
Consumer Svcs	-12.5%	-3.2%	-0.5%	5.2%	6.5%	-5.6%	-0.2%	4.4%	0.3%	13.7%
Media	0.4%	-0.6%	-2.3%	0.1%	-5.5%	1.9%	4.9%	5.4%	-0.2%	2.0%
Retailing	-2.7%	-5.3%	3.3%	9.3%	0.1%	8.1%	0.9%	2.9%	-0.3%	-8.5%
Food & Stap Retail	1.8%	1.0%	1.2%	1.5%	-1.5%	-3.0%	-8.2%	-9.1%	-11.1%	-2.2%
Food Bev & Tob	3.9%	2.7%	2.5%	-1.3%	1.5%	0.3%	-2.1%	-3.3%	-6.3%	-0.9%
HH & Personal Prod	13.8%	0.3%	-6.1%	-8.0%	0.7%	-1.6%	-0.5%	-3.4%	-1.3%	-3.0%
HC Equip & Svcs	2.5%	2.5%	2.7%	3.3%	2.2%	10.1%	-2.2%	14.5%	-9.1%	2.5%
Pharma Biotech & LS	2.3%	4.6%	4.4%	-0.4%	-0.7%	0.2%	-1.9%	-4.1%	-0.8%	-0.9%
Banks	17.5%	-3.1%	-4.7%	-5.4%	-7.2%	-6.9%	1.4%	5.0%	-2.9%	-14.6%
Div Financials	9.0%	3.2%	-3.5%	0.7%	-8.7%	-0.7%	2.1%	-6.3%	2.9%	-13.7%
Insurance	5.6%	4.5%	3.1%	1.4%	-8.3%	-0.2%	-2.1%	-0.2%	-0.6%	-4.3%
Software & Svcs	25.6%	10.3%	-10.0%	7.1%	-1.0%	11.5%	2.7%	-7.9%	-1.7%	2.8%
Tech Hdwr & Equip	-5.5%	-7.6%	-4.6%	2.9%	2.4%	7.0%	5.2%	9.1%	15.9%	5.0%
Semis & Equip	-18.4%	-11.4%	-9.9%	3.5%	0.6%	-2.6%	5.2%	7.2%	1.7%	3.1%

Source: Haver, Factset, UBS

# SOX NTM EPS estimate revisions have peaked within 3-6/9 months of ISM peaks

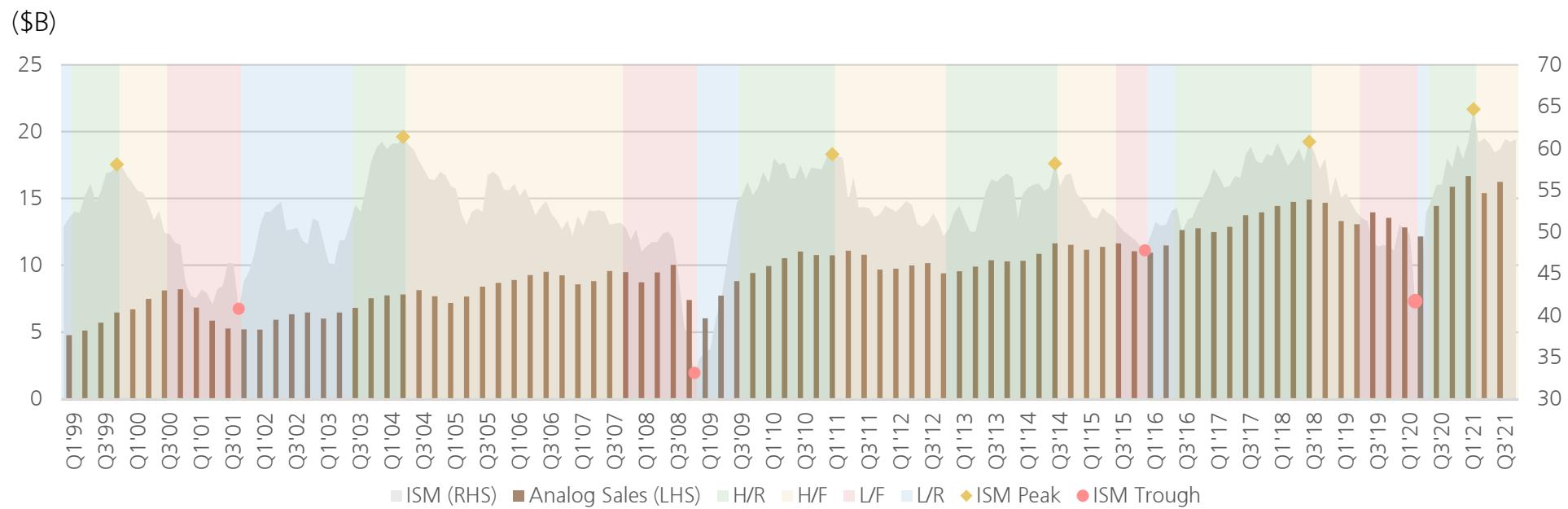
Semis Earnings Peak (SOX) vs. ISM



Source: Factset, ISM, Company reports, UBS

# Analog Revenue vs. ISM

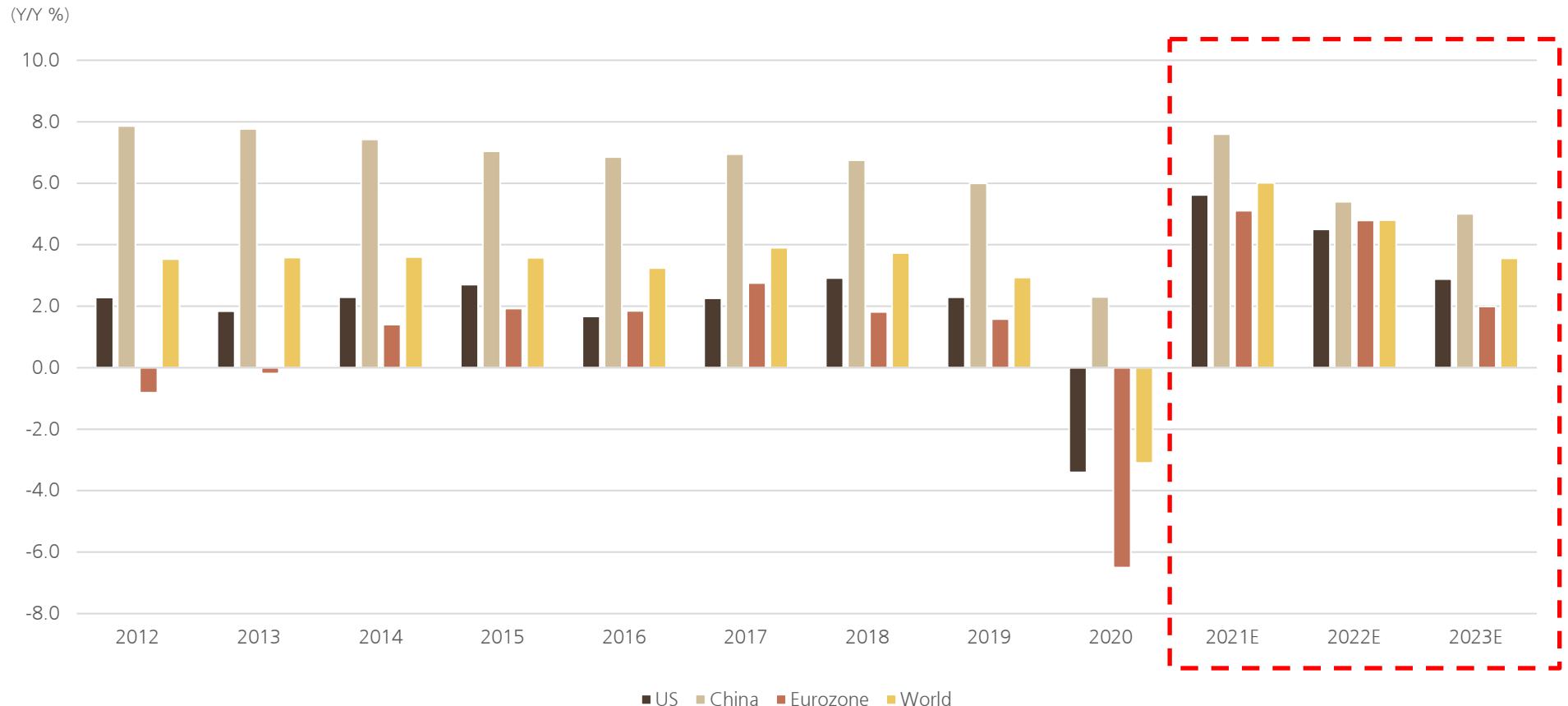
Analog Revenue (\$B) vs. ISM



Source: SIA, UBS

# Global macro outlook robust for '21 and '22

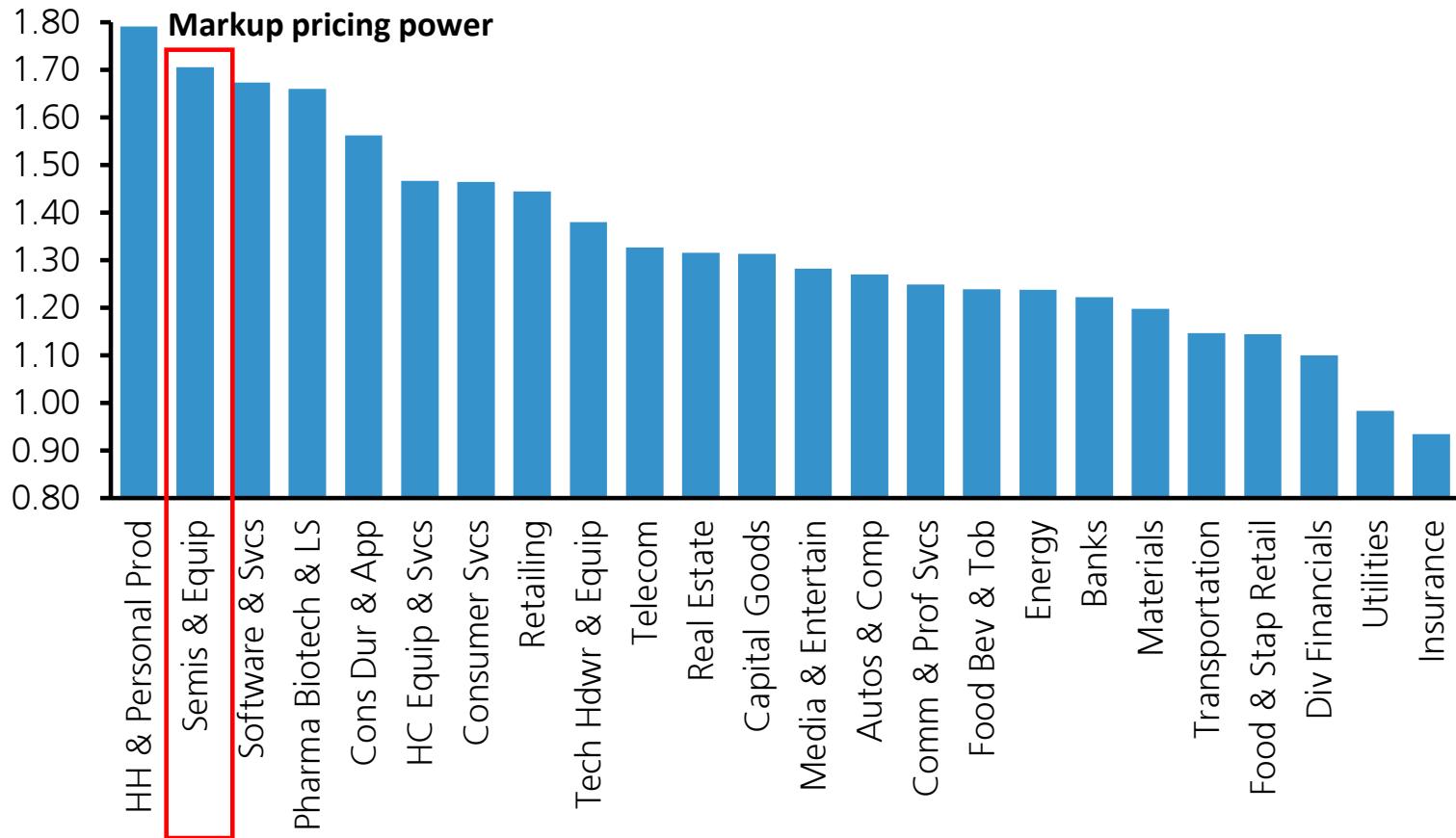
Real GDP Y/Y Growth (%)



Source: Haver, CEIC, National Statistics, UBS estimates

# Semis rank high in terms of pricing power

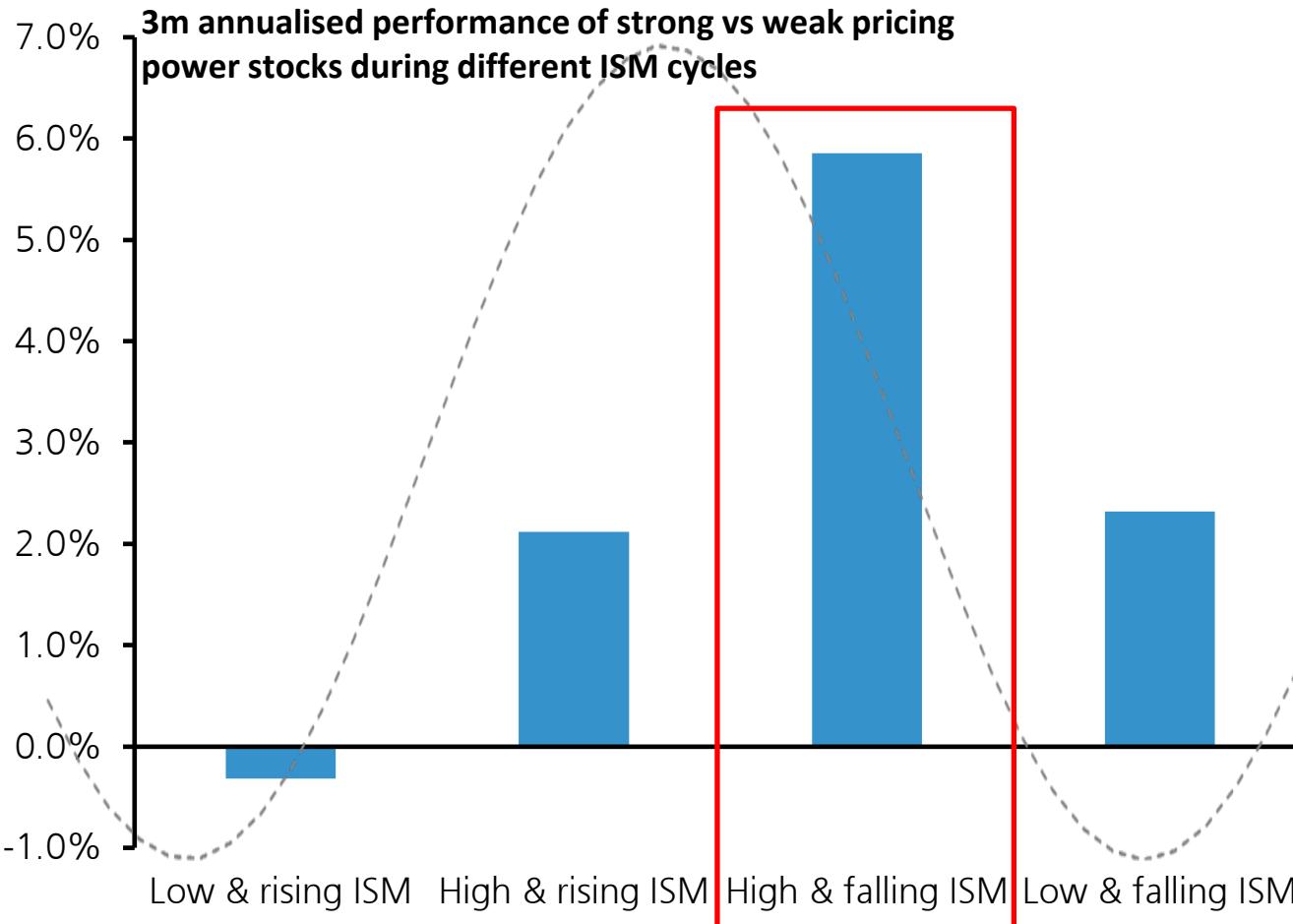
Corporate Markup Pricing Power Across Industry Groups



Source: Factset, UBS

# ...which means Semis can still outperform even in an environment where high ISM is falling

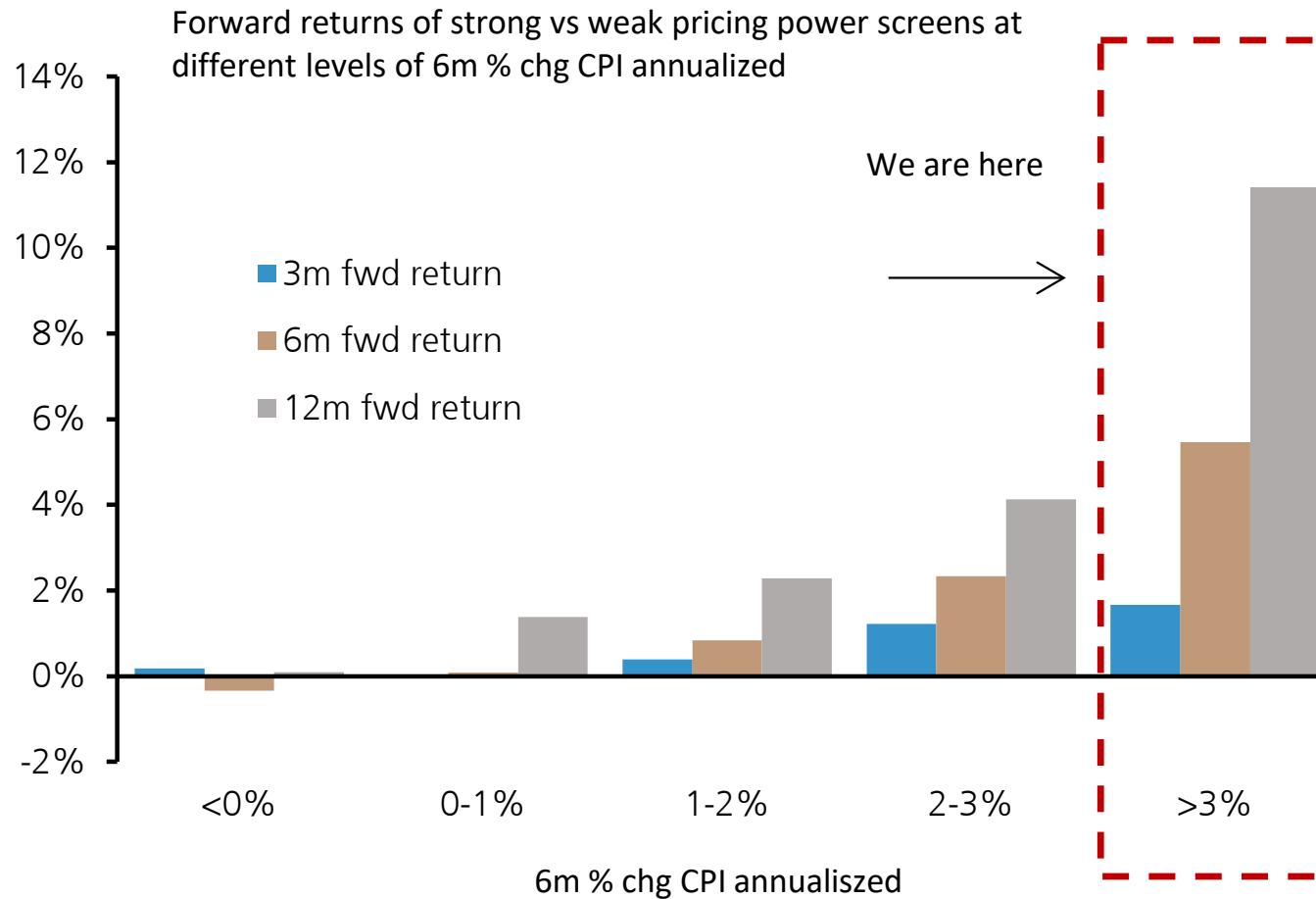
Returns of Strong vs Weak Pricing Power Stocks Around ISM Mfg Cycles



Source: Factset, UBS

# Given pricing power, Semis can still outperform amid rising inflation

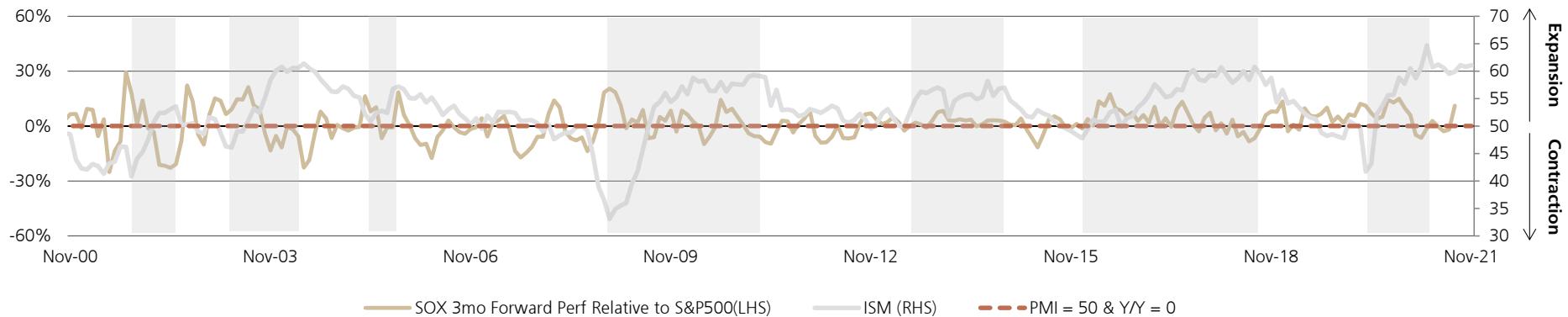
Strong Pricing Power Stocks Outperformed When Inflation Was Rising



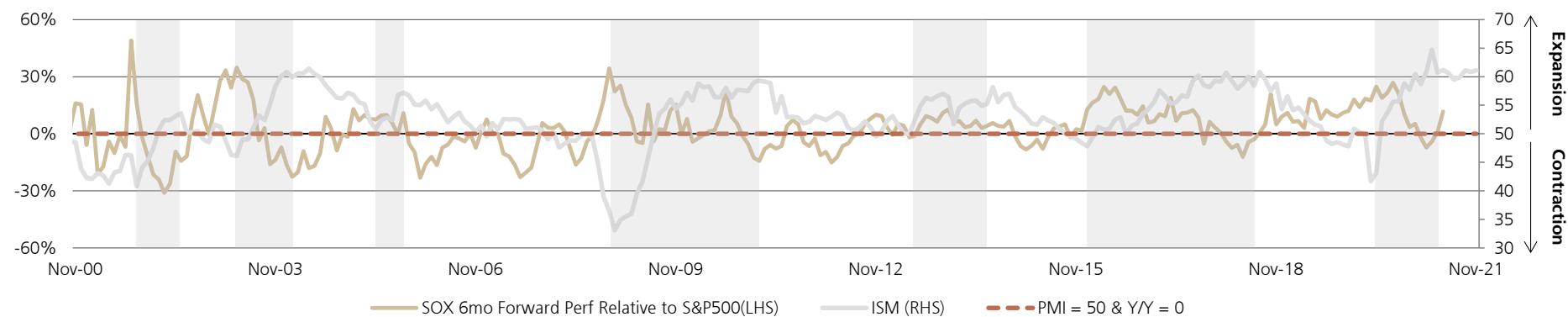
Source: Factset, Bloomberg, UBS

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

## Semis Relative Performance – 3M Forward



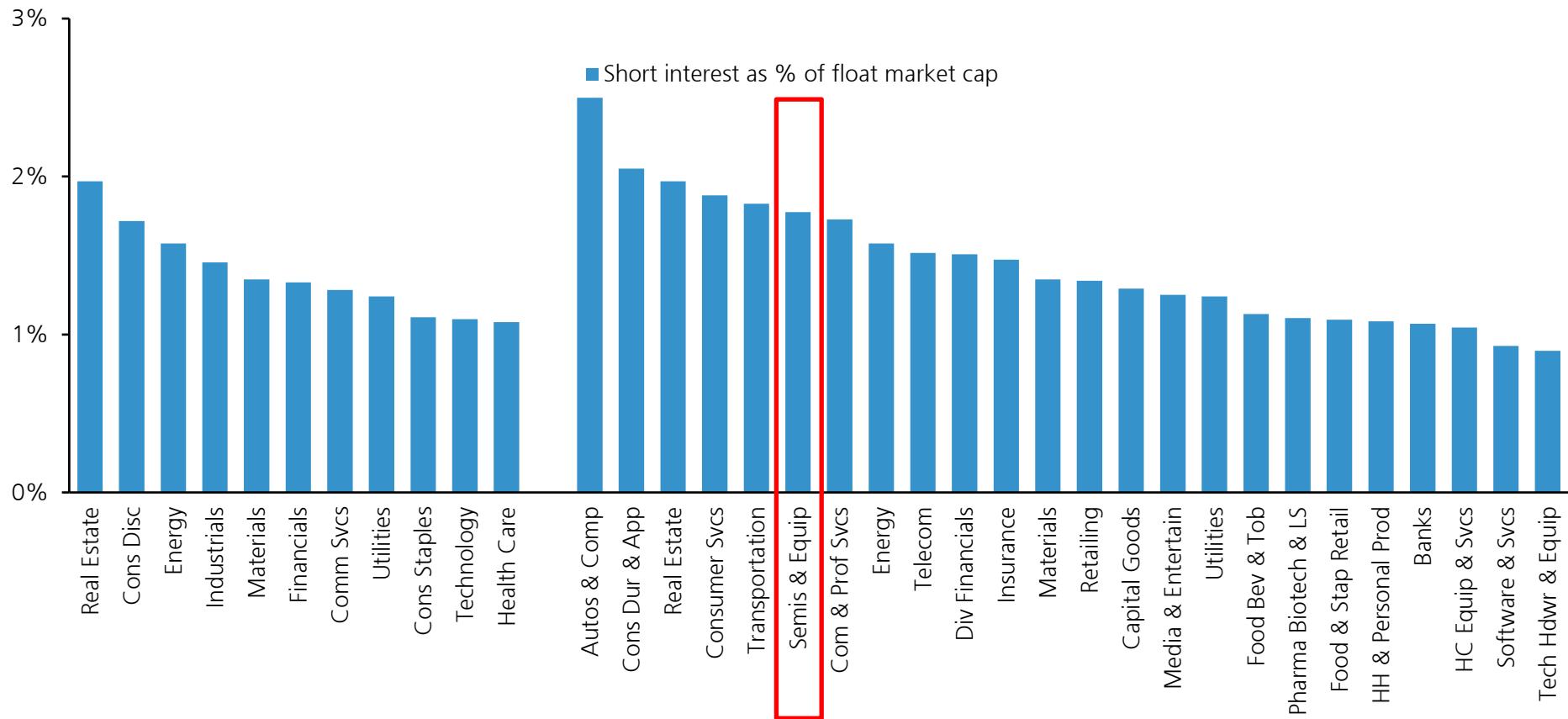
## Semis Relative Performance – 6M Forward



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.

# Short interest is low in technology but relatively high in Semis

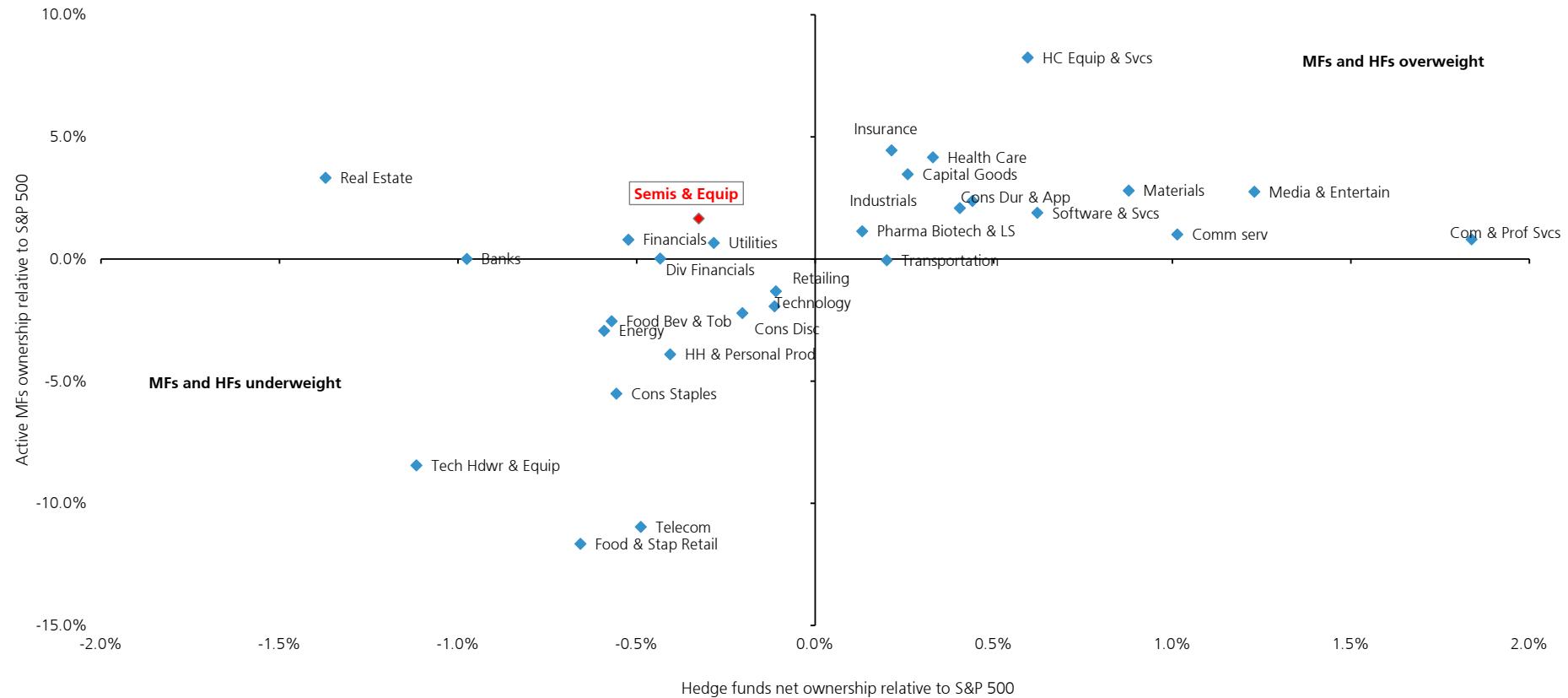
Short Interest Across Sectors and Industry Groups



Source: Factset, UBS

# MFs overweight Semis and HFs underweight Semis

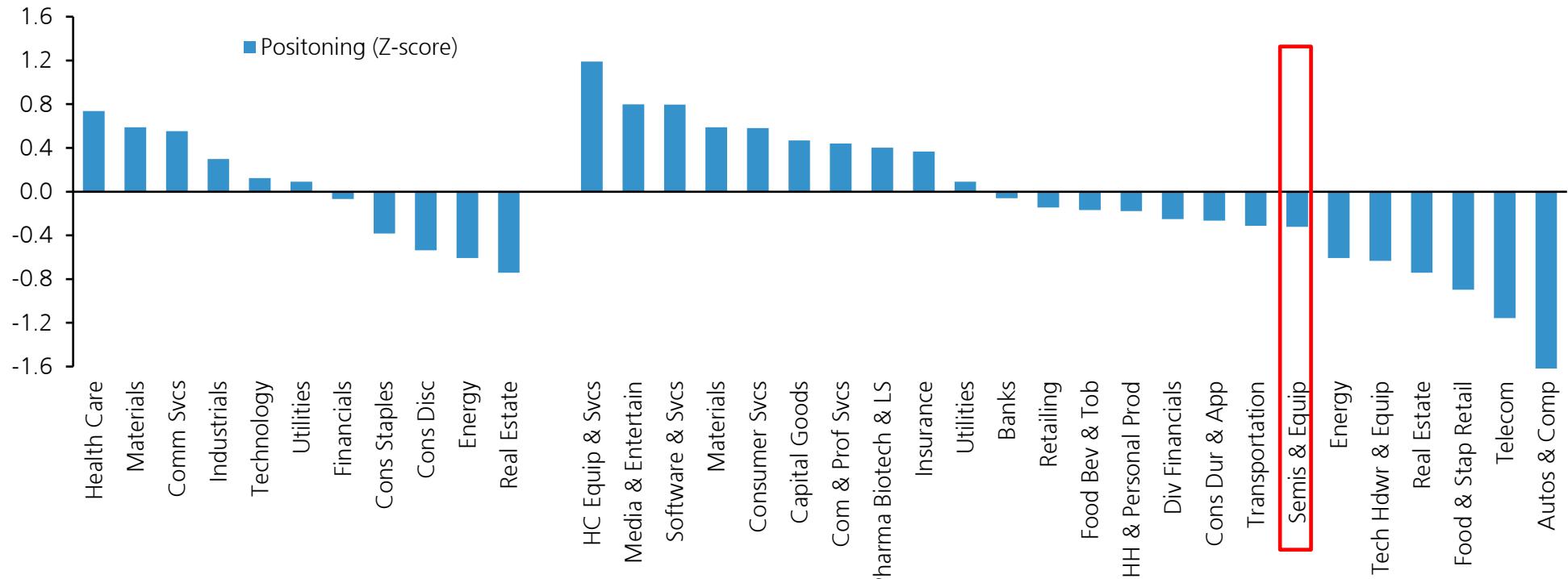
MF vs. HF Ownership Relative to S&P 500



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

# But in aggregate, institutions are underweight

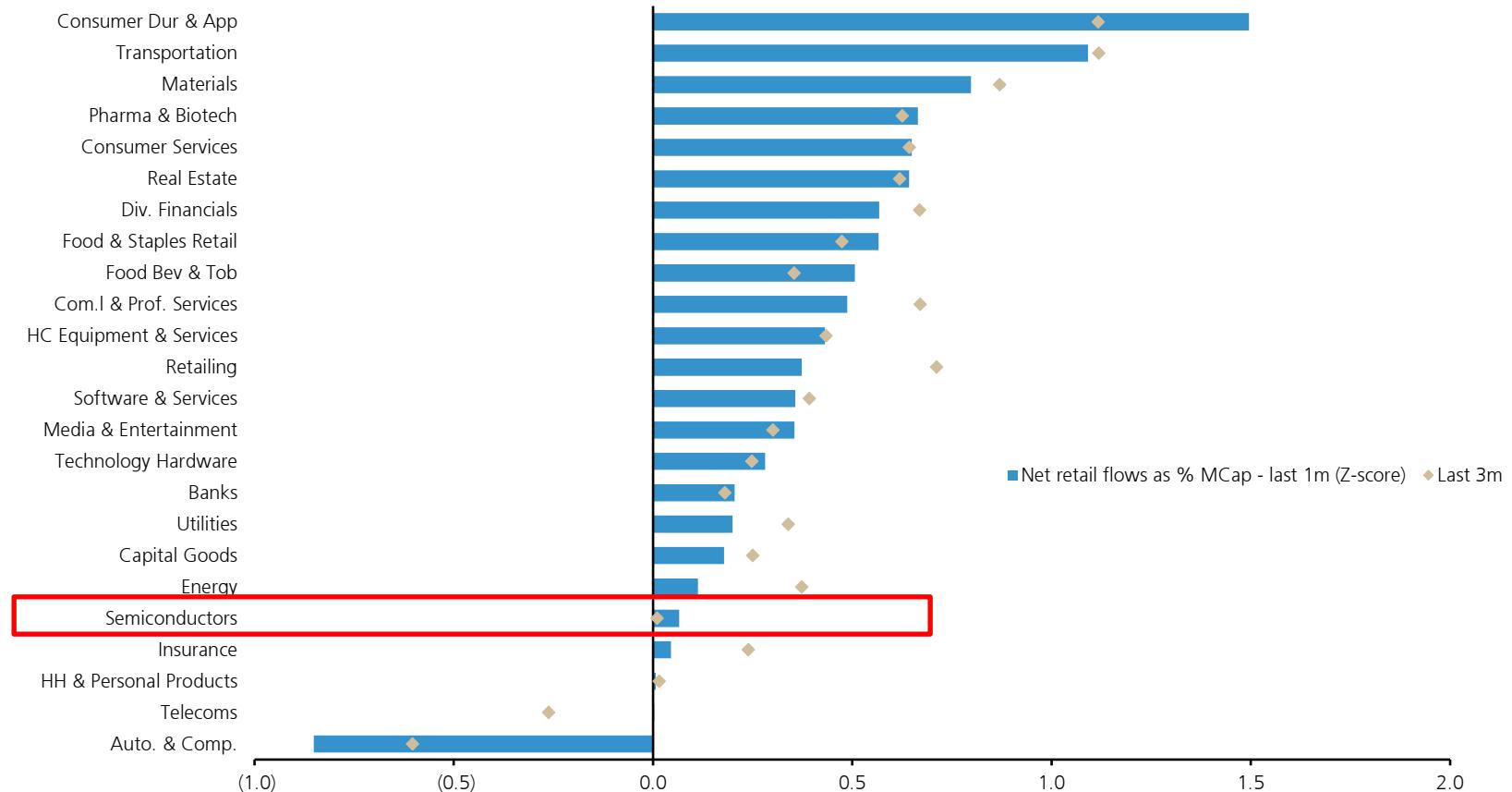
Average of Short Interest, MF Ownership and HF Ownership



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

# Retail net flows have remained low for Semis vs. other sectors

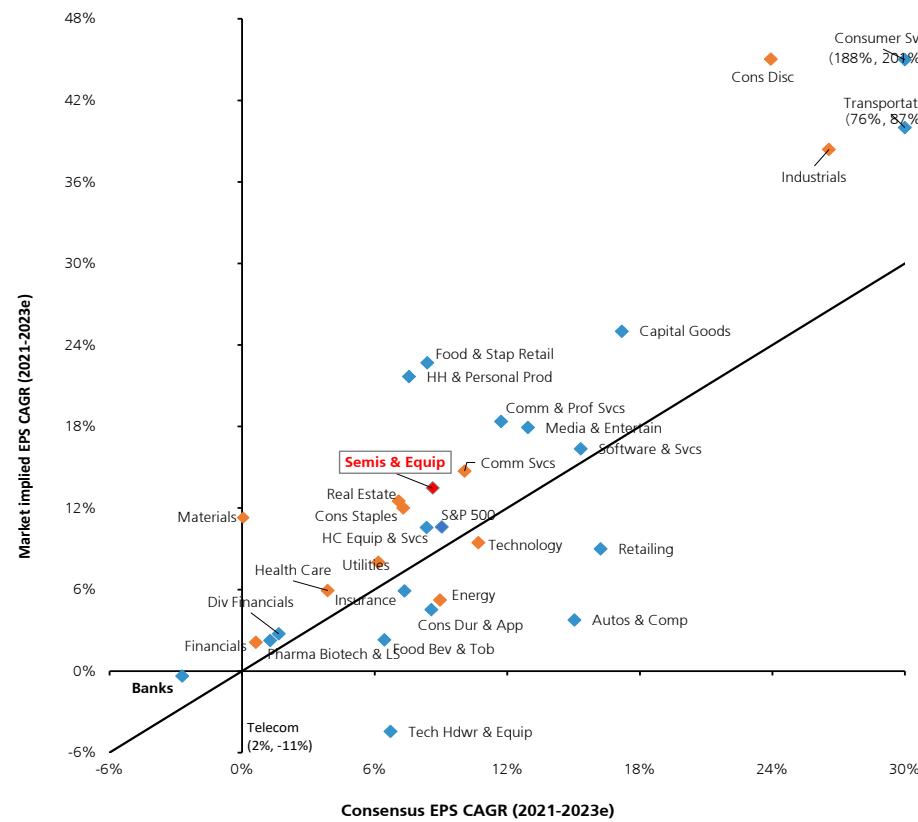
Retail Net Flows by Industry Group (as % of Market Cap, Z-Score)



Source: Factset, UBS Data Solutions, UBS

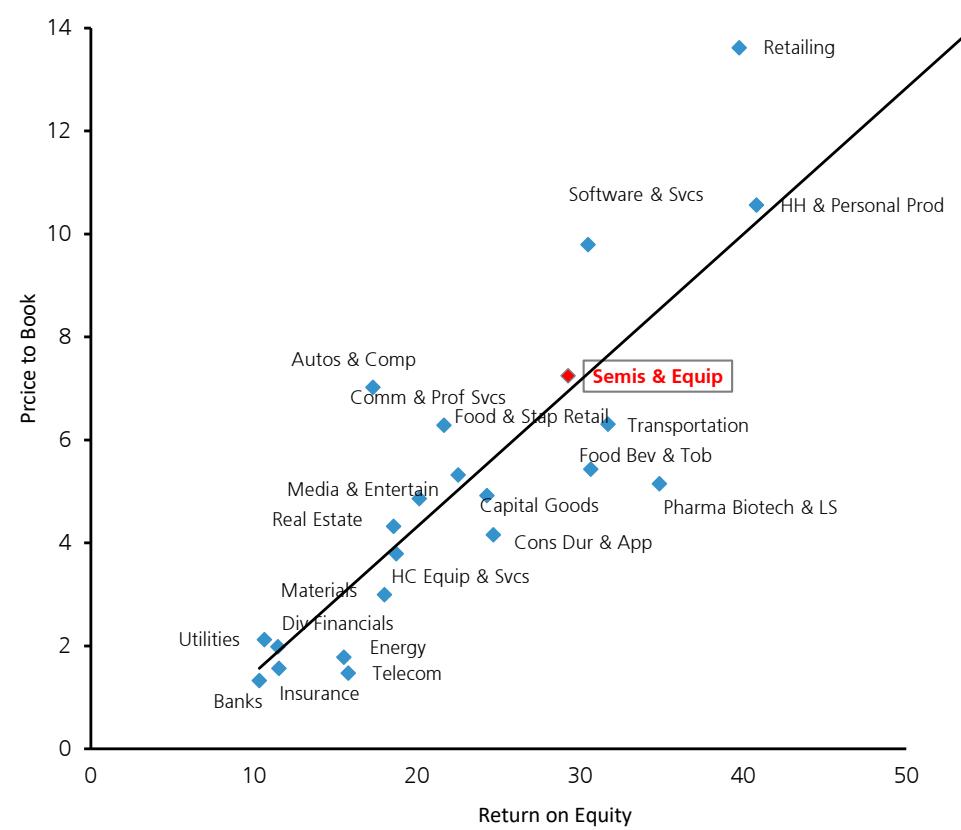
# Market seems to be valuing growth expectations in Semis appropriately

Implied Earnings Growth vs Consensus (2021-2023E CAGR)



Source: Factset, UBS

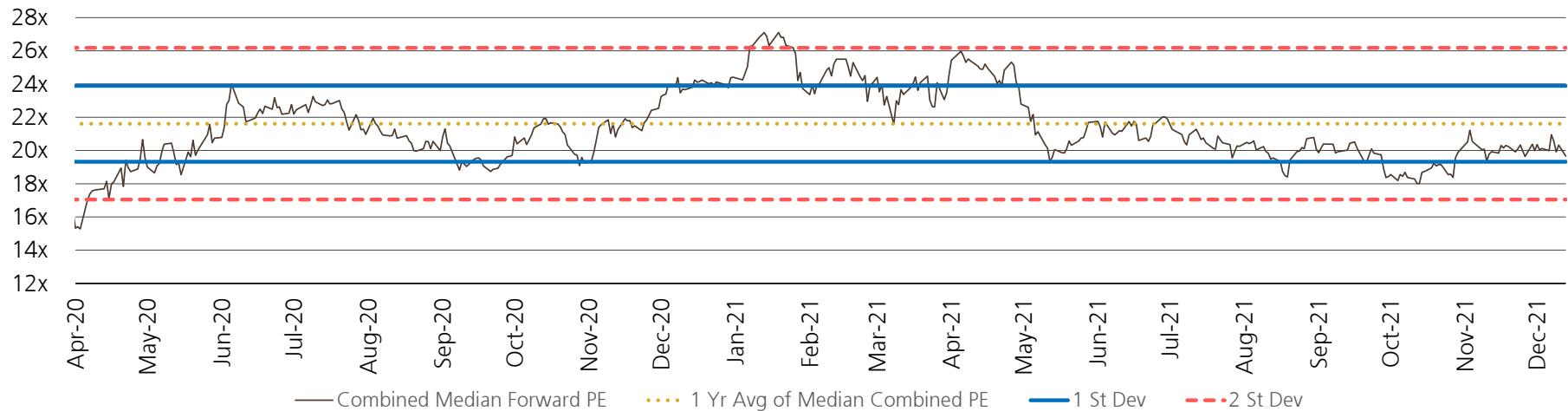
Price-to-Book vs. ROE



Source: Factset, UBS

# Absolute Valuation Versus Historic Ranges (1 and 2 Yr)

Combined Semiconductor/Semi Equipment Forward P/E – 1 yr

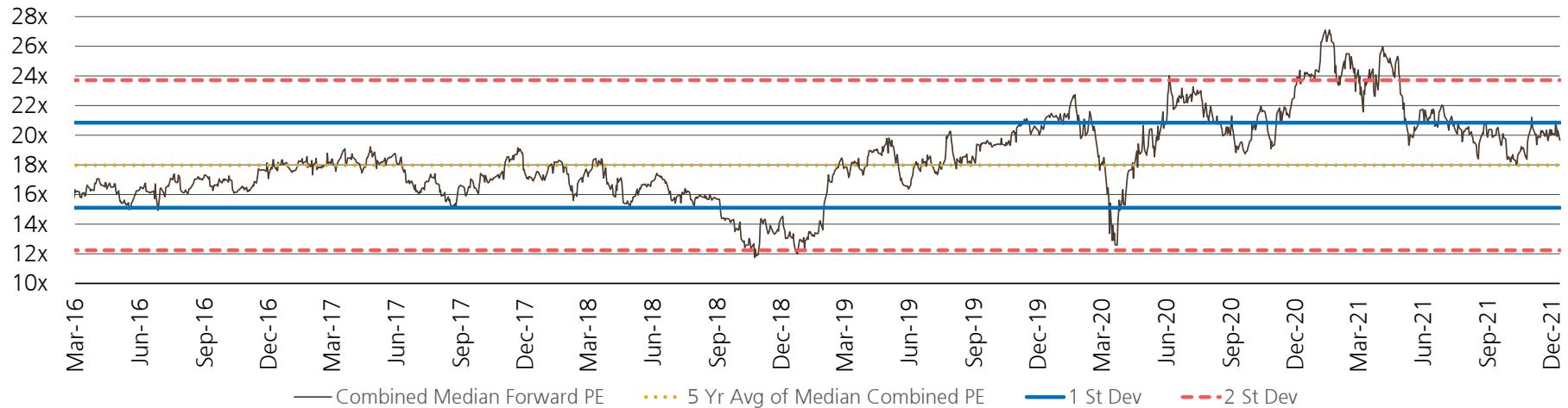


Source: Factset



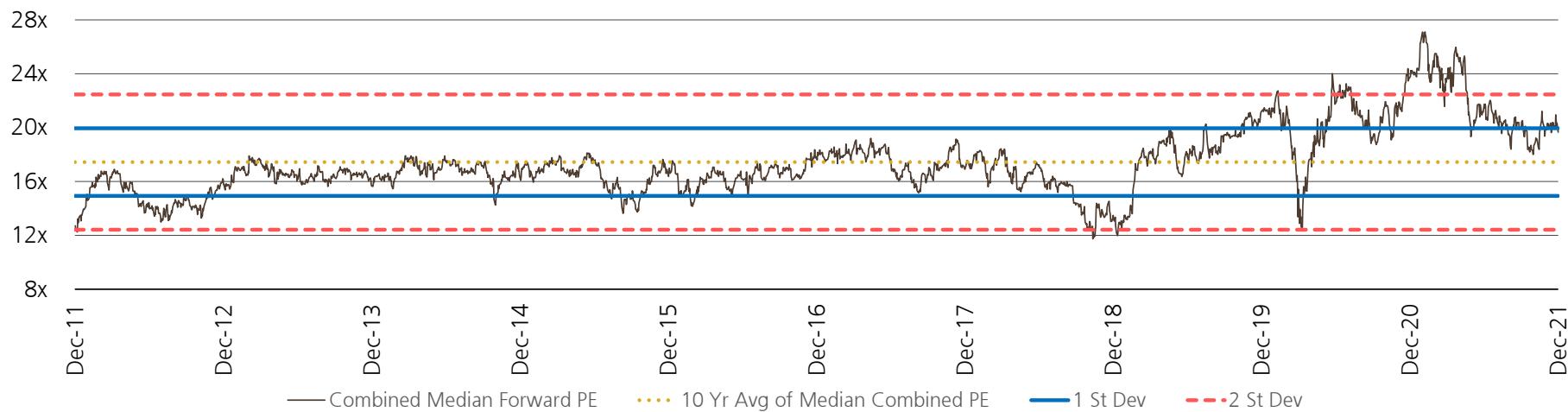
# Absolute Valuation Versus Historic Ranges (5 and 10 Yr)

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



Source: Factset

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

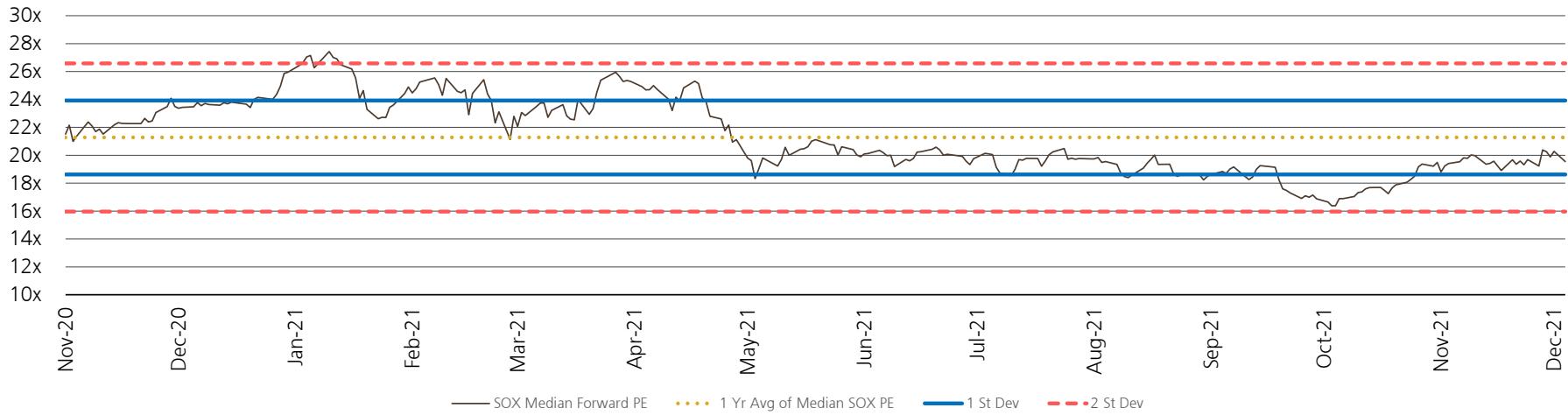


Source: Factset

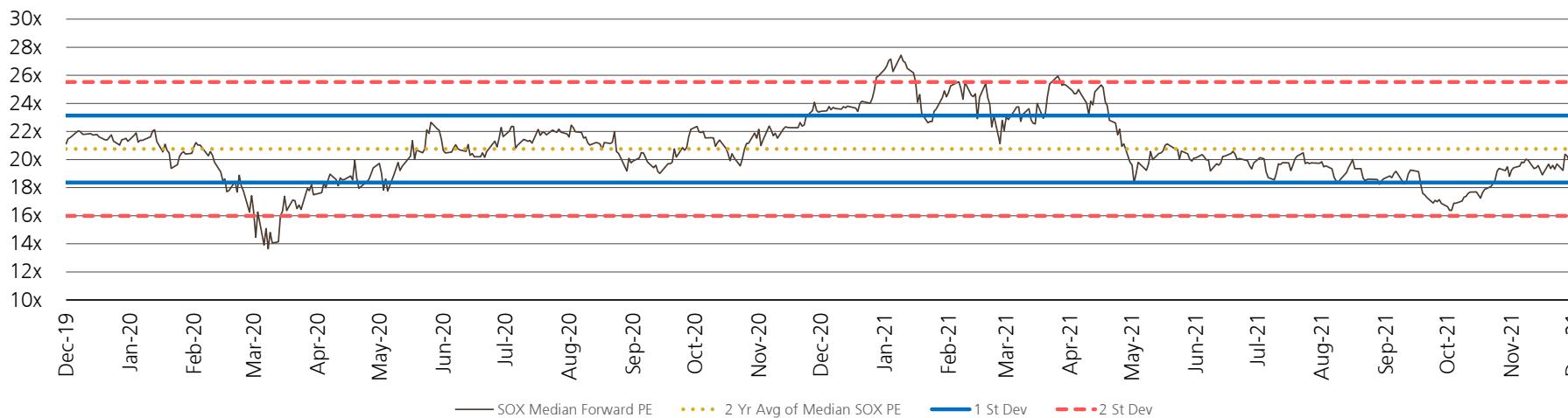


# Absolute Valuation Versus Historic Ranges (1 and 2 Yr)

## SOX Forward P/E– 1 yr



## SOX Forward P/E– 2 yr



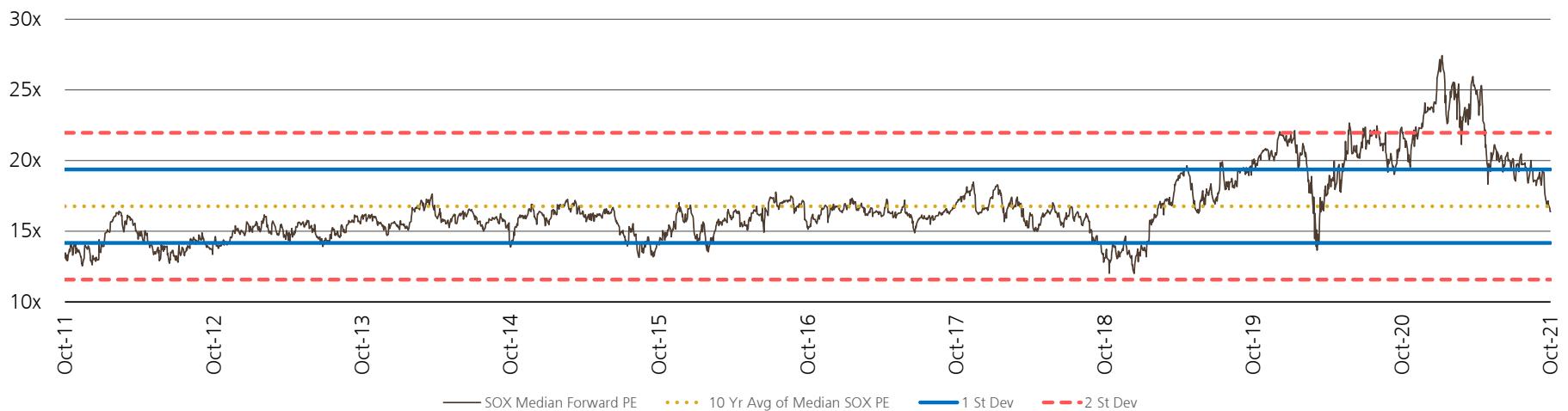
# Absolute Valuation Versus Historic Ranges (5 and 10 Yr)

## SOX Forward P/E– 5 yr



Source: Factset

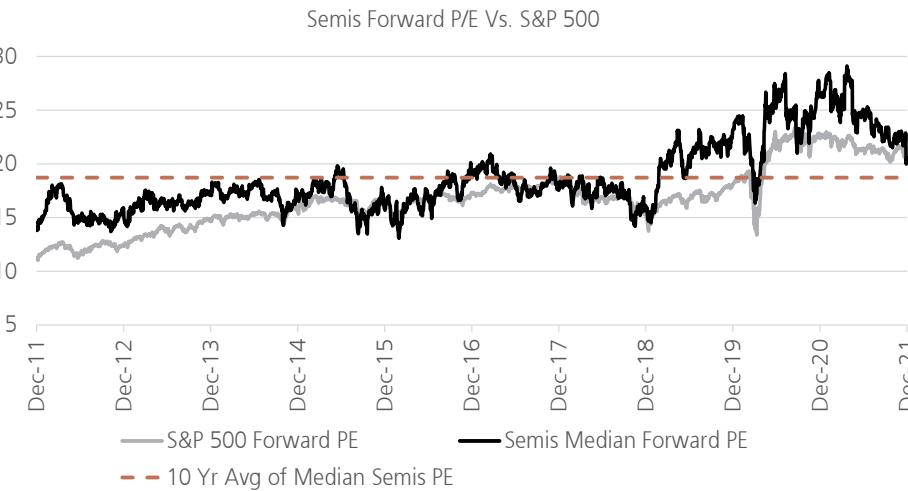
## SOX Forward P/E– 10 yr



Source: Factset

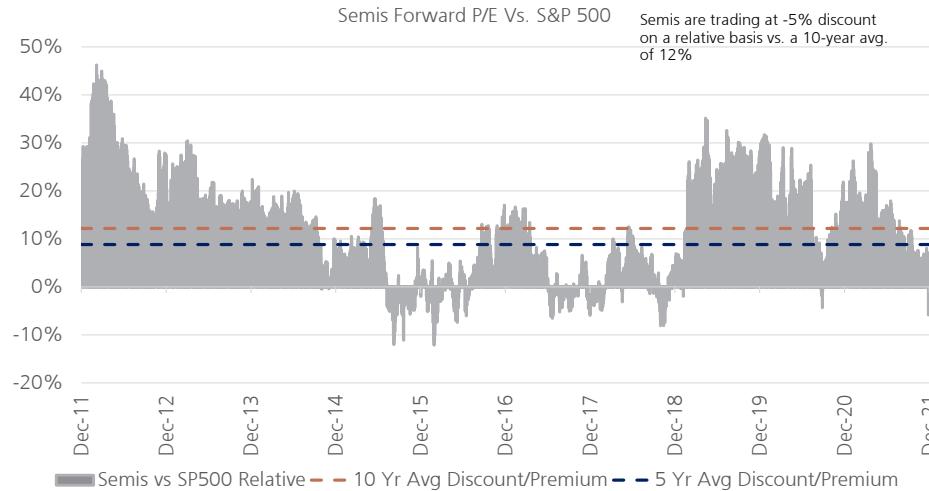
# Semi Components Relative Valuation Versus Historic Ranges (5 and 10 Yr)

## Semiconductors Forward P/E – 10-yr Benchmark



Source: Factset

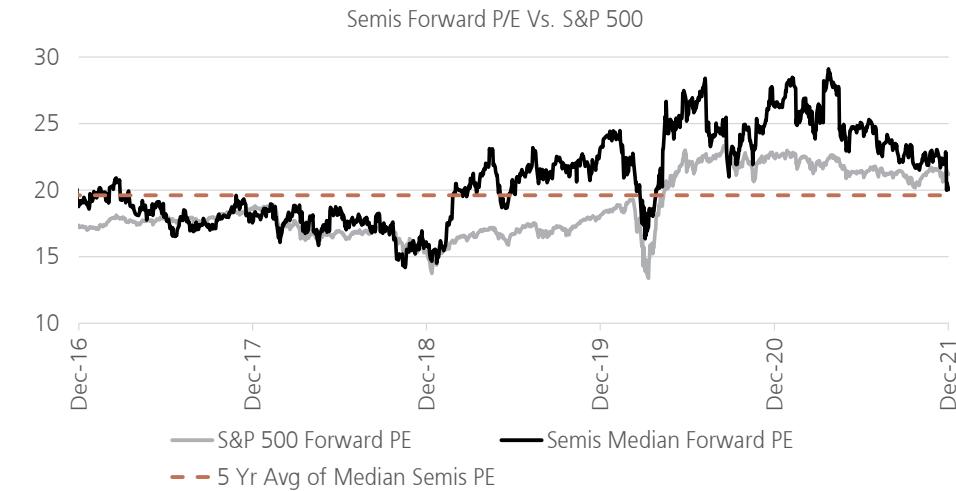
## Relative Semiconductor Valuations vs S&P500 – 10-year



Source: Factset

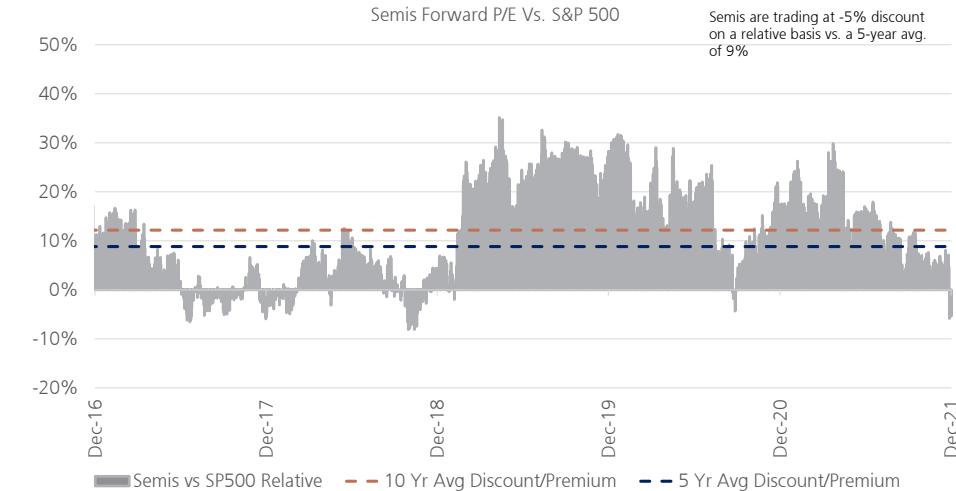


## Semiconductors Forward P/E – 5-yr Benchmark



Source: Factset

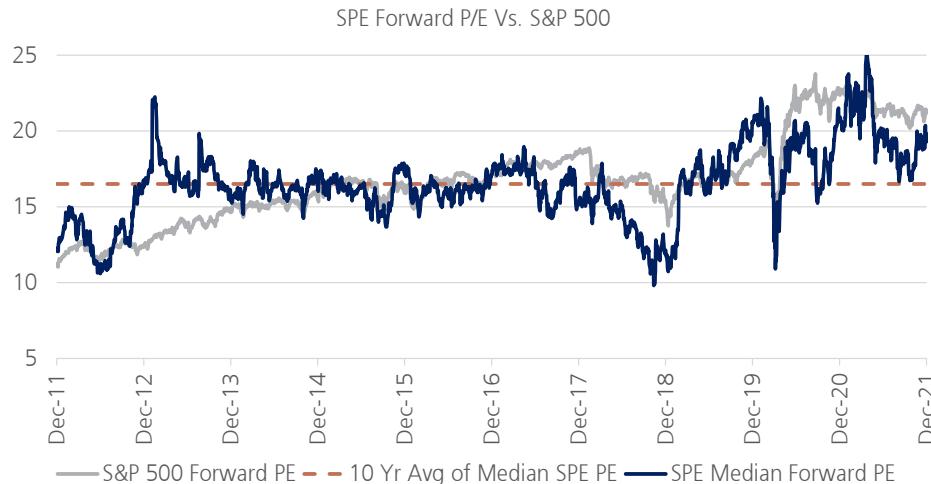
## Relative Semiconductor Valuations vs S&P500 – 5-year



Source: Factset

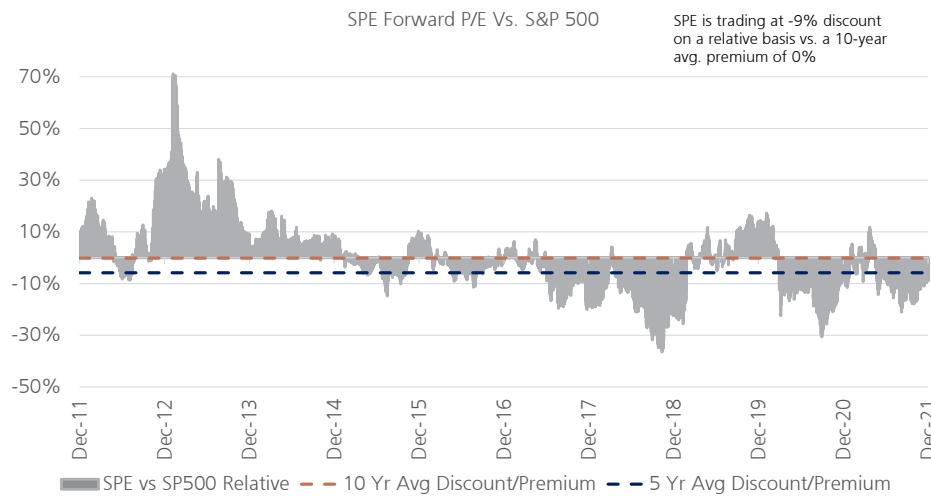
# SPE Relative Valuation Versus Historic Ranges (5 and 10 Yr)

## Semi Equipment Forward P/E – 10-yr Benchmark



Source: Factset

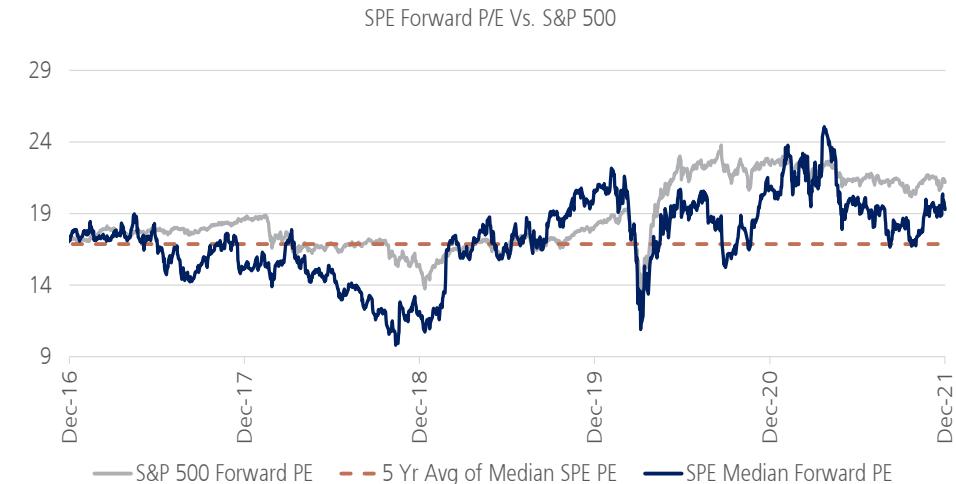
## Relative Semi Equipment Valuations vs S&P500



Source: Factset

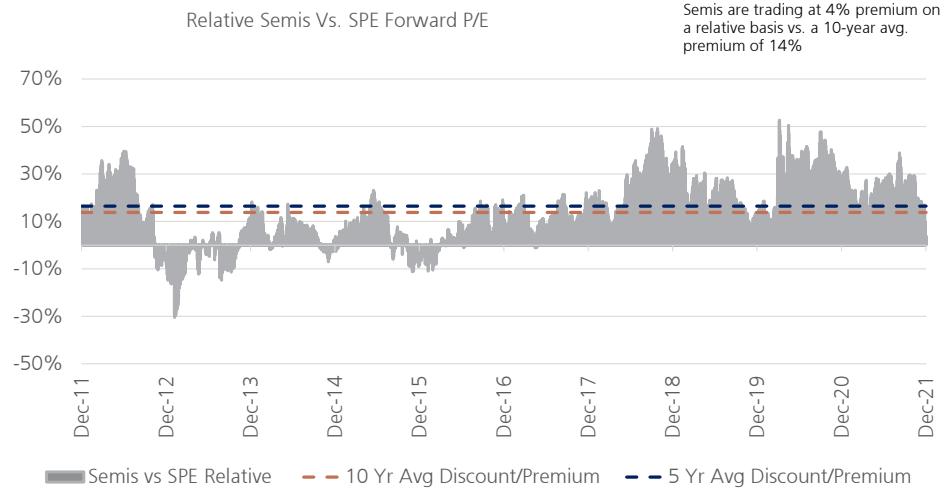


## Semi Equipment Forward P/E – 5-yr Benchmark



Source: Factset

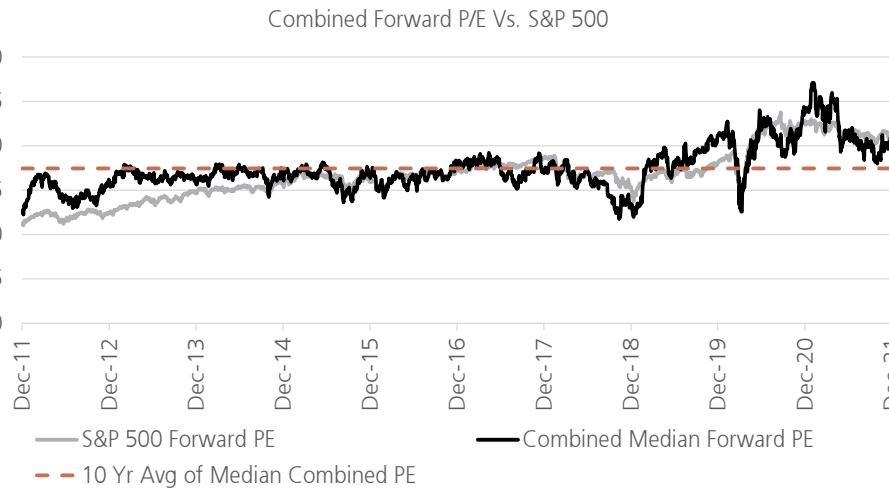
## Relative Semiconductor Valuations vs Semi Equipment



Source: Factset

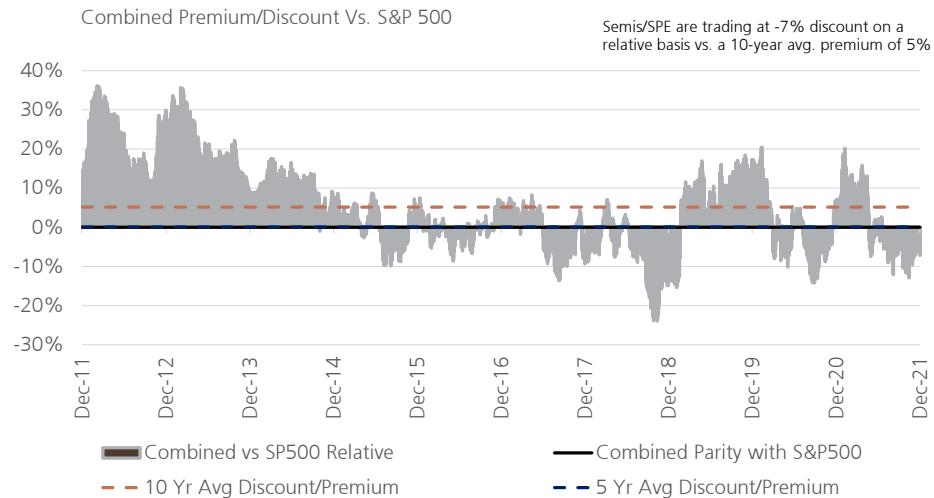
# Semi Components + SPE Relative Valuation Versus Historic Ranges (5 and 10 Yr)

## Combined Semi/Semicap Forward P/E – 10-yr Benchmark



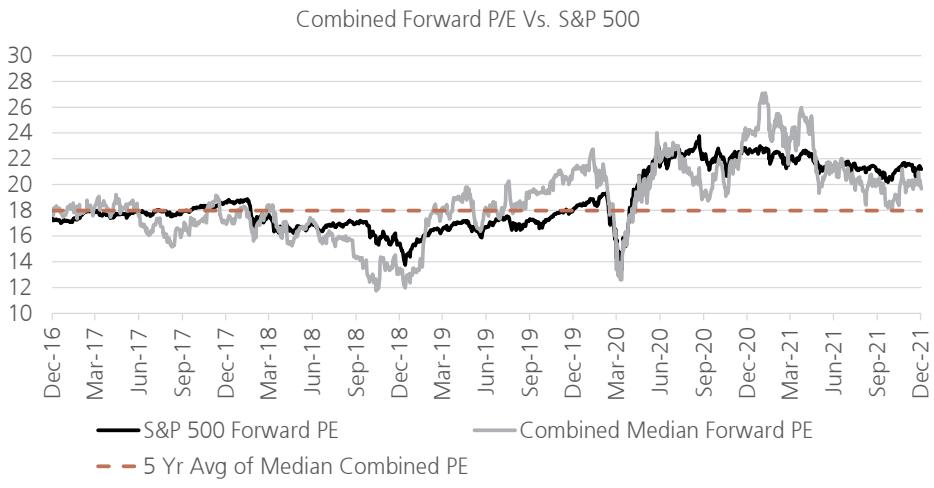
Source: Factset

## Relative Combined Semi/Semicap Valuations vs S&P 500 – 10 Yr



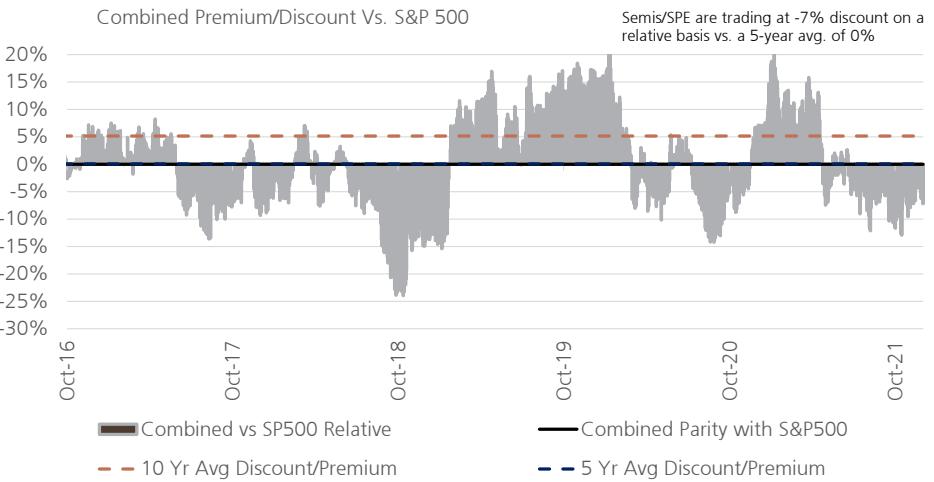
Source: Factset

## Combined Semi/Semicap Forward P/E – 5-yr Benchmark



Source: Factset

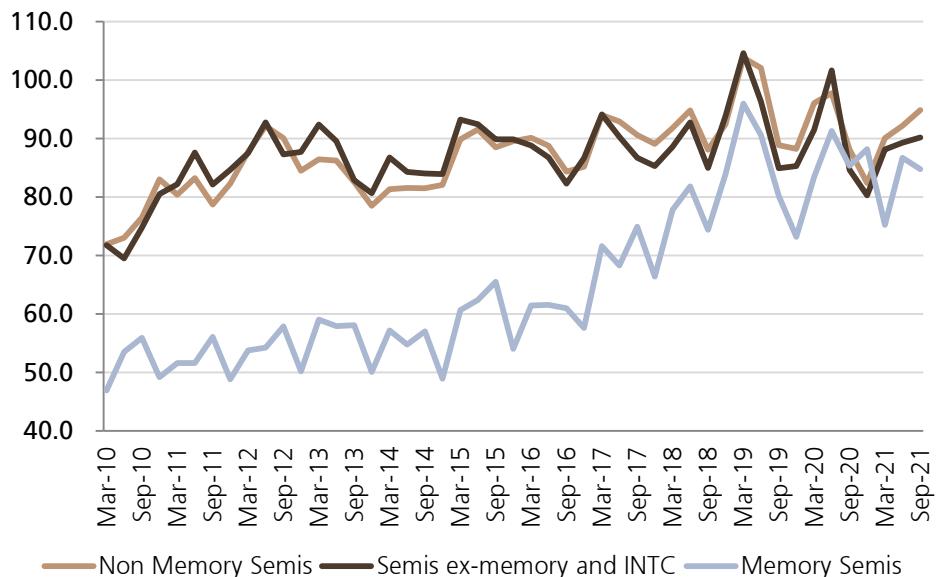
## Relative Combined Semi/Semicap Valuations vs S&P 500 – 5 Yr



Source: Factset

# Inventories: rising but still low...

Upstream (components)

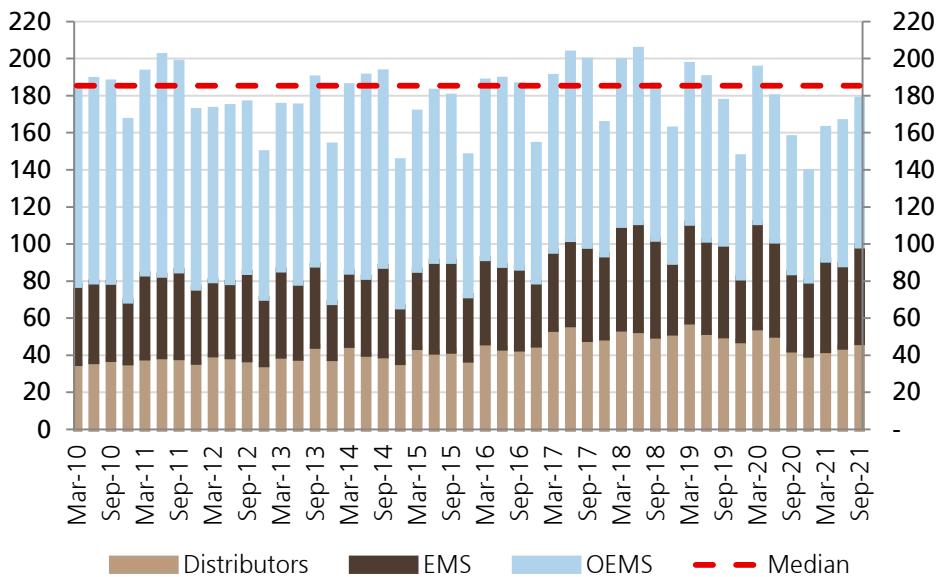


Source: Company reports

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

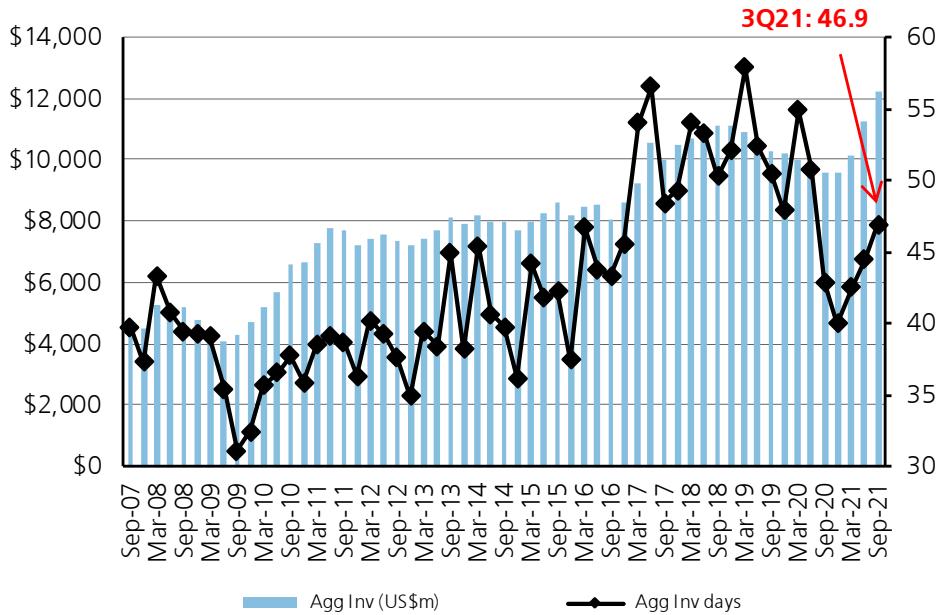
Distributors include: Arrow, Avnet, Digital China, WPG Holdings, Ingram Micro, Synnex, Edom, New Horizons, Yosun.

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

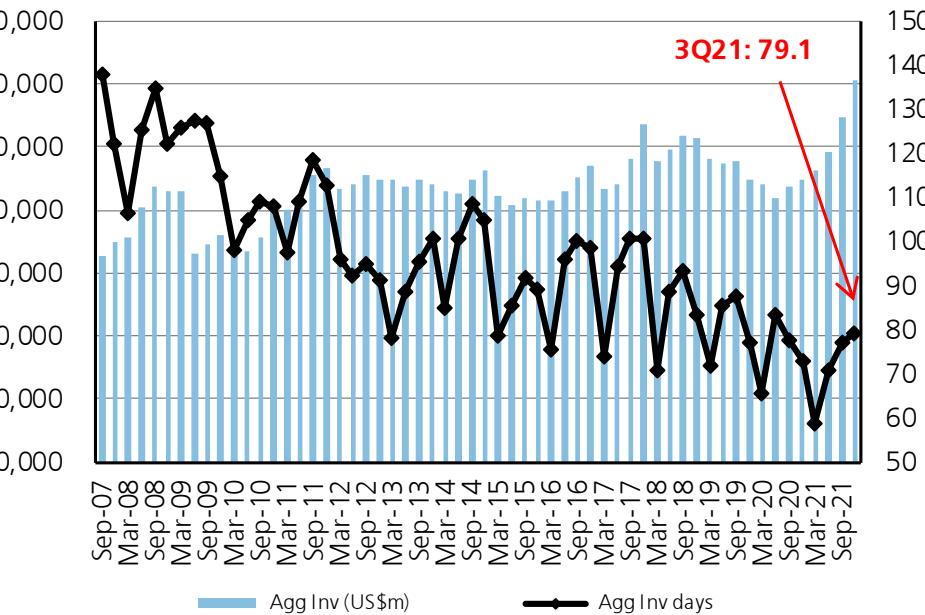
OEM includes Apple, Coolpad, HTC, LG, Motorola, RIMM, Samsung, Sony Ericsson, TCL, Alcatel, Arris, Brocade, Cisco, Ericsson, Juniper, JDS Uniphase, Nokia, Riverbed, ZTE, Acer, Asustek, Dell, HPQ, HPE, IBM, Lenovo, Nidec, Positivo, Seagate, WDC, Konka, Nikon, Nintendo, Skyworth, Sony, TCL Multimedia,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

# Inventory Details: Distributor and OEM

Distributor Days of Inventory



OEM Inventory Days



Source: Company reports, UBS

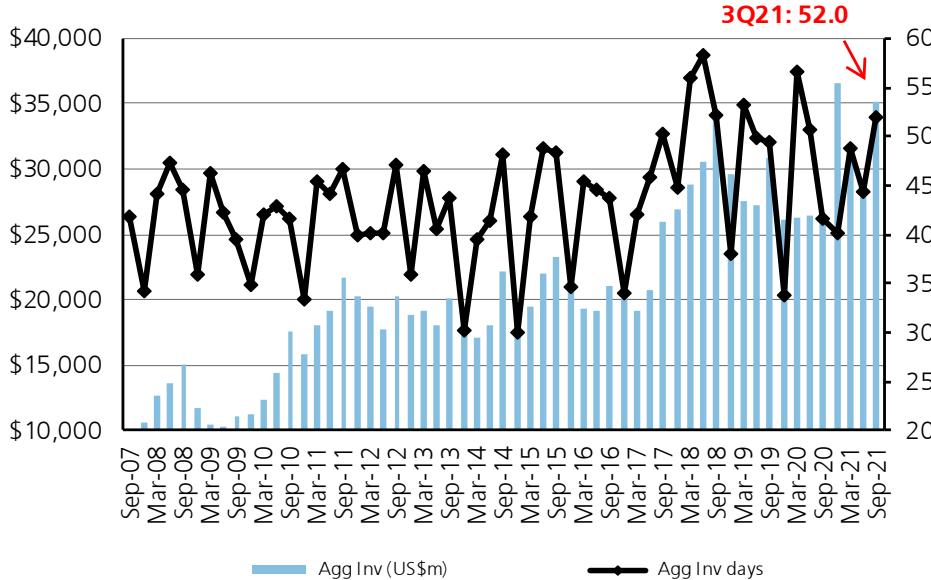
Includes: Arrow, Avnet, Digital China, WPG Holdings, Ingram Micro, Synnex, Edom, New Horizons, Yosun

Source: Company reports, UBS

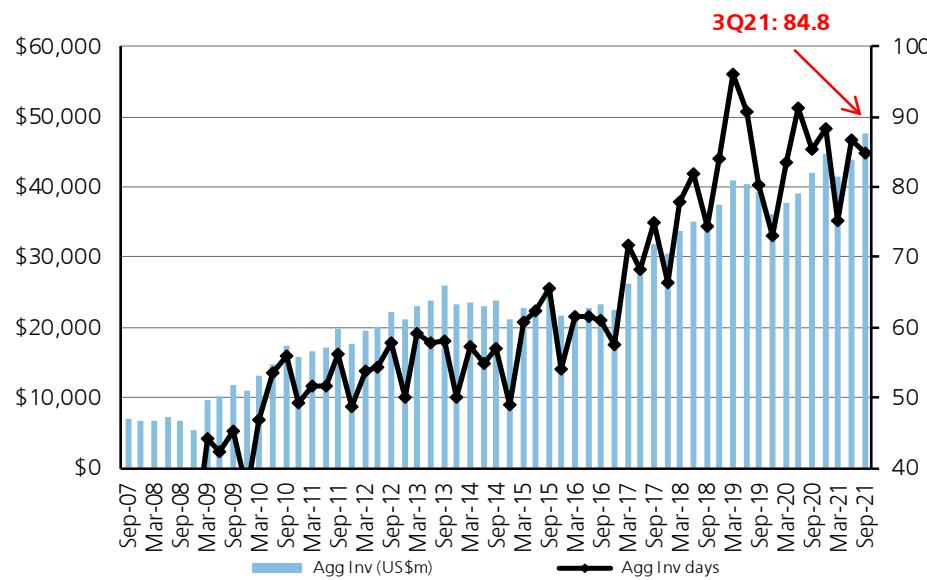
Includes: Apple, Coolpad, HTC, LG Electronics, Motorola, Blackberry, Samsung Electronics, Sony Ericsson, TCL Comms, Alcatel, Arris, Brocade, Cisco, Ericsson, Juniper, JDSU, Nokia, Riverbed, ZTE, Acer, Asustek, DELL, HPQ, HPE, IBM, Lenovo, Nidec, Positivo, STX, WDC, Konka, Nikon, Nintendo, Skyworth, Sony,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

# Inventory Details: EMS and Memory

EMS Inventory Days



Memory Inventory Days



Source: Company reports, UBS

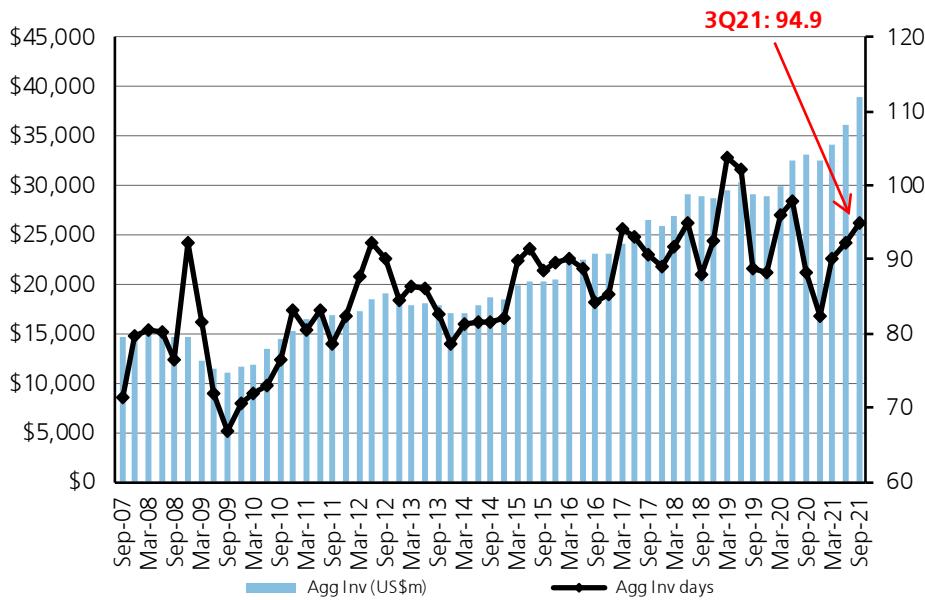
Includes: Flextronics, Jabil, Sanmina, Hon Hai, Celestica

Source: Company reports, UBS

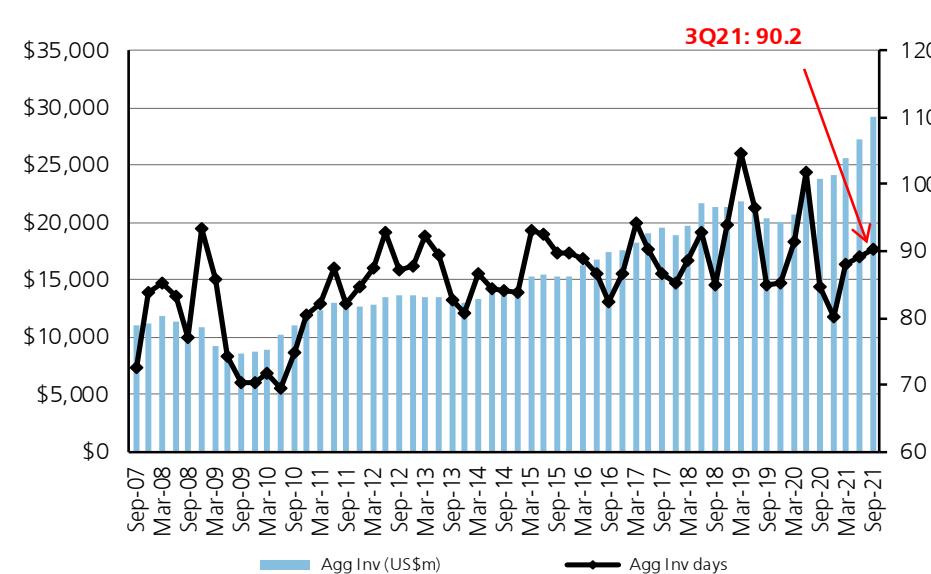
Includes: Hynix, Micron, Nanya

# Inventory Details: Semis ex-Memory

Semis ex-Memory Inventory Days



Semis ex-Memory and INTC Days of Inventory



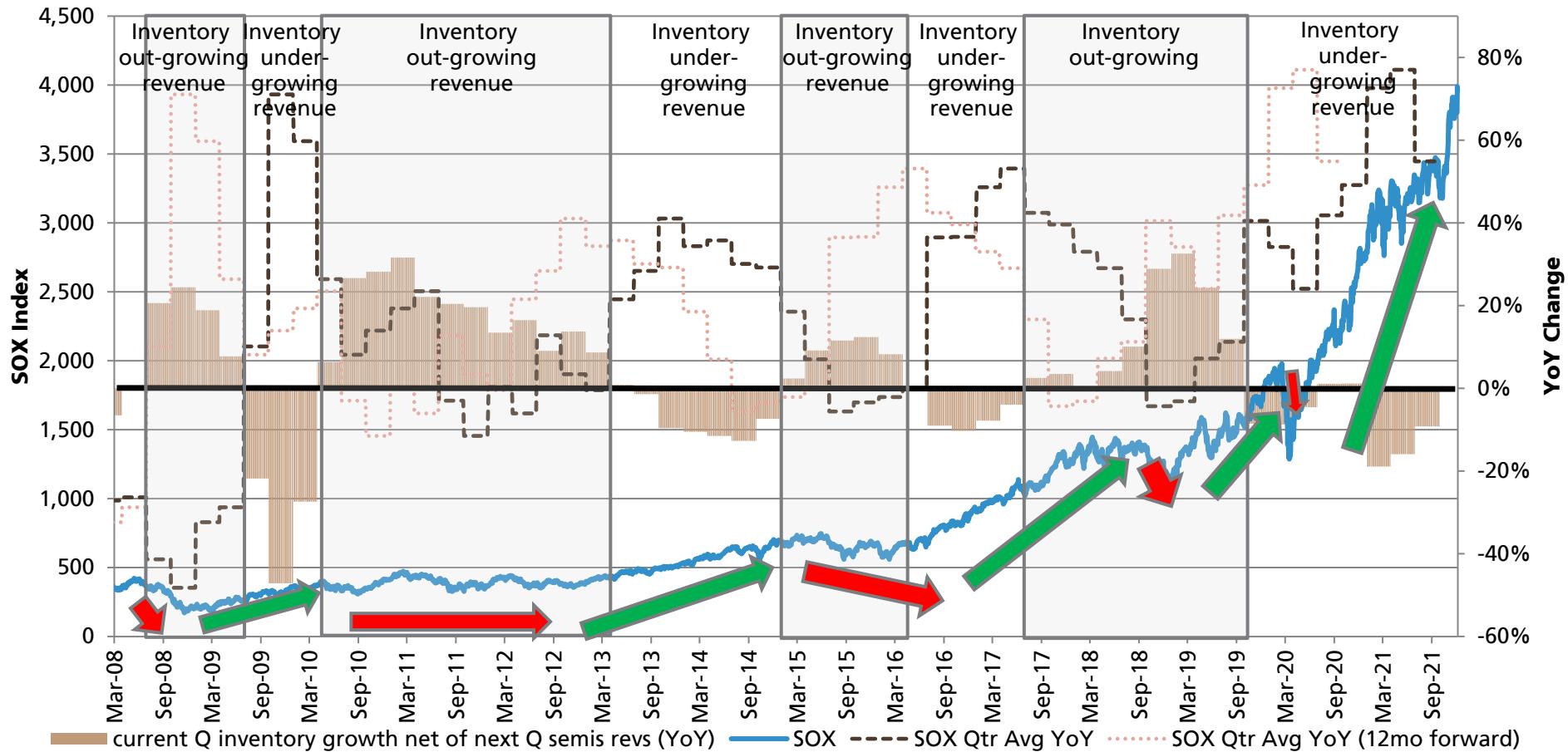
Source: Company reports, UBS

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

Source: Company reports, UBS

# Inventory growth: about to cross over revenue growth

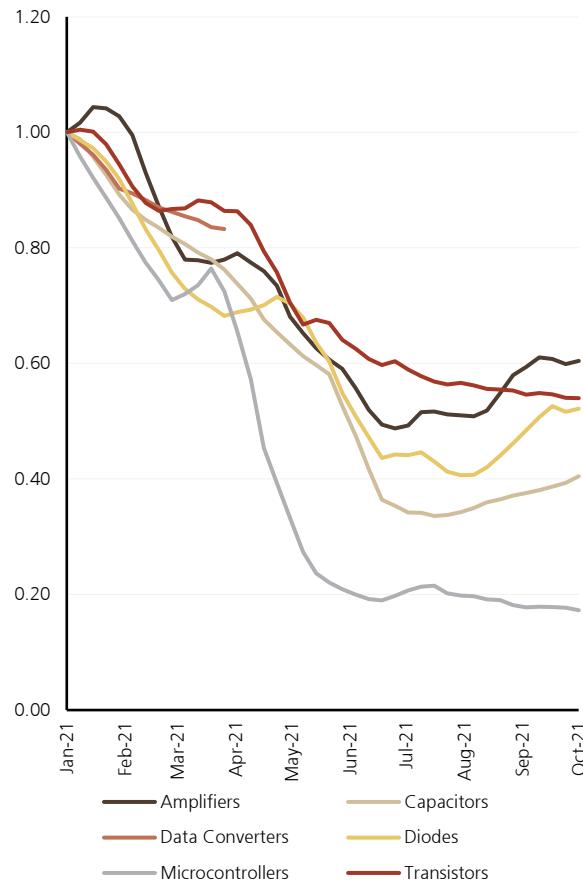
Y/Y Inventory Growth Slower than Semis Revenue Growth on a 1Q Lag Basis



Source: Company data, UBS estimates, SIA

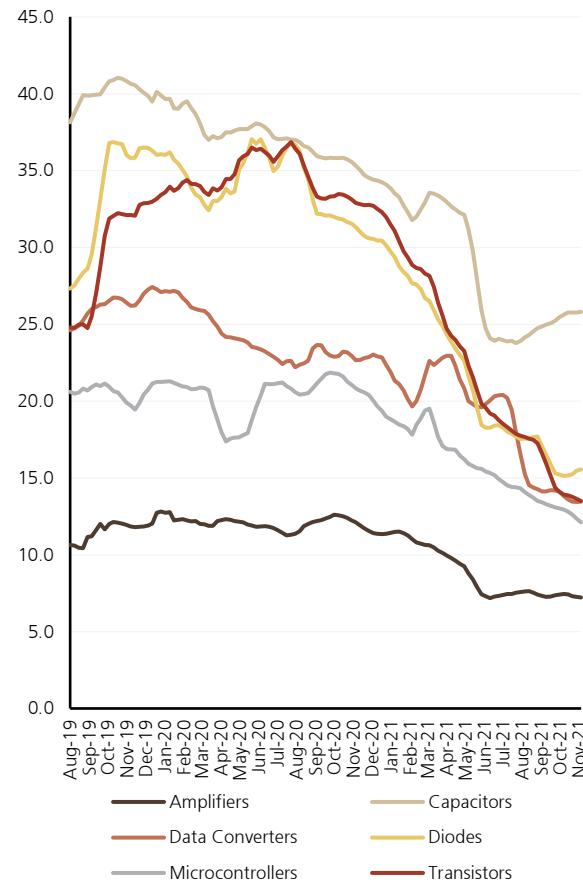
# Supply/product availability still low, but has started to improve

Normalized Inventories



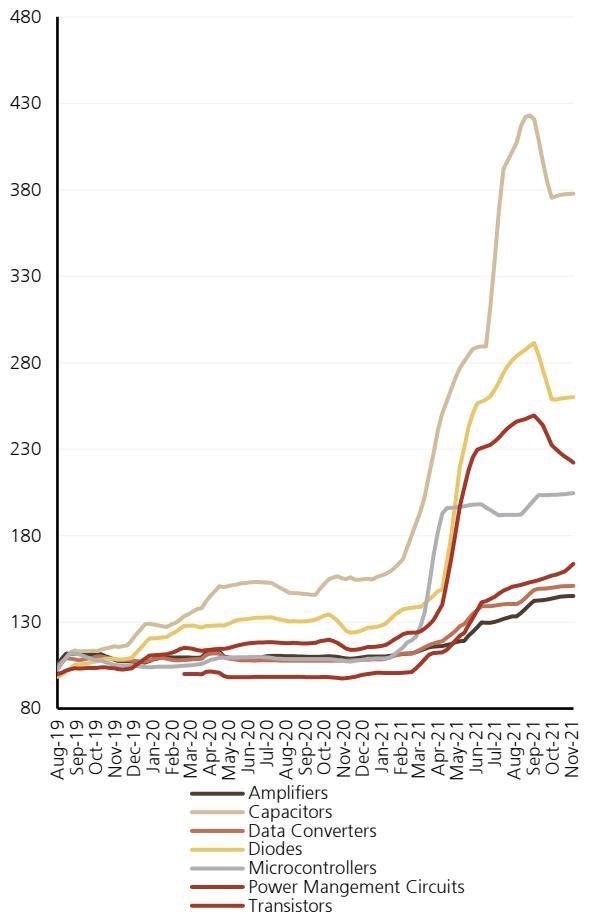
Source: Company data, UBS Evidence Lab,  
Datastream, UBS

Products in Stock (%)



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

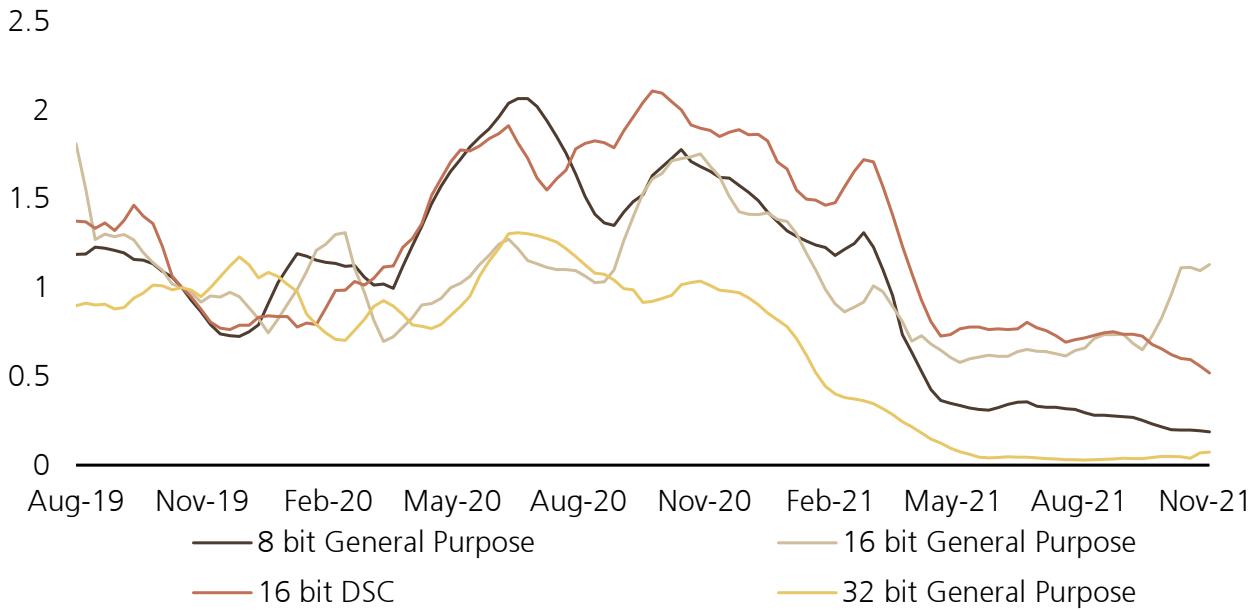
Like-for-like Pricing



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

# Supply/product availability details: MCU

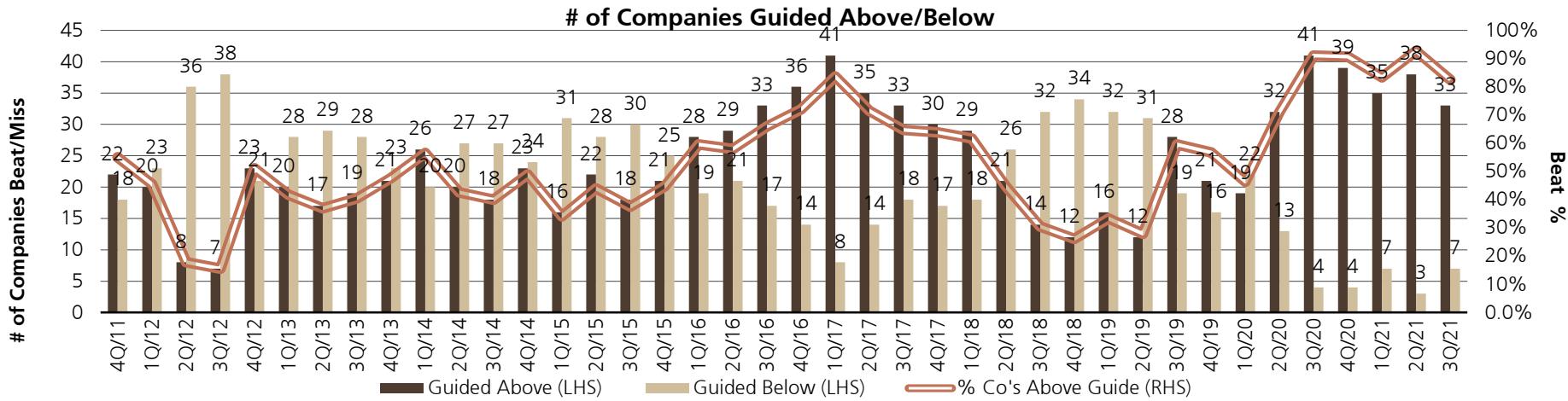
Normalized Unit Inventory: 4-Comp Set Comparison within Microcontrollers



Source: UBS Evidence Lab

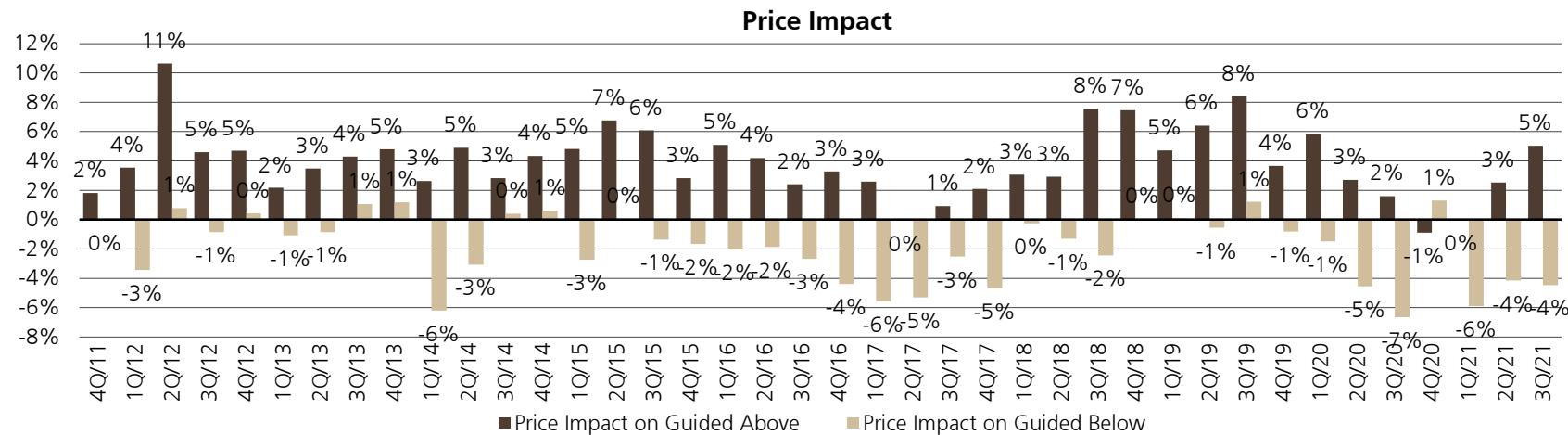
# Stock reaction through this past earnings season was orderly

## Semis Company Guidance Tracker



Source: Company data, Factset, UBS

## Price Impact on Guidance



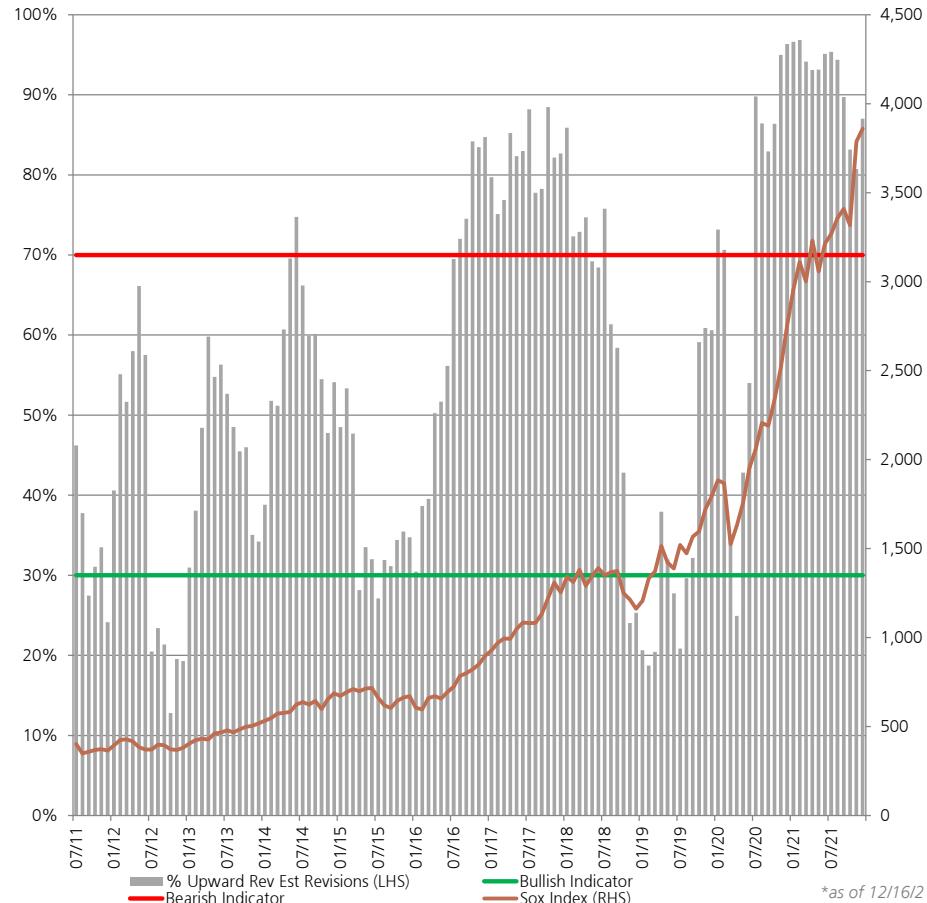
Source: Company data, Factset, UBS

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



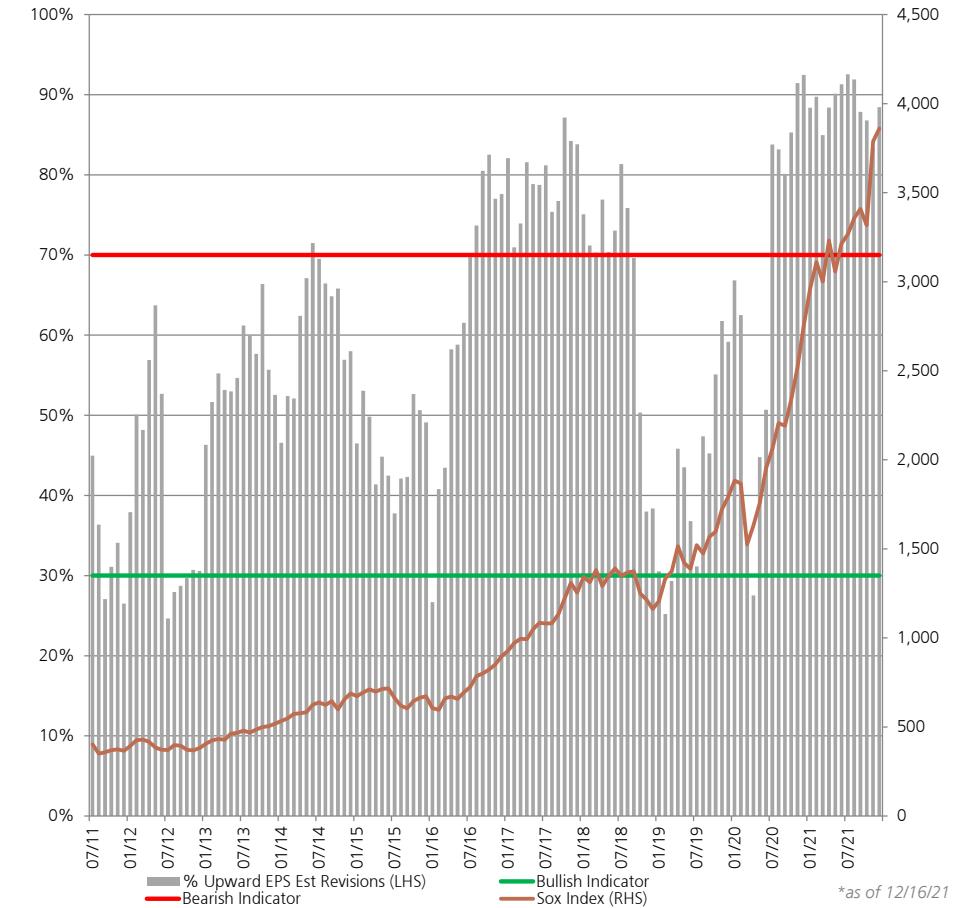
# Monthly estimate revision trends still robust for semis

Upward Revenue Revisions vs. SOX



Source: Factset, UBS estimates

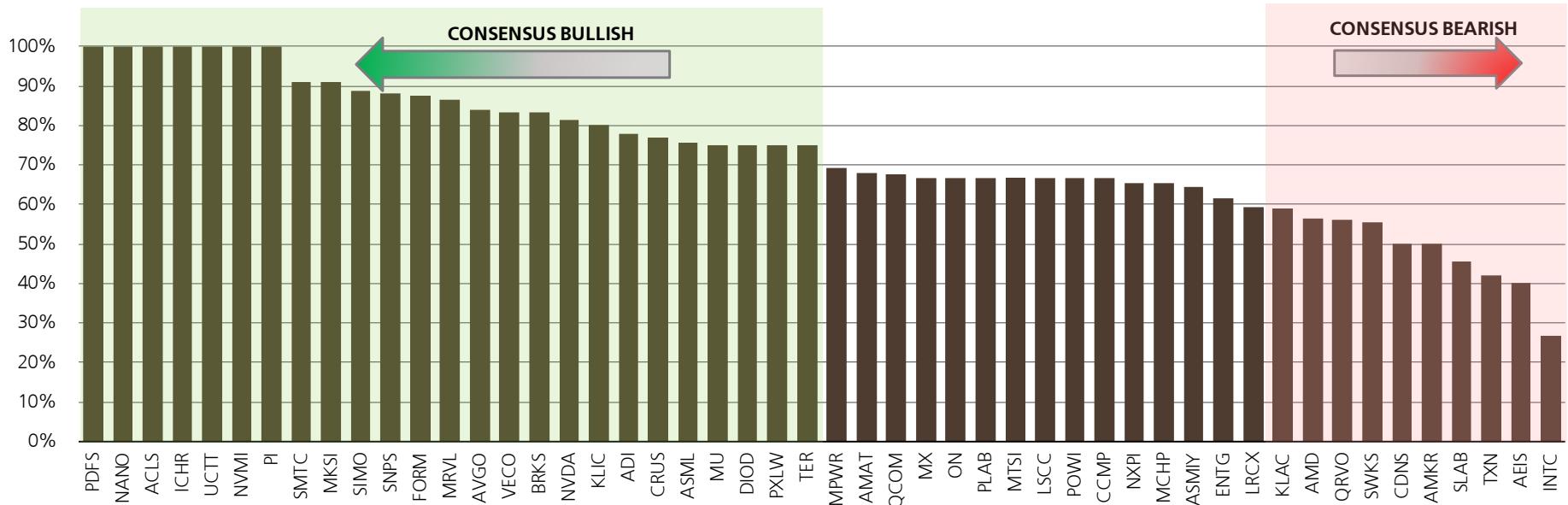
Upward EPS Revisions vs. SOX



Source: Factset, UBS estimates

# Sell side ratings skew

## Semis Sell Side Ratings



Source: Factset

# Stock Performance: Semis v 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	(1.12%)	(1.04%)	4.30%	8.91%	23.38%	27.05%	46.24%	5.18%	0.49%	(10.43%)	(14.46%)	(19.76%)	(17.08%)	(63.76%)	(1.39%)	(0.72%)	(0.84%)	3.74%	0.11%	0.66%	41.26%						
NDX	NASDAQ-100 Index	(2.52%)	(1.76%)	3.46%	12.65%	23.48%	27.71%	87.51%	3.79%	(0.22%)	(11.27%)	(10.71%)	(19.65%)	(16.42%)	(22.50%)	0.63%	(0.50%)	(1.50%)	(5.56%)	(7.24%)	(8.02%)	(19.91%)						
DJIAK	DJ Industrial Average	(0.49%)	(1.54%)	2.80%	3.34%	16.13%	19.03%	26.33%	5.82%	(0.01%)	(11.94%)	(20.02%)	(27.00%)	(25.10%)	(83.67%)	(5.18%)	(0.49%)	10.43%	14.46%	19.76%	17.08%	63.76%						
99900T78	S&P 500 / Semiconductors & Semicondu	(6.31%)	(1.53%)	14.73%	23.36%	43.13%	44.13%	110.00%	16.56%	35.73%	38.67%	111.27%	1.44%	1.53%	(4.73%)	(6.80%)	(7.40%)	(5.46%)	1.27%	(3.75%)	1.04%	5.70%	7.65%	12.36%	11.62%	65.02%		
SOX	PHLX / Semiconductor	(4.87%)	(0.00%)	10.00%	16.56%	35.73%	38.67%	111.27%																				
	Average Median	(3.06%)	(1.18%)	7.06%	12.96%	28.37%	31.32%	76.27%	4.06%	0.45%	(9.59%)	(13.00%)	(18.45%)	(16.01%)	(42.16%)	(2.42%)	(0.17%)	3.45%	5.07%	6.24%	5.34%	37.53%						
		(2.52%)	(1.53%)	4.30%	12.65%	23.48%	27.71%	87.51%	4.49%	0.24%	(10.85%)	(12.58%)	(19.70%)	(16.75%)	(43.13%)	(2.57%)	(0.50%)	2.43%	5.70%	6.23%	6.14%	52.51%						
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						
99900001	S&P 500 / Energy -SEC	(3.28%)	(4.03%)	15.15%	1.27%	45.76%	41.13%	(5.50%)	3.03%	(2.49%)	0.42%	(22.09%)	2.63%	(3.00%)	(115.50%)	(2.16%)	(2.99%)	10.85%	(7.63%)	22.39%	14.08%	(51.74%)						
99900701	S&P 500 / Information Technology -SEC	(1.88%)	1.13%	8.24%	18.05%	29.60%	35.52%	89.52%	4.43%	2.67%	(6.49%)	(5.31%)	(13.53%)	(8.61%)	(20.48%)	(0.75%)	2.17%	3.94%	9.15%	6.23%	8.47%	43.28%						
99900285	S&P 500 / Consumer Discretionary -SEC	(3.93%)	(2.86%)	7.31%	12.63%	20.21%	23.73%	62.53%	2.37%	(1.32%)	(7.42%)	(10.73%)	(22.92%)	(20.40%)	(47.47%)	(2.81%)	(1.81%)	3.01%	3.73%	(3.17%)	(3.32%)	16.29%						
99900037	S&P 500 / Materials -SEC	(0.28%)	(2.97%)	5.60%	3.00%	20.37%	25.16%	45.28%	6.03%	(1.43%)	(9.13%)	(20.37%)	(22.76%)	(18.97%)	(64.72%)	0.84%	(1.93%)	1.30%	(5.91%)	(3.01%)	(1.89%)	(0.96%)						
99900477	S&P 500 / Consumer Staples -SEC	2.84%	2.99%	5.19%	7.37%	12.02%	13.39%	21.66%	9.15%	4.52%	(9.54%)	(15.99%)	(31.11%)	(30.74%)	(88.35%)	3.96%	4.03%	0.89%	(1.53%)	(11.35%)	(13.66%)	(24.59%)						
86099Y65	S&P 500 / Real Estate - SEC	(0.37%)	1.88%	4.73%	7.72%	34.62%	38.08%	32.41%	5.93%	3.42%	(10.00%)	(15.64%)	(8.51%)	(6.05%)	(77.59%)	0.75%	2.92%	0.44%	(1.18%)	11.25%	11.03%	(13.83%)						
SP50	S&P 500	(1.12%)	(1.04%)	4.30%	8.91%	23.38%	27.05%	46.24%	5.18%	0.49%	(10.43%)	(14.46%)	(19.76%)	(17.08%)	(63.76%)													
99900621	S&P 500 / Financials -SEC	(1.11%)	(3.33%)	3.70%	4.59%	31.40%	38.34%	26.94%	5.20%	(1.80%)	(11.03%)	(18.77%)	(11.74%)	(5.79%)	(83.06%)	0.02%	(2.29%)	(0.60%)	(4.32%)	8.02%	11.29%	(19.30%)						
99900125	S&P 500 / Industrials - SEC	(1.66%)	(3.59%)	2.28%	0.23%	16.17%	17.92%	26.89%	4.65%	(2.06%)	(12.45%)	(23.13%)	(26.97%)	(26.21%)	(83.11%)	(0.53%)	(2.55%)	(2.02%)	(8.68%)	(7.21%)	(9.13%)	(19.35%)						
99900565	S&P 500 / Health Care -SEC	1.81%	0.89%	2.23%	8.48%	18.75%	22.04%	35.11%	8.12%	2.43%	(12.50%)	(14.88%)	(24.38%)	(22.09%)	(74.89%)	2.93%	1.93%	(2.07%)	(0.43%)	(4.63%)	(5.01%)	(11.13%)						
99900821	S&P 500 / Utilities -SEC	0.83%	4.09%	2.18%	5.06%	10.10%	12.41%	9.93%	7.13%	5.62%	(12.55%)	(18.30%)	(33.03%)	(31.72%)	(100.07%)	1.95%	5.13%	(2.12%)	(3.84%)	(13.27%)	(14.64%)	(36.31%)						
99900793	S&P 500 / Communication Services -SEC	(1.10%)	(5.31%)	(6.74%)	0.03%	18.49%	19.52%	47.50%	5.21%	(3.78%)	(21.47%)	(23.33%)	(24.65%)	(24.61%)	(62.50%)	0.02%	(4.27%)	(11.04%)	(8.87%)	(4.89%)	(7.53%)	1.26%						
	Average Median	(0.77%)	(1.01%)	4.51%	6.45%	23.41%	26.19%	36.54%	5.54%	0.52%	(10.22%)	(16.92%)	(19.73%)	(17.94%)	(73.46%)	0.38%	0.03%	0.23%	(2.68%)	0.03%	(0.94%)	(10.58%)						
		(1.10%)	(1.95%)	4.52%	6.22%	20.29%	24.44%	33.76%	5.20%	(0.41%)	(10.21%)	(17.14%)	(22.84%)	(19.69%)	(76.24%)	0.02%	(1.81%)	0.44%	(3.84%)	(3.17%)	(3.32%)	(13.83%)						
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						
99900753	S&P 500 / Technology Hardware, Storage & Communications	1.53%	15.49%	17.46%	31.92%	31.55%	43.03%	143.80%	7.84%	17.03%	2.72%	8.56%	(11.58%)	(1.10%)	33.80%	2.65%	16.53%	13.16%	23.01%	8.18%	15.98%	97.56%						
99900778	S&P 500 / Semiconductors & Semiconductor Equipment	(6.31%)	(1.53%)	14.73%	23.36%	43.13%	44.13%	110.00%								(5.18%)	(0.49%)	10.43%	14.46%	19.76%	17.08%	63.76%						
99900725	S&P 500 / Software -IND	(2.28%)	(4.10%)	6.66%	21.84%	39.06%	44.45%	103.38%	4.03%	(2.56%)	(8.07%)	(1.52%)	(4.07%)	0.33%	(6.62%)	(1.16%)	(3.06%)	2.36%	12.93%	15.69%	17.41%	57.14%						
99900741	S&P 500 / Communications Equipment -IND	0.19%	1.72%	4.76%	11.85%	35.74%	38.02%	39.23%	6.50%	3.26%	(9.97%)	(11.51%)	(7.40%)	(6.11%)	(70.77%)													
SP50	S&P 500	(1.12%)	(1.04%)	4.30%	8.91%	23.38%	27.05%	46.24%	5.18%	0.49%	(10.43%)	(14.46%)	(19.76%)	(17.08%)	(63.76%)													
99900765	S&P 500 / Electronic Equipment, Instruments & Components	(2.40%)	(1.76%)	3.27%	11.56%	28.24%	30.54%	57.25%			6.21%	(1.67%)	(21.98%)	(31.71%)	(44.45%)	(40.48%)	(89.34%)	(1.28%)	(0.72%)	(1.03%)	2.65%	4.86%	3.49%	11.01%				
99900790	S&P 500 / IT Services -IND	(0.10%)	(3.20%)	(7.25%)	(8.35%)	(1.32%)	3.65%	20.67%											1.03%	(2.16%)	(11.55%)	(17.25%)	(24.69%)	(23.40%)	(25.58%)			
	Average Median	(1.50%)	0.80%	6.28	14.44%	28.54%	32.98%	74.37%	5.61%	2.72%	-9.86	(10.41%)	(17.03%)	(13.07%)	(41.57%)	(0.44%)	2.14%	2.31	6.46%	6.03%	6.92%	32.81%						
		(1.12%)	(1.53%)	4.76	11.85%	31.55%	38.02%	57.25%	5.70%	0.13%	-10.20	(11.66%)	(13.24%)	(9.85%)	(58.25%)	(0.06%)	(0.61%)	1.41	7.94%	10.27%	13.48%	34.08%						

Source: Factset, UBS estimates



# Stock Performance: Semis (Sorted by 3mo)

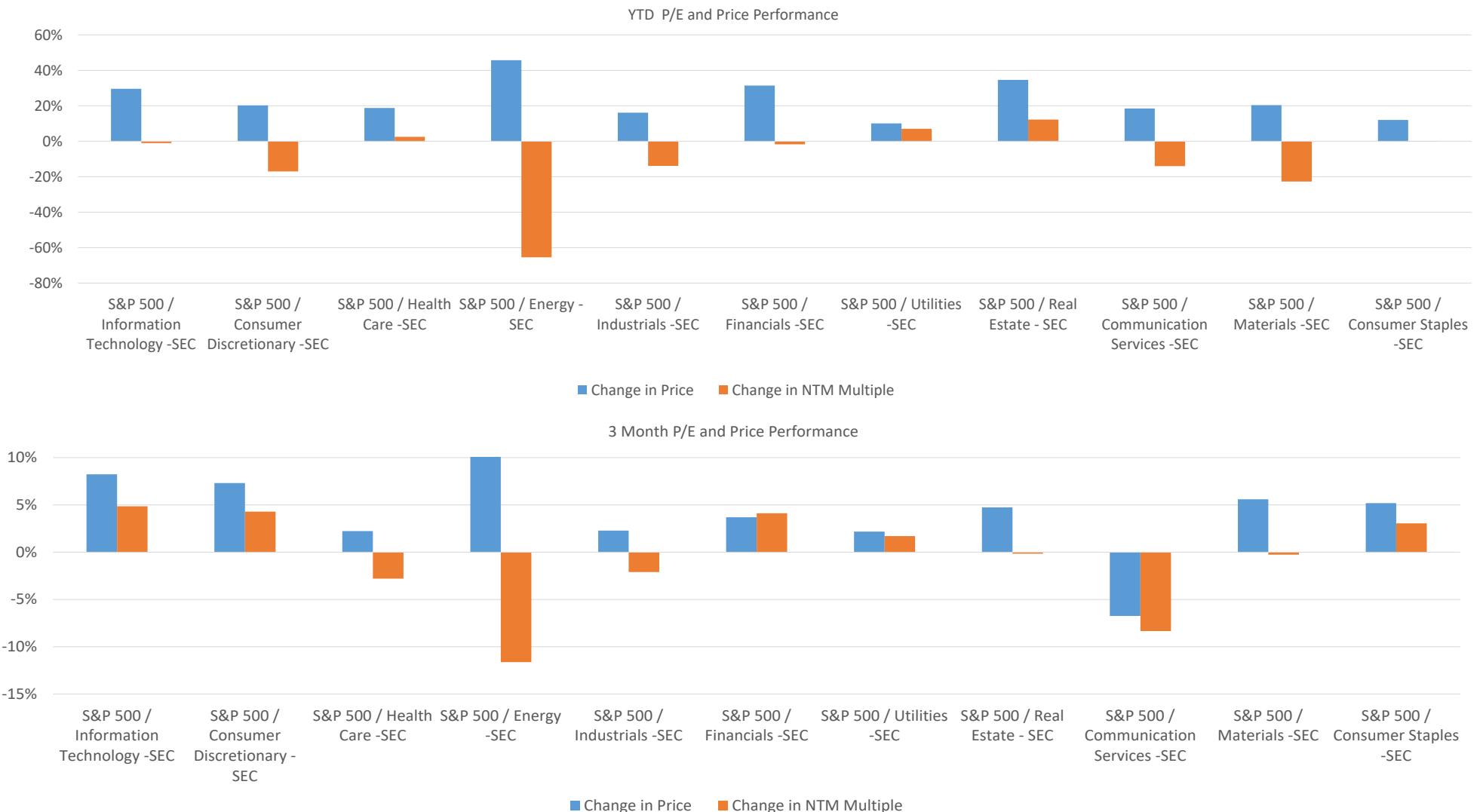
Ticker	Semiconductors/Semi Eqpt	Absolute Performance						Relative to S&P500 Semis & SemiCap Sector						Relative to S&P 500								
		1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year	1 Week	1 Month	3 Month	6 Month	YTD	1 Year	2 Year
PI	Impinj, Inc.	(0.52%)	4.88%	52.59%	61.69%	95.63%	99.54%	214.68%	5.79%	6.41%	37.86%	38.32%	52.50%	55.41%	104.67%	0.60%	5.92%	48.29%	52.78%	72.25%	72.49%	168.43%
SLAB	Silicon Laboratories Inc.	(2.36%)	(2.66%)	37.65%	38.79%	55.16%	62.82%	74.96%	3.95%	(1.13%)	22.92%	15.43%	12.03%	18.69%	(35.04%)	(1.24%)	(1.62%)	33.35%	29.88%	31.78%	35.77%	28.72%
MRVL	Marvell Technology, Inc.	(6.80%)	16.07%	36.90%	58.53%	79.41%	92.40%	231.61%	(0.49%)	17.61%	22.17%	35.17%	36.27%	48.27%	121.61%	(5.67%)	17.11%	32.60%	49.63%	56.03%	65.35%	185.37%
XLNX	Xilinx, Inc.	(6.26%)	(1.87%)	34.86%	63.49%	47.99%	40.78%	118.03%	0.05%	(0.33%)	20.13%	40.13%	4.86%	(3.35%)	8.03%	(5.13%)	(0.82%)	30.56%	54.59%	24.62%	13.74%	71.79%
ON	ON Semiconductor Corporation	(3.77%)	7.47%	31.62%	64.35%	92.42%	104.35%	172.29%	2.53%	9.01%	16.89%	40.99%	49.29%	60.22%	62.29%	(2.65%)	8.52%	27.32%	55.45%	69.05%	77.30%	126.05%
PDFS	PDF Solutions, Inc.	(3.81%)	(10.71%)	30.22%	67.54%	36.67%	33.15%	76.87%	2.50%	(9.17%)	15.49%	44.18%	(6.47%)	(10.98%)	(33.13%)	(2.69%)	(9.67%)	25.92%	58.63%	13.29%	6.10%	30.63%
QCOM	Qualcomm Inc	(0.95%)	10.33%	28.94%	32.53%	19.46%	24.40%	107.20%	5.36%	11.87%	14.21%	9.17%	(23.68%)	(19.73%)	(2.80%)	0.18%	11.37%	24.64%	23.63%	(3.92%)	(2.65%)	60.95%
ACLS	Acelxus Technologies, Inc.	(7.65%)	3.35%	28.93%	52.02%	117.96%	122.78%	169.40%	(1.35%)	4.89%	14.19%	28.66%	74.83%	78.65%	59.40%	(6.53%)	4.40%	24.63%	43.12%	94.58%	95.73%	123.16%
AMD	Advanced Micro Devices, Inc.	(6.39%)	(8.31%)	28.25%	66.28%	47.86%	43.07%	229.53%	(0.08%)	(6.78%)	13.52%	42.92%	4.72%	(1.06%)	119.53%	(5.26%)	(7.27%)	23.95%	57.37%	24.48%	16.02%	183.28%
TER	Teradyne, Inc.	(1.99%)	6.67%	27.49%	18.60%	30.07%	33.08%	133.83%	4.32%	8.20%	12.75%	(4.76%)	(13.06%)	(11.05%)	23.83%	(0.87%)	7.71%	23.19%	9.70%	6.69%	6.03%	87.59%
NVDA	NVIDIA Corporation	(12.61%)	(6.76%)	27.40%	57.26%	117.06%	112.92%	406.04%	(6.31%)	(5.22%)	12.67%	33.90%	73.92%	68.79%	296.04%	(11.49%)	(5.71%)	23.10%	48.36%	93.68%	85.87%	359.80%
AVGO	Broadcom Inc.	4.15%	9.18%	22.52%	29.23%	40.44%	49.32%	94.95%	10.46%	10.71%	7.79%	5.87%	(2.70%)	5.19%	(15.05%)	5.28%	10.22%	18.22%	20.32%	17.06%	22.27%	48.71%
NVMI	Nova Ltd.	(1.87%)	(3.60%)	20.23%	25.78%	79.94%	81.10%	241.87%	4.44%	(2.06%)	5.50%	2.42%	36.81%	36.97%	131.87%	(0.75%)	(2.56%)	15.93%	16.88%	56.57%	54.05%	195.63%
PLAB	Photonics, Inc.	15.96%	15.48%	18.12%	22.42%	47.76%	48.16%	3.45%	22.27%	17.01%	3.39%	(0.94%)	4.63%	4.03%	(106.55%)	17.09%	16.52%	13.82%	13.51%	24.38%	21.11%	(42.79%)
MTSI	MACOM Technology Solutions Holdings	(4.29%)	(1.30%)	17.83%	21.45%	34.23%	50.01%	181.45%	2.02%	0.24%	3.10%	(1.91%)	(8.90%)	5.88%	71.45%	(3.16%)	(0.25%)	13.53%	12.55%	10.85%	22.96%	135.21%
VECO	Veco Instruments Inc.	(4.55%)	(4.44%)	16.56%	0.95%	47.58%	43.37%	84.65%	1.76%	(2.90%)	1.83%	(22.42%)	4.45%	(0.76%)	(25.35%)	(3.42%)	(3.40%)	12.26%	(7.96%)	24.20%	16.32%	38.41%
NANO	Onto Innovation, Inc.	(6.69%)	2.53%	15.50%	22.82%	93.21%	97.57%	164.98%	(0.39%)	4.07%	0.77%	(0.54%)	50.07%	53.44%	54.98%	(5.57%)	3.57%	11.20%	13.92%	69.83%	70.52%	118.74%
LSCC	Lattice Semiconductor Corporation	(5.54%)	(9.02%)	15.06%	41.09%	63.73%	74.02%	291.34%	0.77%	(7.49%)	0.33%	17.73%	20.59%	29.89%	181.34%	(4.42%)	(7.98%)	10.76%	32.19%	40.35%	46.97%	245.10%
CCMP	CMC Materials, Inc.	(1.79%)	0.71%	14.36%	(7.96%)	(3.52%)	0.08%	6.63%	4.52%	2.25%	(0.37%)	(31.32%)	(46.66%)	(44.05%)	(103.38%)	(0.67%)	1.75%	10.06%	(16.87%)	(26.90%)	(26.97%)	(39.62%)
SIMO	Silicon Motion Technology Corporation	(2.86%)	23.86%	13.61%	30.67%	77.49%	87.37%	78.30%	3.44%	25.39%	(1.12%)	7.31%	34.35%	43.24%	(31.70%)	(1.74%)	24.90%	9.31%	21.77%	54.11%	60.32%	32.06%
MU	Micron Technology, Inc.	(2.96%)	7.75%	13.34%	3.48%	10.79%	16.42%	62.68%	3.35%	9.28%	(1.40%)	(19.88%)	(32.35%)	(27.70%)	(47.32%)	(1.84%)	8.79%	9.04%	(5.43%)	(12.59%)	(10.62%)	16.43%
LRCX	Lam Research Corporation	(3.82%)	8.77%	12.55%	4.46%	43.82%	38.09%	140.90%	2.49%	10.31%	(2.19%)	(18.91%)	0.68%	(6.04%)	30.90%	(2.69%)	9.82%	8.25%	(4.45%)	20.44%	11.04%	94.66%
SMTC	Semtech Corporation	(4.48%)	(4.34%)	12.47%	28.30%	19.35%	21.06%	79.29%	1.82%	(2.80%)	(2.26%)	4.94%	(23.78%)	(23.07%)	(30.71%)	(3.36%)	8.17%	19.40%	(4.03%)	(5.98%)	33.05%	
KLAC	KLA Corporation	(4.70%)	(3.34%)	12.09%	22.83%	54.29%	53.56%	133.27%	1.61%	(1.81%)	(2.65%)	(0.53%)	11.15%	9.43%	23.27%	(3.57%)	(2.30%)	7.79%	13.93%	30.91%	26.51%	87.03%
ENTG	Entegris, Inc.	(6.51%)	(4.37%)	11.84%	19.99%	49.03%	50.22%	186.38%	(0.21%)	(2.83%)	(2.89%)	5.90%	6.09%	76.38%	(5.39%)	(3.33%)	7.54%	11.08%	25.66%	23.17%	140.14%	
UCTT	Ultra Clean Holdings, Inc.	(10.90%)	(12.40%)	11.59%	(10.85%)	65.62%	51.20%	126.27%	(4.59%)	(10.86%)	(3.14%)	(34.21%)	22.48%	7.07%	16.27%	(9.77%)	(11.35%)	7.29%	(29.76%)	42.24%	24.15%	80.03%
CDNS	Cadence Design Systems, Inc.	(3.67%)	(2.97%)	6.75%	34.44%	29.05%	45.13%	159.22%	2.64%	(1.43%)	(7.98%)	11.08%	(14.09%)	1.00%	49.22%	(2.55%)	(1.92%)	2.45%	25.53%	5.67%	18.08%	112.98%
DIOD	Diodes Incorporated	(7.77%)	(5.18%)	6.62%	32.52%	45.89%	51.25%	102.86%	(1.46%)	(3.65%)	(8.11%)	9.16%	2.75%	7.12%	(7.14%)	(6.64%)	(4.14%)	2.32%	23.62%	22.51%	24.20%	56.62%
MCHP	Microchip Technology Incorporated	(4.50%)	1.85%	5.68%	9.00%	22.93%	19.99%	66.30%	1.81%	3.38%	(9.05%)	(14.36%)	(20.20%)	(24.14%)	(43.70%)	(3.38%)	2.89%	1.38%	0.10%	(0.45%)	(7.06%)	20.06%
FORM	FormFactor, Inc.	(6.61%)	(3.07%)	5.64%	18.32%	(3.79%)	(4.01%)	64.44%	(0.30%)	(5.33%)	(9.09%)	(46.92%)	(48.14%)	(45.56%)	(5.49%)	(2.03%)	1.34%	9.42%	(27.16%)	(31.06%)	18.20%	
MKSI	MKS Instruments, Inc.	(2.12%)	(4.15%)	5.51%	(11.71%)	6.08%	6.11%	45.98%	4.19%	(2.62%)	(9.22%)	(35.07%)	(37.05%)	(38.02%)	(64.02%)	(1.00%)	(3.11%)	1.21%	(20.61%)	(17.29%)	(20.94%)	(0.26%)
AMAT	Applied Materials, Inc.	(5.84%)	(5.80%)	5.42%	6.26%	71.18%	66.93%	146.75%	0.47%	(4.26%)	(9.31%)	(17.10%)	28.05%	22.80%	36.75%	(4.71%)	1.12%	(2.65%)	47.81%	39.88%	100.51%	
CRUS	Cirrus Logic, Inc.	5.35%	15.38%	4.46%	13.98%	10.61%	15.98%	18.17%	11.66%	16.92%	(10.27%)	(9.38%)	(32.53%)	(28.14%)	(91.83%)	6.48%	16.42%	0.16%	5.07%	(12.77%)	(11.06%)	(28.07%)
BRKS	Azenta, Inc.	(10.82%)	(15.65%)	4.28%	(4.01%)	42.82%	29.08%	129.29%	(4.52%)	(14.12%)	(10.45%)	(27.37%)	(0.32%)	(15.05%)	19.29%	(9.70%)	(14.61%)	(0.02%)	(12.92%)	19.44%	2.03%	83.05%
NXPI	NXP Semiconductors NV	(7.92%)	1.00%	4.02%	8.07%	38.35%	38.83%	77.58%	(1.61%)	2.53%	(10.71%)	(15.29%)	(4.78%)	(5.30%)	(32.42%)	(6.79%)	2.04%	(0.28%)	(0.84%)	14.97%	11.78%	31.34%
SNPS	Synopsys, Inc.	(2.88%)	(0.31%)	4.01%	29.81%	33.44%	44.83%	153.06%	3.42%	1.22%	(10.72%)	6.45%	(9.69%)	0.70%	43.06%	(1.76%)	0.73%	(0.29%)	20.90%	10.06%	17.78%	106.82%
ADI	Analog Devices, Inc.	(5.55%)	(4.61%)	1.62%	4.65%	19.33%	23.85%	48.42%	48.42%	0.76%	(3.07%)	(13.11%)	(18.71%)	(23.81%)	(20.28%)	(61.58%)	(4.43%)	(3.56%)	(2.68%)	(4.25%)	(4.05%)	2.18%
MX	Magnachip Semiconductor Corp.	(1.76%)	(1.98%)	1.36%	(30.99%)	31.95%	38.62%	54.19%	4.55%	(0.44%)	(13.37%)	(54.35%)	(11.18%)	(5.51%)	(55.81%)	(0.64%)	(0.94%)	(2.94%)	(39.89%)	8.58%	11.57%	7.95%
DSPG	DSP Group, Inc.	0.00%	0.14%	0.73%	35.51%	32.49%	34.60%	41.62%	6.31%	1.67%	(14.00%)	12.15%	(10.64%)	(9.53%)	(68.38%)	1.12%	1.18%	(3.57%)	26.61%	9.11%	7.55%	(4.62%)
MIMX	Maxim Integrated Products, Inc.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.31%	1.53%	(14.73%)	(23.36%)	(43.13%)	(44.13%)	(110.00%)	1.12%	1.04%	(4.30%)	(8.91%)	(23.38%)	(27.05%)	(46.24%)
IPHI	Inphi Corporation	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.31%	1.53%	(14.73%)	(23.36%)	(43.13%)	(44.13%)	(110.00%)	1.12%	1.04%	(4.30%)	(8.91%)	(23.38%)	(27.05%)	(46.24%)
AEIS	Advanced Energy Industries, Inc.	(8.05%)	(6.93%)	(0.85%)	(19.68%)	(12.31%)	(15.67%)	23.72%	(1.74%)	(5.39%)	(15.58%)	(40.05%)	(55.45%)	(59.80%)	(86.28%)	(6.92%)	(5.89%)	(5.15%)	(28.59%)	(35.69%)	(42.72%)	(22.53%)
TXN	Texas Instruments Incorporated	(4.40%)	0.10%	(2.48%)	0.01%	15.93%	18.83%	50.24%	1.91%	1.63%	(17.21%)	(23.36%)	(27.21%)	(25.30%)	(59.76%)	(3.28%)	1.14%	(6.78%)	(8.90%)	(7.45%)	(8.22%)	4.00%
ICHR	Ichor Holdings, Ltd.	(8.43%)	(11.77%)	(3.39%)	(23.31%)	42.01%	37.04%	30.28%	(2.12%)	(10.23%)	(18.12%)	(46.67%)	(1.12%)	(7.09%)	(7.92%)	(7.30%)	(10.73%)	(7.68%)	(32.21%)	18.64%	9.99%	(15.96%)
MPWR	Monolithic Power Systems, Inc.	(11.30%)	(14.93%)	(3.54%)	35.85%	30.50%	49.60%	173.72%	(4.99%)	(13.39%)	(18.27%)	12.49%	(12.64%)	5.47%	63.72%	(10.17%)	(13.88%)	(7.84%)	26.95%	7.12%	22.55%	127.48%
INTC	Intel Corporation	(5.46%)	(1.21%)	(8.84%)	(14.59%)	(0.24%)	(1.53%)	(14.00%)	0.85%	0.32%	(23.57%)	(37.95%)	(43.37%)	(45.65%)	(124.00%)	(4.34%)	(0.17%)	(13.14%)	(23.50%)	(23.62%)	(28.57%)</	

# 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
PDFS	PDF Solutions, Inc.	(3.81%)	(10.71%)	30.22%	67.54%	36.67%	33.15%	76.87%	2.50%	(9.17%)	15.49%	44.18%	(6.47%)	(10.98%)	(33.13%)	(2.69%)	(9.67%)	25.92%	58.63%	13.29%	6.10%	30.63%
AMD	Advanced Micro Devices, Inc.	(6.39%)	(8.31%)	28.25%	66.28%	47.86%	43.07%	229.53%	(0.08%)	(6.78%)	13.52%	42.92%	4.72%	(1.06%)	119.53%	(5.26%)	(7.27%)	23.95%	57.37%	24.48%	16.02%	183.28%
ON	ON Semiconductor Corporation	(3.77%)	7.47%	31.62%	64.35%	92.42%	104.35%	172.29%	2.53%	9.01%	16.89%	40.99%	49.29%	60.22%	62.29%	(2.65%)	8.52%	27.32%	55.45%	69.05%	77.30%	126.05%
XLNX	Xilinx, Inc.	(6.26%)	(1.87%)	34.86%	63.49%	47.99%	40.78%	118.03%	0.05%	(0.33%)	20.13%	40.13%	4.86%	(3.35%)	8.03%	(5.13%)	(0.82%)	30.56%	54.59%	24.62%	13.74%	71.79%
PI	Impinj, Inc.	(0.52%)	4.88%	52.59%	61.69%	95.63%	99.54%	214.68%	5.79%	6.41%	37.86%	38.32%	52.50%	55.41%	104.67%	0.60%	5.92%	48.29%	52.78%	72.25%	72.49%	168.43%
MRLV	Marvel Technology, Inc.	(6.80%)	16.07%	36.90%	58.53%	79.41%	92.40%	231.61%	(0.49%)	17.61%	22.17%	35.17%	36.27%	48.27%	121.61%	(5.67%)	17.11%	32.60%	49.63%	56.03%	65.35%	185.37%
NVDA	NVIDIA Corporation	(12.61%)	(6.76%)	27.40%	57.26%	117.06%	112.92%	406.04%	(6.31%)	(5.22%)	12.67%	33.90%	73.92%	68.79%	296.04%	(11.49%)	(5.71%)	23.10%	48.36%	93.68%	85.87%	359.80%
ACLS	Axcelis Technologies, Inc.	(7.65%)	3.35%	28.93%	52.02%	117.96%	122.78%	169.40%	(1.35%)	4.89%	14.19%	28.66%	74.83%	78.65%	59.40%	(6.53%)	4.40%	24.63%	43.12%	94.58%	95.73%	123.16%
LSCC	Lattice Semiconductor Corporation	(5.54%)	(9.02%)	15.06%	41.09%	63.73%	74.02%	291.34%	0.77%	(7.49%)	0.33%	17.73%	20.59%	29.89%	181.34%	(4.42%)	(7.98%)	10.76%	32.19%	40.35%	46.97%	245.10%
SLAB	Silicon Laboratories Inc.	(2.36%)	(2.66%)	37.65%	38.79%	55.16%	62.82%	74.96%	3.95%	(1.13%)	22.92%	15.43%	12.03%	18.69%	(35.04%)	(1.24%)	(1.62%)	33.35%	29.88%	31.78%	35.77%	28.72%
MPWR	Monolithic Power Systems, Inc.	(11.30%)	(14.93%)	(3.54%)	35.85%	30.50%	49.60%	173.72%	(4.99%)	(13.39%)	(18.27%)	12.49%	(12.64%)	5.47%	63.72%	(10.17%)	(13.88%)	(7.84%)	26.95%	7.12%	22.55%	127.48%
DSPG	DSP Group, Inc.	0.00%	0.14%	0.73%	35.51%	32.49%	34.60%	41.62%	6.31%	1.67%	(14.00%)	12.15%	(10.64%)	(9.53%)	(68.38%)	1.12%	1.18%	(3.57%)	26.61%	9.11%	7.55%	(4.62%)
CDNS	Cadence Design Systems, Inc.	(3.67%)	(2.97%)	6.75%	34.44%	29.05%	45.13%	159.22%	2.64%	(1.43%)	(7.98%)	11.08%	(14.09%)	1.00%	49.22%	(2.55%)	(1.92%)	2.45%	25.53%	5.67%	18.08%	112.98%
QCOM	Qualcomm Inc	(0.95%)	10.33%	28.94%	32.53%	19.46%	24.40%	107.20%	5.36%	11.87%	14.21%	9.17%	(23.68%)	(19.73%)	(2.80%)	0.18%	11.37%	24.64%	23.63%	(3.92%)	(2.65%)	60.95%
DIOD	Diodes Incorporated	(7.77%)	(5.18%)	6.62%	32.52%	45.89%	51.25%	102.86%	(1.46%)	(3.65%)	(8.11%)	9.16%	2.75%	7.12%	(7.14%)	(6.64%)	(4.14%)	2.32%	23.62%	22.51%	24.20%	56.62%
SIMO	Silicon Motion Technology Corporation	(2.86%)	23.86%	13.61%	30.67%	77.49%	87.37%	78.30%	3.44%	25.39%	(1.12%)	7.31%	34.35%	43.24%	(31.70%)	(1.74%)	24.90%	9.31%	21.77%	54.11%	60.32%	32.06%
SNPS	Synopsys, Inc.	(2.88%)	(0.31%)	4.01%	29.81%	33.44%	44.83%	153.06%	3.42%	1.22%	(10.72%)	6.45%	(9.69%)	0.70%	43.06%	(1.76%)	0.73%	(0.29%)	20.90%	10.06%	17.78%	106.82%
AVGO	Broadcom Inc.	4.15%	9.18%	22.52%	49.23%	40.44%	49.95%	10.46%	10.71%	7.79%	5.87%	(2.70%)	5.19%	(15.05%)	5.28%	10.22%	18.22%	20.32%	17.06%	22.27%	48.71%	
SMTC	Semtech Corporation	(4.48%)	(4.34%)	12.47%	28.30%	19.35%	21.06%	79.29%	1.82%	(2.80%)	(2.26%)	4.94%	(23.78%)	(23.07%)	(30.71%)	(3.36%)	(3.29%)	8.17%	19.40%	(4.03%)	(5.98%)	33.05%
NVMI	Novatek Ltd.	(1.87%)	(3.60%)	20.23%	25.78%	79.94%	81.10%	241.87%	4.44%	(2.06%)	5.50%	2.42%	36.81%	36.97%	131.87%	(0.75%)	(2.56%)	15.93%	16.88%	56.57%	54.05%	195.63%
KLAC	KLA Corporation	(4.70%)	(3.34%)	12.09%	22.83%	54.29%	53.56%	133.27%	1.61%	(1.81%)	(2.65%)	(0.53%)	11.15%	9.43%	23.27%	(3.57%)	(2.30%)	7.79%	13.93%	30.91%	26.51%	87.03%
NANO	Onto Innovation, Inc.	(6.69%)	2.53%	15.50%	22.82%	93.21%	97.57%	164.98%	(0.39%)	4.07%	0.77%	(0.54%)	50.07%	53.44%	54.98%	(5.57%)	(3.57%)	11.20%	13.92%	69.83%	70.52%	118.74%
PLAB	Photonics, Inc.	15.96%	15.48%	18.12%	22.42%	47.76%	48.16%	3.45%	22.27%	17.01%	3.39%	(0.94%)	4.63%	4.03%	(106.55%)	17.09%	16.52%	13.82%	13.51%	24.38%	21.11%	(42.79%)
ASML	ASM International N.V. Sponsored ADR	(9.14%)	(16.22%)	(9.19%)	22.20%	82.64%	99.91%	249.21%	(2.83%)	(14.69%)	(23.92%)	(1.16%)	39.50%	55.78%	139.21%	(8.01%)	(15.18%)	(13.49%)	13.30%	59.26%	72.86%	202.97%
MTSI	MACOM Technology Solutions Holdings	(4.29%)	(1.30%)	17.83%	21.45%	34.23%	50.01%	181.45%	2.02%	0.24%	3.10%	(1.91%)	(8.90%)	5.88%	71.45%	(3.16%)	(0.25%)	13.53%	12.55%	10.85%	22.96%	135.21%
ENTG	Entegris, Inc.	(6.51%)	(4.37%)	11.84%	19.99%	49.03%	50.22%	186.38%	(0.21%)	(2.83%)	(2.89%)	(3.37%)	5.90%	6.09%	76.38%	(5.39%)	(3.33%)	7.54%	11.08%	25.66%	23.17%	140.14%
TER	Teradyne, Inc.	(1.99%)	6.67%	27.49%	18.60%	30.07%	33.08%	133.83%	4.32%	8.20%	12.75%	(4.76%)	(13.06%)	(11.05%)	23.83%	(0.87%)	7.71%	23.19%	9.70%	6.69%	6.03%	87.59%
FORM	FormFactor, Inc.	(2.28%)	(1.53%)	<b>7.31%</b>	<b>22.42%</b>	<b>34.23%</b>	<b>41.13%</b>	<b>79.29%</b>	<b>4.23%</b>	<b>(0.05%)</b>	<b>(7.70%)</b>	<b>(1.05%)</b>	<b>(9.30%)</b>	<b>(3.17%)</b>	<b>(31.21%)</b>	<b>(1.24%)</b>	<b>(0.72%)</b>	<b>3.94%</b>	<b>13.92%</b>	<b>11.25%</b>	<b>15.98%</b>	<b>43.28%</b>
PXLW	Pixelworks, Inc.	(11.45%)	(21.56%)	(18.61%)	17.34%	53.55%	58.03%	44.82%	(5.14%)	(20.02%)	(33.34%)	(6.02%)	10.41%	13.90%	(65.18%)	(10.33%)	(20.52%)	(22.91%)	8.44%	30.17%	30.98%	(1.43%)
CRUS	Cirrus Logic, Inc.	5.35%	15.38%	4.46%	13.98%	10.61%	15.98%	18.17%	11.65%	16.92%	(10.27%)	(9.38%)	(32.53%)	(28.14%)	(91.83%)	6.48%	16.42%	0.16%	5.07%	(12.77%)	(11.06%)	(28.07%)
MCHP	Microchip Technology Incorporated	(4.50%)	1.85%	5.68%	9.00%	22.93%	19.99%	66.30%	1.81%	3.38%	(9.05%)	(14.36%)	(20.20%)	(24.14%)	(43.70%)	(3.38%)	2.89%	1.38%	0.10%	(0.45%)	(7.06%)	20.06%
NXPI	NXP Semiconductors NV	(7.92%)	1.00%	4.02%	8.07%	38.35%	38.83%	77.58%	(1.61%)	2.53%	(10.71%)	(15.29%)	(4.78%)	(5.30%)	(32.42%)	(6.79%)	2.04%	(0.28%)	(0.84%)	14.97%	11.78%	31.34%
ASML	ASML Holding NV ADR	(6.40%)	(11.42%)	(15.05%)	6.35%	54.68%	66.54%	160.23%	(0.10%)	(9.88%)	(29.78%)	(17.01%)	11.54%	22.41%	50.23%	(5.28%)	(10.38%)	(19.35%)	(2.55%)	31.30%	39.49%	113.99%
AMAT	Applied Materials, Inc.	(5.84%)	(5.80%)	5.42%	6.26%	71.18%	66.93%	146.75%	0.47%	(4.26%)	(9.31%)	(17.10%)	28.05%	22.80%	36.75%	(4.71%)	(4.76%)	1.12%	(2.65%)	47.81%	39.88%	100.51%
ADI	Analog Devices, Inc.	(5.55%)	(4.61%)	1.62%	4.65%	19.33%	23.85%	48.42%	0.76%	(3.07%)	(13.11%)	(18.71%)	(23.81%)	(20.28%)	(61.58%)	(4.43%)	(3.56%)	(2.68%)	(4.25%)	(4.05%)	(3.20%)	2.18%
LCRX	Lam Research Corporation	(3.82%)	8.77%	12.55%	4.46%	43.82%	38.09%	140.90%	2.49%	10.31%	(2.19%)	(18.91%)	0.68%	(6.04%)	30.90%	(2.69%)	9.82%	8.25%	(4.45%)	20.44%	11.04%	94.66%
POWI	Power Integrations, Inc.	(9.12%)	(15.82%)	(19.53%)	3.76%	6.52%	16.67%	86.56%	(2.81%)	0.32%	(34.26%)	(19.60%)	(36.61%)	(27.46%)	(23.44%)	(8.00%)	(14.78%)	(23.83%)	(5.15%)	(16.85%)	(10.38%)	40.32%
MU	Micron Technology, Inc.	(2.96%)	7.75%	13.34%	3.48%	10.79%	16.42%	62.68%	3.35%	9.28%	(1.40%)	(19.88%)	(32.35%)	(27.70%)	(47.32%)	(1.84%)	8.79%	9.04%	(5.43%)	(12.59%)	16.43%	
VECO	Veeco Instruments Inc.	(4.55%)	(4.44%)	16.56%	0.95%	47.58%	43.37%	84.65%	1.76%	(2.90%)	1.83%	(22.42%)	4.45%	(0.76%)	(25.35%)	(3.42%)	(3.40%)	12.26%	(7.96%)	24.20%	16.32%	38.41%
TXN	Texas Instruments Incorporated	(4.40%)	0.10%	(2.48%)	0.01%	15.93%	18.83%	50.24%	1.91%	1.63%	(17.21%)	(23.36%)	(2.50%)	(59.76%)	(3.28%)	(1.14%)	(6.78%)	(7.45%)	(8.22%)	4.00%		
MXIM	Maxim Integrated Products, Inc.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.31%	1.53%	14.73%	(23.36%)	(43.13%)	(44.13%)	(110.00%)	1.12%	1.04%	(4.30%)	(8.91%)	(23.38%)	(27.05%)	(46.24%)	
IPHI	Inphi Corporation	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.31%	1.53%	14.73%	(23.36%)	(43.13%)	(44.13%)	(110.00%)	1.12%	1.04%	(4.30%)	(8.91%)	(23.38%)	(27.05%)	(46.24%)	
K																						

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

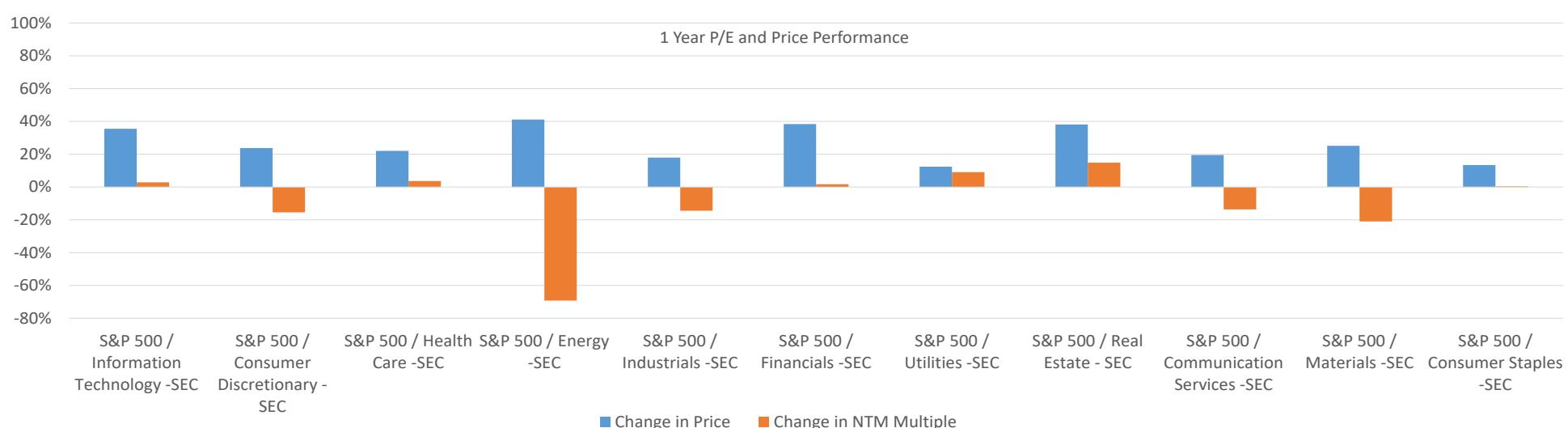
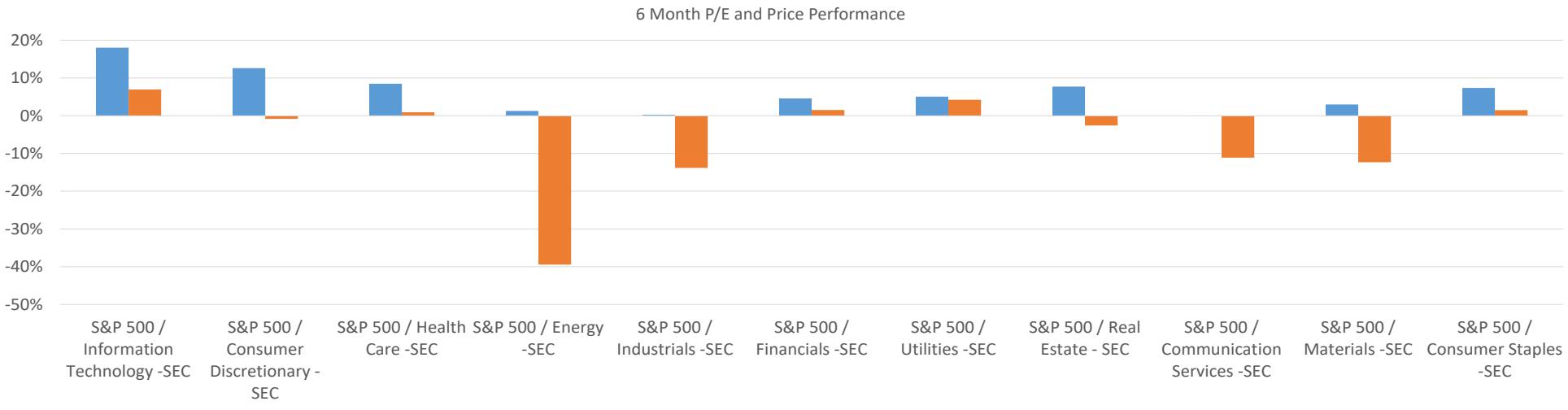
## S&P 500 Industry Sector Performance vs NTM P/E multiple change



Source: Factset, UBS estimates

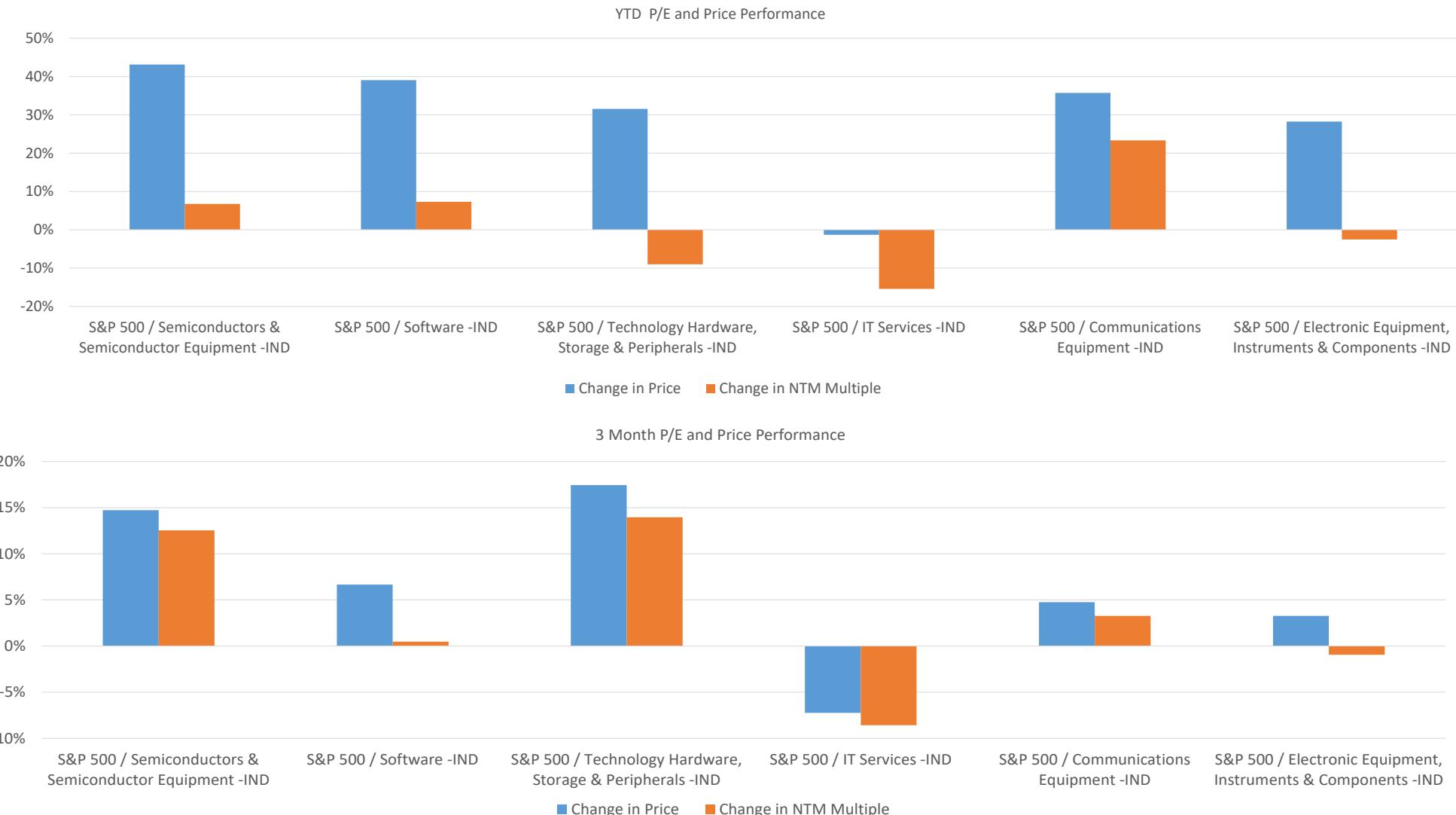
# Breakdown of Stock Performance: S&P 500 Sectors (6mo, 12mo)

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



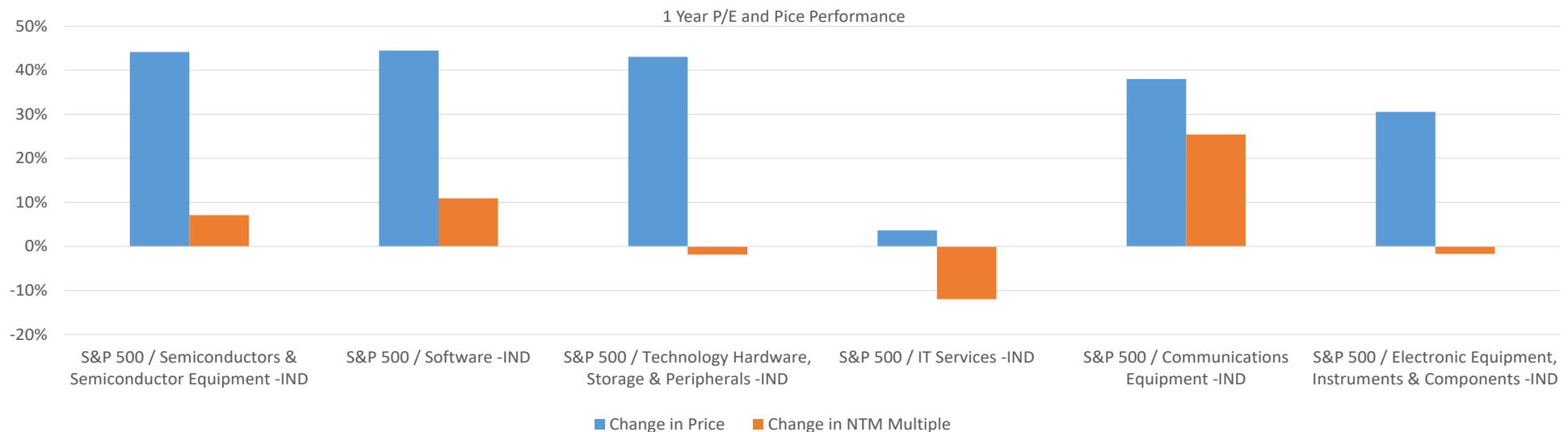
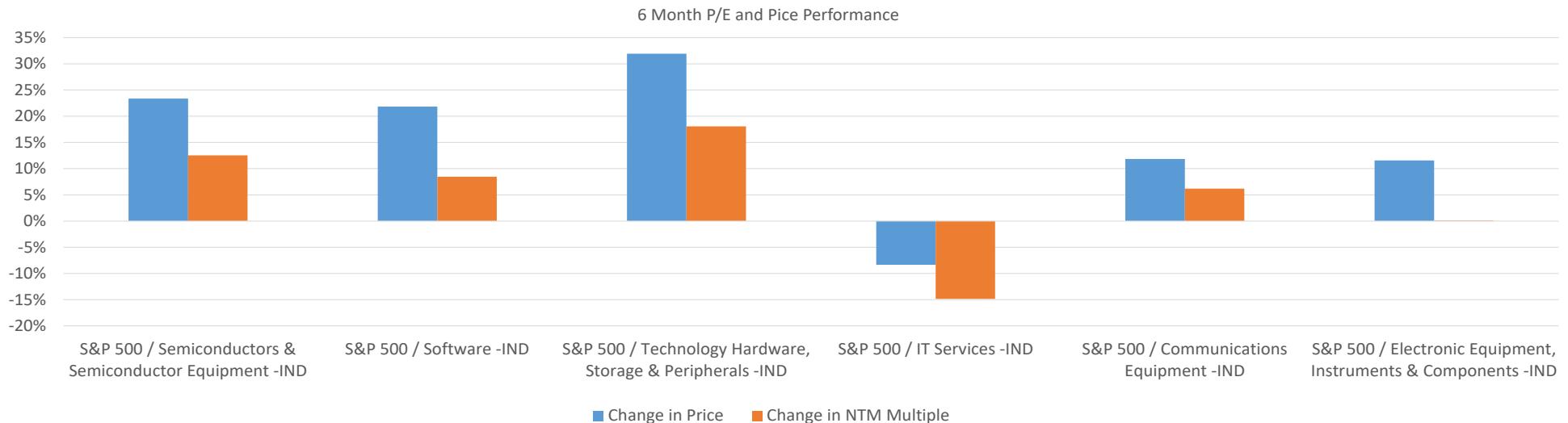
Source: Factset, UBS estimates

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



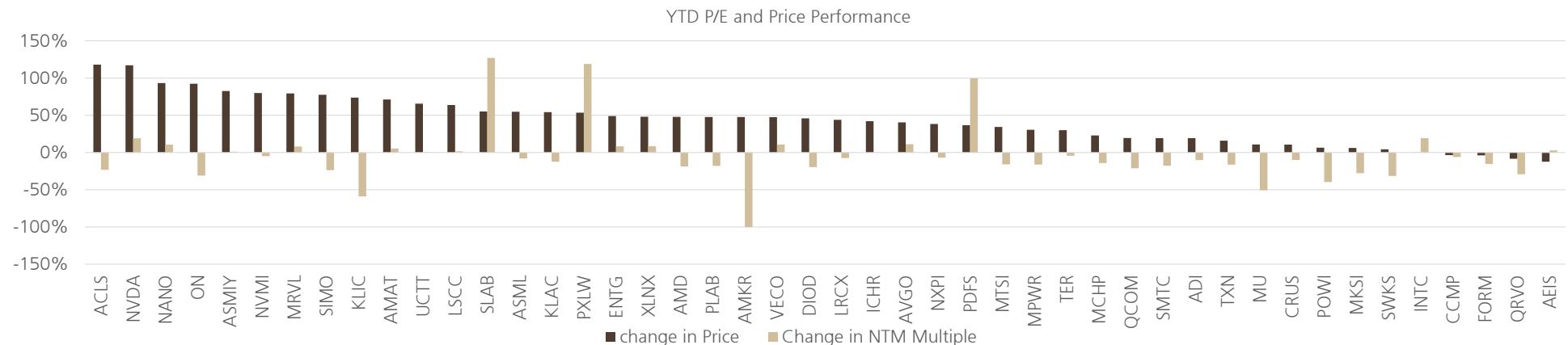
Source: Factset, UBS estimates

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

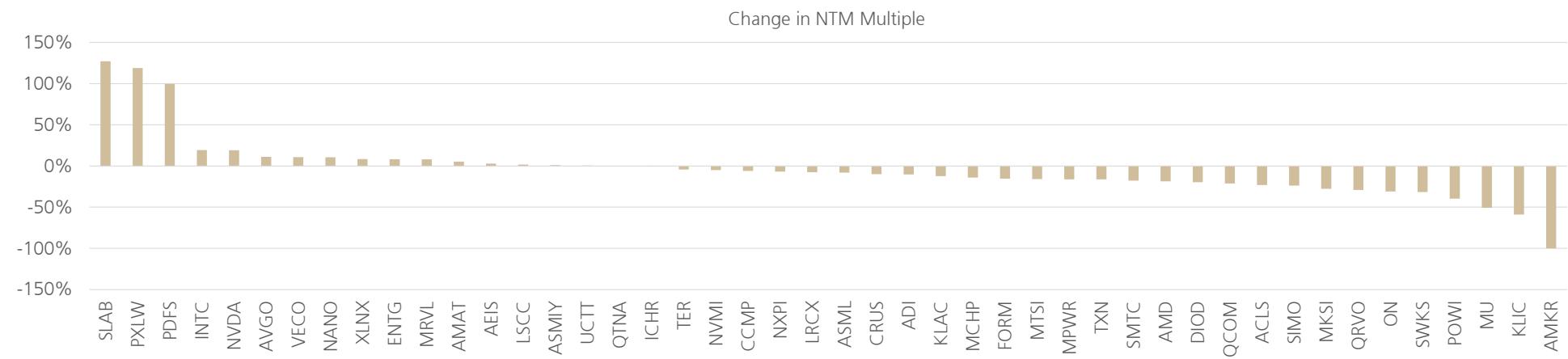


Source: Factset, UBS estimates

# Breakdown of Stock Performance: Semis (YTD)

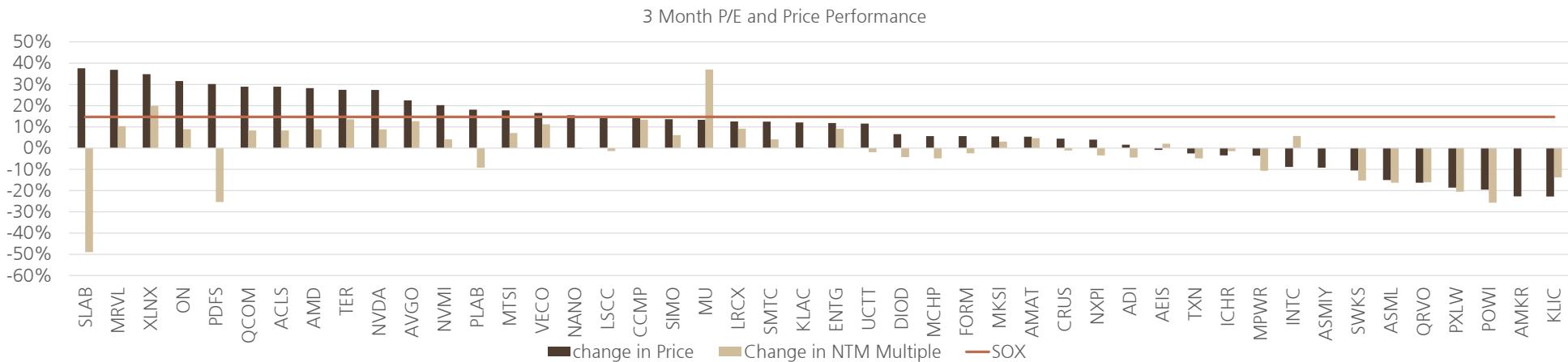


Source: Factset

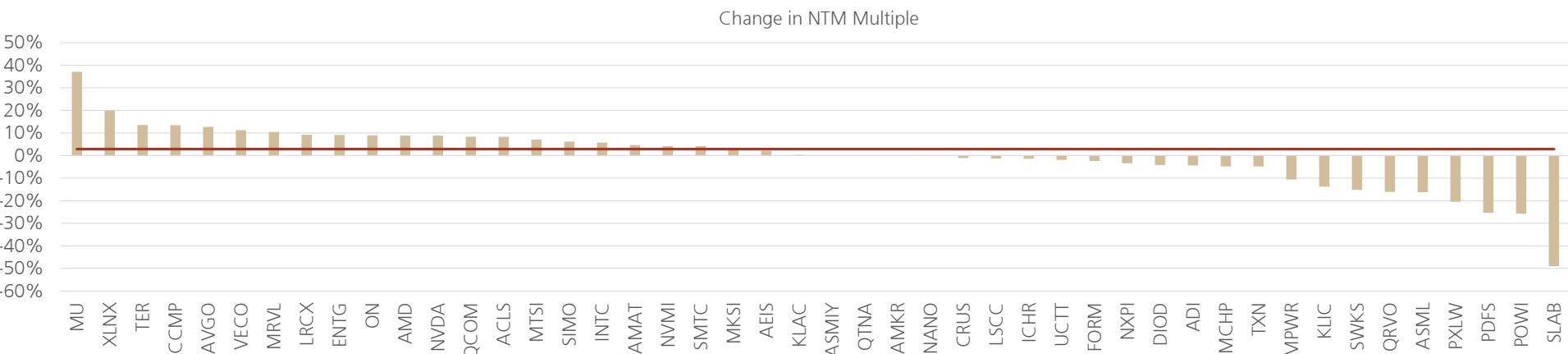


Source: Factset

# Breakdown of Stock Performance: Semis (3mo)

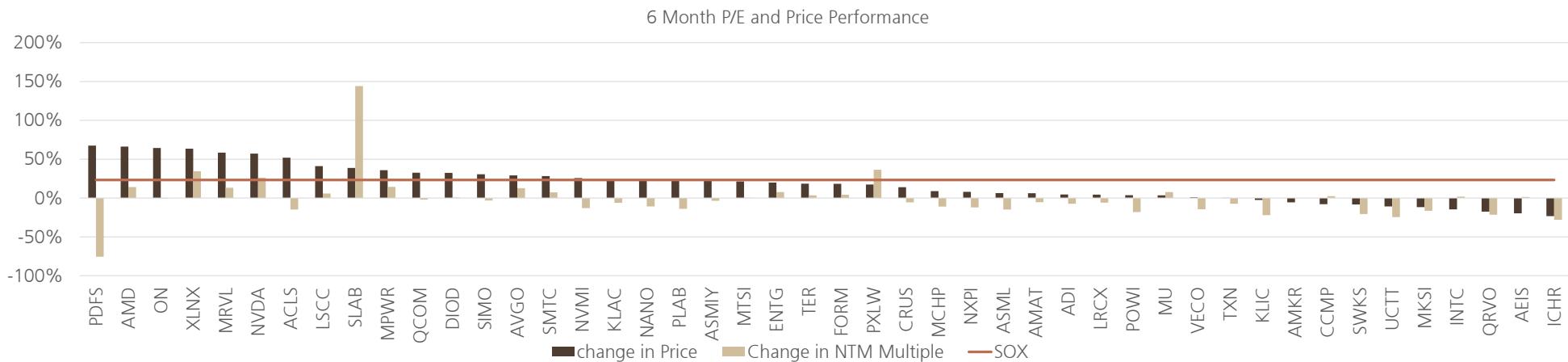


Source: Factset

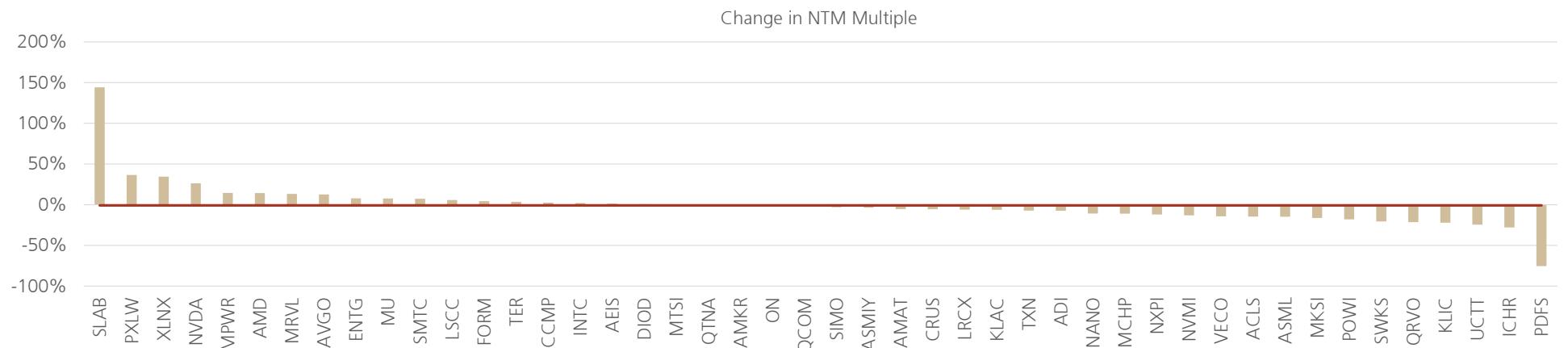


Source: Factset

# Breakdown of Stock Performance: Semis (6mo)

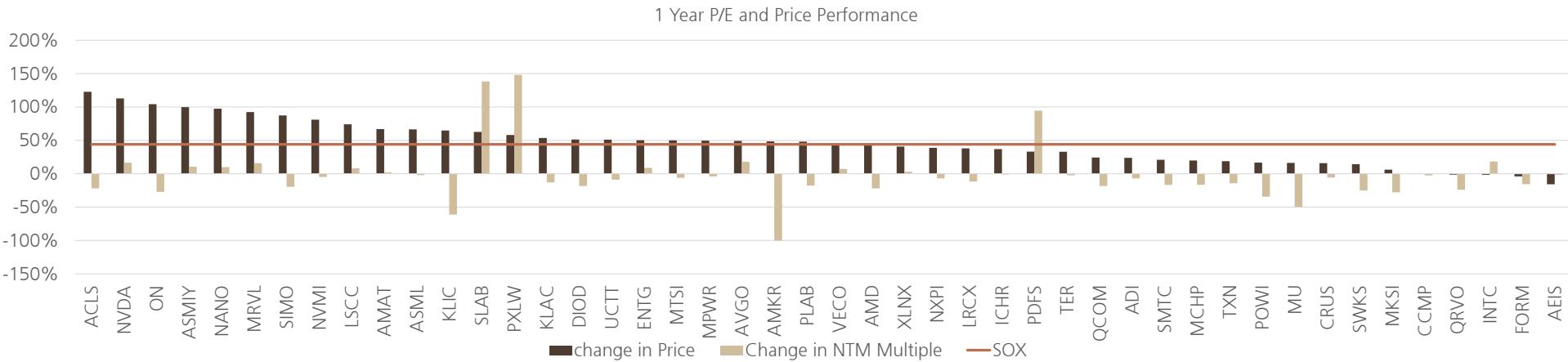


Source: Factset

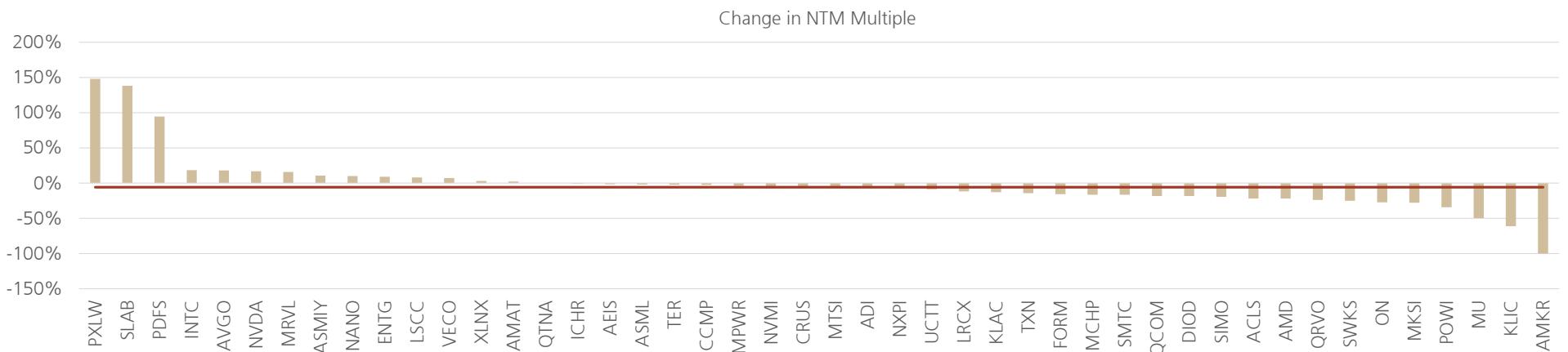


Source: Factset

# Breakdown of Stock Performance: Semis (12mo)

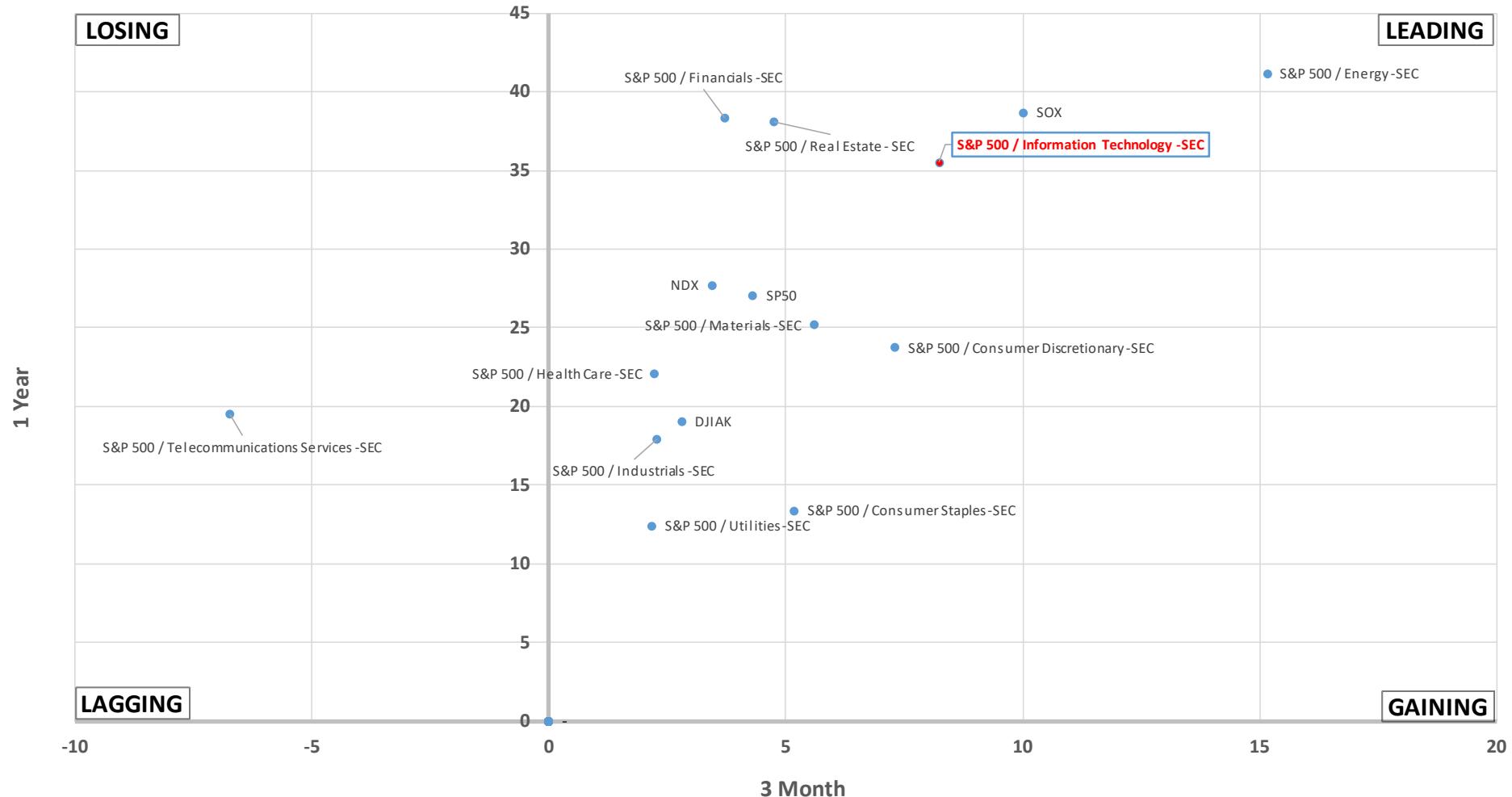


Source: Factset



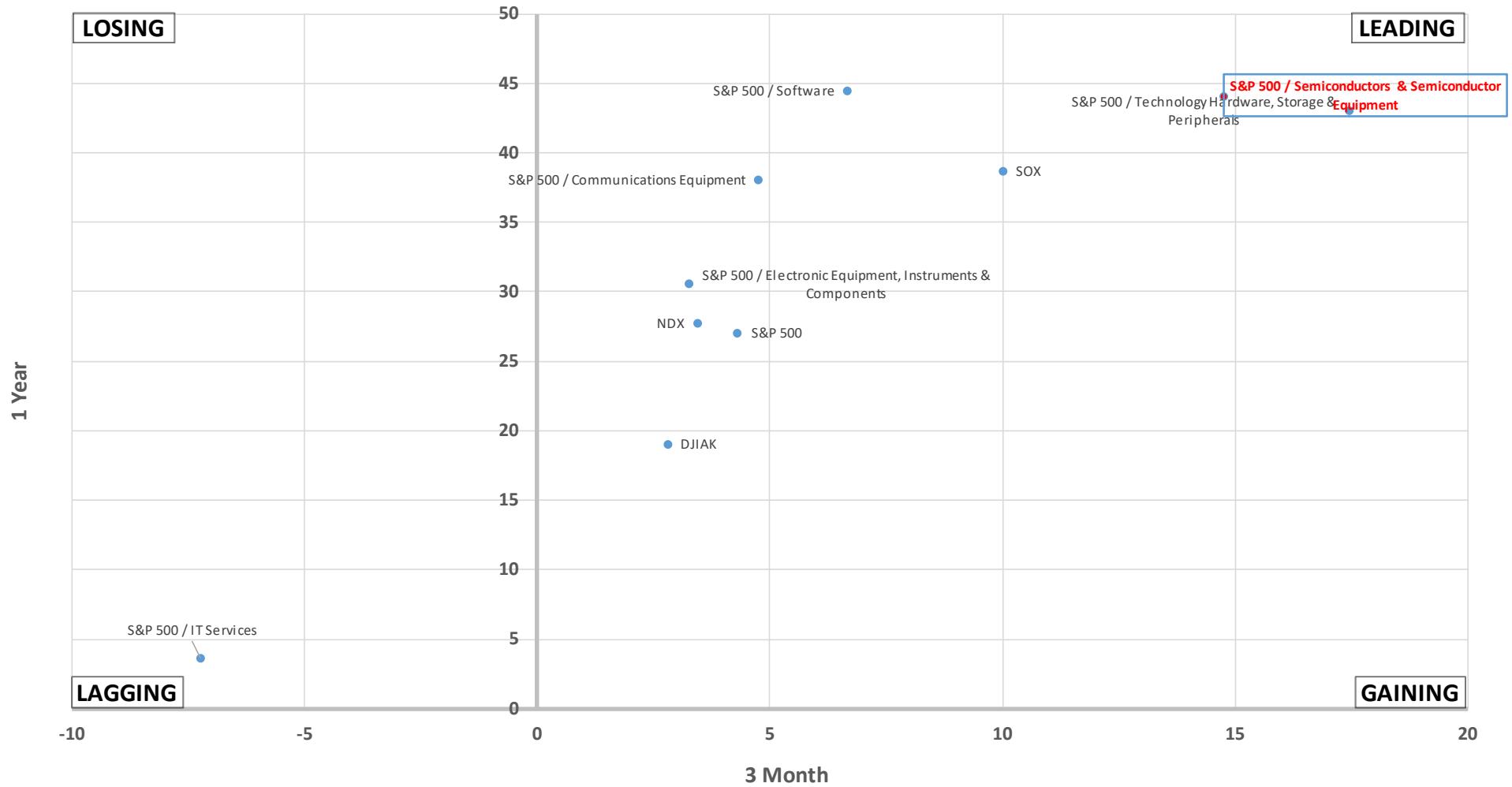
Source: Factset

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



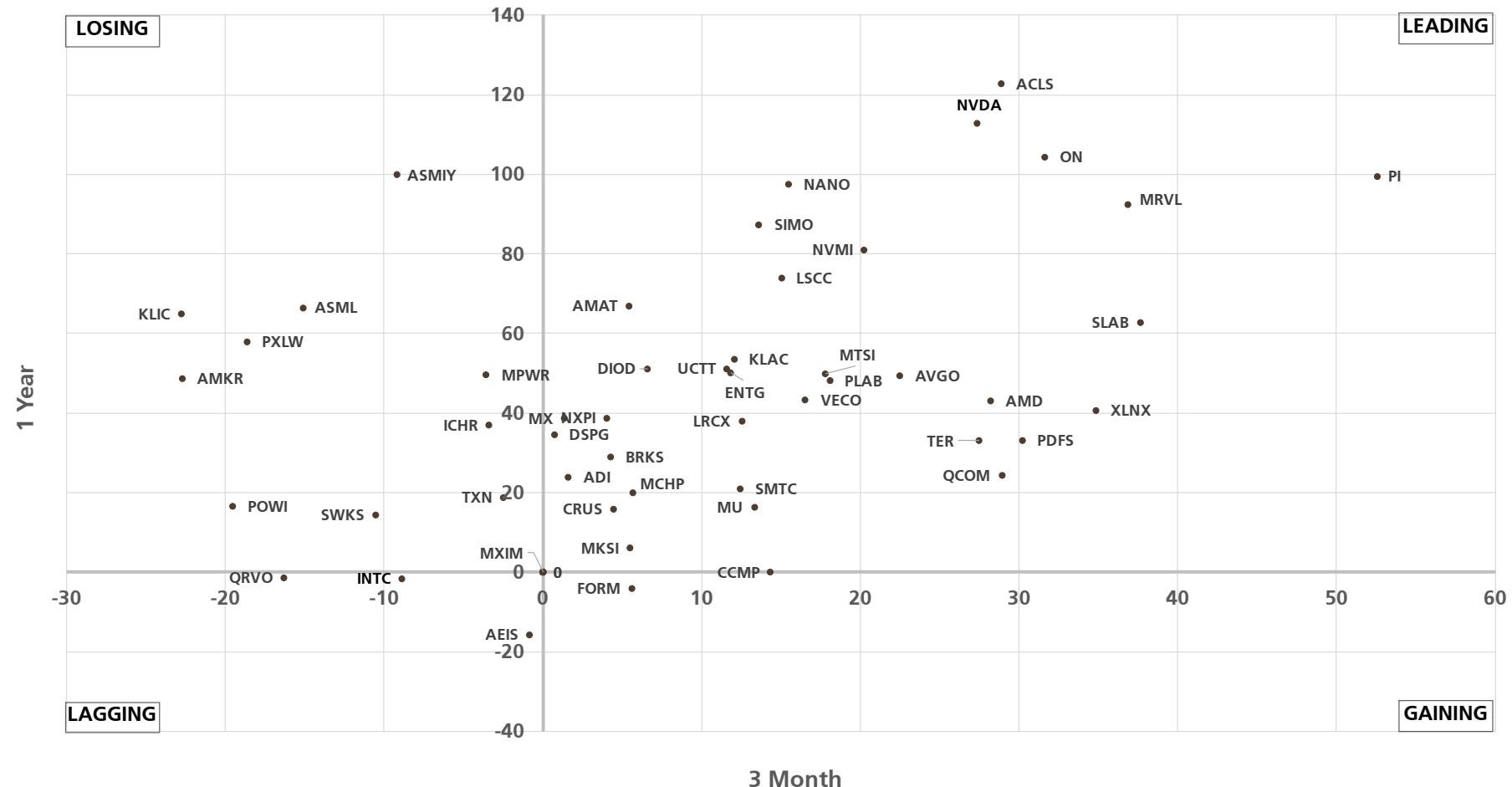
Source: Factset

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



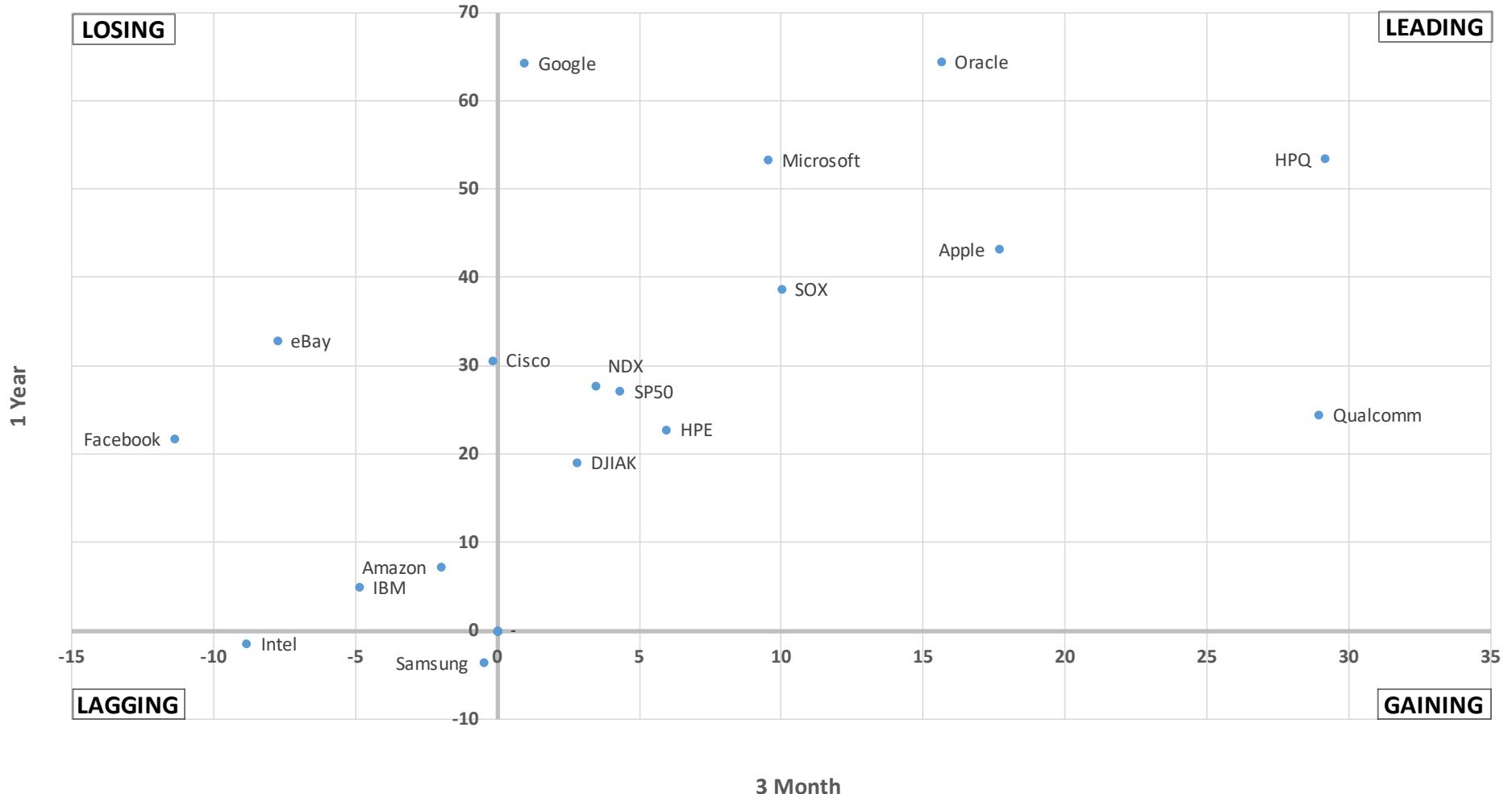
Source: Factset

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



Source: Factset

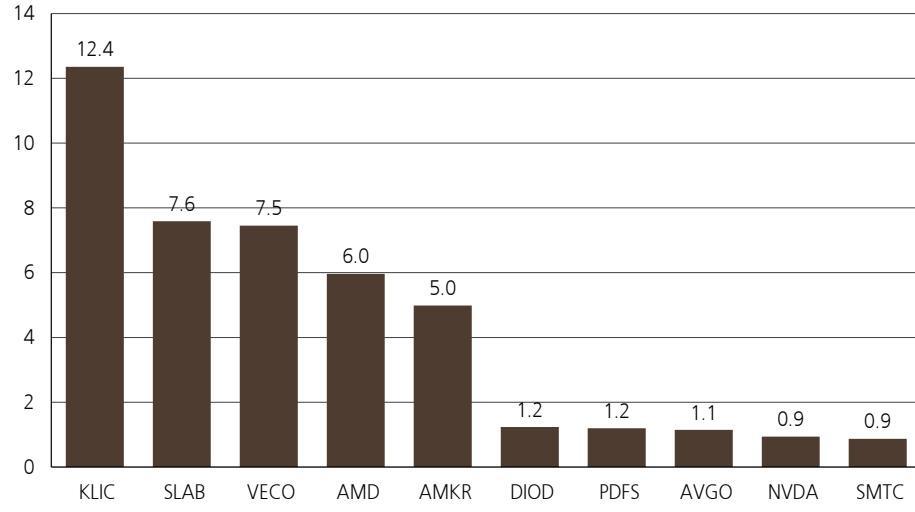
# Stock Performance Momentum: Large Cap Tech (12mo vs 3mo)



Source: Factset

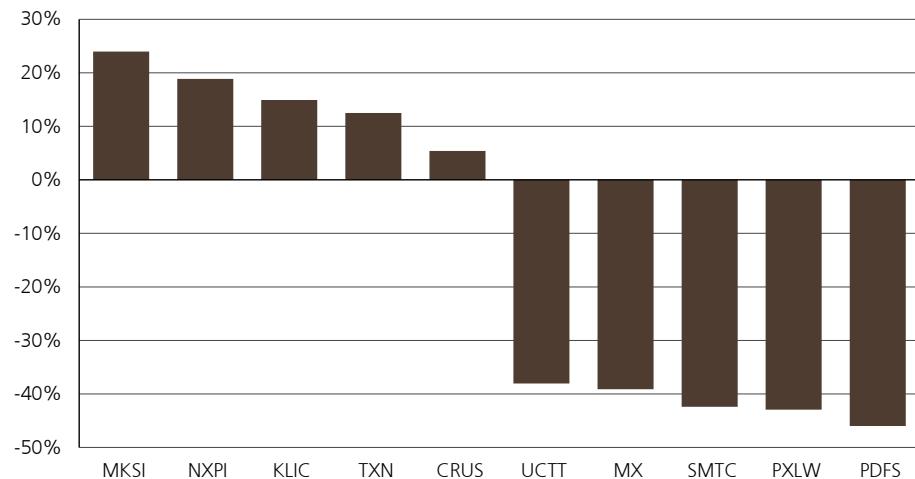
# Short Interest Highlights

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



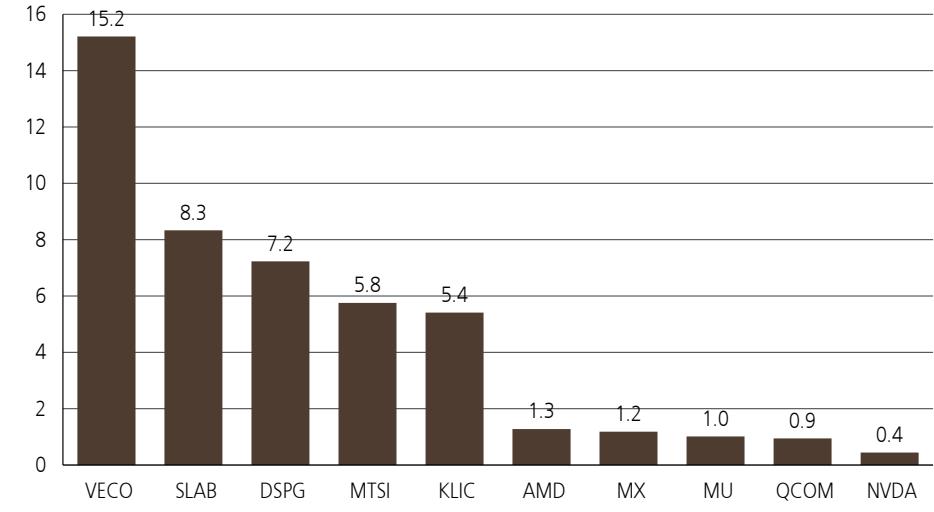
Source: Factset

Top/Bottom 5 Short Interest Change – Last 4 Weeks



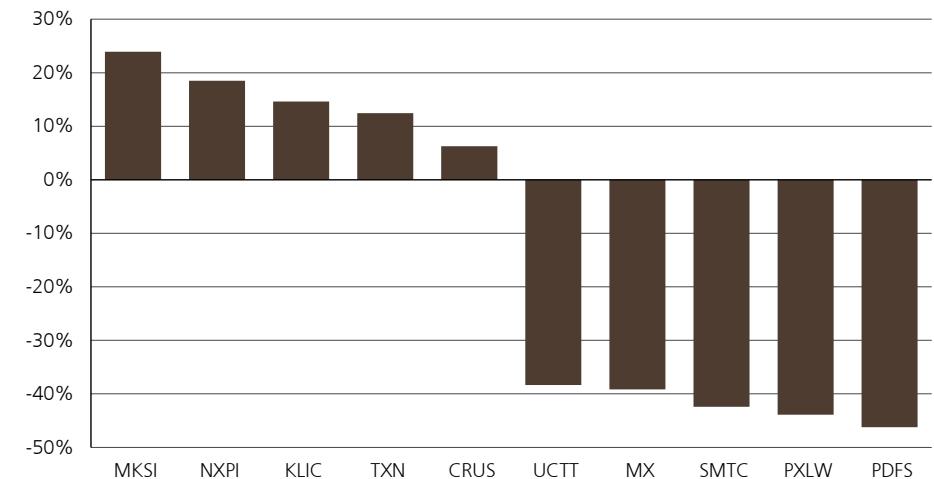
Source: Factset

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



Source: Factset

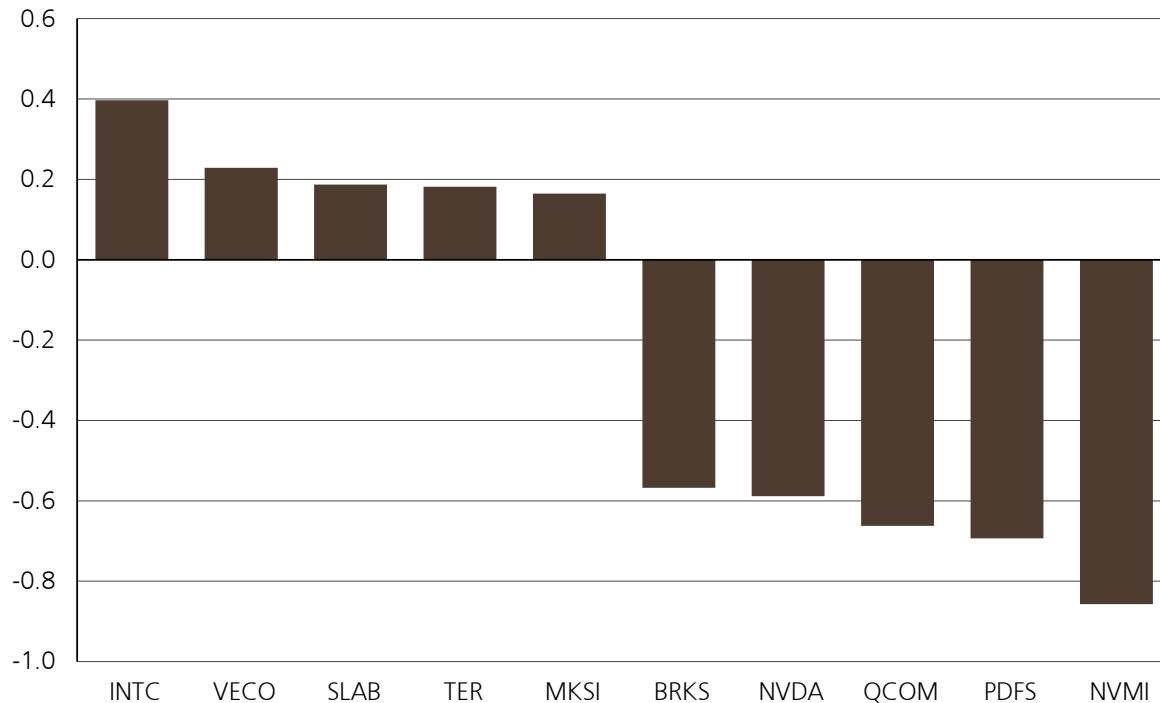
Top/Bottom 5 Short Interest % Float Change – Last 4 Weeks



Source: Factset

# Short Interest Highlights (continued)

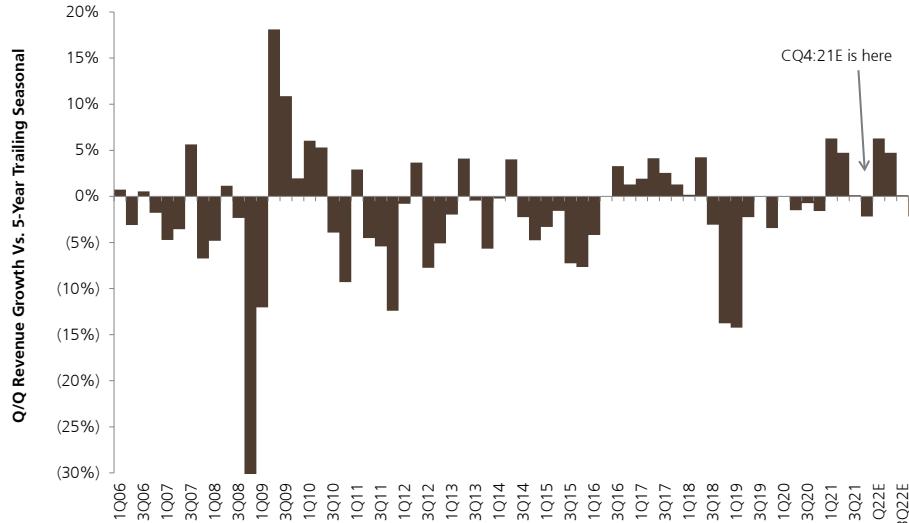
Top/Bottom 5 Short Interest Days to Cover – Last 4 Weeks



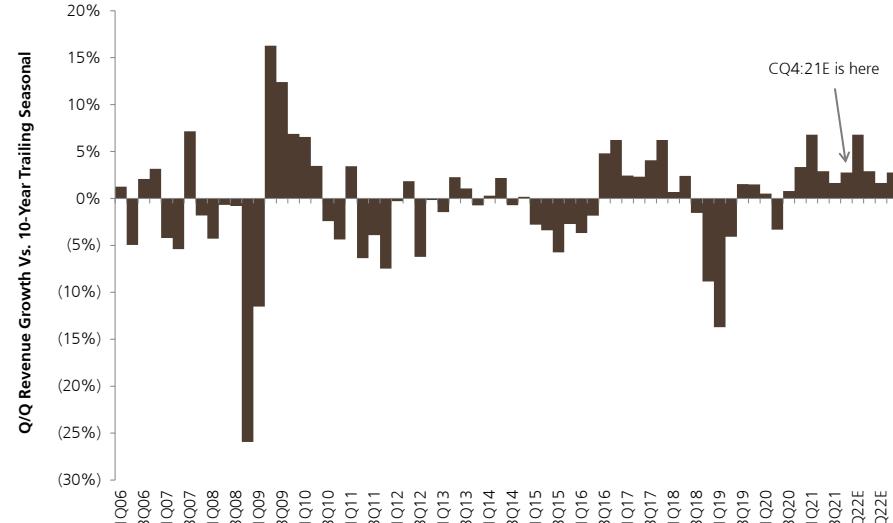
Source: Factset

# Street Estimates Versus Normal Seasonal (5 and 10Yr)

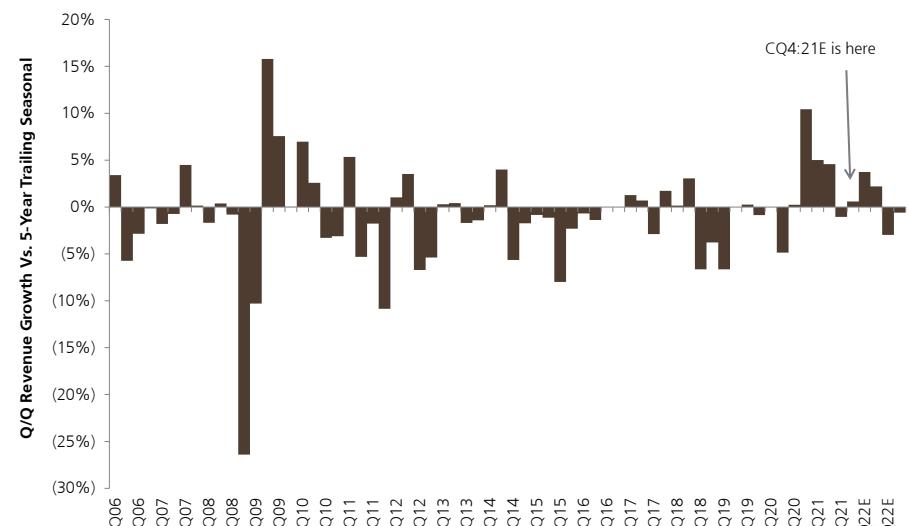
Historical Rev Q/Q vs 5-Year Seasonality (incl Memory)



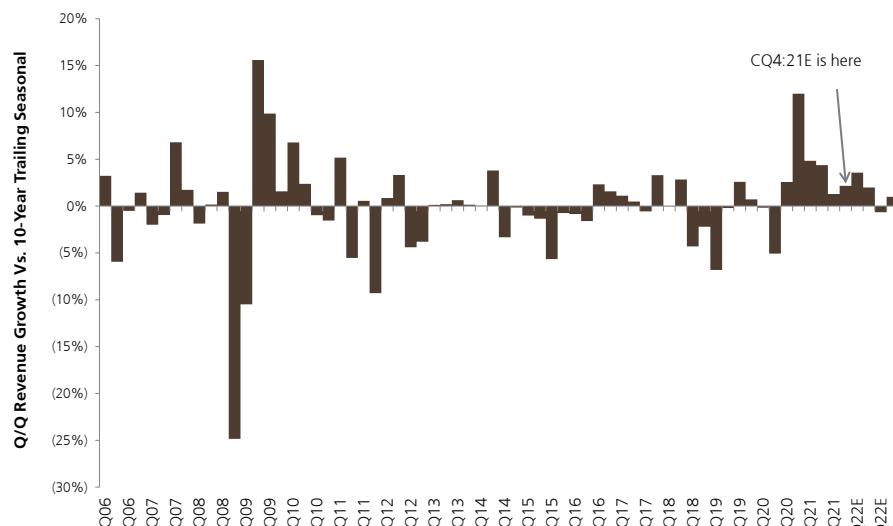
Historical Rev Q/Q vs 10-Year Seasonality (incl Memory)



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

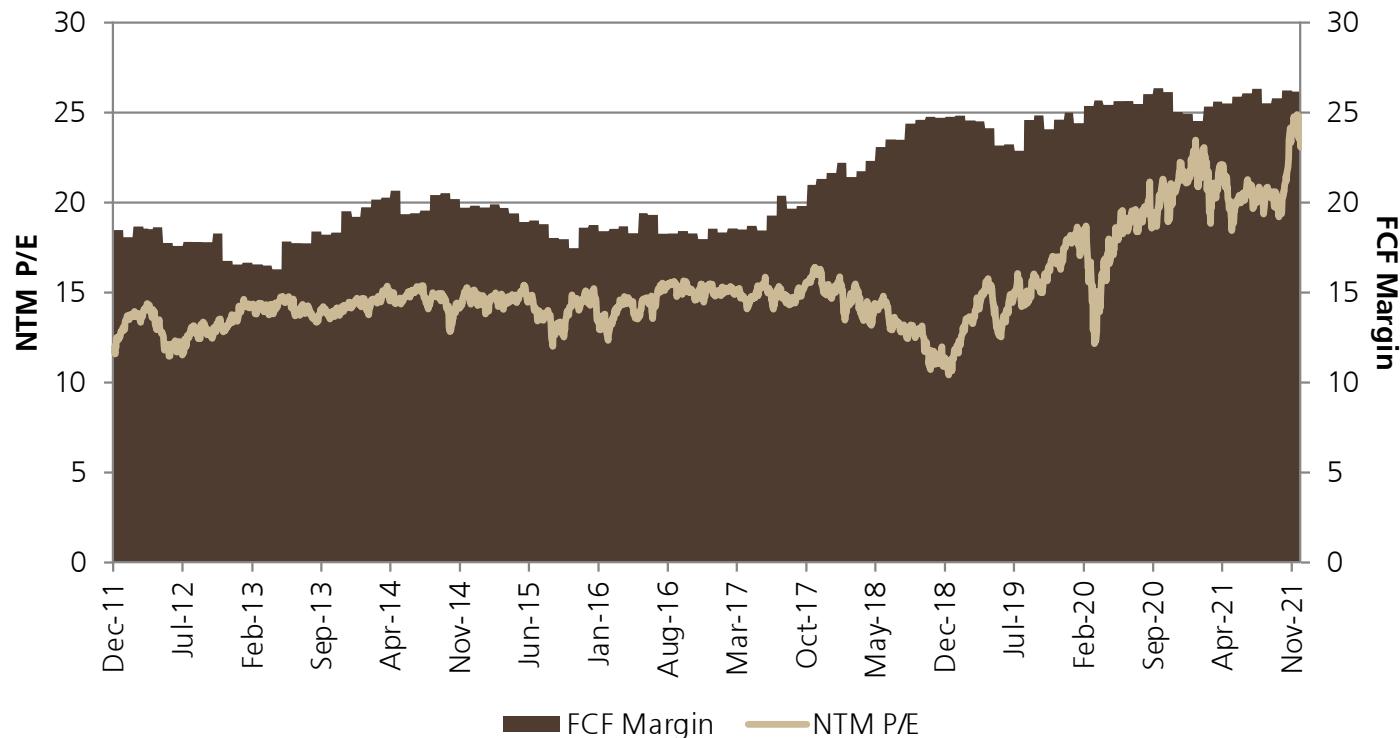


Historical Rev Q/Q vs 10-Year Seasonality (excl Memory)



# FCF Margin Has Expanded (Semis + SPE)

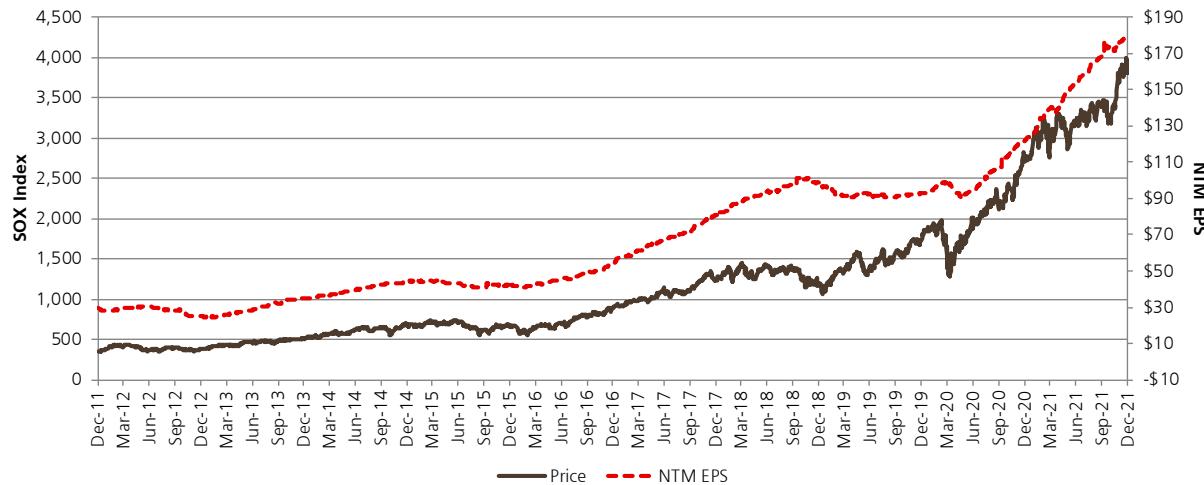
S&P 500 Semiconductors and Semi Equipment Industry Group – FCF Margin vs P/E



Source: Factset

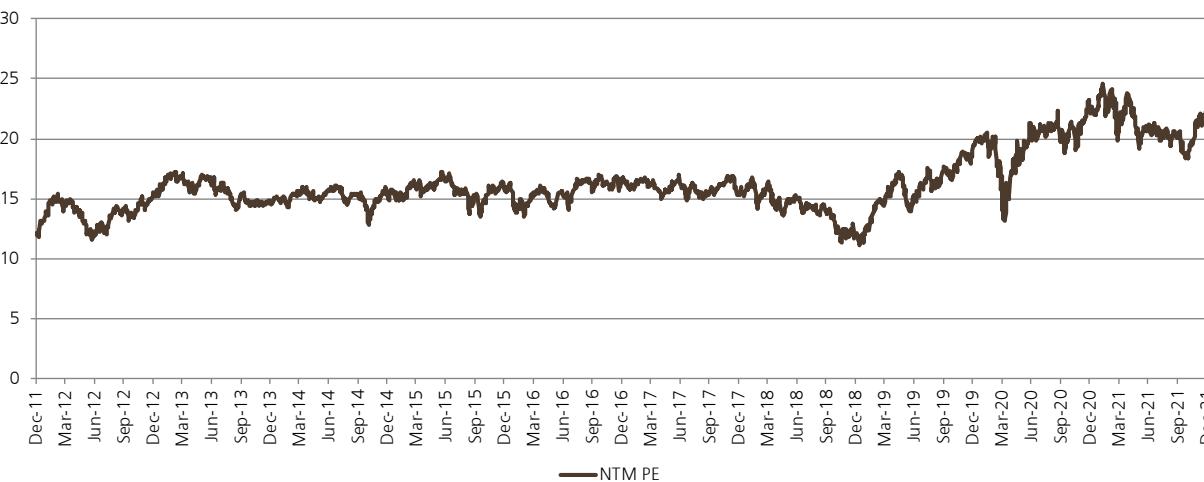
# SOX Index: P/E and NTM EPS (10 Year)

SOX v NTM EPS (10yr)



Source: Factset

SOX NTM P/E (10yr)

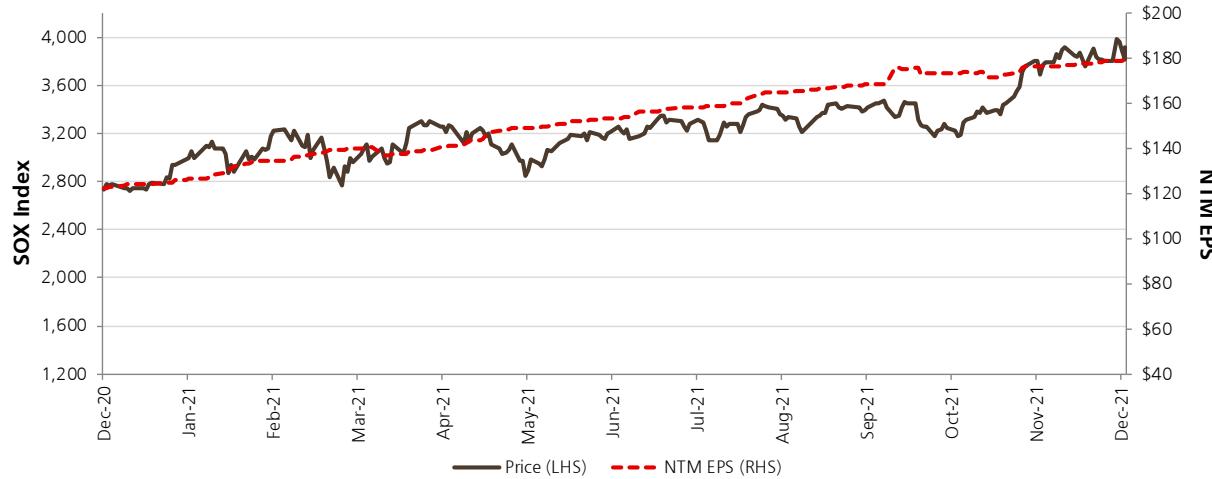


Source: Factset



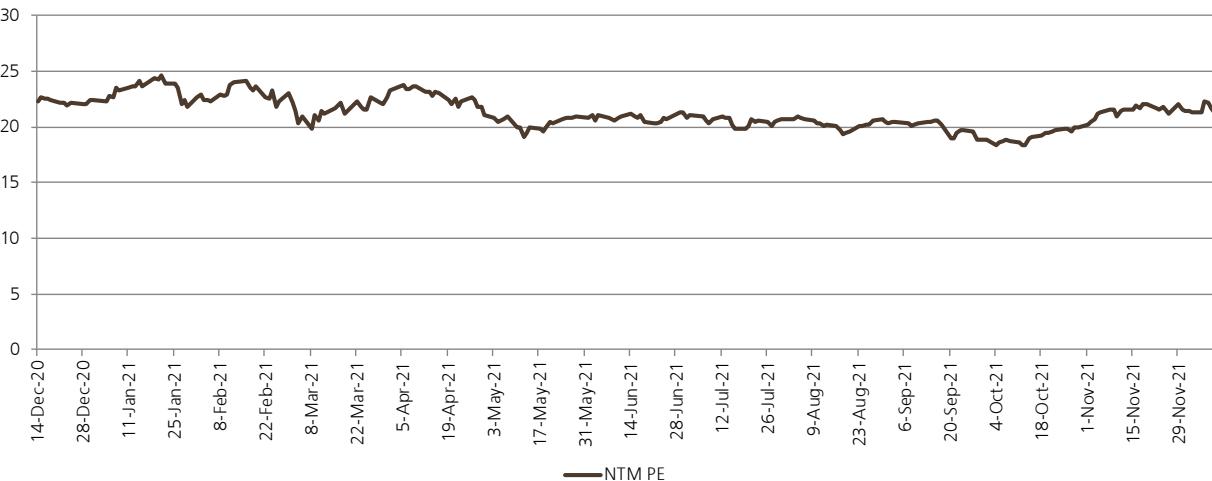
# SOX Index: P/E and NTM EPS (12mo)

SOX v NTM EPS (1yr)



Source: Factset

SOX NTM PE (1yr)

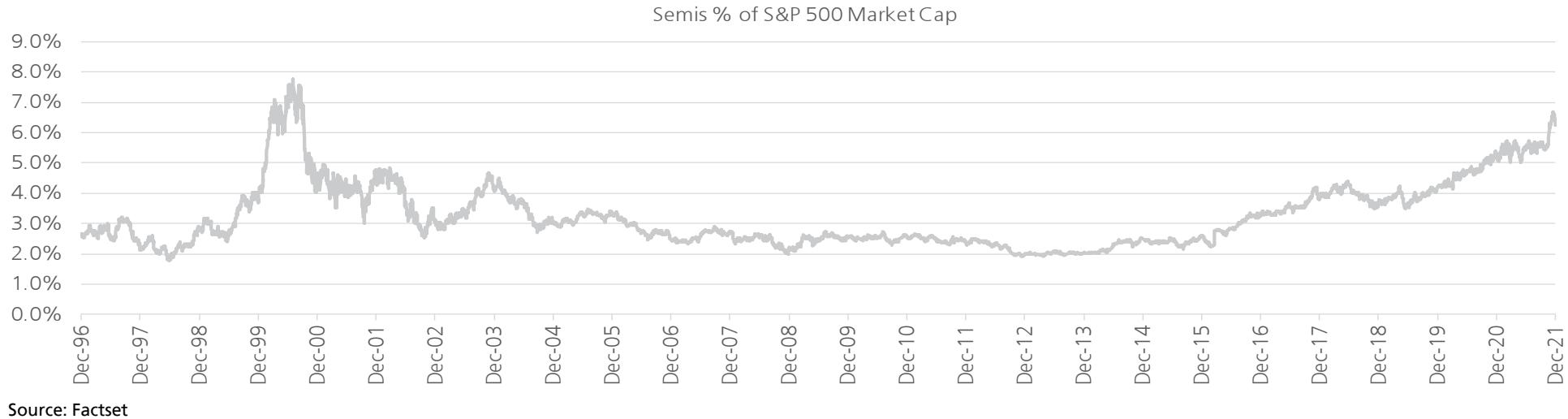


Source: Factset

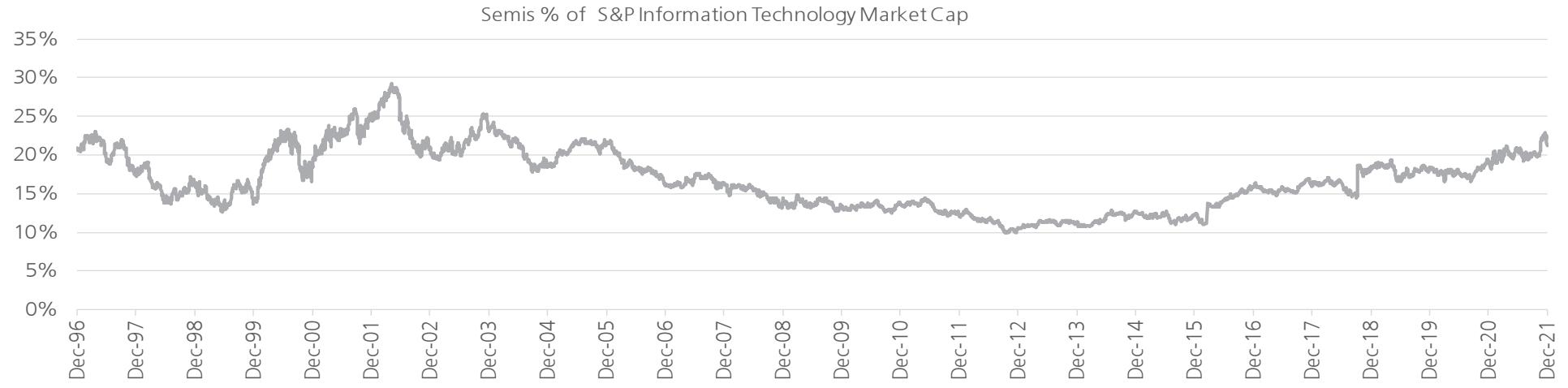


# Semis Weightings Among Key Indices

Semis are back near 1999/2000 levels in terms of their weighting of the S&P500 market cap



Within the tech component of S&P 500, semis have also grown in weighting and are back to 1999/2000 levels



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			
	2021E	2022E	2023E	2021E	2022E	2023E	2021E	2022E	2023E	2021E	2022E	2023E	2021E	2022E	2023E
S&P 500 / Communication Services -SEC	\$262.95	\$4,045,442	4.3	3.9x	3.6x	12.3x	11.5x	10.4x	22.1x	20.6x	18.0x	16%	8%	8%	
S&P 500 / Consumer Discretionary -SEC	\$1,565.80	\$4,945,817	3.1	2.8x	2.5x	21.4x	17.6x	15.2x	42.5x	32.1x	26.7x	19%	14%	8%	
S&P 500 / Consumer Staples -SEC	\$780.03	\$2,303,215	1.7	1.7x	1.6x	15.0x	14.4x	13.6x	22.4x	21.2x	19.6x	7%	4%	4%	
S&P 500 / Energy -SEC	\$417.09	\$1,066,250	1.4	1.3x	1.3x	6.7x	5.8x	6.1x	13.9x	11.0x	11.7x	59%	5%	-1%	
S&P 500 / Financials -SEC	\$644.40	\$4,293,550	3.3	3.3x	3.1x	NM	NM	NM	13.1x	14.4x	12.9x	10%	2%	6%	
S&P 500 / Health Care -SEC	\$1,572.25	\$5,129,505	2.7	2.6x	2.5x	13.6x	13.1x	13.2x	17.9x	16.9x	16.6x	14%	6%	4%	
S&P 500 / Industrials -SEC	\$870.72	\$3,067,271	2.8	2.5x	2.3x	16.8x	13.6x	12.2x	27.8x	20.4x	17.4x	14%	12%	5%	
S&P 500 / Information Technology -SEC	\$2,969.58	\$11,467,517	7.7	7.1x	6.5x	21.7x	19.7x	18.0x	30.5x	27.8x	24.9x	19%	9%	8%	
S&P 500 / Materials -SEC	\$548.54	\$1,000,515	2.6	2.5x	2.5x	10.6x	10.3x	10.5x	16.9x	16.4x	16.9x	28%	3%	0%	
S&P 500 / Real Estate - SEC	\$306.80	\$1,052,135	11.8	10.8x	10.1x	25.5x	23.6x	22.0x	25.0x	23.4x	21.7x	13%	9%	7%	
S&P 500 / Utilities -SEC	\$351.31	\$971,540	4.9	4.9x	4.7x	13.5x	12.4x	11.5x	21.3x	20.2x	18.9x	7%	1%	4%	
Industry Sectors			Mean	4.2	3.9x	3.7x	15.7x	14.2x	13.3x	23.0x	20.4x	18.7x	19%	7%	5%
			Median	3.1	2.8x	2.5x	14.3x	13.3x	12.7x	22.1x	20.4x	18.0x	14%	6%	5%

Source: Factset

## S&P Tech Sector Valuations

Company	Price	Market Cap (\$m)	EV/Sales			EV/EBITDA			Price/Earnings			Revenue Growth			
	2021E	2022E	2023E	2021E	2022E	2023E	2021E	2022E	2023E	2021E	2022E	2023E	2021E	2022E	2023E
S&P 500 / Communications Equipment -IND	\$599.85	\$341,502	5.0	4.7x	4.4x	14.1x	13.1x	12.6x	20.4x	18.9x	17.5x	6%	7%	5%	
S&P 500 / Electronic Equipment, Instruments & Components -IND	\$358.11	\$270,254	3.7	3.5x	3.3x	17.9x	16.4x	15.0x	27.2x	24.8x	22.3x	22%	7%	6%	
S&P 500 / IT Services -IND	\$622.25	\$1,732,416	6.1	5.6x	5.2x	19.3x	17.2x	15.5x	28.8x	24.9x	21.5x	9%	9%	8%	
S&P 500 / Semiconductors & Semiconductor Equipment -IND	\$2,531.23	\$2,460,516	7.9	7.1x	6.6x	17.8x	16.1x	14.9x	24.7x	23.0x	20.9x	25%	11%	7%	
S&P 500 / Software -IND	\$5,559.42	\$3,805,466	13.0	11.4x	10.0x	28.4x	24.6x	21.5x	41.1x	36.3x	31.4x	19%	15%	13%	
S&P 500 / Technology Hardware, Storage & Peripherals -IND	\$7,728.04	\$2,857,363	6.2	5.9x	5.7x	22.1x	21.3x	20.4x	28.8x	27.4x	25.6x	24%	5%	5%	
IT Sectors			Mean	7.0	6.4x	5.9x	19.9x	18.2x	16.7x	28.5x	25.9x	23.2x	17%	9%	7%
			Median	6.2	5.8x	5.4x	18.6x	16.8x	15.3x	28.0x	24.8x	21.9x	20%	8%	7%

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)		Gross Margin		ROE		Revenue Growth	
	(lc)	Cap (\$m)	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	Current	2022E	2023E	2022E	2023E	2022E	2023E	
Advanced Micro Dev.	135.60	\$163,752	8.9x	7.9x	34.2x	28.7x	43.9x	35.7x	41.1x	34.4x	0.0%	0.0%	2.3%	2.8%	25.9%	27.5%	2%	50.1%	52.3%	43.1%	39.7%	14%	13%	
ams AG	16.33	\$4,846	1.1x	1.1x	5.7x	4.9x	36.5x	13.3x	12.1x	8.9x	0.0%	0.5%	3.8%	10.4%	19.8%	21.9%	-43%	33.2%	34.4%	11.2%	14.0%	0%	6%	
Broadcom	614.91	\$253,107	9.1x	8.8x	11.8x	11.7x	11.8x	11.7x	16.7x	15.9x	2.7%	2.9%	6.0%	6.5%	nm	nm	-13%	75.1%	75.5%	69.4%	82.6%	12%	4%	
Cirrus Logic	90.92	\$5,195	3.0x	3.0x	11.9x	nm	nm	nm	16.1x	15.7x	0.0%	nm	nm	nm	25.6%	nm	6%	50.0%	50.1%	19.2%	nm	10%	1%	
Dialog Semiconductor	#N/A	#N/A	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	
Intel	50	\$202,130	2.9x	2.7x	6.9x	6.4x	102.4x	67.4x	13.4x	12.9x	2.9%	3.0%	1.0%	1.5%	41.1%	42.5%	-1%	52.4%	52.5%	15.0%	14.0%	0%	4%	
Marvell Technology	85.29	\$71,968	11.9x	10.0x	nm	31.5x	38.1x	32.6x	38.3x	30.5x	0.3%	0.3%	2.5%	2.9%	nm	31.8%	-6%	64.3%	66.2%	11.2%	13.0%	35%	18%	
MediaTek	1,070	\$60,947	2.6x	2.4x	10.8x	10.1x	12.9x	12.5x	14.3x	13.6x	7.2%	7.5%	7.1%	7.3%	24.2%	23.4%	12%	46.5%	45.9%	26.3%	27.5%	21%	10%	
NVIDIA	283.37	\$708,425	22.8x	19.5x	44.0x	38.3x	59.4x	49.8x	55.8x	46.0x	0.1%	0.1%	1.7%	2.0%	51.7%	50.9%	1%	67.2%	67.8%	35.8%	31.7%	21%	17%	
Qorvo	152	\$16,806	3.6x	3.4x	nm	nm	13.2x	9.7x	12.1x	11.2x	nm	nm	8.1%	11.1%	nm	nm	-4%	52.0%	52.7%	27.1%	26.3%	10%	8%	
Qualcomm	181.98	\$203,818	5.2x	4.8x	12.7x	12.5x	14.1x	14.1x	17.0x	16.4x	1.8%	1.8%	5.9%	6.3%	28.8%	28.8%	-1%	58.3%	59.4%	65.2%	49.3%	24%	7%	
Skyworks Solutions	159	\$26,359	4.8x	4.5x	8.9x	8.5x	11.4x	nm	13.5x	12.2x	1.4%	1.4%	7.4%	nn	28.8%	28.8%	-5%	51.3%	51.7%	28.9%	28.1%	8%	7%	
Texas Instruments	190.27	\$175,719	9.0x	8.7x	16.8x	16.3x	21.2x	20.8x	22.2x	22.0x	2.5%	2.9%	3.8%	4.3%	53.8%	52.9%	1%	67.0%	66.8%	55.6%	49.1%	7%	4%	
TSMC	599	\$559,498	8.0x	7.1x	11.1x	9.2x	74.9x	42.8x	21.0x	18.4x	2.2%	2.3%	1.3%	2.3%	72.2%	76.5%	2%	52.6%	52.0%	28.6%	27.4%	20%	13%	
UMC	62.40	\$28,147	2.9x	2.7x	6.3x	5.6x	13.5x	12.3x	12.5x	11.3x	5.8%	7.1%	6.7%	7.3%	46.0%	47.1%	12%	37.9%	35.0%	21.0%	22.3%	15%	10%	
<b>Processor/Wireless/Comms</b>		<b>Mean</b>	<b>6.8x</b>	<b>6.2x</b>	<b>15.1x</b>	<b>15.3x</b>	<b>34.9x</b>	<b>26.9x</b>	<b>21.9x</b>	<b>19.2x</b>	<b>2.1%</b>	<b>2.5%</b>	<b>4.4%</b>	<b>5.4%</b>	<b>38.0%</b>	<b>39.3%</b>	<b>-3%</b>	<b>54.1%</b>	<b>54.5%</b>	<b>32.7%</b>	<b>32.7%</b>	<b>14%</b>	<b>9%</b>	
<b>Processor/Wireless/Comms</b>		<b>Median</b>	<b>5.0x</b>	<b>4.7x</b>	<b>11.4x</b>	<b>10.9x</b>	<b>21.2x</b>	<b>17.5x</b>	<b>16.4x</b>	<b>15.8x</b>	<b>1.8%</b>	<b>2.1%</b>	<b>3.8%</b>	<b>5.3%</b>	<b>28.8%</b>	<b>31.8%</b>	<b>0%</b>	<b>52.2%</b>	<b>52.4%</b>	<b>27.9%</b>	<b>27.5%</b>	<b>13%</b>	<b>8%</b>	

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)		Gross Margin		ROE		Revenue Growth	
	(lc)	Cap (\$m)	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	Current	2022E	2023E	2022E	2023E	2022E	2023E	
ams AG	16.33	\$4,846	1.1x	1.1x	5.7x	4.9x	36.5x	13.3x	12.1x	8.9x	0.0%	0.5%	3.8%	10.4%	19.8%	21.9%	-43%	33.2%	34.4%	11.2%	14.0%	0%	6%	
Broadcom	614.91	\$253,107	9.1x	8.8x	11.8x	11.7x	11.8x	11.7x	16.7x	15.9x	2.7%	2.9%	6.0%	6.5%	nm	nm	-13%	75.1%	75.5%	69.4%	82.6%	12%	4%	
Cirrus Logic	90.92	\$5,195	3.0x	3.0x	11.9x	nm	nm	nm	16.1x	15.7x	0.0%	nm	nm	nm	25.6%	nm	6%	50.0%	50.1%	19.2%	nm	10%	1%	
Dialog Semiconductor	#N/A	#N/A	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	
Qualcomm	181.98	\$203,818	5.2x	4.8x	12.7x	12.5x	14.1x	14.1x	17.0x	16.4x	1.8%	1.8%	5.9%	6.3%	28.8%	28.8%	-1%	58.3%	59.4%	65.2%	49.3%	24%	7%	
Skyworks Solutions	159	\$26,359	4.8x	4.5x	8.9x	8.5x	11.4x	nm	13.5x	12.2x	1.4%	1.4%	7.4%	7.4%	nm	28.8%	28.8%	-5%	51.3%	51.7%	28.9%	28.1%	8%	7%
Qorvo	152.47	\$16,806	3.6x	3.4x	nm	nm	13.2x	9.7x	12.1x	11.2x	nm	nm	8.1%	11.1%	nm	nm	-4%	52.0%	52.7%	27.1%	26.3%	10%	8%	
Catcher	155	\$4,204	nm	nm	nm	nm	1.6x	1.3x	nm	nm	9.2%	11.4%	nm	nm	91%	91%	34.7%	35.8%	nm	nm	nm	nm		
Foxconn Technology	64.20	\$3,250	0.3x	0.3x	3.9x	3.6x	4.0x	3.7x	11.1x	10.4x	4.4%	4.7%	9.3%	10.1%	nm	nm	110%	nm	nm	nm	4%	8%		
Zhen Ding Technology	97	\$3,273	0.8x	0.7x	4.3x	3.9x	nm	25.0x	8.7x	7.5x	5.6%	6.5%	-1.7%	5.8%	19.2%	19.9%	-8%	20.3%	21.2%	12.3%	13.8%	9%	10%	
Largan	2045.00	\$9,817	3.6x	3.4x	6.0x	5.6x	9.2x	7.7x	14.3x	13.5x	3.4%	3.5%	7.0%	8.3%	61.0%	61.1%	42%	61.3%	65.6%	13.1%	13.0%	3%	7%	
Goertek	57.06	\$30,445	1.9x	1.5x	23.9x	20.4x	79.3x	73.5x	36.9x	30.3x	0.5%	0.7%	1.2%	1.3%	7.9%	7.3%	0%	16.1%	15.1%	15.9%	17.4%	30%	26%	
Luxshare	46.35	\$50,261	2.2x	1.9x	19.8x	17.0x	82.4x	48.7x	28.1x	22.7x	0.4%	0.5%	1.3%	2.2%	11.3%	11.2%	-2%	17.3%	17.1%	24.8%	24.0%	21%	18%	
AAC	32	\$4,886	1.6x	1.5x	7.3x	6.6x	20.1x	15.1x	17.4x	14.5x	2.1%	2.5%	5.6%	7.4%	22.2%	21.9%	-5%	25.8%	26.3%	5.7%	6.6%	20%	12%	
<b>Apple suppliers</b>		<b>Mean</b>	<b>3.1x</b>	<b>2.9x</b>	<b>10.6x</b>	<b>9.4x</b>	<b>25.8x</b>	<b>20.3x</b>	<b>17.0x</b>	<b>14.9x</b>	<b>2.0%</b>	<b>2.5%</b>	<b>5.3%</b>	<b>7.4%</b>	<b>25.0%</b>	<b>25.1%</b>	<b>13%</b>	<b>41.3%</b>	<b>42.1%</b>	<b>26.6%</b>	<b>27.5%</b>	<b>13%</b>	<b>9%</b>	
<b>Apple suppliers</b>		<b>Median</b>	<b>2.6x</b>	<b>2.4x</b>	<b>8.9x</b>	<b>7.5x</b>	<b>13.2x</b>	<b>13.3x</b>	<b>15.2x</b>	<b>14.0x</b>	<b>1.8%</b>	<b>2.2%</b>	<b>5.9%</b>	<b>7.4%</b>	<b>22.2%</b>	<b>21.9%</b>	<b>-2%</b>	<b>42.4%</b>	<b>42.9%</b>	<b>19.2%</b>	<b>20.7%</b>	<b>10%</b>	<b>8%</b>	

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	176.28	\$92,605	7.1x	6.7x	14.1x	13.2x	20.7x	16.4x	22.9x	20.5x	1.7%	1.9%	4.0%	5.0%	50.1%	50.4%	-5%	71.8%	72.4%	11.6%	11.9%	42%	6%	
Infinion	38.70	\$56,975	4.2x	nm	13.3x	nm	48.5x	33.7x	23.5x	21.6x	1.3%	nm	2.2%	3.2%	31.6%	nm	-9%	43.5%	43.8%	18.3%	nm	16%	8%	
Microchip Technology	84.89	\$47,103	7.8x	7.4x	17.4x	15.1x	22.7x	21.1x	17.6x	16.6x	1.2%	1.5%	5.2%	5.6%	44.7%	49.0%	-17%	66.1%	67.1%	38.1%	35.3%	12%	5%	
Melexis	98.85	\$4,502	5.5x	5.2x	17.8x	17.6x	33.0x	29.7x	29.4x	28.3x	3.3%	2.4%	3.0%	3.3%	30.7%	29.5%	1%	42.3%	42.7%	31.8%	30.1%	12%	5%	
NXP	219.99	\$58,503	5.6x	5.3x	14.4x	13.7x	24.5x	20.8x	18.2x	16.7x	1.1%	1.1%	4.8%	5.7%	38.8%	38.4%	-12%	56.3%	56.4%	43.2%	40.7%	12%	7%	
ON Semi	62.98	\$27,134	4.2x	4.0x	12.5x	11.7x	24.6x	22.0x	19.3x	18.0x	0.0%	0.0%	4.4%	5.0%	33.1%	34.1%	-7%	43.2%	43.2%	26.3%	21.7%	7%	4%	
Renesas Electronics	1418.00	\$24,266	2.9x	2.8x	7.7x	7.7x	13.3x	12.3x	13.8x	13.7x	0.0%	0.0%	8.9%	9.6%	37.2%	36.6%	-23%	53.1%	53.4%	15.7%	13.7%	16%	2%	
Rohm	10430.00	\$9,565	1.7x	1.7x	6.6x	6.1x	46.8x	20.2x	18.7x	17.3x	1.7%	1.9%	1.5%	3.5%	26.1%	27.3%	36%	37.5%	40.0%	6.6%	6.8%	6%	4%	
STMicroelectronics	41.71	\$42,816	3.1x	3.1x	10.6x	10.8x	33.9x	24.8x	19.9x	20.8x	0.5%	0.5%	3.0%	4.0%	29.6%	28.3%	2%	42.6%	43.3%	19.6%	15.9%	8%	2%	
TE Connectivity	157.10	\$51,264	3.5x	3.2x	15.1x	13.8x	23.8x	21.9x	21.5x	19.0x	1.3%	1.3%	4.6%	5.0%	23.0%	23.5%	-6%	33.6%	34.6%	20.0%	20.2%	6%	7%	
Texas Instruments	190.27	\$175,719	9.2x	8.8x	17.0x	16.6x	26.2x	23.4x	23.1x	22.1x	2.5%	2.9%	3.8%	4.3%	53.9%	53.3%	1%	67.0%	66.8%	48.6%	46.9%	7%	4%	
<b>Analog Semis</b>		<b>Mean</b>	<b>5.0x</b>	<b>4.8x</b>	<b>13.3x</b>	<b>12.6x</b>	<b>28.9x</b>	<b>22.4x</b>	<b>20.7x</b>	<b>19.5x</b>	<b>1.3%</b>	<b>1.3%</b>	<b>4.1%</b>	<b>4.9%</b>	<b>36.3%</b>	<b>37.0%</b>	<b>-4%</b>	<b>50.6%</b>	<b>51.2%</b>	<b>25.4%</b>	<b>24.3%</b>	<b>13%</b>	<b>5%</b>	
<b>Analog Semis</b>		<b>Median</b>	<b>4.2</b>	<b>4.6</b>	<b>14.1</b>	<b>13.5</b>	<b>24.6</b>	<b>21.9</b>	<b>19.9</b>	<b>19.0</b>	<b>1.3%</b>	<b>1.4%</b>	<b>4.0%</b>	<b>5.0%</b>	<b>33.1%</b>	<b>35.3%</b>	<b>-6%</b>	<b>43.5%</b>	<b>43.8%</b>	<b>20.0%</b>	<b>20.9%</b>	<b>12%</b>	<b>5%</b>	

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	121000.00	\$76,023	1.8x	1.7x	3.3x	3.5x	14.4x	9.5x	7.8x	8.3x	1.2%	1.2%	7.0%	10.6%	54.4%	49.1%	1%	44.3%	45.8%	15.6%	12.9%	17%	5%		
Nanya Tech	74.80	\$8,466	1.9x	1.6x	4.2x	3.3x	16.9x	6.2x	12.6x	8.9x	3.9%	4.8%	4.1%	11.3%	46.0%	47.5%	30%	36.6%	40.0%	10.3%	13.1%	-1%	23%		
Micron Technology	83.29	\$93,299	2.6x	2.2x	4.5x	3.5x	18.7x	14.6x	7.5x	5.3x	0.5%	0.5%	5.4%	6.9%	58.4%	62.6%	3%	47.8%	48.2%	22.9%	26.8%	18%	20%		
Samsung Electronics	77,000	\$391,709	1.4x	1.3x	4.8x	4.7x	14.5x	10.0x	11.8x	11.8x	2.8%	3.3%	5.7%	8.3%	28.9%	28.2%	25%	41.6%	42.6%	11.6%	10.5%	11%	5%		
<b>Memory Semis</b>		<b>Mean</b>	<b>1.9x</b>	<b>1.7x</b>	<b>4.2x</b>	<b>3.8x</b>	<b>16.1x</b>	<b>10.1x</b>	<b>9.9x</b>	<b>8.6x</b>	<b>2.1%</b>	<b>2.4%</b>	<b>5.6%</b>	<b>5.6%</b>	<b>9.3%</b>	<b>9.3%</b>	<b>46.9%</b>	<b>46.8%</b>	<b>15%</b>	<b>42.6%</b>	<b>44.2%</b>	<b>15.1%</b>	<b>15.8%</b>	<b>11%</b>	<b>13%</b>
<b>Memory Semis</b>		<b>Median</b>	<b>1.9x</b>	<b>1.6x</b>	<b>4.4x</b>	<b>3.5x</b>	<b>15.7x</b>	<b>9.8x</b>	<b>9.8x</b>	<b>8.6x</b>	<b>2.0%</b>	<b>2.2%</b>	<b>5.6%</b>	<b>5.6%</b>	<b>9.5%</b>	<b>9.5%</b>	<b>50.2%</b>	<b>48.3%</b>	<b>14%</b>	<b>42.9%</b>	<b>44.2%</b>	<b>13.6%</b>	<b>13.0%</b>	<b>14%</b>	<b>12%</b>

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	10220.00	\$17,635	4.2x	4.0x	12.6x	11.7x	21.9x	19.0x	20.3x	18.7x	1.6%	1.7%	4.2%	4.9%	33.4%	34.3%	-7%	56.5%	57.8%	29.3%	26.4%	14%	5%	
Applied Materials	147.73	\$133,390	5.0x	4.8x	14.7x	14.6x	15.0x	14.9x	17.1x	16.9x	0.9%	1.0%	5.1%	5.5%	33.6%	32.7%	2%	47.7%	48.2%	61.1%	59.7%	15%	2%	
ASM International	356.70	\$19,824	8.2x	7.4x	23.9x	21.3x	35.9x	32.0x	30.9x	27.5x	0.9%	1.0%	2.7%	3.0%	34.5%	34.9%	3%	46.1%	45.7%	22.9%	23.1%	20%	11%	
ASM Pacific Tech	81.20	\$4,249	1.4x	1.3x	6.6x	6.2x	9.7x	16.2x	10.7x	9.9x	4.9%	5.3%	10.4%	6.3%	21.5%	21.6%	0%	39.5%	40.3%	19.1%	18.7%	10%	5%	
ASML	661.00	\$308,004	12.0x	11.6x	30.2x	28.7x	50.9x	43.8x	36.7x	35.2x	0.6%	0.7%	2.0%	2.3%	39.8%	40.5%	0%	53.1%	53.7%	48.4%	40.6%	20%	2%	
Disco	32,600	\$10,380	4.3x	4.1x	11.5x	10.8x	20.0x	18.2x	19.1x	17.8x	2.5%	3.0%	4.5%	5.0%	37.4%	38.0%	10%	59.5%	60.3%	19.9%	19.5%	9%	5%	
Eugene Tech	47450.00	\$97	2.1x	1.8x	7.9x	7.0x	11.6x	7.3x	11.7x	0.7%	0.8%	7.6%	12.0%	26.2%	26.2%	11%	49.2%	46.5%	23.9%	21.7%	3%	14%		
Jusung Engineering	19,300	\$791	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	14%	nm	nm	nm	nm	nm	nm	
KLA Corp	399.46	\$60,567	6.6x	6.4x	15.1x	15.0x	24.7x	24.3x	18.4x	18.1x	1.1%	1.0%	4.2%	4.3%	43.7%	42.9%	-2%	62.6%	61.9%	60.5%	51.0%	27%	2%	
LAM Research Corp.	679	\$95,632	5.1x	4.9x	14.6x	14.0x	21.7x	19.9x	17.2x	16.2x	0.9%	1.0%	4.7%	5.2%	34.9%	35.0%	0%	46.5%	46.9%	87.5%	82.2%	14%	4%	
Nikon	1177.00	\$3,996	0.4x	0.4x	3.3x	3.1x	15.4x	6.4x	13.7x	13.0x	3.2%	3.4%	3.1%	7.4%	12.1%	12.6%	73%	42.3%	42.7%	5.6%	5.7%	5%	0%	
Screen	11,690	\$5,222	1.2x	1.2x	6.4x	6.4x	16.2x	12.7x	10.9x	10.8x	2.3%	2.3%	5.4%	6.9%	18.0%	18.1%	18%	30.9%	31.2%	18.4%	16.4%	12%	0%	
Teradyne	155.94	\$25,419	6.1x	6.1x	16.3x	16.2x	25.5x	31.3x	20.2x	19.7x	0.4%	0.4%	4.3%	3.5%	37.6%	37.4%	5%	58.7%	59.9%	46.9%	41.2%	23%	1%	
Tokyo Electron	61,540	\$84,844	nm	nm	nm	nm	26.8x	21.2x	na	nm	3.6%	4.5%	nm	nm	4%	46.8%	47.3%	nm	nm	nm	nm	nm	nm	
VAT Group	430.60	\$13,981	12.6x	13.0x	35.9x	37.0x	57.3x	48.7x	49.2x	50.4x	1.4%	1.5%	1.8%	2.1%	35.2%	35.3%	-1%	62.7%	63.3%	35.9%	32.2%	16%	-3%	
Wonik IPS	41,300	\$1,716	1.3x	1.4x	7.6x																			

## Section 2

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# Semiconductor and SPE Industry Forecasts

# Key Messages

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- Semiconductor revenue has been above 10-yr seasonal for past 5 Qs despite supply constraints; we are now tracking to ~25% Y/Y growth this year (~\$550B), albeit still partially gated by supply constraints
  - We model semis revenue +12% in 2022E and +5% in 2023E despite memory revenue that should start to flatten off in this timeframe
  - Y/Y comps become much more challenging in '22E but will remain positive through most of '23E
- WFE is tracking up ~41% this year (~\$84.5B) as chipmakers have scrambled to add capacity to alleviate constraints and hedge against geo-political risk
  - We model WFE up another ~14% in 2022E but down ~1% in 2023E due mostly to memory
- This implies WFE intensity of ~15.4% in '21E and ~15.7% in '22E with moderation likely in '23 as supply starts to catch up with demand, backlogs normalize, inventory builds to structurally higher levels, and the cycle starts to move the other way through '23E.
  - We view 13.5-14% as "normalized" which reflects some secular growth in WFE intensity from the 11.3% LT median through 2018
  - WFE intensity in foundry/logic is much higher than historic 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	2021E	2022E	2023E
<b>Global GDP (Nominal)</b>	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	89,797.9	94,106.7	97,454.3
real 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%	6.0%	4.8%	3.6%
<b>US GDP (nominal)</b>	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	22,885.7	24,437.1	25,824.7
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%	9.5%	6.8%	5.7%
% of Glob 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%	25.5%	26.0%	26.5%
<b>Semiconductor Revenue</b>	226.3	298.3	299.5	291.6	305.6	335.8	335.2	338.9	412.1	468.8	412.1	440.4	549.7	613.5	644.8
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%	24.8%	11.6%	5.1%
% 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%	0.5%	0.6%	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%	2.5%	2.5%
<b>Memory Semis Revenue</b>	44.8	69.6	60.7	57.0	66.1	78.9	77.2	76.8	123.6	158.0	106.4	117.5	154.1	171.3	176.9
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%	31.2%	11.1%	3.3%
% 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%	28.0%	27.9%	27.4%
<b>DRAM Revenue</b>	22.4	39.2	29.4	26.1	34.2	46.9	45.0	123.9	72.6	99.3	62.5	64.3	90.4	106.3	121.1
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%	40.5%	17.6%	13.9%
% 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%	58.6%	62.0%	68.5%
% 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%	16.4%	17.3%	18.8%
<b>NAND Revenue</b>	14.8	21.7	24.4	25.4	27.4	111.6	28.8	32.0	47.1	54.2	40.2	49.4	59.1	60.3	51.2
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%	19.7%	2.0%	-15.1%
% 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%	38.4%	35.2%	29.0%
% of Total Semis Revenue	6.6%	7.3%	8.2%	8.7%	9.0%	33.2%	8.6%	9.4%	11.4%	11.6%	9.8%	11.2%	10.8%	9.8%	7.9%
<b>IC Revenue</b>	190.3	249.9	246.1	238.2	251.8	277.3	274.5	276.7	343.0	393.3	333.2	361.2	457.1	514.4	541.8
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%	26.5%	12.5%	5.3%
% 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%	83.2%	83.8%	84.0%
Figures are \$B	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E	2023E
<b>Semiconductor Capital Spending</b>	25.9	56.5	66.6	58.7	57.8	64.6	64.7	70.4	92.1	106.8	102.0	117.6	158.5	181.8	185.7
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%	34.8%	14.7%	2.1%
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%	28.8%	29.6%	28.8%
<b>WFE</b>	12.9	31.6	36.4	29.6	27.5	32.0	33.3	35.3	47.2	53.9	50.9	60.0	84.5	96.5	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%	40.8%	14.2%	-1.0%
% 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%	53.3%	53.1%	51.4%
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%	15.4%	15.7%	14.8%
<b>Memory WFE</b>	4.5	13.5	12.5	7.1	9.3	12.7	16.0	17.0	26.4	34.4	22.9	29.1	40.1	37.0	36.6
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%	37.9%	-7.6%	-1.1%
% 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%	47.4%	38.3%	38.3%
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%	26.0%	21.6%	20.7%
<b>NAND WFE</b>	1.5	4.6	7.3	4.4	5.2	6.4	7.2	10.9	17.3	18.8	12.6	15.9	21.5	18.7	19.1
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%	35.3%	-12.8%	2.1%
% 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%	53.6%	50.5%	52.2%
% 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%	25.4%	19.4%	20.0%
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%	36.3%	31.0%	37.3%
<b>DRAM WFE</b>	2.9	8.9	5.2	2.7	4.1	6.3	8.8	6.0	9.1	15.6	10.3	13.2	18.6	18.3	17.5
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%	40.9%	-1.6%	-4.4%
% of Memory 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%	19.0%	18.3%	
% of Total WFE	11.4%	15.8%	7.8%	4.7%	7.1%	9.8%	13.6%	8.5%	9.9%	14.6%	10.0%	11.2%	11.7%	10.1%	9.4%
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%	20.6%	17.2%	14.5%
<b>Non-memory WFE</b>	8.4	18.1	23.8	22.6	18.1	19.2	17.2	18.3	20.8	19.5	28.0	31.0	44.5	59.5	58.9
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%	43.6%	33.9%	-1.0%
% 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%	52.6%	61.7%	61.7%
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%	11.2%	13.5%	12.6%

Source: SIA, SEMI, UBS estimates



# We model Semis revenue growth of ~25% in '21E, ~12% in '22E, and ~5% in '23E

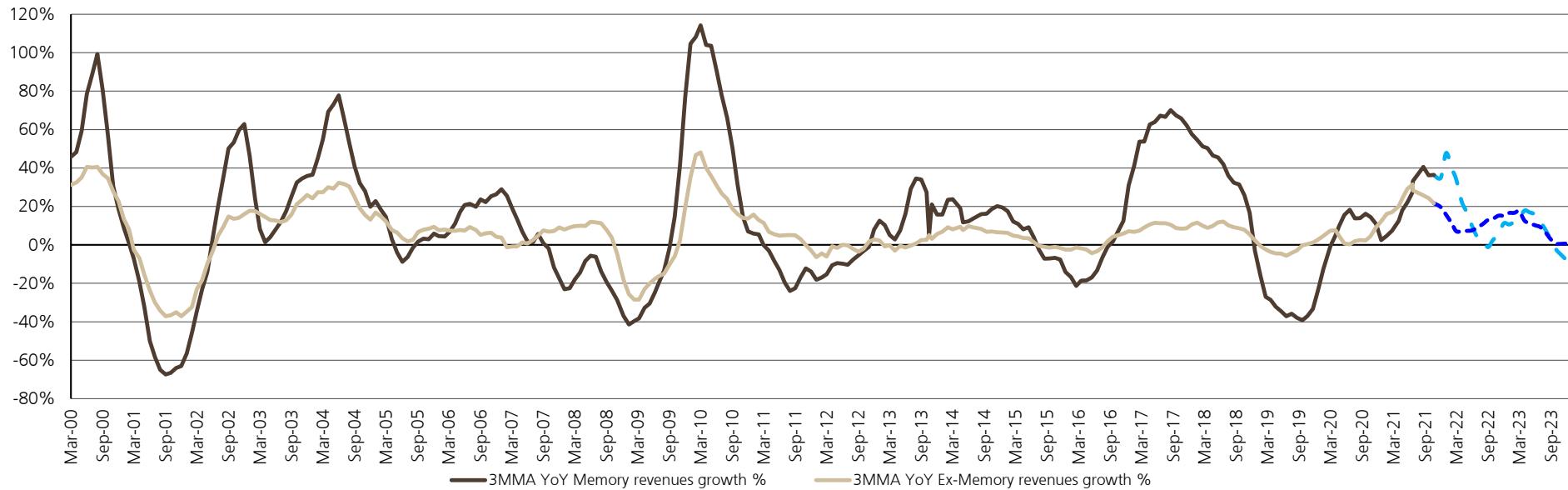
## Total Semiconductors Revenue and ASP by Segment

	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E	2023E
<b>MPU, Sales</b>	41,120,167	44,033,382	43,268,451	43,050,304	44,369,658	46,899,058	47,974,176	51,811,870	58,547,413	63,553,217	68,129,049
MPU, Units	458,121	488,207	494,826	494,091	457,500	428,249	384,220	421,985	496,712	582,268	685,925
MPU, ASPs	89.8	90.2	87.4	87.1	97.0	109.5	124.9	122.8	117.9	109.1	99.3
<b>MCU, Sales</b>	14,658,774	15,310,211	15,478,968	16,258,630	16,437,022	17,068,878	15,807,854	15,483,891	18,890,347	20,212,671	20,819,051
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	29,023,370	30,190,084	30,190,084
MCU, ASPs	0.9	0.8	0.7	0.8	0.6	0.6	0.6	0.6	0.7	0.7	0.7
<b>DSP, Sales</b>	2,909,345	2,728,208	2,550,621	2,869,143	3,285,817	3,265,021	2,657,836	2,382,134	2,858,561	3,001,489	3,091,534
DSP, Units	467,389	426,095	446,414	418,648	460,959	443,356	408,847	393,251	440,652	409,900	409,900
DSP, ASPs	6.2	6.4	5.7	6.9	7.1	7.4	6.5	6.1	6.5	7.3	7.5
<b>Analog, Sales</b>	40,116,781	44,365,411	45,227,611	47,847,781	53,072,260	58,785,389	53,903,091	55,657,641	68,737,187	73,205,104	76,865,359
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	213,015,059	230,947,668	230,947,668
Analog, ASPs	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
<b>CMOS Logic, Sales</b>	85,927,195	91,633,002	90,752,745	89,902,602	102,200,535	109,303,107	106,382,346	118,407,779	153,930,113	183,176,834	195,999,213
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	87,017,247	75,447,308	75,447,308
CMOS Logic, ASPs	1.8	2.0	1.9	1.7	1.7	1.7	1.8	1.8	1.8	2.4	2.6
<b>Total IC ex-Memory, Sales</b>	\$ 184,732,262	\$ 198,070,214	\$ 197,278,396	\$ 199,928,460	\$ 219,365,292	\$ 235,321,453	\$ 226,725,303	\$ 243,743,315	\$ 302,963,620	\$ 343,149,315	\$ 364,904,205
% Growth	1.9%	7.2%	-0.4%	1.3%	9.7%	7.3%	-3.7%	7.5%	24.3%	13.3%	6.3%
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	329,993,038	337,577,228	337,680,884
Total IC ex-Memory, ASP	1.10	1.09	1.02	0.97	0.91	0.87	0.91	0.92	0.92	1.02	1.08
<b>Memory, Sales</b>	\$ 67,043,368	\$ 78,916,369	\$ 77,205,278	\$ 76,766,947	\$ 123,973,749	\$ 157,966,749	\$ 106,431,501	\$ 117,482,479	\$ 154,129,979	\$ 171,289,001	\$ 176,867,486
% Growth	17.6%	17.7%	-2.2%	-0.6%	61.5%	27.4%	-32.6%	10.4%	31.2%	11.1%	3.3%
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	55,440,096	87,077,853	105,184,806
Memory, ASP	1.97	2.10	2.10	2.04	1.83	2.87	3.79	2.51	2.63	2.78	1.97
<b>Total IC, Sales</b>	\$ 251,775,630	\$ 277,302,214	\$ 274,483,673	\$ 276,695,407	\$ 343,010,225	\$ 393,288,202	\$ 333,156,804	\$ 361,225,794	\$ 457,093,599	\$ 514,438,316	\$ 541,771,690
% Growth	5.7%	10.1%	-1.0%	0.8%	24.0%	14.7%	-15.3%	8.4%	26.5%	12.5%	5.3%
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	385,433,134	424,655,081	442,865,690
Total IC, ASP	1.24	1.26	1.19	1.12	1.21	1.27	1.14	1.16	1.19	1.21	1.22
<b>Discrete&amp;Opto&amp;Passives Sales</b>	\$ 53,808,234	\$ 58,544,636	\$ 60,684,188	\$ 62,193,832	\$ 69,074,897	\$ 75,490,083	\$ 78,944,564	\$ 79,163,564	\$ 92,621,370	\$ 99,104,866	\$ 103,069,060
% Growth	0.9%	8.8%	3.7%	2.5%	11.1%	9.3%	4.6%	0.3%	17.0%	7.0%	4.0%
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	764,471,521	705,131,054	705,131,054
Discrete&Opto&Passives, ASP	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.14	0.15
<b>Total Semiconductor Sales</b>	\$ 305,583,864	\$ 335,846,850	\$ 335,167,861	\$ 338,889,239	\$ 412,085,122	\$ 468,778,285	\$ 412,101,368	\$ 440,389,358	\$ 549,714,969	\$ 613,543,182	\$ 644,840,751
% Growth	4.8%	9.9%	-0.2%	1.1%	21.6%	13.8%	-12.1%	6.9%	24.8%	11.6%	5.1%
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	1,149,904,655	1,129,786,135	1,147,996,744
Total Semiconductor, ASP	0.43	0.44	0.43	0.41	0.44	0.47	0.44	0.46	0.48	0.54	0.56

Source: SIA, UBS estimates

# Y/Y Revenue Growth is Decelerating, But Should Remain Positive Through '23E

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	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%	-5.3%	-3.5%	-4.0%	-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%	9.3%	+2.4%	+1.2%	+2.7%	+2.9%
	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%	7.4%	+9.3%	+9.8%	+6.8%	+7.2%
	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%		+1.7%	+4.7%	-0.4%	-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%	-3.9%	+2.3%	-2.0%	+0.8%
	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%	+4.6%	+5.7%	+4.2%	+4.1%
	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%	+11.0%	+9.3%	+6.0%	+7.1%
	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%		-0.0%	+1.9%	-0.9%	-2.6%
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%)	-6.2%	-5.1%	-5.0%	-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%	7.2%	+1.5%	+2.0%	+1.9%	+2.2%
	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%	6.2%	+8.3%	+10.1%	+6.9%	+7.8%
	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%		+3.7%	+2.2%	+0.8%	+0.7%
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%	-2.9%	-2.2%	-1.5%	-0.6%
	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%	+0.6%	+2.2%	+1.9%	+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%	+8.7%	+6.9%	+5.7%	+5.9%
	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%		+2.0%	+1.1%	-1.4%	-1.3%
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%)	-9.0%	-10.9%	-7.5%	-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%	10.1%	+1.5%	+0.7%	+0.9%	+1.0%
	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%	0.4%	+8.5%	+9.9%	+8.8%	+8.6%
	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%		+3.5%	+5.9%	+1.6%	+1.1%

Source: SIA, UBS Estimates

# SIA Data – Quarterly Semiconductor Units

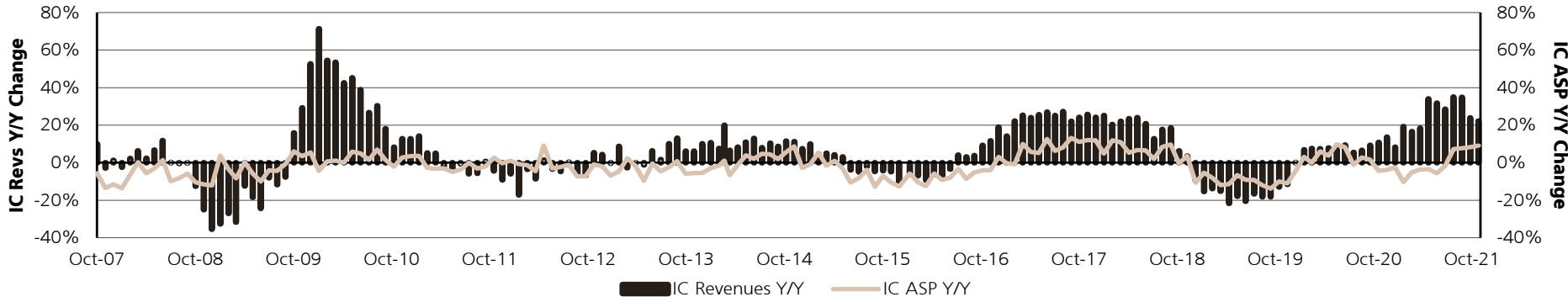
## Quarterly Semiconductor Units Relative to 10-Year Seasonality

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	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%	-2.4%	-0.6%	-1.0%	-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%	+2.0%	+3.0%	+4.2%	+4.5%	
	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%	+8.1%	+7.3%	+5.0%	+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%		-1.1%	-1.6%	-3.0%	-3.0%	
	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%	-5.8%	-7.3%	-2.8%	-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%	+4.3%	+4.0%	+4.1%	+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%)	+10.0%	+8.1%	+5.6%	+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%		-1.8%	-1.0%	-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%	-4.6%	-4.2%	-2.4%	-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%	7.8%	+4.2%	+5.4%	+5.7%	+6.1%	
	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%	3.7%	+10.3%	+10.1%	+7.2%	+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%		-0.0%	-0.4%	-2.8%	-3.3%	
	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%)	-5.4%	-4.1%	-2.7%	-0.3%	
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%	+3.6%	+5.3%	+6.0%	+6.1%	
	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%	+11.8%	+11.1%	+7.7%	+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%		+0.6%	+0.5%	-2.5%	-3.3%	
	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%)	-10.2%	-12.5%	-8.7%	-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%	14.0%	+1.7%	+2.2%	+1.3%	+1.8%	
	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%	4.5%	+2.7%	+5.0%	+6.8%	+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%		+4.9%	+3.6%	+1.1%	-2.1%	

Source: SIA, UBS Estimates

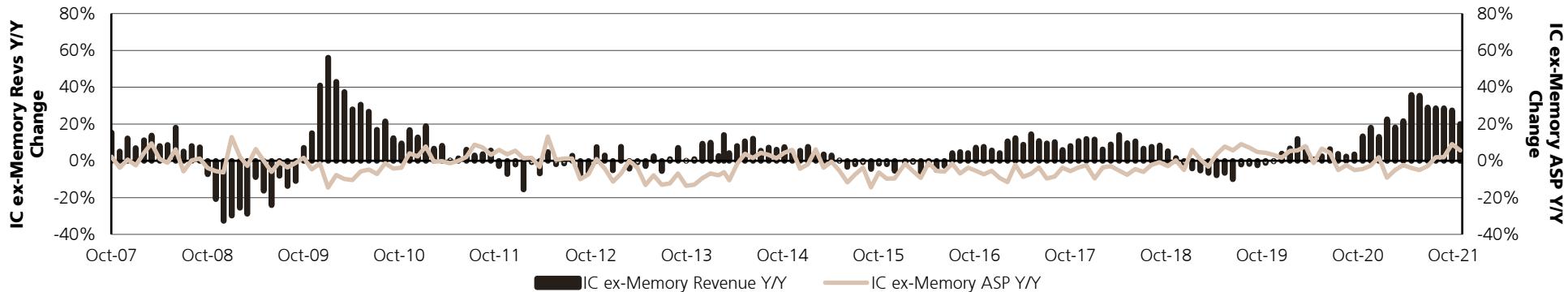
# Semis Pricing Is Growing

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



Source: SIA, UBS estimates

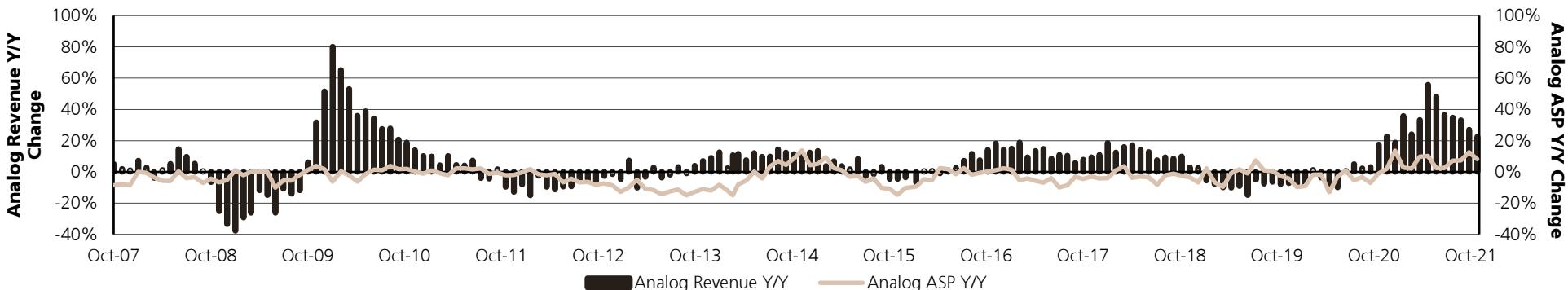
Total IC (excl. Memory) Revenue and ASP Y/Y Change



Source: SIA, UBS estimates

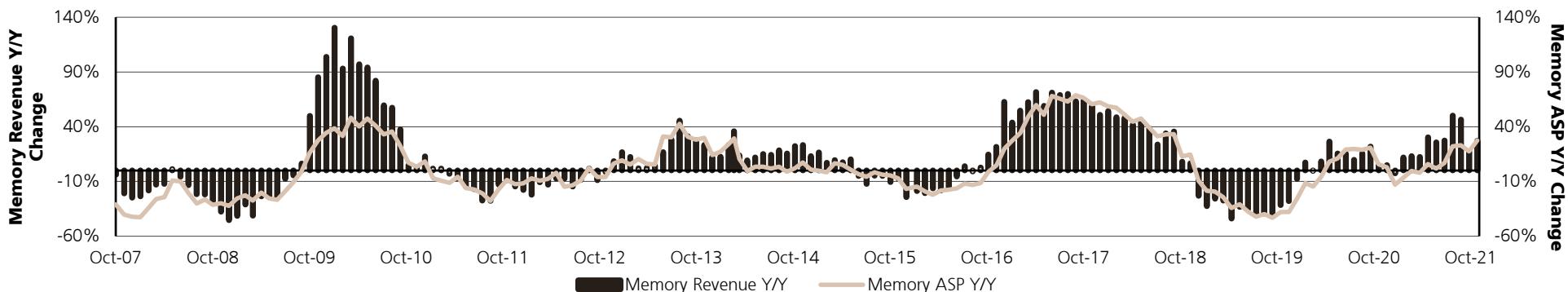
# Especially for Memory and Analog

Analog Revenue and ASP Y/Y Change



Source: SIA, UBS estimates

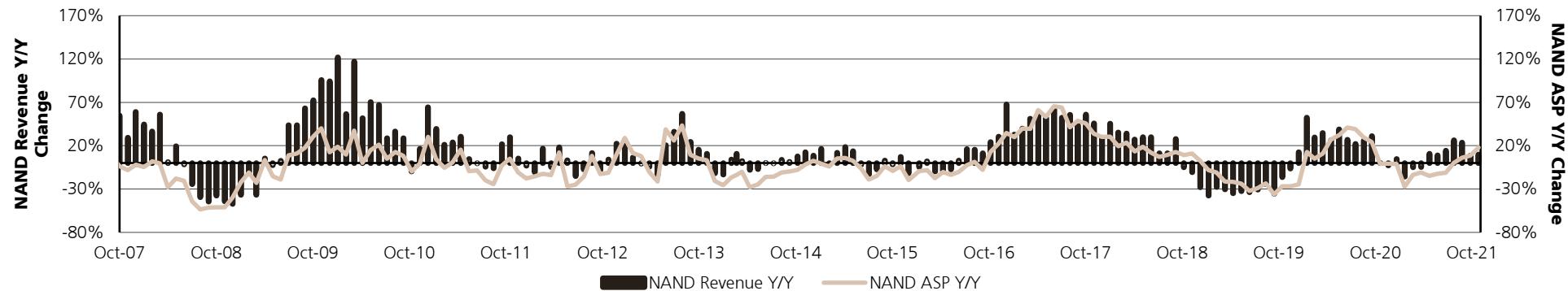
Memory Revenue and ASP Y/Y Change



Source: SIA, UBS estimates

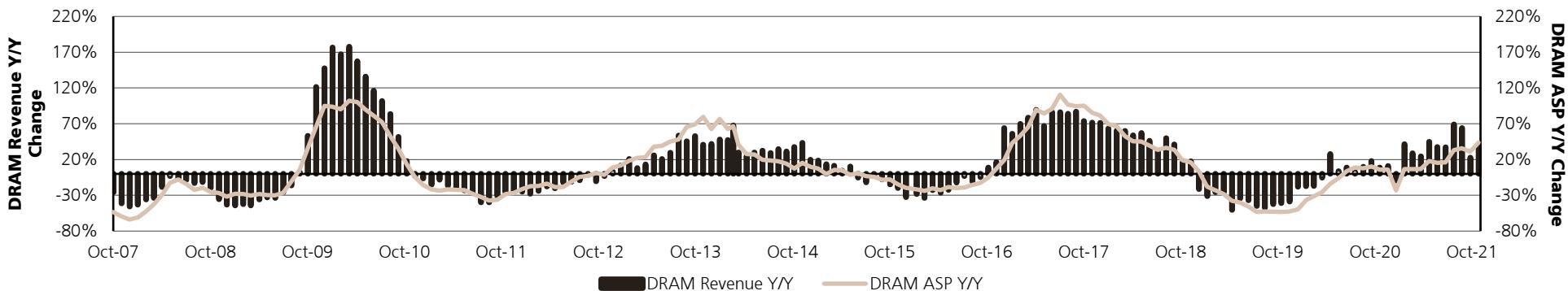
# Memory Pricing Details

## NAND Revenue and ASP Y/Y Change



Source: SIA, UBS estimates

## DRAM Revenue and ASP Y/Y Change



Source: SIA, UBS estimates

# Taiwan Monthly Sales Highlights Recent Supply Improvements

Taiwan Sales M/M Growth

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

Source: UBS, Company filings

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

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

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

Source: UBS, Company filings



## M/M Relative to 5 Year Seasonal Average

	2015	2016	2017	2018	2019	2020	2021
Smartphone-related	Jan	4%	(1%)	(8%)	(3%)	(10%)	(7%)
	Feb	(16%)	(6%)	7%	(8%)	(8%)	5%
	Mar	9%	4%	(8%)	(1%)	11%	19%
	Apr	(6%)	(8%)	(2%)	5%	5%	10%
	May	(14%)	(1%)	(3%)	2%	3%	(2%)
	Jun	(1%)	6%	10%	(2%)	(5%)	(9%)
	Jul	(1%)	(0%)	7%	10%	6%	3%
	Aug	2%	9%	1%	1%	(2%)	(6%)
	Sep	34%	13%	4%	(10%)	(4%)	(26%)
	Oct	(0%)	(8%)	1%	7%	(9%)	7%
	Nov	(14%)	(9%)	(5%)	(6%)	(0%)	18%
	Dec	(17%)	(9%)	7%	(3%)	(1%)	7%
PC-related	Jan	(24%)	(9%)	6%	6%	(10%)	4%
	Feb	(10%)	3%	4%	(7%)	(15%)	(4%)
	Mar	11%	11%	0%	1%	17%	33%
	Apr	(8%)	(15%)	(2%)	2%	5%	22%
	May	(3%)	5%	4%	4%	(2%)	(12%)
	Jun	19%	12%	3%	(10%)	(8%)	(9%)
	Jul	(14%)	(10%)	2%	9%	2%	12%
	Aug	5%	8%	1%	1%	(3%)	(4%)
	Sep	19%	3%	(3%)	(9%)	1%	(8%)
	Oct	(12%)	(7%)	5%	10%	(0%)	(1%)
	Nov	5%	8%	(3%)	(7%)	(3%)	5%
	Dec	8%	2%	(9%)	(2%)	1%	5%
Foundry-related	Jan	8%	(17%)	(21%)	(18%)	(4%)	7%
	Feb	(19%)	(5%)	6%	(4%)	(6%)	(0%)
	Mar	5%	14%	6%	36%	3%	(7%)
	Apr	(5%)	(18%)	(37%)	(17%)	4%	(2%)
	May	(9%)	10%	20%	(6%)	1%	(9%)
	Jun	(14%)	12%	14%	(13%)	5%	23%
	Jul	26%	(14%)	(20%)	3%	(3%)	(9%)
	Aug	(18%)	20%	21%	9%	10%	(10%)
	Sep	(2%)	(1%)	(1%)	4%	(4%)	6%
	Oct	19%	(8%)	(1%)	(3%)	(14%)	(14%)
	Nov	(12%)	13%	8%	5%	8%	9%
	Dec	(2%)	(9%)	2%	(4%)	3%	3%
Apple Supply Chain-related	Jan	(3%)	(4%)	(7%)	(1%)	(8%)	(7%)
	Feb	(15%)	(1%)	8%	(8%)	(9%)	(6%)
	Mar	6%	6%	(5%)	2%	11%	26%
	Apr	(2%)	(10%)	(2%)	5%	6%	12%
	May	(10%)	(1%)	(0%)	3%	4%	(5%)
	Jun	1%	5%	7%	(5%)	(7%)	(8%)
	Jul	(2%)	(3%)	4%	12%	5%	5%
	Aug	2%	10%	3%	1%	(1%)	(7%)
	Sep	32%	13%	1%	(9%)	(5%)	5%
	Oct	(6%)	(11%)	1%	7%	(6%)	9%
	Nov	(11%)	(6%)	(4%)	(6%)	(0%)	15%
	Dec	(13%)	(5%)	7%	(5%)	(4%)	7%

# Taiwan Monthly Sales (Sector Detail - Quarterly)

## Taiwan Sales Q/Q Growth

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

Source: UBS, Company filings

## Q/Q Relative to 5 Year Seasonal Average

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

Source: UBS, Company filings

# Taiwan Sales – Quarterly Summary Heat Map

Quarterly Summary Heat Map

	3Q2021		2Q2021		1Q2021		4Q2020	
	QoQ	Above/Below Seasonal	QoQ	Above/Below Seasonal	QoQ	Above/Below Seasonal	QoQ	Above/Below Seasonal
<b>Smartphones Related</b>	8.2%	(13.4%)	7.9%	1.6%	(31.8%)	2.9%	32.6%	9.1%
<b>Apple Related</b>	9.3%	(11.5%)	4.4%	(2.1%)	(32.9%)	0.9%	33.4%	10.2%
<b>PC Related</b>	12.7%	(0.3%)	4.1%	(5.0%)	(15.1%)	6.4%	5.5%	(3.0%)
<b>Foundry</b>	11.3%	(3.0%)	3.5%	1.8%	0.6%	9.0%	1.5%	(2.9%)
<b>OSATs</b>	14.2%	(0.7%)	7.1%	(0.8%)	(12.9%)	1.4%	12.6%	8.7%
<b>Fabless</b>	6.4%	(6.1%)	13.6%	(0.3%)	7.6%	17.9%	1.1%	3.1%
<b>Memory</b>	6.5%	(4.5%)	16.8%	12.8%	4.2%	8.2%	4.6%	4.6%
<b>IC Substrates and PCBs</b>	14.4%	(5.1%)	2.7%	(3.2%)	(7.4%)	10.9%	3.2%	1.2%
<b>Distribution/EMS</b>	5.9%	(10.5%)	10.5%	0.3%	(2.0%)	15.1%	4.7%	3.8%
<b>Components (Motherboard)</b>	(1.2%)	(24.7%)	21.2%	(3.4%)	(10.6%)	2.3%	(1.3%)	5.6%
<b>Components (Camera)</b>	41.3%	4.6%	(12.0%)	(33.0%)	(28.8%)	6.4%	1.3%	3.7%
<b>Components (display)</b>	2.6%	(3.6%)	13.4%	4.7%	4.6%	18.6%	7.2%	8.5%
<b>Components (Lithium-Ion Battery)</b>	0.4%	(14.7%)	6.2%	(11.0%)	(17.2%)	9.3%	17.5%	8.5%
<b>Other components / periphs</b>	4.1%	(4.4%)	10.7%	(5.5%)	(4.9%)	11.1%	0.3%	2.4%
<b>Servers &amp; Data Centre</b>	4.3%	(9.0%)	4.6%	(6.4%)	(25.2%)	3.8%	22.1%	(0.1%)
<b>EMS/ODM</b>	10.1%	(6.1%)	4.1%	(3.3%)	(32.9%)	1.1%	39.8%	12.5%
<b>Total</b>	<b>8.4%</b>	<b>(7.4%)</b>	<b>6.1%</b>	<b>(1.4%)</b>	<b>(21.2%)</b>	<b>5.4%</b>	<b>21.0%</b>	<b>5.6%</b>

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	November 2021	Above/Below Seasonal	M/M	October 2021	Above/Below Seasonal	M/M	September 2021	Above/Below Seasonal	M/M
ODM/EMS	Hon Hai Precision	2317.TW	248,685	6.1%	12.9%	220,356	-14.3%	(5.9%)	234,292	6.8%	46.4%
	Pegatron	4938.TW	87,034	19.4%	14.7%	75,893	-20.6%	(7.4%)	81,971	23.3%	74.7%
	Compal	2324.TW	30,823	9.6%	5.5%	29,209	-14.7%	(7.6%)	31,622	8.5%	23.5%
	Wistron	3231.TW	12,931	3.1%	7.4%	12,036	-8.2%	(2.9%)	12,389	5.9%	17.5%
	Quanta	2382.TW	39,636	-0.6%	12.5%	35,225	25.6%	22.6%	28,740	-5.9%	(3.1%)
	Inventec	2356.TW	4,799	6.6%	0.3%	4,785	-1.8%	(6.0%)	5,088	-1.2%	4.5%
Foundry/OSAT	TSMC	2330.TW	22,240	9.4%	10.2%	20,181	-14.4%	(11.9%)	22,903	11.9%	11.1%
	ASE	2311.TW	18,157	14.2%	14.7%	15,825	-2.0%	(1.8%)	16,121	-2.1%	6.5%
Display	TPK Holding	3673.TW	8,512	35.3%	29.6%	6,568	-21.8%	(19.2%)	8,124	0.3%	2.4%
	AU Optronics	2409.TW	30,885	0.9%	1.6%	30,384	-2.7%	(7.9%)	32,999	-0.3%	0.9%
Metal Castings	Catcher Technology	2474.TW	2,732	6.6%	(3.5%)	2,831	-19.4%	(10.2%)	3,152	-18.8%	(2.9%)
	Foxconn Tech	2354.TW	8,248	-25.0%	(29.2%)	11,648	3.1%	(6.8%)	12,501	-4.2%	10.2%
Camera Modules	Largan Precision	3008.TW	4,352	7.1%	3.5%	4,203	0.6%	0.7%	4,172	0.9%	4.0%
	Genius Electronic Optical	3406.TW	1,925	0.0%	(2.1%)	1,966	-3.0%	(11.6%)	2,223	6.2%	8.9%
Lithium-Ion Battery	Simplio Technology	6121.TW	8,122	-4.6%	1.5%	8,003	-8.3%	(4.2%)	8,352	-9.1%	1.5%
	Dynapack International	3211.TW	2,078	55.2%	58.7%	1,309	-14.3%	(24.3%)	1,728	-15.9%	(14.1%)
Electronic Components	Lite-On Technology	2301.TW	14,918	1.2%	2.2%	14,593	8.5%	(0.1%)	14,613	2.6%	7.9%
	Unimicron	3037.TW	10,276	6.8%	2.3%	10,049	4.2%	6.3%	9,455	-3.4%	(1.2%)
	Delta Electronics	2308.TW	27,336	0.8%	3.6%	26,378	0.2%	(3.5%)	27,345	2.9%	5.5%
Total AAPL Supply Chain			583,688	14.6%	9.8%	531,442	-3.2%	(4.7%)	557,790	7.1%	28.5%

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

## Section 3

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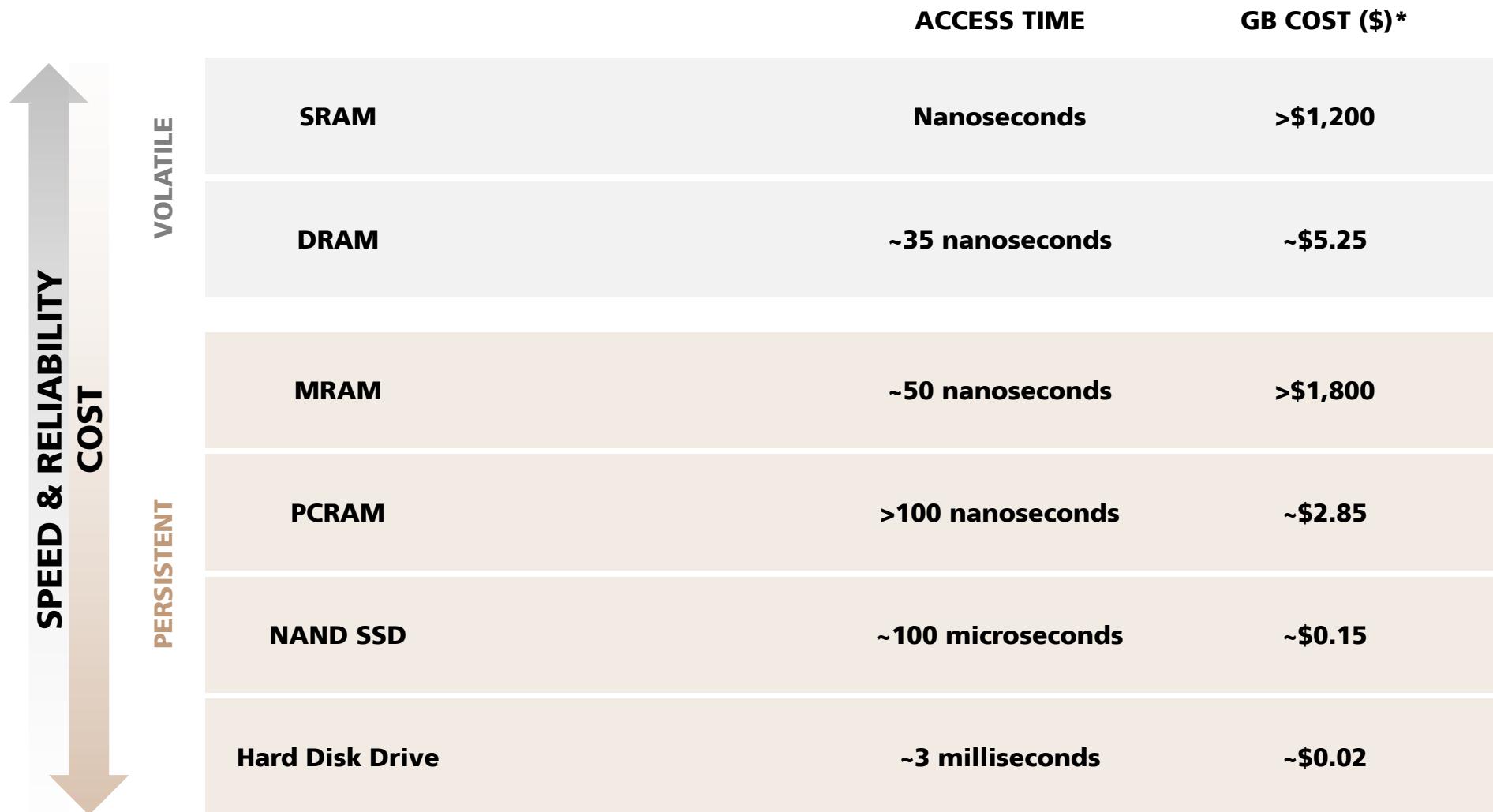
# Memory

# Key Messages

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- We are secular bulls on memory demand; growth continues to exceed non-memory and this should continue as AI workloads proliferate into new verticals of the 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 as hyperscaler demand requirements have growth; while still cyclical, we see it as fundamentally more stable as more demand shifts from consumer to infrastructure; industry OpM has been >30% since 2014
  - Server demand – notably the coming Sapphire Rapids/Eagle Stream refresh – should drive strong server DRAM demand in '22; expect server to be ~60% of incremental bit demand growth
  - DRAM inventory reduction underway
  - We expect DRAM to move into moderate under-supply in 2H:22
  - Profit share among vendors is stable; Samsung mid 40's bit share and ~50% of OP
- NAND – we are less positive as we see a stronger likelihood for significant over-supply as the supply side seems less variable than DRAM's and demand growth starts to wane post pandemic; industry OpM has been <20% in '19 ~ '21 and expected to be the case in '22
  - 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

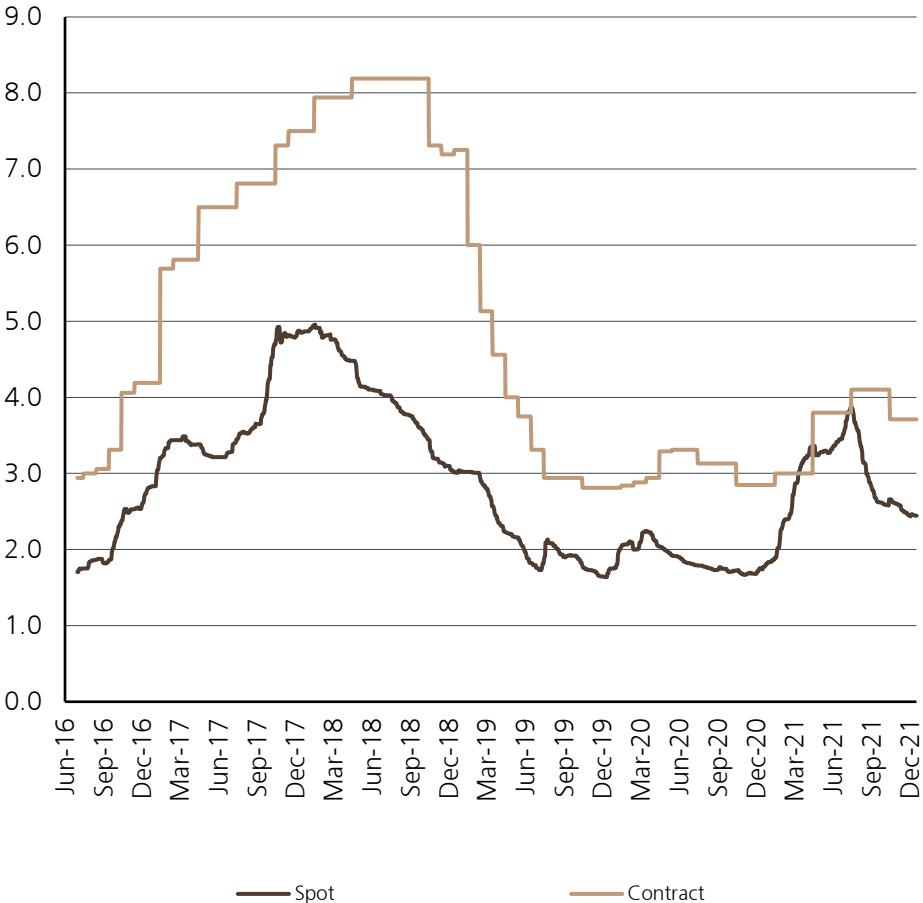


Source: Applied Materials, May 2021

\*Note: Cost estimates based on retail devices and pricing

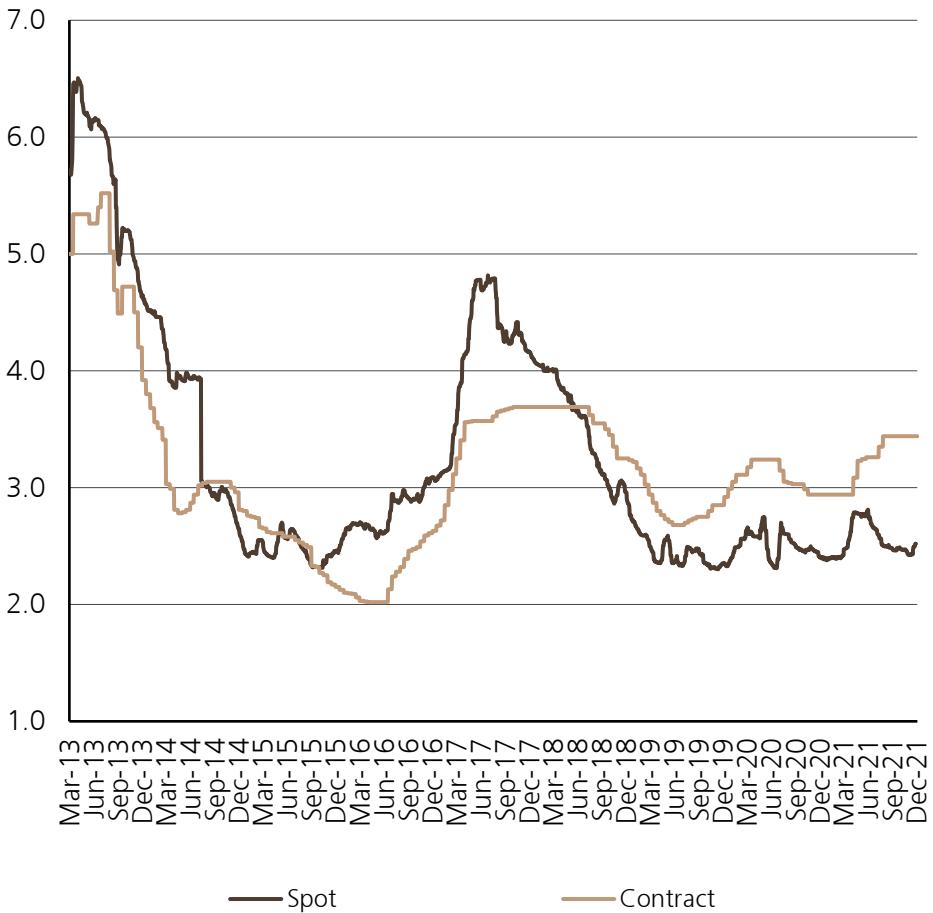
# Spot & Contract Pricing

DRAM Spot vs. Contract Pricing



Source: DRAM eXchange, UBS

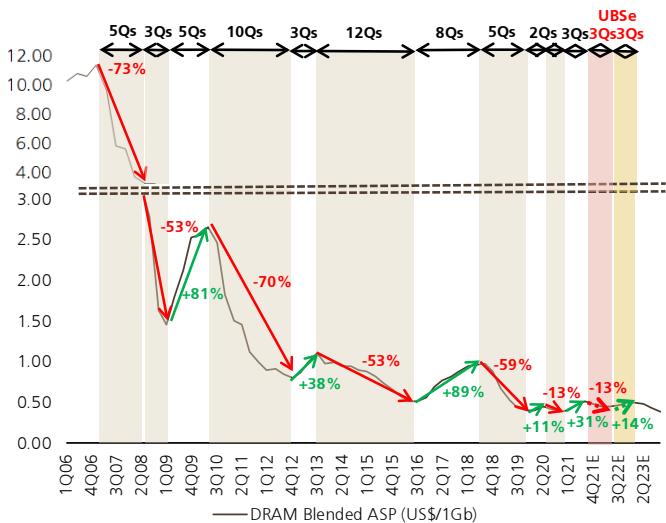
NAND Spot vs. Contract Pricing



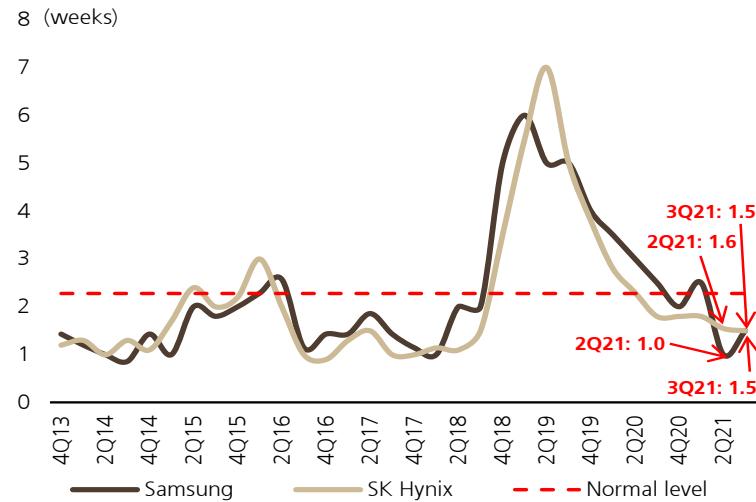
Source: DRAM eXchange, UBS

# DRAM Summary

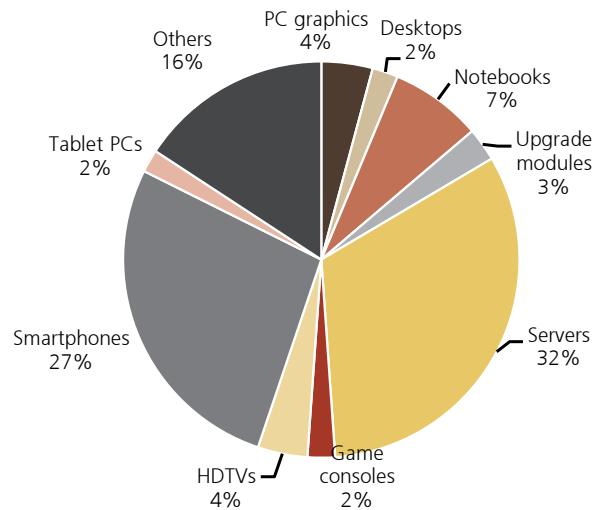
## DRAM Cycles in Context



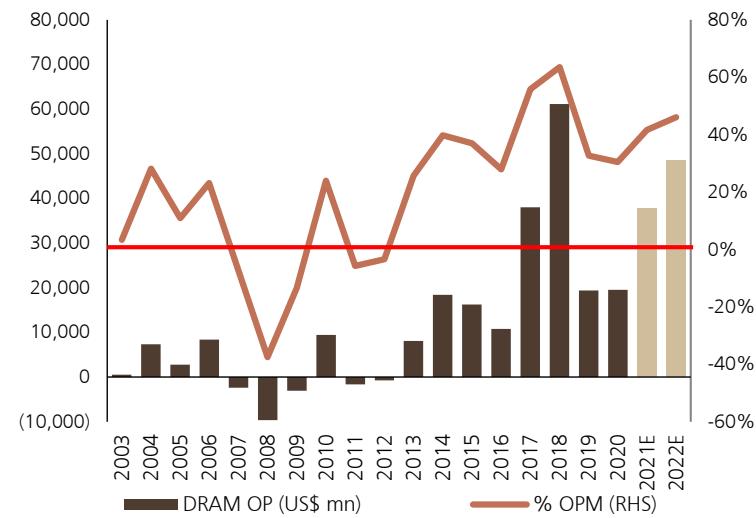
## DRAM Finished Wafers and Dies Inventories



## DRAM Bit Demand by Applications (2022E)



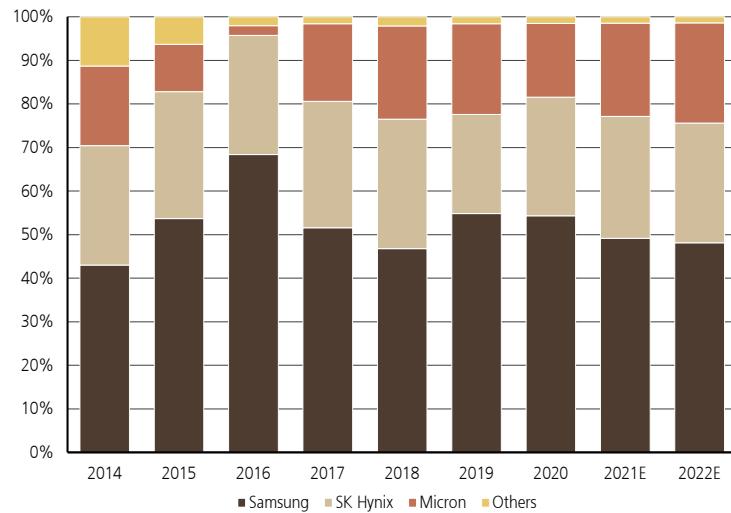
## DRAM Industry OP and % OP margin



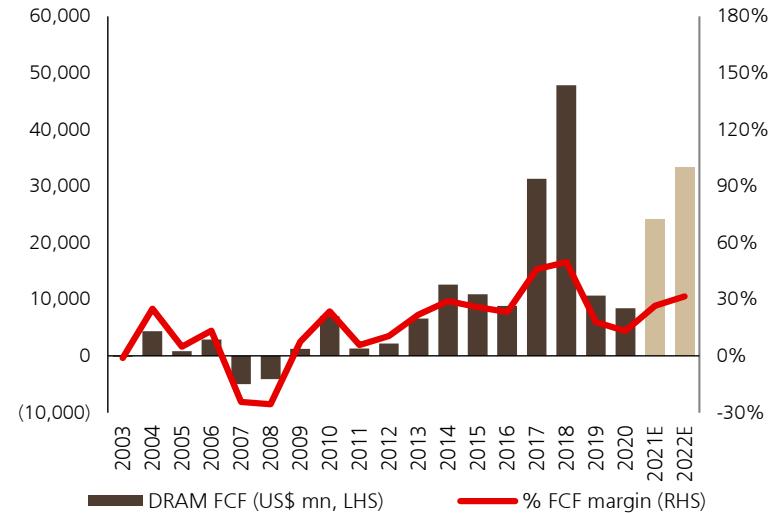
Source: Company data, UBS estimates

# DRAM Summary – Other Key Charts

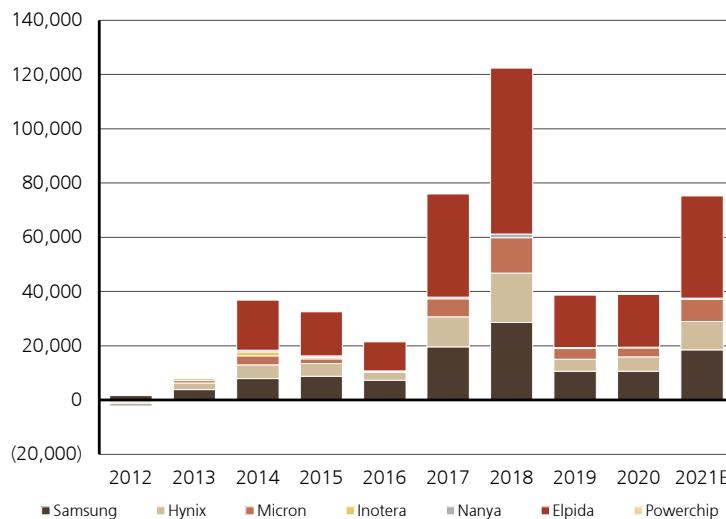
DRAM Producer Share of Industry OP



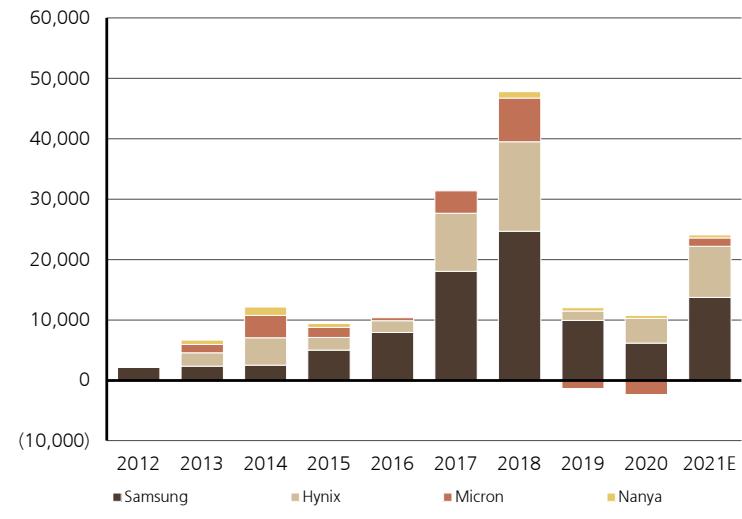
DRAM Industry FCF and % FCF margin



DRAM Producer OP



DRAM Producer FCF



Source: Company data, UBS estimates

# Expect DRAM over-supply through 1H:22E, but moderate under-supply in 2H:22E

## DRAM Supply/Demand Summary

DRAM Supply Demand Model Summary		2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Revenues (\$ mil)</b>		62,475	64,324	18,231	22,819	25,055	24,285	90,390	23,127	24,149	27,767	31,215	106,257
% QoQ				9.0%	25.2%	9.8%	-3.1%		-4.8%	4.4%	15.0%	12.4%	
% YoY		-37.1%	3.0%	27.0%	38.9%	49.0%	45.3%	40.5%	26.9%	5.8%	10.8%	28.5%	17.6%
<b>Supply (Shipments Based) (M 1Gb)</b>		125,947	154,782	44,957	48,054	48,810	49,800	191,619	50,451	53,755	59,433	63,031	226,669
% QoQ				5.2%	6.9%	1.6%	2.0%		1.3%	6.6%	10.6%	6.1%	
% YoY		20.7%	22.9%	27.3%	30.8%	22.1%	16.5%	23.8%	12.2%	11.9%	21.8%	26.6%	18.3%
<b>Demand (End Consumption) (M 1Gb)</b>		127,110	156,786	44,486	46,467	49,239	53,677	193,869	50,740	52,578	59,365	65,563	228,245
% QoQ				1.7%	4.5%	6.0%	9.0%		-5.5%	3.6%	12.9%	10.4%	
% YoY		19.6%	23.3%	26.7%	27.7%	18.5%	22.7%	23.7%	14.1%	13.2%	20.6%	22.1%	17.7%
Inventory adjustment		-3,900	-2,100	800	3,300	400	-4,400	100	-800	1,000	600	-1,800	-1,000
<b>Inventory Adj. Demand (M 1Gb)</b>		123,210	154,686	45,286	49,767	49,639	49,277	193,969	49,940	53,578	59,965	63,763	227,245
% QoQ				7.2%	9.9%	-0.3%	-0.7%		1.3%	7.3%	11.9%	6.3%	
% YoY		18.0%	25.5%	27.9%	32.8%	25.5%	16.7%	25.4%	10.3%	7.7%	20.8%	29.4%	17.2%
<b>Wafer out (k wpm, 12" equi.)</b>		1,315	1,350	1,427	1,483	1,524	1,557	1,498	1,582	1,582	1,591	1,600	1,589
% QoQ				2.2%	4.0%	2.7%	2.2%		1.6%	0.0%	0.6%	0.6%	
% YoY		4.7%	2.7%	9.2%	11.7%	11.3%	11.5%	10.9%	10.9%	6.7%	4.4%	2.8%	6.1%
<b>% Sufficiency Ratio</b>		2.2%	0.1%	-0.7%	-3.4%	-1.7%	1.1%	-1.2%	1.0%	0.3%	-0.9%	-1.1%	-0.3%
<b>DRAM ASP (\$/Gb)</b>		0.50	0.42	0.41	0.47	0.51	0.49	0.47	0.46	0.45	0.47	0.50	0.47
% QoQ				3.7%	17.1%	8.1%	-5.0%		-6.0%	-2.0%	4.0%	6.0%	
% YoY		-47.9%	-16.2%	-0.3%	6.2%	22.1%	24.7%	13.5%	13.0%	-5.4%	-9.0%	1.6%	-0.6%
<b>PC DRAM ASP (\$/Gb)</b>		0.43	0.38	0.38	0.48	0.52	0.47	0.46	0.44	0.42	0.44	0.47	0.44
% QoQ				4.2%	26.7%	8.4%	-9.0%		-7.0%	-3.0%	5.0%	5.0%	
% YoY		-55.8%	-11.5%	3.8%	15.5%	32.1%	30.2%	21.0%	16.2%	-11.0%	-13.8%	-0.5%	-3.7%

Source: Gartner, Company Data, UBS estimates

# We forecast ~11% DRAM wafer growth in '21 and ~6% in '22

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

DRAM Bit supply share by Vendor												
	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
Samsung	45.6%	44.7%	44.7%	46.4%	46.9%	46.7%	46.2%	47.8%	46.6%	46.0%	45.0%	46.2%
SK Hynix	29.5%	29.3%	29.0%	28.3%	27.6%	28.9%	28.4%	28.4%	28.2%	28.3%	28.7%	28.4%
Micron	21.9%	22.7%	23.3%	22.4%	22.8%	21.7%	22.5%	20.9%	22.4%	23.1%	23.7%	22.6%
Nanya Tech	2.5%	2.7%	2.5%	2.3%	2.0%	2.0%	2.2%	2.0%	1.9%	1.8%	1.8%	1.9%
CXMT	0.0%	0.1%	0.1%	0.3%	0.3%	0.4%	0.3%	0.5%	0.5%	0.5%	0.5%	0.5%
Others	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
<b>Total Supply</b>	<b>100%</b>											

DRAM Bit supply Growth by Vendor (Year % YoY; Quarters % QoQ)												
	2019 YoY	2020 YoY	Q121 QoQ	Q221 QoQ	Q321E QoQ	Q421E QoQ	2021E YoY	Q122E QoQ	Q222E QoQ	Q322E QoQ	Q422E QoQ	2022E YoY
Samsung	22.5%	20.5%	5.0%	11.0%	2.7%	1.5%	27.9%	3.7%	3.9%	9.1%	3.8%	18.4%
SK Hynix	21.0%	22.3%	4.0%	4.0%	-0.9%	6.9%	20.0%	-0.4%	5.7%	11.0%	7.5%	18.2%
Micron	18.1%	27.0%	7.0%	2.8%	3.4%	-3.0%	22.9%	-2.0%	14.0%	14.0%	9.0%	19.0%
Nanya Tech	10.4%	35.8%	4.0%	0.0%	-11.0%	0.0%	-0.2%	2.0%	3.0%	5.0%	3.0%	1.5%
CXMT	62.7%	318.4%	95.5%	107.1%	9.2%	30.6%	277.0%	25.0%	12.5%	0.0%	11.1%	100.5%
Others	4.9%	11.7%	-5.4%	2.9%	2.8%	2.7%	2.1%	-2.6%	2.7%	2.6%	2.6%	5.5%
<b>Bit supply Growth</b>	<b>20.7%</b>	<b>22.9%</b>	<b>5.2%</b>	<b>6.9%</b>	<b>1.6%</b>	<b>2.0%</b>	<b>23.8%</b>	<b>1.3%</b>	<b>6.6%</b>	<b>10.6%</b>	<b>6.1%</b>	<b>18.3%</b>

DRAM Wafer supply vendor kwpm 12-inch OUT												
	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
Samsung	509	522	581	615	645	670	628	677	678	681	679	679
SK Hynix	351	352	356	357	360	360	358	362	361	367	378	367
Micron	332	340	340	340	340	340	340	340	340	340	340	340
Nanya Tech	72	73	73	73	73	73	73	73	73	73	73	73
CXMT	10	26	27	48	56	64	64	80	80	80	80	100
Other	50	50	50	50	50	50	50	50	50	50	50	50
<b>Total</b>	<b>1,323</b>	<b>1,363</b>	<b>1,427</b>	<b>1,483</b>	<b>1,524</b>	<b>1,557</b>	<b>1,513</b>	<b>1,582</b>	<b>1,582</b>	<b>1,591</b>	<b>1,600</b>	<b>1,609</b>
<b>% YoY</b>	<b>4.7%</b>	<b>2.7%</b>	<b>9.2%</b>	<b>11.7%</b>	<b>11.3%</b>	<b>11.5%</b>	<b>10.9%</b>	<b>10.9%</b>	<b>6.7%</b>	<b>4.4%</b>	<b>2.8%</b>	<b>6.1%</b>

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

# DRAM bit demand growth to slow in '22E but remains at ~18%

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

DRAM Bit demand by application (Unit mn, 1Gb)	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Total PC DRAM</b>	<b>18,738</b>	<b>23,405</b>	<b>6,074</b>	<b>6,408</b>	<b>7,112</b>	<b>7,595</b>	<b>27,190</b>	<b>6,400</b>	<b>6,417</b>	<b>7,412</b>	<b>7,852</b>	<b>28,081</b>
Desktops	4,627	4,092	1,098	1,138	1,126	1,152	4,514	1,050	1,135	1,252	1,356	4,793
Notebooks	9,079	12,748	3,432	3,445	4,109	4,731	15,717	3,944	3,839	4,459	4,840	17,083
Upgrade Modules	5,033	6,565	1,544	1,826	1,877	1,712	6,958	1,406	1,442	1,701	1,656	6,205
<b>Servers</b>	<b>29,850</b>	<b>42,341</b>	<b>11,449</b>	<b>13,631</b>	<b>13,928</b>	<b>14,781</b>	<b>53,788</b>	<b>15,935</b>	<b>16,746</b>	<b>19,478</b>	<b>21,733</b>	<b>73,892</b>
Graphics	3,949	4,979	2,039	2,074	2,125	2,192	8,430	2,161	2,314	2,558	2,510	9,543
Game Consoles	1,947	2,577	900	1,060	1,285	1,321	4,566	1,051	1,154	1,456	1,453	5,113
HDTVs	6,027	7,458	1,892	1,807	2,112	2,694	8,504	2,021	1,923	2,324	2,986	9,255
<b>Total Mobile DRAM</b>	<b>47,531</b>	<b>51,033</b>	<b>14,514</b>	<b>13,499</b>	<b>14,433</b>	<b>16,538</b>	<b>58,985</b>	<b>14,690</b>	<b>15,216</b>	<b>17,083</b>	<b>19,378</b>	<b>66,367</b>
<b>Smartphones</b>	<b>44,433</b>	<b>46,927</b>	<b>13,420</b>	<b>12,387</b>	<b>13,263</b>	<b>15,394</b>	<b>54,463</b>	<b>13,655</b>	<b>14,155</b>	<b>15,945</b>	<b>18,258</b>	<b>62,013</b>
Apple	5,133	6,419	2,056	1,653	1,763	3,063	8,534	2,000	1,761	2,345	3,899	10,005
Samsung	8,803	9,233	2,940	2,188	2,687	2,793	10,608	3,209	3,224	3,384	3,277	13,095
Non-Apple/Samsung	30,497	31,275	8,423	8,546	8,813	9,539	35,321	8,446	9,170	10,215	11,081	38,912
Tablet PCs	2,845	3,943	1,046	1,086	1,134	1,112	4,378	1,004	1,033	1,108	1,091	4,236
Other	19,067	24,991	7,618	7,989	8,243	8,556	32,406	8,481	8,808	9,053	9,652	35,994
<b>Total Bit Demand</b>	<b>127,110</b>	<b>156,786</b>	<b>44,486</b>	<b>46,467</b>	<b>49,239</b>	<b>53,677</b>	<b>193,869</b>	<b>50,740</b>	<b>52,578</b>	<b>59,365</b>	<b>65,563</b>	<b>228,245</b>
% QoQ			1.7%	4.5%	6.0%	9.0%		-5.5%	3.6%	12.9%	10.4%	
% YoY	19.6%	23.3%	26.7%	27.7%	18.5%	22.7%	23.7%	14.1%	13.2%	20.6%	22.1%	17.7%

Source: Gartner, Company Data, UBS estimates

# Servers will be the biggest driver of bit demand growth in '22E

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

### DRAM Bit demand by application (%)

	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Total PC DRAM</b>	<b>3.5%</b>	<b>15.7%</b>	<b>14.9%</b>	<b>6.9%</b>	<b>10.1%</b>	<b>9.2%</b>	<b>10.2%</b>	<b>5.2%</b>	<b>0.1%</b>	<b>3.0%</b>	<b>2.2%</b>	<b>2.6%</b>
Desktops	2.6%	-1.8%	1.3%	2.4%	1.4%	-0.5%	1.1%	-0.8%	0.0%	1.2%	1.7%	0.8%
Notebooks	5.7%	12.4%	15.2%	2.9%	6.6%	7.5%	8.0%	8.2%	6.5%	3.5%	0.9%	4.0%
Upgrade Modules	-4.9%	5.2%	-1.6%	1.6%	2.1%	2.1%	1.1%	-2.2%	-6.3%	-1.7%	-0.5%	-2.2%
<b>Servers</b>	<b>25.0%</b>	<b>42.1%</b>	<b>3.9%</b>	<b>26.3%</b>	<b>39.7%</b>	<b>54.1%</b>	<b>30.9%</b>	<b>71.7%</b>	<b>51.0%</b>	<b>54.8%</b>	<b>58.5%</b>	<b>58.5%</b>
Graphics	2.9%	3.5%	11.3%	9.5%	9.9%	6.8%	9.3%	2.0%	3.9%	4.3%	2.7%	3.2%
Game Consoles	-1.6%	2.1%	4.9%	4.9%	6.5%	5.4%	5.4%	2.4%	1.5%	1.7%	1.1%	1.6%
HDTVs	5.1%	4.8%	5.3%	3.6%	-0.1%	1.9%	2.8%	2.1%	1.9%	2.1%	2.5%	2.2%
<b>Total Mobile DRAM</b>	<b>36.8%</b>	<b>11.8%</b>	<b>40.9%</b>	<b>26.8%</b>	<b>8.8%</b>	<b>7.4%</b>	<b>21.4%</b>	<b>2.8%</b>	<b>28.1%</b>	<b>26.2%</b>	<b>23.9%</b>	<b>21.5%</b>
<b>Smartphones</b>	<b>37.5%</b>	<b>8.4%</b>	<b>38.0%</b>	<b>25.4%</b>	<b>7.7%</b>	<b>8.2%</b>	<b>20.3%</b>	<b>3.8%</b>	<b>28.9%</b>	<b>26.5%</b>	<b>24.1%</b>	<b>22.0%</b>
Apple	3.1%	4.3%	9.1%	5.8%	7.5%	1.0%	5.7%	-0.9%	1.8%	5.8%	7.0%	4.3%
Samsung	11.2%	1.4%	7.7%	3.3%	-3.1%	5.6%	3.7%	4.3%	17.0%	6.9%	4.1%	7.2%
Non-Apple/Samsung	23.1%	2.6%	21.2%	16.3%	3.3%	1.6%	10.9%	0.4%	10.2%	13.8%	13.0%	10.4%
Tablet PCs	-0.7%	3.7%	2.9%	1.5%	1.1%	-0.7%	1.2%	-0.7%	-0.9%	-0.3%	-0.2%	-0.4%
Other	28.3%	20.0%	18.8%	22.0%	24.9%	15.3%	20.0%	13.8%	13.4%	8.0%	9.2%	10.4%
<b>Total Bit Demand</b>	<b>100.0%</b>											

Source: Gartner, Company Data, UBS estimates

# Servers growth remains robust, and PCs to slow in '22E

## DRAM Bit Demand Growth by Application

	DRAM Bit demand growth by application - QoQ & YoY											
	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
	YoY	YoY	QoQ	QoQ	QoQ	QoQ	YoY	QoQ	QoQ	QoQ	QoQ	YoY
<b>Total PC DRAM</b>	<b>4.1%</b>	<b>24.9%</b>	<b>-9.1%</b>	<b>5.5%</b>	<b>11.0%</b>	<b>6.8%</b>	<b>16.2%</b>	<b>-15.7%</b>	<b>0.3%</b>	<b>15.5%</b>	<b>5.9%</b>	<b>3.3%</b>
Desktops	13.5%	-11.6%	-8.4%	3.6%	-1.0%	2.4%	10.3%	-8.9%	8.1%	10.3%	8.3%	6.2%
Notebooks	15.2%	40.4%	-13.9%	0.4%	19.3%	15.1%	23.3%	-16.6%	-2.7%	16.2%	8.5%	8.7%
Upgrade Modules	-16.8%	30.5%	2.9%	18.3%	2.8%	-8.8%	6.0%	-17.9%	2.6%	17.9%	-2.7%	-10.8%
<b>Servers</b>	<b>21.1%</b>	<b>41.8%</b>	<b>21.7%</b>	<b>19.1%</b>	<b>2.2%</b>	<b>6.1%</b>	<b>27.0%</b>	<b>7.8%</b>	<b>5.1%</b>	<b>16.3%</b>	<b>11.6%</b>	<b>37.4%</b>
Graphics	17.8%	26.1%	34.3%	1.7%	2.5%	3.1%	69.3%	-1.4%	7.1%	10.6%	-1.9%	13.2%
Game Consoles	-14.3%	32.3%	14.8%	17.8%	21.3%	2.8%	77.2%	-20.5%	9.8%	26.2%	-0.2%	12.0%
HDTVs	21.3%	23.7%	-24.6%	-4.5%	16.9%	27.6%	14.0%	-25.0%	-4.9%	20.8%	28.5%	8.8%
<b>Total Mobile DRAM</b>	<b>19.3%</b>	<b>7.4%</b>	<b>-8.1%</b>	<b>-7.0%</b>	<b>6.9%</b>	<b>14.6%</b>	<b>15.6%</b>	<b>-11.2%</b>	<b>3.6%</b>	<b>12.3%</b>	<b>13.4%</b>	<b>12.5%</b>
Smartphones	21.4%	5.6%	-7.9%	-7.7%	7.1%	16.1%	16.1%	-11.3%	3.7%	12.6%	14.5%	13.9%
Apple	14.7%	25.0%	-30.6%	-19.6%	6.6%	73.8%	33.0%	-34.7%	-12.0%	33.2%	66.3%	17.2%
Samsung	36.3%	4.9%	31.4%	-25.6%	22.8%	4.0%	14.9%	14.9%	0.5%	5.0%	-3.2%	23.4%
Non-Apple/Samsung	18.8%	2.6%	-10.2%	1.5%	3.1%	8.2%	12.9%	-11.5%	8.6%	11.4%	8.5%	10.2%
Tablet PCs	-4.8%	38.6%	-11.7%	3.8%	4.4%	-1.9%	11.0%	-9.7%	2.8%	7.3%	-1.5%	-3.3%
Others	44.9%	31.1%	8.2%	4.9%	3.2%	3.8%	29.7%	-0.9%	3.9%	2.8%	6.6%	11.1%
<b>Total Bit Demand</b>	<b>19.6%</b>	<b>23.3%</b>	<b>1.7%</b>	<b>4.5%</b>	<b>6.0%</b>	<b>9.0%</b>	<b>23.7%</b>	<b>-5.5%</b>	<b>3.6%</b>	<b>12.9%</b>	<b>10.4%</b>	<b>17.7%</b>

Source: Gartner, Company Data, UBS estimates

# Content growth remains high in Servers

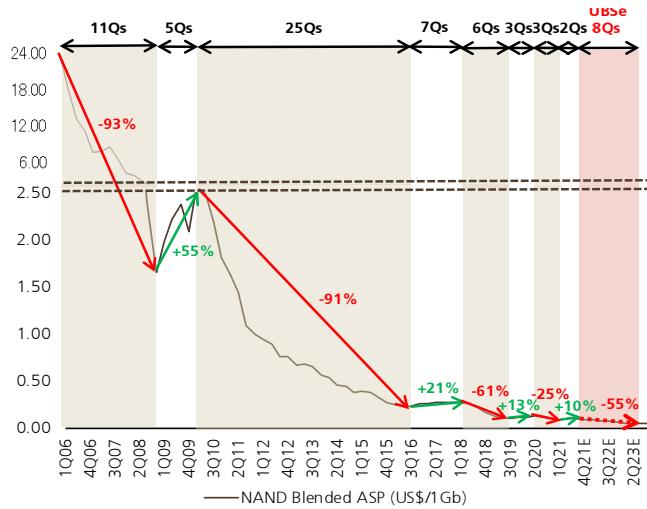
DRAM Content Assumptions (MB/unit) by Application

DRAM content assumption (MB/Unit) by application		2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Total PC</b>		6,373	7,352	7,771	7,929	8,198	8,563	8,130	8,734	8,903	9,161	9,445	9,076
	% YoY	16%	15%	14%	10%	10%	10%	11%	12%	12%	12%	10%	12%
Desktops		5,904	6,562	6,841	7,033	7,233	7,633	7,178	7,733	7,933	8,133	8,333	8,049
Notebooks		7,160	8,237	8,568	8,768	8,968	9,318	8,933	9,518	9,718	10,018	10,318	9,910
Upgrade Modules		5,663	6,484	7,000	7,200	7,400	7,500	7,279	7,700	7,900	8,100	8,300	8,010
<b>Servers</b>		<b>303,603</b>	<b>419,652</b>	<b>466,548</b>	<b>508,466</b>	<b>518,923</b>	<b>547,858</b>	<b>511,459</b>	<b>565,000</b>	<b>585,000</b>	<b>639,500</b>	<b>696,744</b>	<b>623,669</b>
	% YoY	25%	38%	15%	22%	19%	30%	22%	21%	15%	23%	27%	22%
<b>Smartphones</b>		<b>4,148</b>	<b>4,643</b>	<b>4,972</b>	<b>5,060</b>	<b>5,147</b>	<b>5,267</b>	<b>5,115</b>	<b>5,483</b>	<b>5,539</b>	<b>5,755</b>	<b>5,938</b>	<b>5,694</b>
	% YoY	24%	12%	9%	12%	12%	9%	10%	10%	9%	12%	13%	11%
Apple		3,396	4,110	4,700	4,600	4,700	4,900	4,750	4,900	4,900	5,800	6,200	5,556
Samsung		3,820	4,672	4,952	4,913	4,984	5,258	5,029	5,869	5,772	5,894	6,124	5,912
Non-Apple/Samsung		4,422	4,761	5,050	5,200	5,300	5,400	5,240	5,500	5,600	5,700	5,800	5,659

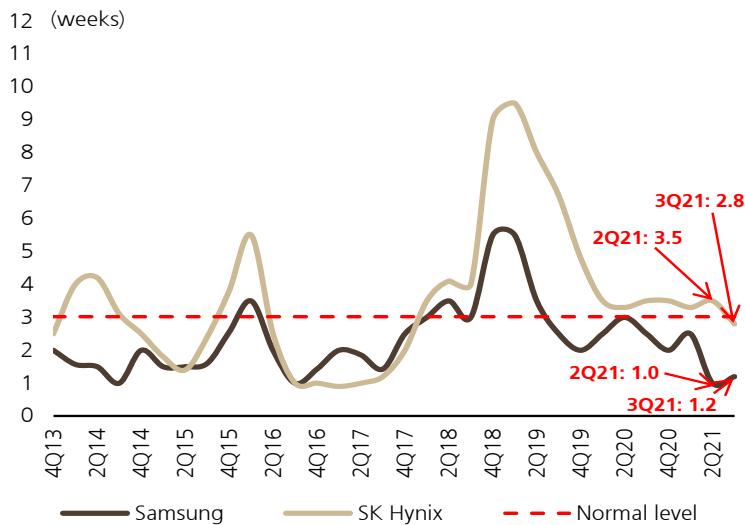
Source: Gartner, Company Data, UBS estimates

# NAND Summary

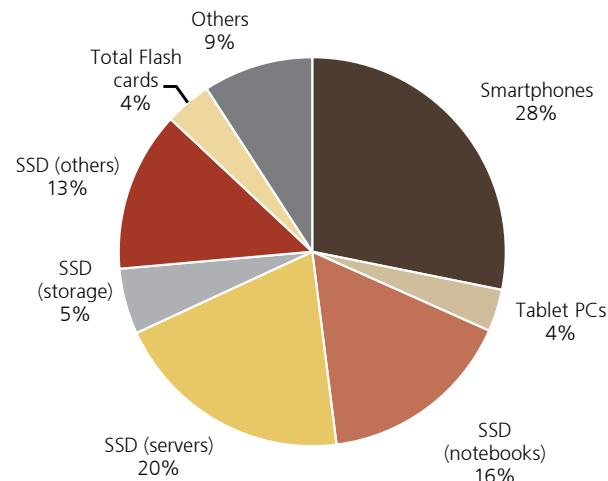
## NAND Cycles in Context



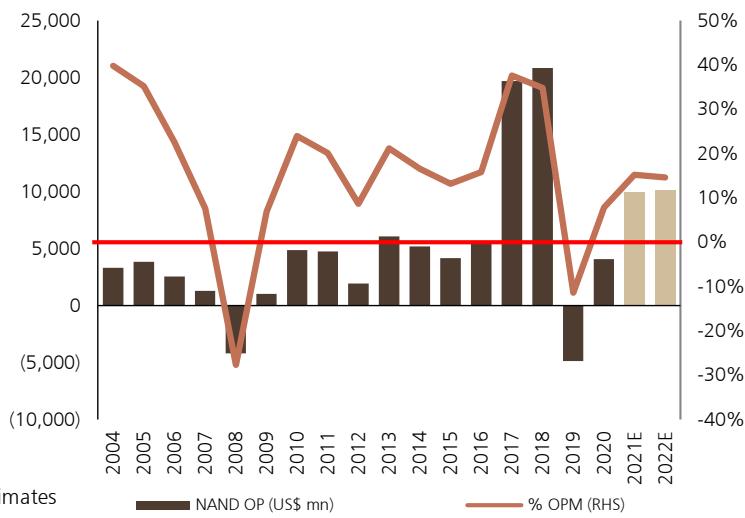
## NAND Finished Wafers and Die Inventories



## NAND Bits Demand Split by Apps (2022E)



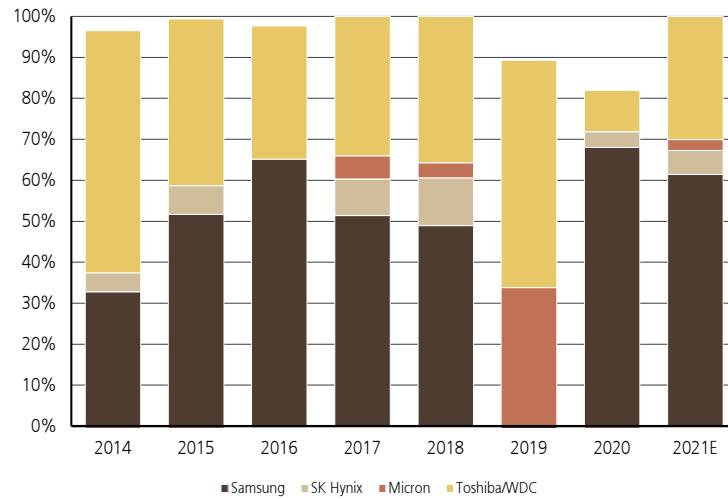
## NAND Industry OP and % OP margin



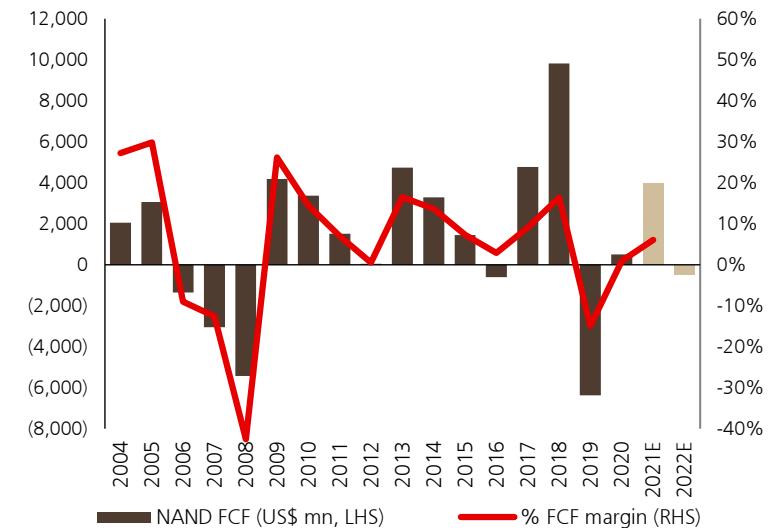
Source: Company data, UBS estimates

# NAND Summary – Other Key Charts

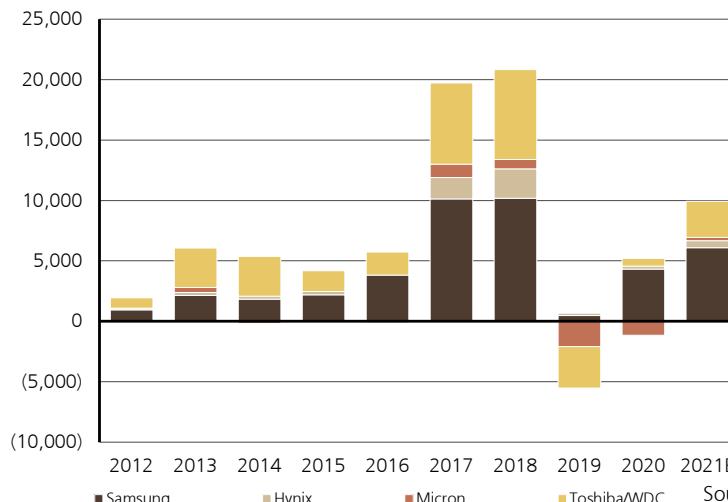
NAND Producer Share of Industry OP



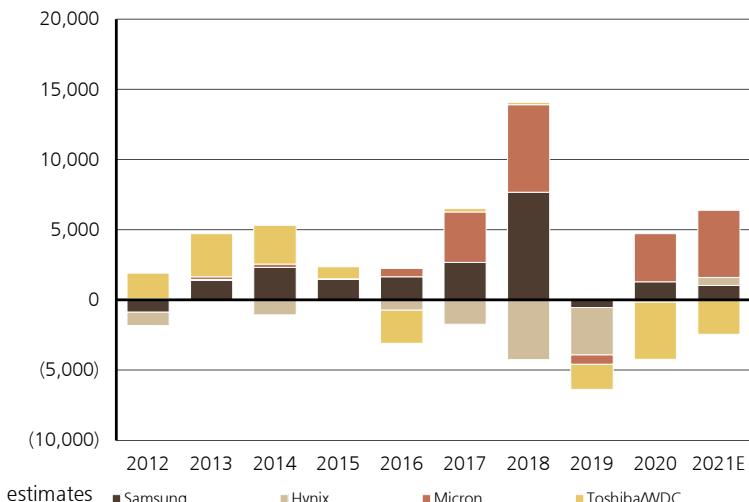
NAND Industry FCF and % FCF Margin



NAND Producer OP



NAND Producer FCF



# NAND oversupply to continue through 2022E

## NAND Flash Supply/Demand Summary

NAND Supply Demand Model Summary		2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Revenues (\$ mil)</b>		40,095	49,390	12,666	14,066	16,151	16,255	59,138	15,210	15,190	15,488	14,415	60,302
% QoQ				4.5%	11.0%	14.8%	0.6%		-6.4%	-0.1%	2.0%	-6.9%	
% YoY		-26.1%	23.2%	5.8%	12.8%	26.0%	34.1%	19.7%	20.1%	8.0%	-4.1%	-11.3%	2.0%
<b>Supply (Shipments Based) (M 1GB)</b>		345,809	442,469	137,797	145,735	159,373	168,840	611,744	169,878	186,429	213,579	228,490	798,376
% QoQ				12.4%	5.8%	9.4%	5.9%		0.6%	9.7%	14.6%	7.0%	
% YoY		44.7%	28.0%	35.0%	43.4%	37.3%	37.7%	38.3%	23.3%	27.9%	34.0%	35.3%	30.5%
<b>Demand (End Consumption) (M 1GB)</b>		362,675	460,343	132,978	138,224	155,974	184,233	611,409	171,705	180,615	201,981	228,200	782,501
% QoQ				-2.0%	3.9%	12.8%	18.1%		-6.8%	5.2%	11.8%	13.0%	
% YoY		44.3%	26.9%	35.1%	30.2%	29.8%	35.8%	32.8%	29.1%	30.7%	29.5%	23.9%	28.0%
Inventory adjustment		-22,200	-20,500	2,900	9,000	4,900	-17,000	-200	-4,000	2,400	7,300	-5,700	0
<b>Inventory Adj. Demand (M 1GB)</b>		340,475	439,843	135,878	147,224	160,874	167,233	611,209	167,705	183,015	209,281	222,500	782,501
% QoQ				13.0%	8.4%	9.3%	4.0%		0.3%	9.1%	14.4%	6.3%	
% YoY		45.7%	29.2%	31.8%	43.4%	41.3%	39.1%	39.0%	23.4%	24.3%	30.1%	33.0%	28.0%
<b>Wafer out (k wpm, 12" equi.)</b>		1,446	1,503	1,589	1,607	1,644	1,698	1,634	1,717	1,741	1,813	1,847	1,779
% QoQ				1.6%	1.1%	2.3%	3.3%		1.1%	1.4%	4.1%	1.9%	
% YoY		-6.4%	4.0%	9.7%	8.4%	8.1%	8.6%	8.7%	8.1%	8.3%	10.3%	8.7%	8.9%
<b>% Sufficiency Ratio</b>		1.6%	0.6%	1.4%	-1.0%	-0.9%	1.0%	0.1%	1.3%	1.9%	2.1%	2.7%	2.0%
<b>NAND ASP (\$/1GB)</b>		0.12	0.11	0.09	0.10	0.10	0.10	0.10	0.09	0.08	0.07	0.06	0.08
% QoQ				-7.0%	5.0%	5.0%	-5.0%		-7.0%	-9.0%	-11.0%	-13.0%	
% YoY		-48.9%	-3.7%	-21.6%	-21.3%	-8.2%	-2.6%	-13.4%	-2.6%	-15.6%	-28.4%	-34.5%	-21.9%

Source: Gartner, Company Data, UBS estimates

# We forecast ~9% NAND wafer growth for both '21 and '22

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

NAND Flash bit supply share by vendor

	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
Samsung	36.3%	34.0%	35.3%	36.2%	34.8%	35.0%	35.3%	35.8%	36.2%	35.3%	33.9%	35.2%
Kioxia	17.9%	18.3%	17.2%	17.4%	18.8%	17.7%	17.8%	16.7%	16.3%	17.7%	17.3%	17.1%
Western Digital	13.1%	14.5%	13.6%	13.4%	13.2%	12.8%	13.2%	13.4%	13.3%	13.1%	13.1%	13.2%
SK Hynix	11.3%	12.4%	13.5%	13.0%	14.4%	16.0%	14.3%	14.3%	14.2%	14.5%	15.8%	14.8%
Micron	10.2%	9.6%	9.5%	9.1%	8.6%	7.9%	8.7%	7.6%	8.3%	8.7%	9.7%	8.7%
Intel	7.7%	7.6%	6.6%	6.6%	6.5%	6.5%	6.5%	6.6%	6.2%	5.5%	5.3%	5.9%
YMTC	0.1%	0.4%	0.9%	1.0%	1.3%	1.9%	1.3%	2.4%	2.6%	2.5%	2.5%	2.5%
<b>Total Bit Supply</b>	<b>100%</b>											

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

	2019 YoY	2020 YoY	Q121 QoQ	Q221 QoQ	Q321E QoQ	Q421E QoQ	2021E YoY	Q122E QoQ	Q222E QoQ	Q322E QoQ	Q422E QoQ	2022E YoY
Samsung	45.5%	19.8%	13.5%	8.6%	5.0%	6.4%	43.4%	3.1%	11.0%	11.5%	2.8%	30.2%
Kioxia	33.0%	31.0%	6.0%	7.0%	18.0%	0.0%	34.5%	-5.0%	7.0%	24.0%	5.0%	25.0%
Western Digital	22.3%	41.2%	8.4%	4.0%	7.6%	3.0%	26.4%	5.0%	9.0%	13.0%	7.0%	30.2%
SK Hynix	50.0%	41.0%	22.2%	2.0%	20.8%	18.1%	59.2%	-10.1%	8.6%	17.4%	16.6%	34.7%
Micron	40.1%	20.9%	8.0%	2.0%	3.0%	-3.0%	25.5%	-3.0%	20.0%	20.0%	20.0%	29.7%
Intel	135.6%	27.0%	3.4%	4.7%	8.9%	5.2%	18.3%	1.8%	3.4%	2.8%	3.2%	16.8%
YMTC	1228.0%	461.0%	45.2%	12.3%	41.2%	55.5%	307.8%	28.7%	15.8%	12.1%	7.2%	149.3%
<b>Total Bit Supply</b>	<b>44.7%</b>	<b>28.0%</b>	<b>12.4%</b>	<b>5.8%</b>	<b>9.4%</b>	<b>5.9%</b>	<b>38.3%</b>	<b>0.6%</b>	<b>9.7%</b>	<b>14.6%</b>	<b>7.0%</b>	<b>30.5%</b>

NAND Flash Wafer supply vendor kwpm 12-inch

	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
Samsung	464	493	570	588	610	630	599	648	658	659	657	655
Kioxia / WDC	495	550	550	550	560	560	553	543	540	590	610	571
SK Hynix	227	208	199	195	191	187	193	187	193	204	215	200
Micron	183	165	165	165	170	175	169	180	185	190	195	188
Intel	70	70	70	70	70	70	70	70	70	70	70	70
YMTC	13	25	35	39	53	76	70	90	95	100	100	100
<b>Total</b>	<b>1,446</b>	<b>1,503</b>	<b>1,589</b>	<b>1,607</b>	<b>1,644</b>	<b>1,698</b>	<b>1,634</b>	<b>1,717</b>	<b>1,741</b>	<b>1,813</b>	<b>1,847</b>	<b>1,779</b>
<b>% YoY</b>	<b>-6.4%</b>	<b>4.0%</b>	<b>9.7%</b>	<b>8.4%</b>	<b>8.1%</b>	<b>8.6%</b>	<b>8.7%</b>	<b>8.1%</b>	<b>8.3%</b>	<b>10.3%</b>	<b>8.7%</b>	<b>8.9%</b>

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

# NAND bit demand growth to decelerate in '22E to ~28%

## NAND Flash Bit Demand by Application

NAND Flash Demand Summary		2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Total Embedded</b>		333,835	433,224	125,794	131,184	148,463	177,391	582,831	164,680	173,004	193,836	220,610	752,130
Mobile Phones - Embedded		117,145	134,947	40,560	37,299	43,499	58,351	179,709	48,157	49,067	55,118	68,278	220,620
Smartphones		116,482	134,517	40,432	37,230	43,403	58,267	179,333	48,074	48,989	55,034	68,197	220,294
iPhones		30,949	36,687	10,573	8,685	11,121	22,784	53,162	14,881	13,101	15,235	25,708	68,925
Samsung		29,344	27,158	9,010	6,976	9,417	10,091	35,494	11,119	11,326	11,796	11,442	45,683
Non- iPhone/Samsung		56,189	70,672	20,850	21,570	22,865	25,392	90,677	22,073	24,563	28,003	31,046	105,685
Feature phones		663	430	127	69	96	83	376	84	78	84	81	327
Tablet PCs		11,298	20,941	6,476	6,318	6,602	6,810	26,205	6,861	6,637	7,035	6,915	27,449
<b>Total SSD</b>		159,295	233,568	67,758	75,067	84,362	93,231	320,417	93,661	100,300	113,683	124,917	432,561
SSD (notebooks)		41,427	68,227	20,505	21,885	27,135	31,864	101,388	27,542	27,951	33,955	38,375	127,822
SSD (servers)		49,187	80,929	22,132	26,177	28,308	30,514	107,131	34,161	37,195	41,576	44,663	157,595
SSD (storage)		18,075	23,997	6,592	7,114	7,896	8,467	30,068	9,316	10,205	11,133	12,100	42,754
SSD (others)		50,606	60,415	18,530	19,891	21,024	22,386	81,830	22,642	24,950	27,019	29,780	104,390
Other Embedded		46,096	43,769	11,000	12,500	14,000	19,000	56,500	16,000	17,000	18,000	20,500	71,500
<b>Total Flash cards</b>		28,840	27,119	7,184	7,040	7,511	6,842	28,577	7,025	7,611	8,144	7,591	30,370
Mobile Phones - Flash Cards		8,446	8,190	2,750	2,263	2,318	2,088	9,420	2,200	2,334	2,393	2,187	9,115
USB Flash Drives		12,198	12,560	2,884	3,177	3,542	3,054	12,658	3,225	3,626	4,051	3,653	14,555
Other flash cards		8,196	6,369	1,550	1,600	1,650	1,700	6,500	1,600	1,650	1,700	1,750	6,700
<b>Total Bit Demand</b>		362,675	460,343	132,978	138,224	155,974	184,233	611,409	171,705	180,615	201,981	228,200	782,501
% QoQ				-2.0%	3.9%	12.8%	18.1%		-6.8%	5.2%	11.8%	13.0%	
% YoY		44.3%	26.9%	35.1%	30.2%	29.8%	35.8%	32.8%	29.1%	30.7%	29.5%	23.9%	28.0%

Source: Gartner, Company Data, UBS estimates

# SSDs continue to drive most of the bit demand growth

## Breakdown of NAND Annual Bit Growth Y/Y

### NAND Flash Demand Summary

	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Total Embedded</b>	<b>95.8%</b>	<b>101.8%</b>	<b>97.8%</b>	<b>97.7%</b>	<b>99.3%</b>	<b>100.6%</b>	<b>99.0%</b>	<b>100.4%</b>	<b>98.7%</b>	<b>98.6%</b>	<b>98.3%</b>	<b>99.0%</b>
<b>Mobile Phones - Embedded</b>	<b>30.3%</b>	<b>18.2%</b>	<b>37.1%</b>	<b>29.9%</b>	<b>21.6%</b>	<b>30.0%</b>	<b>29.6%</b>	<b>19.6%</b>	<b>27.8%</b>	<b>25.3%</b>	<b>22.6%</b>	<b>23.9%</b>
<b>Smartphones</b>	<b>30.2%</b>	<b>18.5%</b>	<b>37.2%</b>	<b>30.0%</b>	<b>21.6%</b>	<b>30.0%</b>	<b>29.7%</b>	<b>19.7%</b>	<b>27.7%</b>	<b>25.3%</b>	<b>22.6%</b>	<b>23.9%</b>
iPhones	5.6%	5.9%	9.1%	5.2%	11.1%	15.8%	10.9%	11.1%	10.4%	8.9%	6.7%	9.2%
Samsung	11.9%	-2.2%	6.7%	4.9%	2.6%	7.3%	5.5%	5.4%	10.3%	5.2%	3.1%	6.0%
Non- iPhone/Samsung	12.7%	14.8%	21.3%	20.0%	7.9%	7.0%	13.2%	3.2%	7.1%	11.2%	12.9%	8.8%
Feature phones	0.0%	-0.2%	0.0%	-0.1%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
Tablet PCs	2.8%	9.9%	9.8%	4.4%	2.3%	-0.8%	3.5%	1.0%	0.8%	0.9%	0.2%	0.7%
<b>Total SSD</b>	<b>48.9%</b>	<b>76.0%</b>	<b>51.7%</b>	<b>56.2%</b>	<b>65.1%</b>	<b>56.8%</b>	<b>57.5%</b>	<b>66.9%</b>	<b>59.5%</b>	<b>63.7%</b>	<b>72.1%</b>	<b>65.5%</b>
SSD (notebooks)	7.1%	27.4%	29.9%	16.4%	21.5%	20.3%	22.0%	18.2%	14.3%	14.8%	14.8%	15.5%
SSD (servers)	11.4%	32.5%	4.8%	15.9%	21.8%	24.0%	17.3%	31.1%	26.0%	28.8%	32.2%	29.5%
SSD (storage)	2.8%	6.1%	2.6%	5.0%	5.7%	3.2%	4.0%	7.0%	7.3%	7.0%	8.3%	7.4%
SSD (others)	27.7%	10.0%	14.4%	18.9%	16.2%	9.4%	14.2%	10.6%	11.9%	13.0%	16.8%	13.2%
Other Embedded	13.7%	-2.4%	-0.9%	7.2%	10.3%	14.5%	8.4%	12.9%	10.6%	8.7%	3.4%	8.8%
<b>Total Flash cards</b>	<b>4.2%</b>	<b>-1.8%</b>	<b>2.2%</b>	<b>2.3%</b>	<b>0.7%</b>	<b>-0.6%</b>	<b>1.0%</b>	<b>-0.4%</b>	<b>1.3%</b>	<b>1.4%</b>	<b>1.7%</b>	<b>1.0%</b>
Mobile Phones - Flash Cards	1.3%	-0.3%	1.7%	1.0%	0.3%	0.4%	0.8%	-1.4%	0.2%	0.2%	0.2%	-0.2%
USB Flash Drives	1.9%	0.4%	0.8%	1.3%	0.1%	-1.3%	0.1%	0.9%	1.1%	1.1%	1.4%	1.1%
Other flash cards	1.0%	-1.9%	-0.3%	0.0%	0.4%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
<b>Total Bit Demand</b>	<b>100.0%</b>											

Source: Gartner, Company Data, UBS estimates

# Smartphones and SSDs decelerate a bit through '22E

NAND Flash Bit Demand Growth by Application

NAND Flash Demand Growth	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
	YoY	YoY	QoQ	QoQ	QoQ	QoQ	YoY	QoQ	QoQ	QoQ	QoQ	YoY
<b>Total Embedded</b>	<b>46.9%</b>	<b>29.8%</b>	<b>-2.1%</b>	<b>4.3%</b>	<b>13.2%</b>	<b>19.5%</b>	<b>34.5%</b>	<b>-7.2%</b>	<b>5.1%</b>	<b>12.0%</b>	<b>13.8%</b>	<b>29.0%</b>
<b>Smartphones</b>	<b>40.6%</b>	<b>15.5%</b>	<b>-7.4%</b>	<b>-7.9%</b>	<b>16.6%</b>	<b>34.2%</b>	<b>33.3%</b>	<b>-17.5%</b>	<b>1.9%</b>	<b>12.3%</b>	<b>23.9%</b>	<b>22.8%</b>
iPhones	25.4%	18.5%	-30.0%	-17.9%	28.0%	104.9%	44.9%	-34.7%	-12.0%	16.3%	68.7%	29.7%
Samsung	82.5%	-7.4%	37.2%	-22.6%	35.0%	7.2%	30.7%	10.2%	1.9%	4.2%	-3.0%	28.7%
Non- iPhone/Samsung	33.6%	25.8%	-5.2%	3.5%	6.0%	11.1%	28.3%	-13.1%	11.3%	14.0%	10.9%	16.6%
Tablet PCs	38.6%	85.3%	-9.8%	-2.4%	4.5%	3.2%	25.1%	0.8%	-3.3%	6.0%	-1.7%	4.7%
<b>SSD-Total</b>	<b>52.0%</b>	<b>46.6%</b>	<b>3.3%</b>	<b>10.8%</b>	<b>12.4%</b>	<b>10.5%</b>	<b>37.2%</b>	<b>0.5%</b>	<b>7.1%</b>	<b>13.3%</b>	<b>9.9%</b>	<b>35.0%</b>
SSD (notebooks)	23.6%	64.7%	-6.9%	6.7%	24.0%	17.4%	48.6%	-13.6%	1.5%	21.5%	13.0%	26.1%
SSD (servers)	34.6%	64.5%	17.4%	18.3%	8.1%	7.8%	32.4%	12.0%	8.9%	11.8%	7.4%	47.1%
SSD (storage)	20.8%	32.8%	-5.0%	7.9%	11.0%	7.2%	25.3%	10.0%	9.5%	9.1%	8.7%	42.2%
SSD (others)	155.7%	19.4%	4.1%	7.3%	5.7%	6.5%	35.4%	1.1%	10.2%	8.3%	10.2%	27.6%
<b>Total Flash cards</b>	<b>19.5%</b>	<b>-6.0%</b>	<b>0.9%</b>	<b>-2.0%</b>	<b>6.7%</b>	<b>-8.9%</b>	<b>5.4%</b>	<b>2.7%</b>	<b>8.3%</b>	<b>7.0%</b>	<b>-6.8%</b>	<b>6.3%</b>
Mobile Phones - Flash cards	21.3%	-3.0%	47.0%	-17.7%	2.4%	-9.9%	15.0%	5.4%	6.1%	2.5%	-8.6%	-3.2%
<b>Total Bit Demand</b>	<b>44.3%</b>	<b>26.9%</b>	<b>-2.0%</b>	<b>3.9%</b>	<b>12.8%</b>	<b>18.1%</b>	<b>32.8%</b>	<b>-6.8%</b>	<b>5.2%</b>	<b>11.8%</b>	<b>13.0%</b>	<b>28.0%</b>

Source: Gartner, Company Data, UBS estimates

# Content growths increase in Notebooks and Servers

NAND Flash Content Assumptions (MB/unit) by Application

NAND Flash - End Market Content Assumption

	2019	2020	Q121	Q221	Q321E	Q421E	2021E	Q122E	Q222E	Q322E	Q422E	2022E
<b>Smartphones - Blended</b>	74,111	95,219	106,243	114,023	121,580	145,775	122,328	140,741	141,369	146,098	163,473	148,590
% YoY	40%	28%	21%	26%	29%	39%	28%	32%	24%	20%	12%	21%
iPhones	159,965	183,522	193,331	193,331	237,240	291,635	231,140	291,635	291,635	301,466	327,025	299,025
Samsung	101,854	109,943	121,398	125,315	139,760	151,964	134,615	162,659	162,201	164,343	171,047	165,007
Non- iPhone/Samsung	65,186	86,066	100,000	105,000	110,000	115,000	107,617	115,000	120,000	125,000	130,000	122,965
<b>SSD - Notebook PCs</b>	279	332	347	367	416	455	399	463	457	493	541	491
% YoY	8%	19%	9%	12%	23%	36%	20%	33%	25%	18%	19%	23%
<b>SSD- Servers</b>	1,641	1,725	1,904	2,051	2,197	2,344	2,130	2,490	2,637	2,734	2,832	2,680
% YoY	13%	5%	13%	20%	26%	32%	24%	31%	29%	24%	21%	26%
<b>SSD- Storage</b>	3,674	4,013	4,395	4,590	4,785	4,980	4,698	5,176	5,371	5,566	5,762	5,481
% YoY	12%	9%	14%	17%	18%	18%	17%	18%	17%	16%	16%	17%

Source: Gartner, Company Data, UBS estimates

## Section 4

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PC's

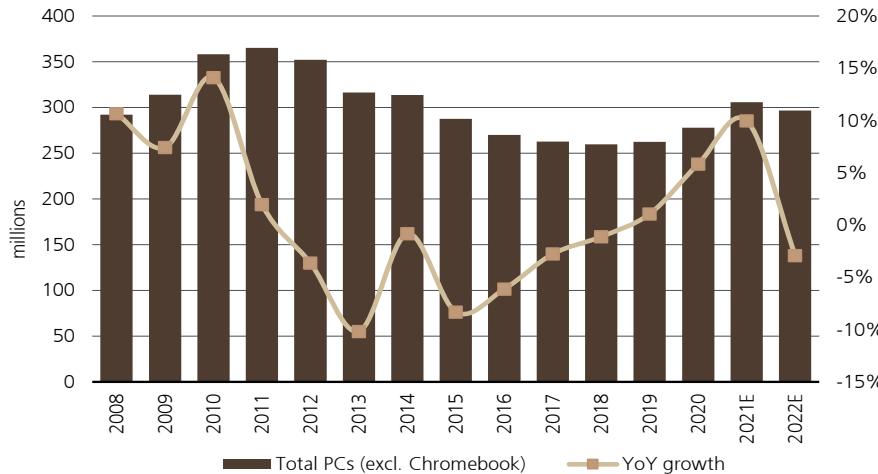
# Key Messages

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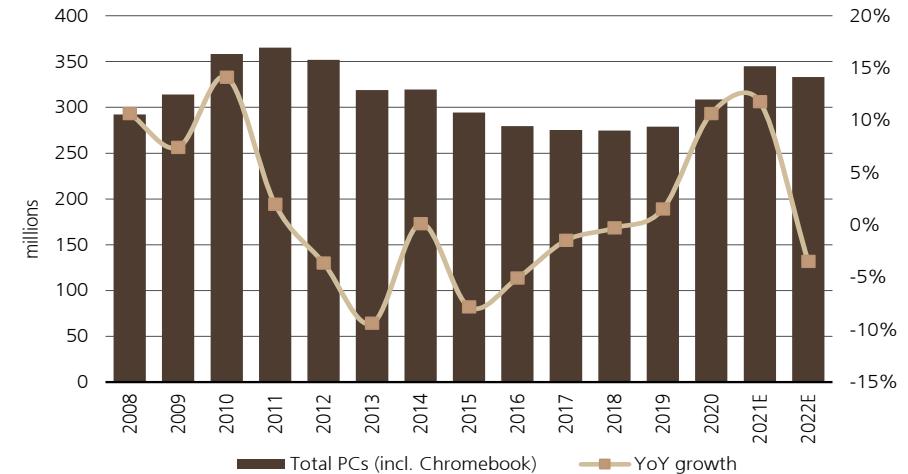
- PC demand remains robust, though Q321 PC shipments were soft due to weak Chromebook and some supply constraints
  - Government purchases in mature countries have pressured Chromebook
- Supply constraints are starting to ease but MPU shipments significantly lagged PC shipments in CQ3:21, suggesting channel draw-down and setting up a period of strong MPU shipments as they "catch up" to PC shipments
- We model overall PC unit shipments to moderate and decline by 3-4% Y/Y in '22E following a very strong +11.8% YoY in '21E
- AMD continues to gain share in PC CPU with notebook share back to prior highs but desktop share still below prior peak levels

# Global PCs: Softening Chromebooks are the main downside driver in 3Q

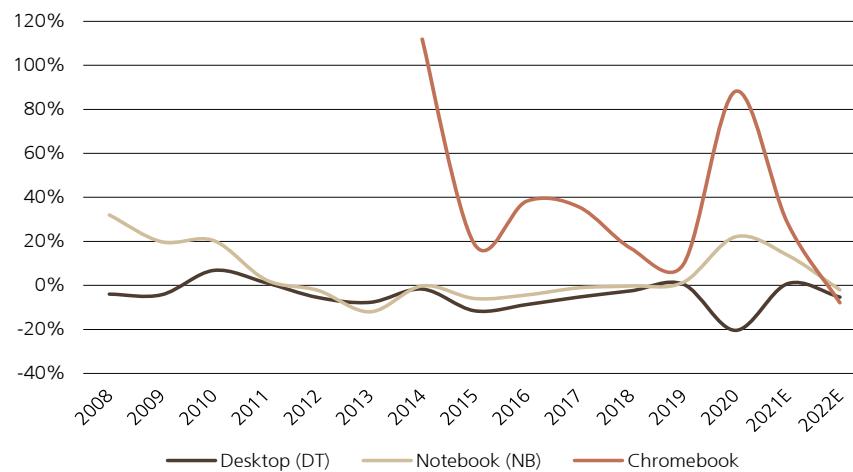
Global PC (excl. C-Books) Shipment and Growth YoY



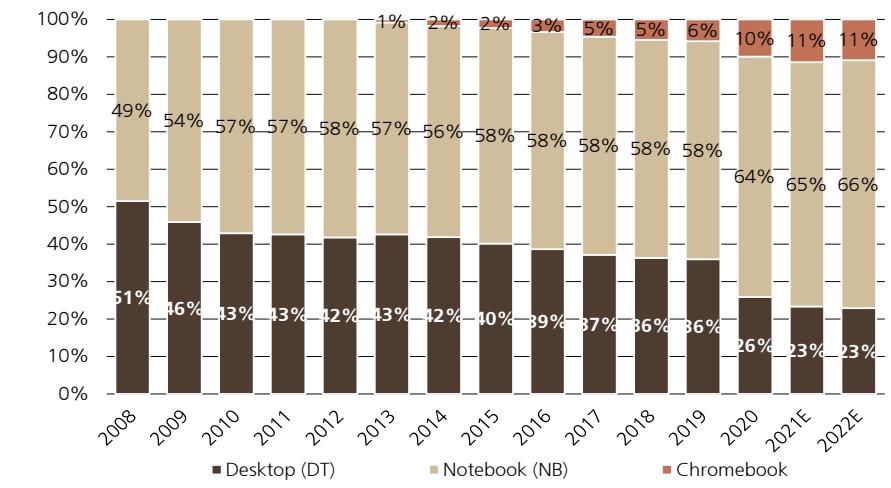
Global PC (incl. C-Books) Shipment and Growth YoY



Global PC Shipment YoY Growth by Form Factor



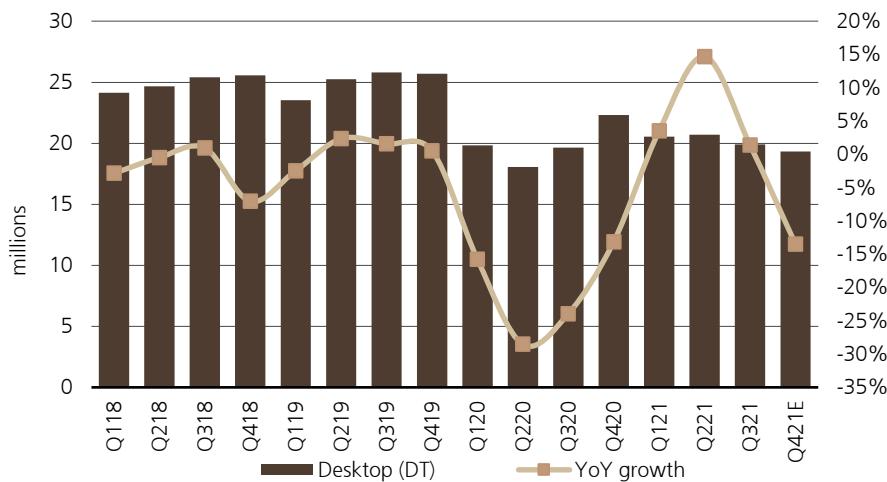
Global PC Shipment Mix by Form Factor



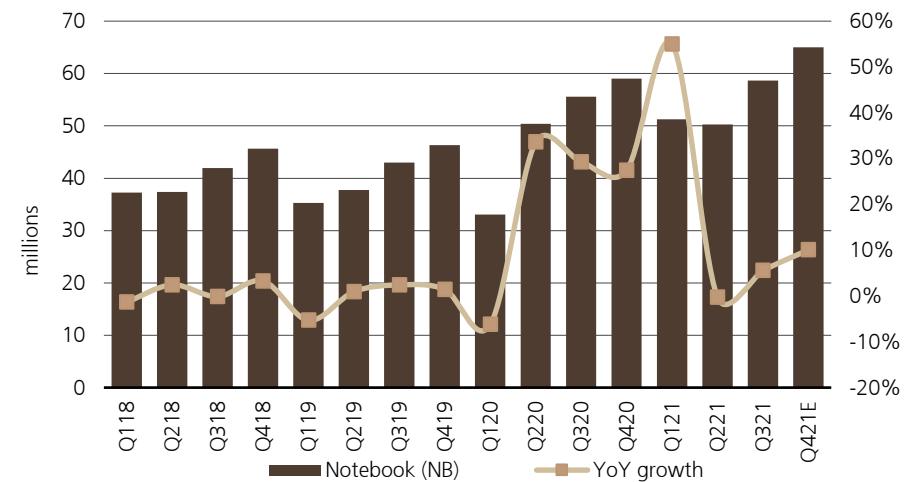
Source : Gartner, UBS estimates

# Global PCs: Regular NBs outperforming other form factors

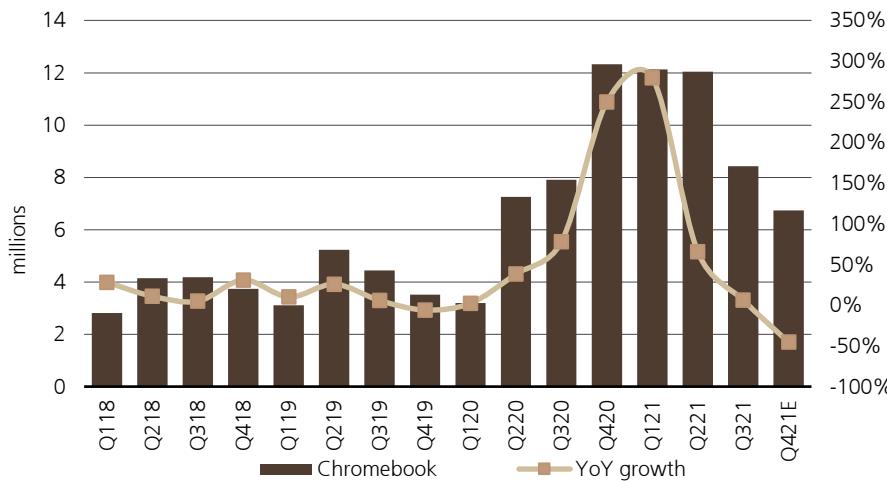
Desktop Shipment and Growth YoY (Quarterly)



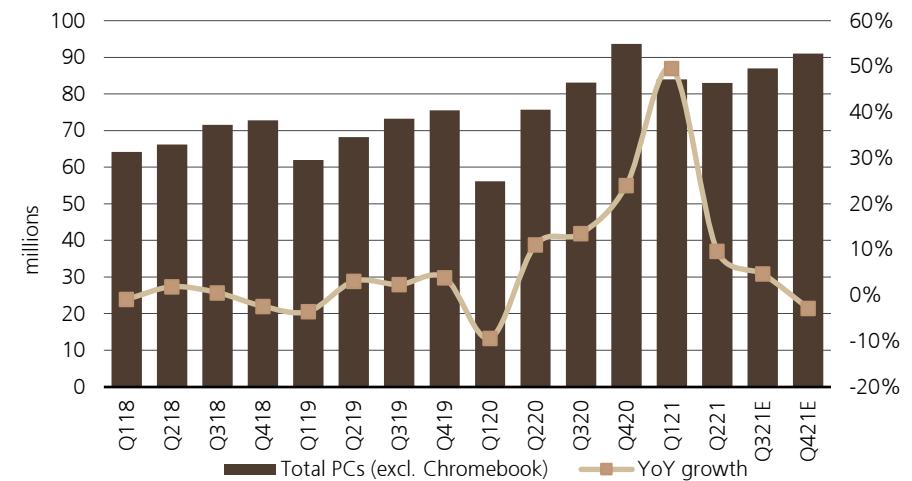
Notebook Shipment and Growth YoY (Quarterly)



Chromebook Shipment and Growth YoY (Quarterly)



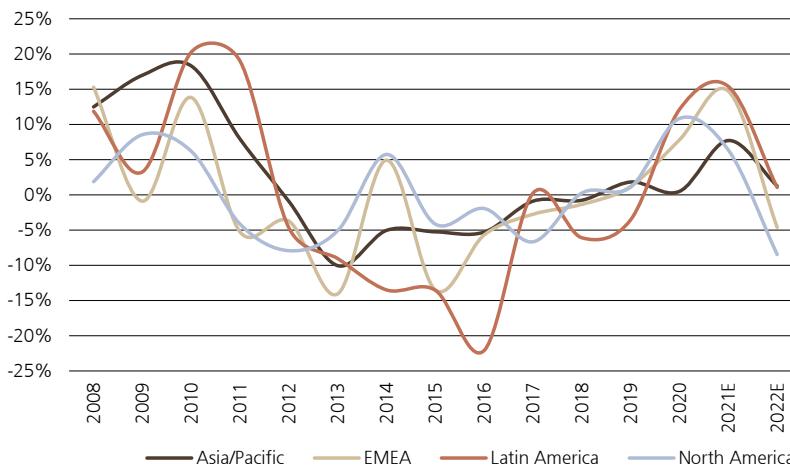
Total PC Shipment and Growth YoY (Quarterly)



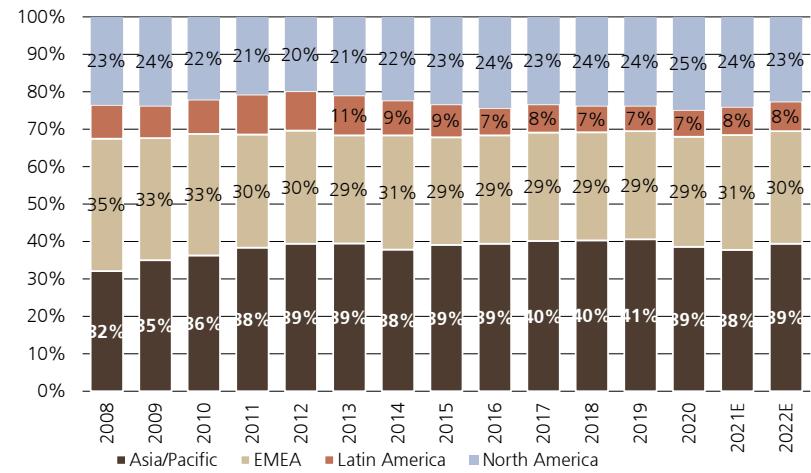
Source : Gartner, UBS estimates

# Global PCs: Demand in the US has softened

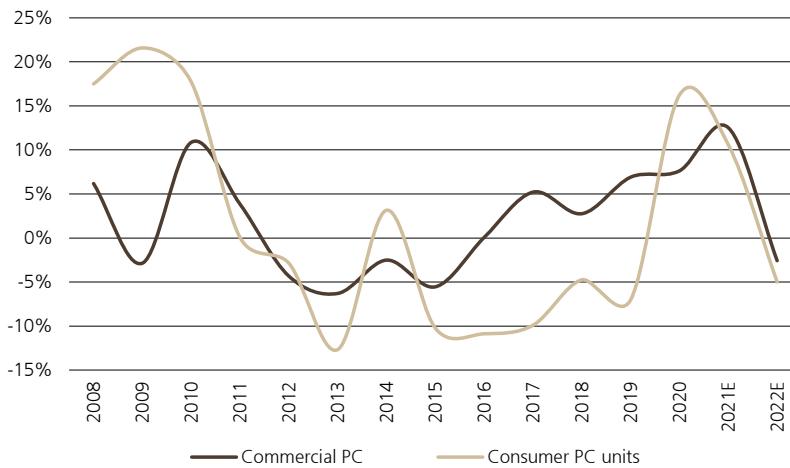
Global PC Shipment YoY Growth by Region



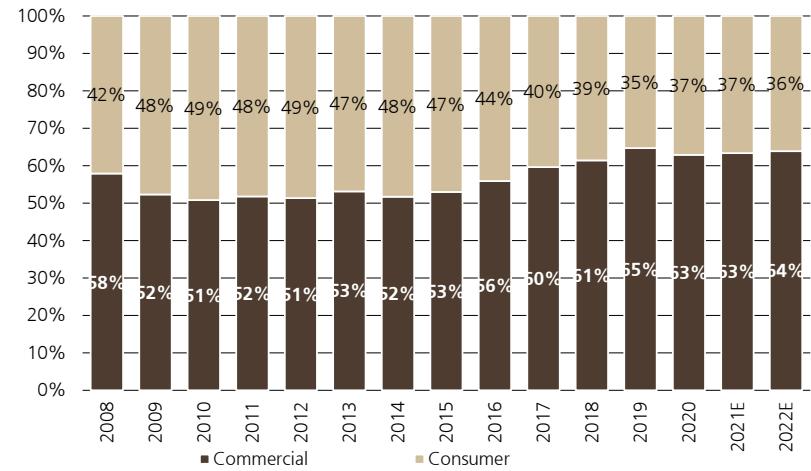
Global PC Shipment Mix by Region



Global PC Shipment YoY Growth by End Market



Global PC Shipment Mix by End Market



Source : Gartner, UBS estimates

# UBS Global PC Shipment Forecast: -3.5% Y/Y in '22

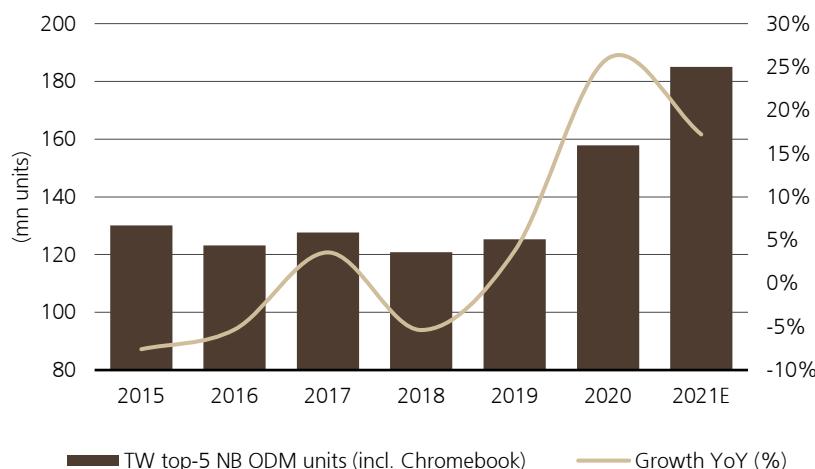
## UBS Global PC Model

	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E
<b>PC units by form factor (m)</b>										
Desktop	135.8	133.6	118.2	108.0	102.3	99.8	100.3	79.9	80.5	76.2
Notebook	180.5	180.1	169.5	162.2	160.4	160.0	162.3	198.1	225.2	220.6
<b>Sub-total</b>	<b>316.3</b>	<b>313.7</b>	<b>287.7</b>	<b>270.1</b>	<b>262.7</b>	<b>259.8</b>	<b>262.6</b>	<b>278.0</b>	<b>305.7</b>	<b>296.9</b>
Chromebook	2.7	5.7	6.8	9.4	12.8	14.9	16.3	30.7	39.3	36.2
<b>Total PC</b>	<b>319.0</b>	<b>319.4</b>	<b>294.5</b>	<b>279.5</b>	<b>275.4</b>	<b>274.7</b>	<b>278.9</b>	<b>308.7</b>	<b>345.1</b>	<b>333.1</b>
<b>Consumer PC</b>	<b>149.5</b>	<b>154.2</b>	<b>138.4</b>	<b>123.3</b>	<b>111.1</b>	<b>105.9</b>	<b>98.4</b>	<b>114.4</b>	<b>126.5</b>	<b>120.2</b>
Consumer NB	100.9	106.3	98.5	89.5	83.1	80.4	75.5	92.9	104.5	99.5
Consumer DT	48.6	47.9	39.9	33.8	28.0	25.5	22.9	21.6	22.0	20.7
<b>Commercial PC</b>	<b>169.5</b>	<b>165.3</b>	<b>156.1</b>	<b>156.2</b>	<b>164.3</b>	<b>168.8</b>	<b>180.5</b>	<b>194.2</b>	<b>218.5</b>	<b>212.9</b>
Commercial NB	79.5	73.9	71.0	72.6	77.3	79.6	86.8	105.2	120.7	121.2
Commercial DT	87.3	85.7	78.3	74.1	74.3	74.3	77.4	58.3	58.5	55.5
Chromebook	2.7	5.7	6.8	9.4	12.8	14.9	16.3	30.7	39.3	36.2
<b>Total PC</b>	<b>319.0</b>	<b>319.4</b>	<b>294.5</b>	<b>279.5</b>	<b>275.4</b>	<b>274.7</b>	<b>278.9</b>	<b>308.7</b>	<b>345.1</b>	<b>333.1</b>
<b>Unit growth (%)</b>										
Desktop	-7.7%	-1.7%	-11.5%	-8.7%	-5.3%	-2.4%	0.5%	-20.4%	0.8%	-5.3%
Notebook	-12.0%	-0.2%	-5.9%	-4.3%	-1.1%	-0.2%	1.4%	22.1%	13.7%	-2.0%
<b>Sub-total</b>	<b>-10.2%</b>	<b>-0.8%</b>	<b>-8.3%</b>	<b>-6.1%</b>	<b>-2.8%</b>	<b>-1.1%</b>	<b>1.1%</b>	<b>5.9%</b>	<b>10.0%</b>	<b>-2.9%</b>
Chromebook	0.0%	111.9%	18.8%	38.2%	35.7%	16.8%	9.4%	88.2%	28.2%	-7.9%
<b>Total PC</b>	<b>-9.4%</b>	<b>0.1%</b>	<b>-7.8%</b>	<b>-5.1%</b>	<b>-1.5%</b>	<b>-0.3%</b>	<b>1.5%</b>	<b>10.7%</b>	<b>11.8%</b>	<b>-3.5%</b>
<b>Consumer PC</b>	<b>-12.7%</b>	<b>3.2%</b>	<b>-10.2%</b>	<b>-10.9%</b>	<b>-9.9%</b>	<b>-4.7%</b>	<b>-7.0%</b>	<b>16.2%</b>	<b>10.6%</b>	<b>-5.0%</b>
Consumer NB	-13.8%	5.3%	-7.3%	-9.1%	-7.1%	-3.3%	-6.1%	23.0%	12.5%	-4.8%
Consumer DT	-10.3%	-1.3%	-16.7%	-15.3%	-17.2%	-9.0%	-9.9%	-6.1%	2.2%	-5.9%
<b>Commercial PC</b>	<b>-6.3%</b>	<b>-2.5%</b>	<b>-5.6%</b>	<b>0.1%</b>	<b>5.2%</b>	<b>2.8%</b>	<b>6.9%</b>	<b>7.6%</b>	<b>12.5%</b>	<b>-2.6%</b>
Commercial NB	-9.6%	-7.1%	-3.9%	2.3%	6.4%	3.1%	9.0%	21.2%	14.7%	0.4%
Commercial DT	-6.1%	-1.9%	-8.6%	-5.3%	0.2%	0.0%	4.1%	-24.6%	0.3%	-5.1%
Chromebook	n.a	111.9%	18.8%	38.2%	35.7%	16.8%	9.4%	88.2%	28.2%	-7.9%
<b>Total PC</b>	<b>-9.4%</b>	<b>0.1%</b>	<b>-7.8%</b>	<b>-5.1%</b>	<b>-1.5%</b>	<b>-0.3%</b>	<b>1.5%</b>	<b>10.7%</b>	<b>11.8%</b>	<b>-3.5%</b>

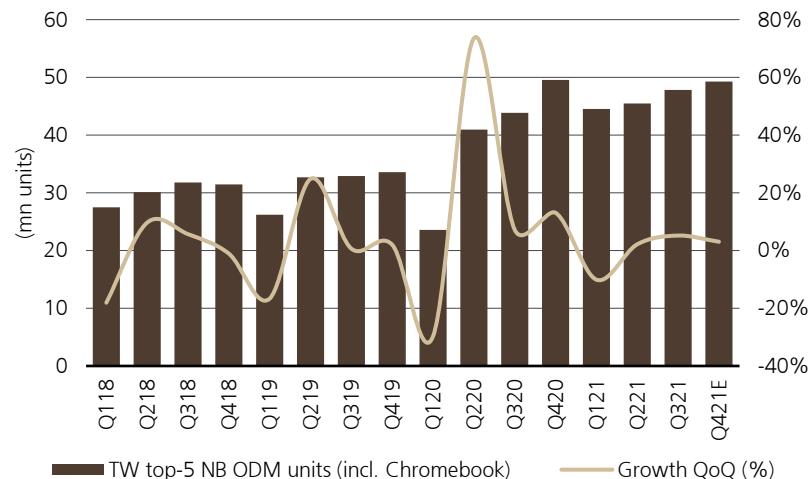
Source : Company data, UBS estimates

# NB ODM Shipments: Muted Q4:21 and component shortage persists

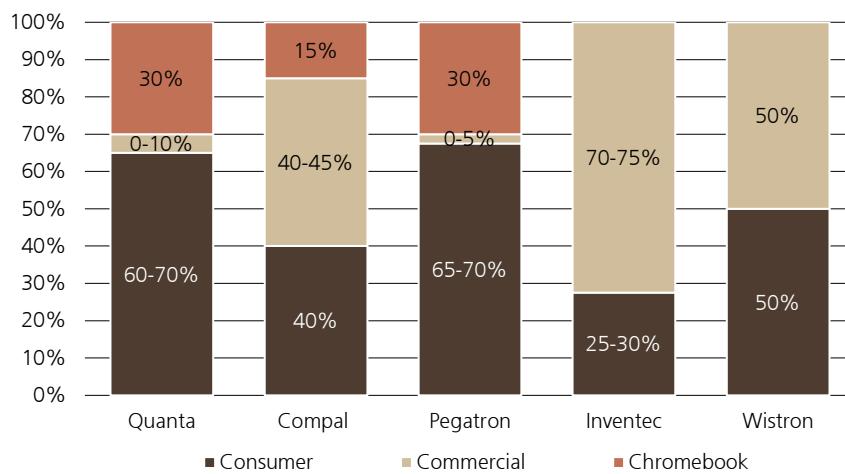
Taiwan NB ODM Shipment and Growth YoY (Yearly)



Taiwan NB ODM Shipment and Growth YoY (Quarterly)



NB shipment mix for Taiwan NB ODMs



Total NB shipment growth trend for Taiwan NB ODMs

	1Q21	2Q21	3Q21	4Q21E
<b>YoY change (%)</b>				
Quanta	160%	31%	-5%	-3%
Compal	68%	4%	32%	-3%
Pegatron	48%	-21%	-13%	3%
Inventec	41%	-12%	4%	8%
Wistron	52%	17%	27%	3%
<b>Total</b>	<b>89%</b>	<b>11%</b>	<b>9%</b>	<b>-1%</b>
<b>QoQ change (%)</b>				
Quanta	-4%	0%	-8%	10%
Compal	-17%	-1%	18%	0%
Pegatron	-13%	7%	10%	0%
Inventec	-8%	4%	18%	-5%
Wistron	-16%	13%	8%	0%
<b>Total</b>	<b>-10%</b>	<b>2%</b>	<b>5%</b>	<b>3%</b>

Source : Gartner, UBS estimates

# NB ODM Shipments: Upside into 1Q22 from improved component supply situation

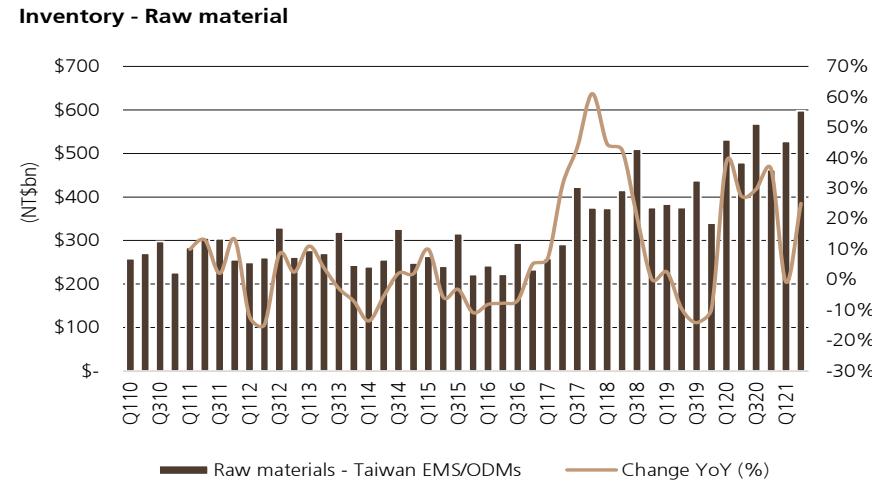
## Taiwanese Top-5 NB ODM shipments

	1Q19	2Q19	3Q19	4Q19	1Q20	2Q20	3Q20	4Q20	1Q21	2Q21	3Q21E	4Q21E	2018	2019	2020	2021E
Quanta	7,300	8,700	9,300	9,800	7,300	14,500	18,300	19,700	19,000	19,000	17,400	19,140	37,600	35,100	59,800	74,540
Compal	9,300	12,500	11,500	10,600	7,800	12,500	11,600	15,700	13,100	13,000	15,300	15,300	39,500	43,900	47,600	56,700
Pegatron	1,900	2,400	2,700	3,050	1,525	3,025	3,050	2,575	2,250	2,400	2,650	2,650	7,700	10,050	10,175	9,950
Inventec	4,100	4,900	4,900	5,000	3,400	5,700	5,700	5,200	4,800	5,000	5,900	5,605	18,500	18,900	20,000	21,305
Wistron	3,600	4,200	4,500	5,100	3,550	5,200	5,200	6,400	5,400	6,100	6,600	6,600	17,500	17,400	20,350	24,700
<b>Total</b>	<b>26,200</b>	<b>32,700</b>	<b>32,900</b>	<b>33,550</b>	<b>23,575</b>	<b>40,925</b>	<b>43,850</b>	<b>49,575</b>	<b>44,550</b>	<b>45,500</b>	<b>47,850</b>	<b>49,295</b>	<b>120,800</b>	<b>125,350</b>	<b>157,925</b>	<b>187,195</b>
<b>YoY change (%)</b>																
Quanta	-18%	-5%	-6%	2%	0%	67%	97%	101%	160%	31%	-5%	-3%	-11.3%	-6.6%	70.4%	24.6%
Compal	9%	21%	10%	4%	-16%	0%	1%	48%	68%	4%	32%	-3%	0.3%	11.1%	8.4%	19.1%
Pegatron	-3%	60%	50%	24%	-20%	26%	13%	-16%	48%	-21%	-13%	3%	-13.5%	30.5%	1.2%	-2.2%
Inventec	2%	2%	-2%	6%	-17%	16%	16%	4%	41%	-12%	4%	8%	3.1%	2.2%	5.8%	6.5%
Wistron	-12%	-2%	-2%	13%	-1%	24%	16%	25%	52%	17%	27%	3%	-7.9%	-0.6%	17.0%	21.4%
<b>Total</b>	<b>-5%</b>	<b>9%</b>	<b>3%</b>	<b>7%</b>	<b>-10%</b>	<b>25%</b>	<b>33%</b>	<b>48%</b>	<b>89%</b>	<b>11%</b>	<b>9%</b>	<b>-1%</b>	<b>-5.4%</b>	<b>3.8%</b>	<b>26.0%</b>	<b>18.5%</b>
<b>QoQ change (%)</b>																
Quanta	-24%	19%	7%	5%	-26%	99%	26%	8%	-4%	0%	-8%	10%				
Compal	-9%	34%	-8%	-8%	-26%	60%	-7%	35%	-17%	-1%	18%	0%				
Pegatron	-22%	26%	13%	13%	-50%	98%	1%	-16%	-13%	7%	10%	0%				
Inventec	-13%	20%	0%	2%	-32%	68%	0%	-9%	-8%	4%	18%	-5%				
Wistron	-20%	17%	7%	13%	-30%	46%	0%	23%	-16%	13%	8%	0%				
<b>Total</b>	<b>-17%</b>	<b>25%</b>	<b>1%</b>	<b>2%</b>	<b>-30%</b>	<b>74%</b>	<b>7%</b>	<b>13%</b>	<b>-10%</b>	<b>2%</b>	<b>5%</b>	<b>3%</b>				

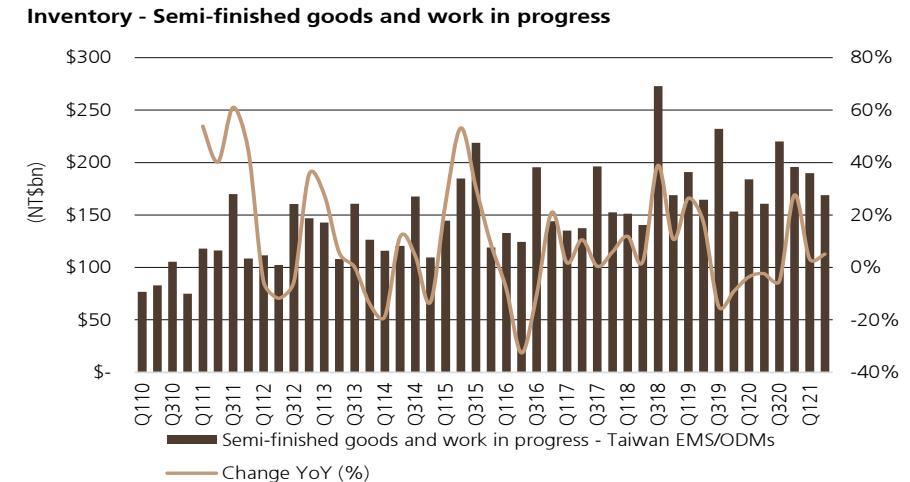
Source : Company data, UBS estimates

# EMS/ODM Inventory: Build in raw materials evident

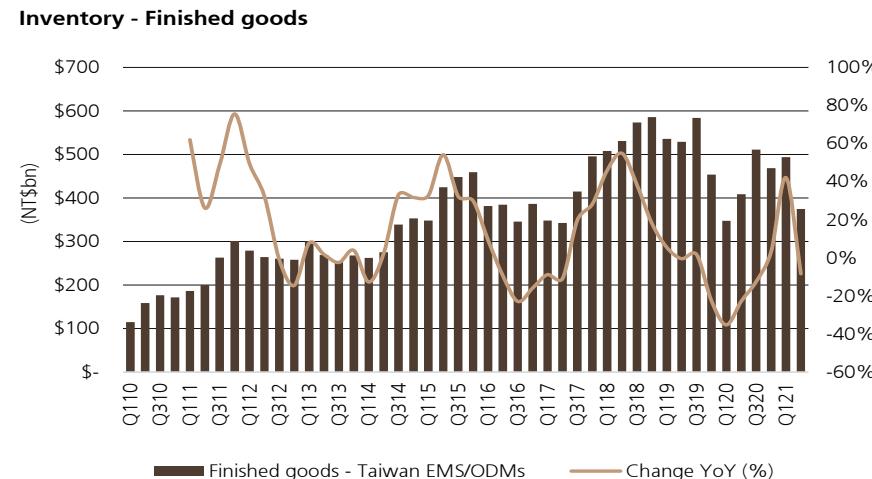
## Raw Material Inventory – Taiwan EMS/ODMs



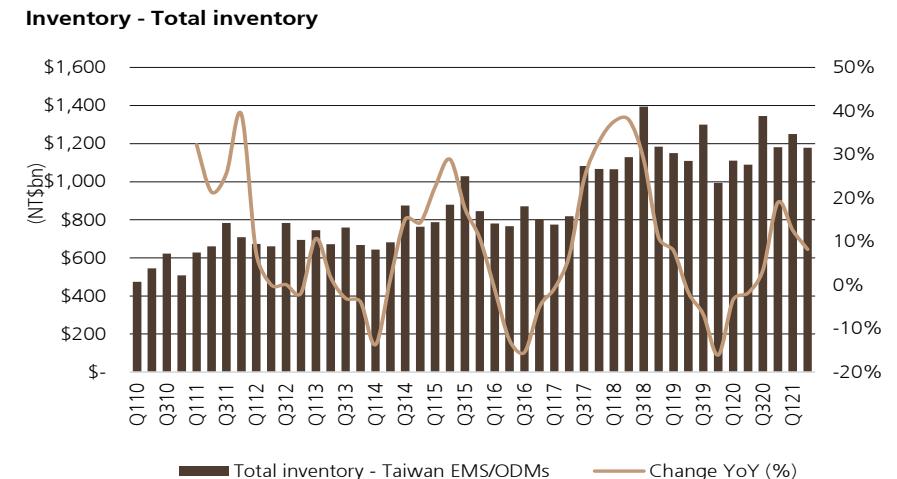
## Semi-finished Goods & WIP Inventory – Taiwan EMS/ODMs



## Finished Goods Inventory – Taiwan EMS/ODMs



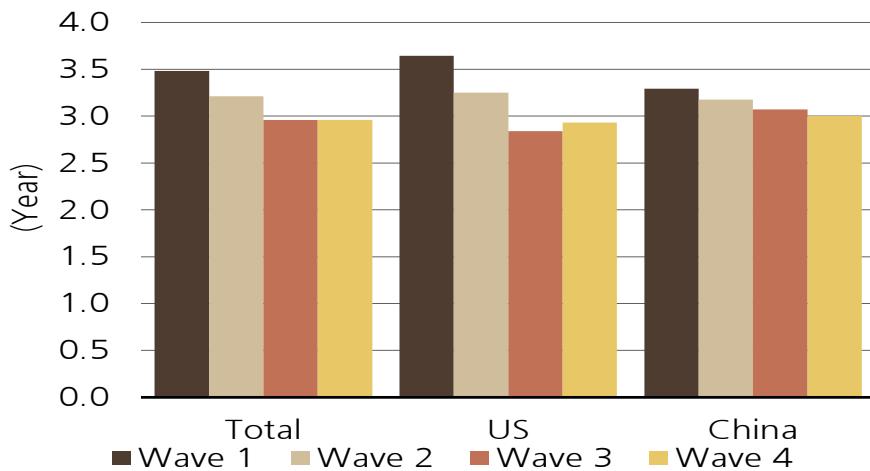
## Total Inventory – Taiwan EMS/ODMs



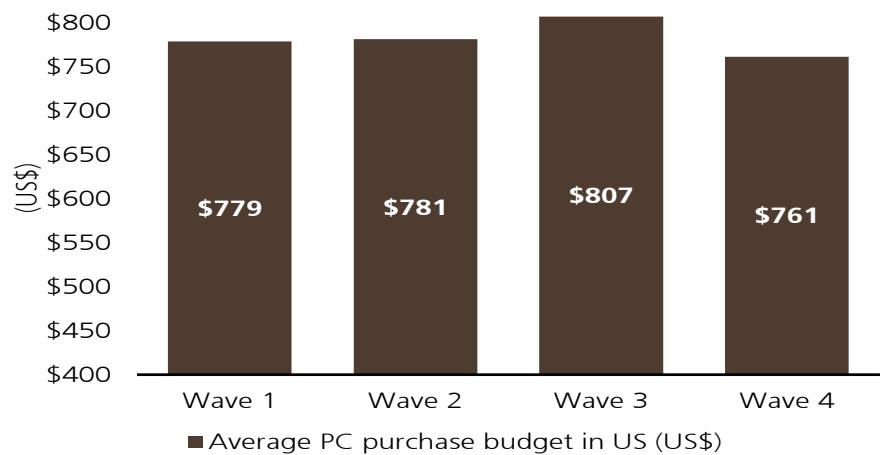
Source : Gartner, UBS estimates

# Consumer Survey: PC purchase intent appeared toppish in US

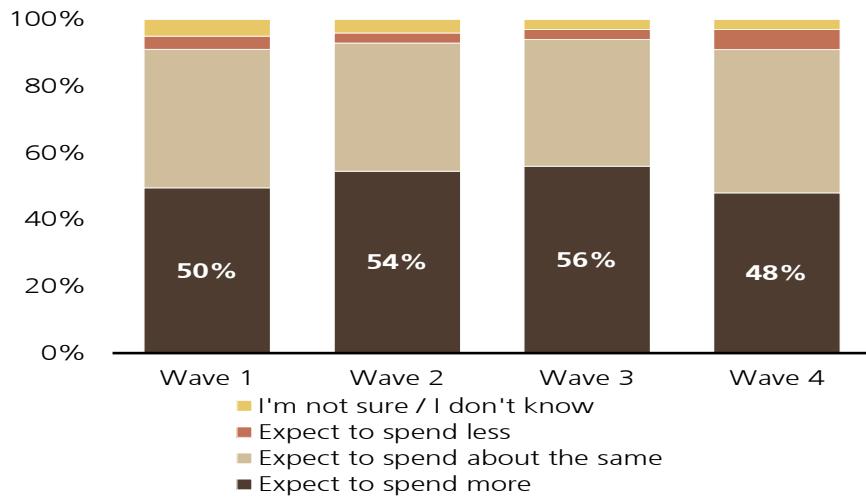
PC Replacement Cycle Stabilized at 2.9 Years



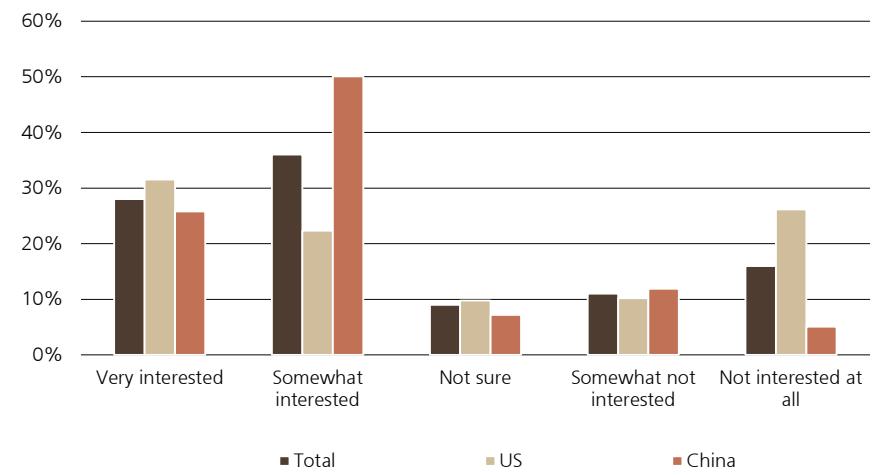
PC Purchase Budget Declined in the US



PC Spending Willingness Skewed to the Negative Side



Strong Demand for Gaming PC Likely to Continue

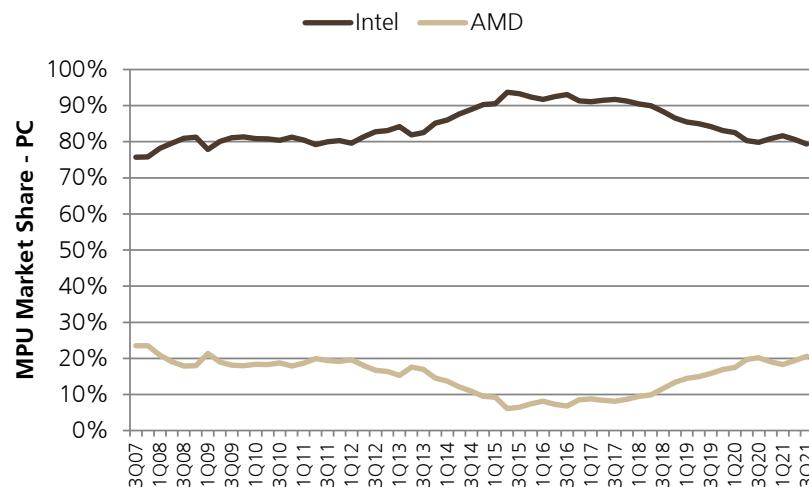


Source : Gartner, UBS Evidence Lab ([Access Dataset](#))

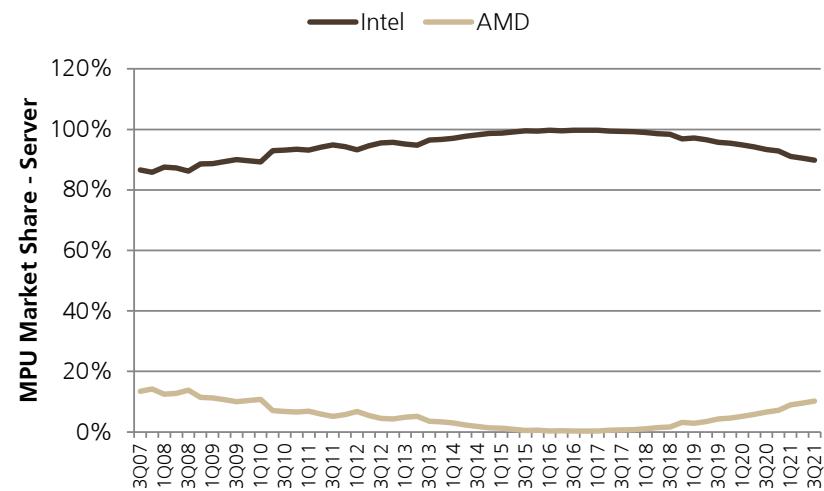
Note: Latest Wave 4 was as of June, 2021

# Processor Market: AMD has been gaining share

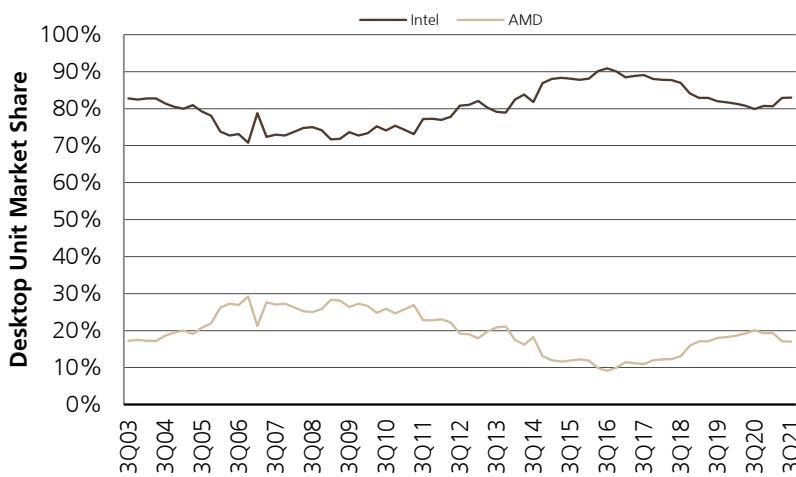
Overall PC MPU Market Share (Units)



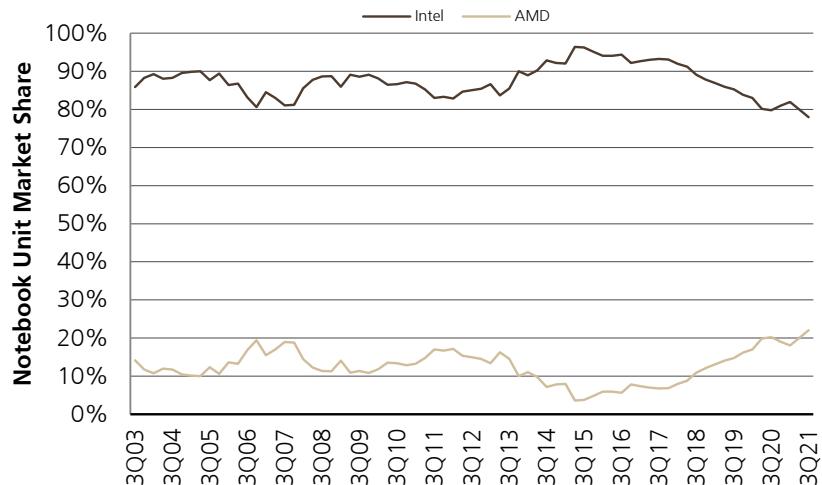
Server MPU Market Share (Units)



Overall Desktop Market Share (Units)



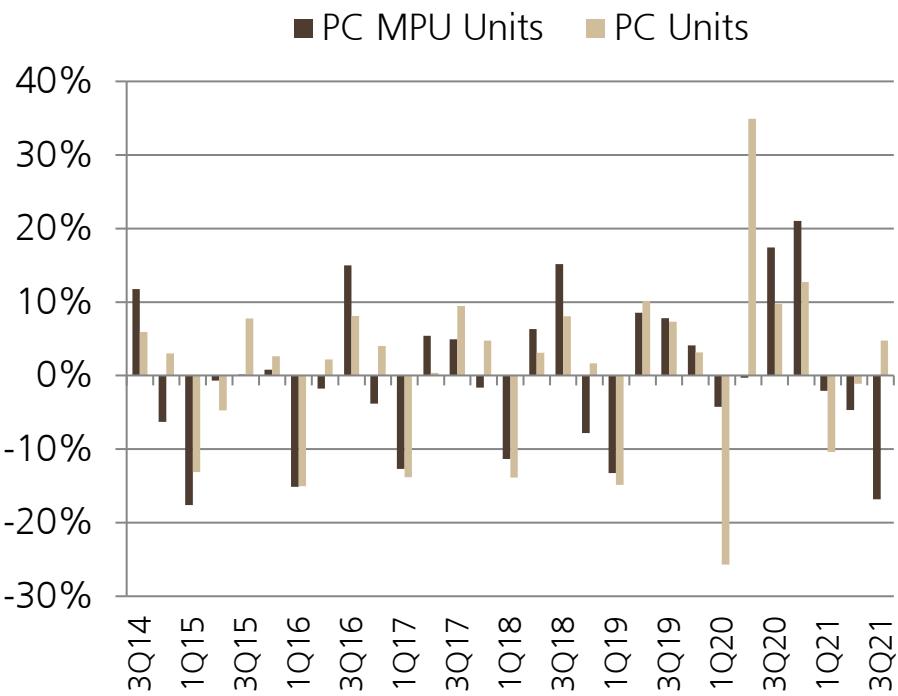
Overall Notebook Market Share (Units)



Source: Mercury Research

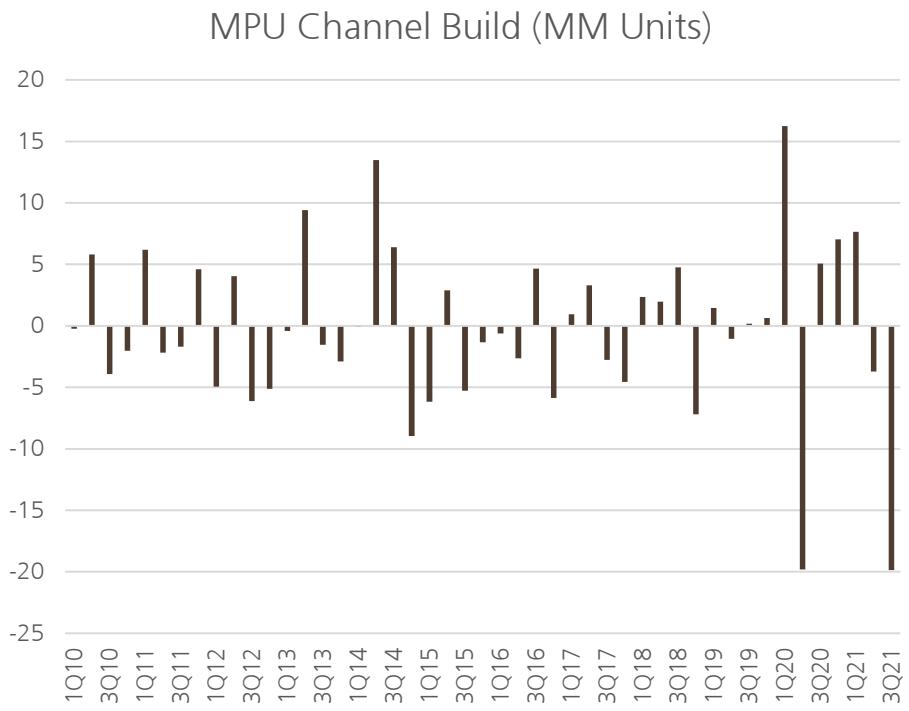
# PC MPU Channel: MPU inventory ran down in 3Q

PC MPU vs. PC Unit Shipments Q/Q



Source: Mercury Research, UBS

Quarterly PC MPU Channel Inventory



Source: Mercury Research, UBS

## Section 5

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### Server

# Key Messages

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- Cloud capex remains robust with growth of ~32% in 2021E and we expect another strong year in 2022E with capex up ~22% Y/Y
  - Within this, servers should be a larger piece of the mix in '22 as we see server units up ~13% in '22E following growth of ~4% in '21E – drivers are more AI/ML workloads and an enterprise recovery
- 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 grows from ~12% of all servers in '21

# Cloud capex remains robust, further catalyzed by Metaverse

## Cloud Capex Forecast

### UBS cloud capex forecast

US\$ mn	C2017	C2018	C2019	C2020	C2021E	C2022E	C2023E
<b>Capital expenditure</b>							
Apple	11,927	13,858	9,247	8,702	10,404	9,153	9,438
Alphabet	13,139	25,500	24,783	23,822	24,398	30,691	37,473
Microsoft	8,696	14,223	13,546	17,592	23,151	27,294	30,992
Amazon.com	10,057	11,322	13,259	35,046	56,255	64,087	67,178
Facebook	6,732	15,277	16,381	17,172	19,073	26,193	25,937
Baidu	1,820	2,336	2,769	773	2,671	2,798	2,969
Alibaba	3,437	6,628	7,358	5,886	7,502	11,164	14,191
Tencent	2,227	3,460	4,520	4,742	5,763	6,472	7,429
<b>Total</b>	<b>58,035</b>	<b>92,604</b>	<b>91,862</b>	<b>113,734</b>	<b>149,218</b>	<b>177,851</b>	<b>195,607</b>
<b>Total ex Apple</b>	<b>46,108</b>	<b>78,746</b>	<b>82,615</b>	<b>105,032</b>	<b>138,814</b>	<b>168,699</b>	<b>186,169</b>
<b>% YoY ex Apple</b>	<b>30.3%</b>	<b>70.8%</b>	<b>4.9%</b>	<b>27.1%</b>	<b>32.2%</b>	<b>21.5%</b>	<b>10.4%</b>
Apple	-4.2%	16.2%	-33.3%	-5.9%	19.6%	-12.0%	3.1%
Alphabet	31.8%	94.1%	-2.8%	-3.9%	2.4%	25.8%	22.1%
Microsoft	-4.6%	63.6%	-4.8%	29.9%	31.6%	17.9%	13.5%
Amazon.com	49.3%	12.6%	17.1%	164.3%	60.5%	13.9%	4.8%
Facebook	49.9%	126.9%	7.2%	4.8%	11.1%	37.3%	-1.0%
Baidu	15.6%	28.4%	18.5%	-72.1%	245.6%	4.7%	6.1%
Alibaba	127.7%	92.8%	11.0%	-20.0%	27.5%	48.8%	27.1%
Tencent	12.3%	55.3%	30.6%	4.9%	21.5%	12.3%	14.8%

Source: Company data, UBS estimates

# Server unit shipments

## Total Server Shipments (K unit)

	2017	2018	2019	2020	2021E	2022E	2023E	2024E	2025E
<b>Total Server shipments (K unit)</b>	<b>11,451</b>	<b>12,951</b>	<b>12,585</b>	<b>12,915</b>	<b>13,461</b>	<b>15,165</b>	<b>16,528</b>	<b>17,335</b>	<b>18,924</b>
<i>Yoy growth (%)</i>	<i>2.5%</i>	<i>13.1%</i>	<i>-2.8%</i>	<i>2.6%</i>	<i>4.2%</i>	<i>12.7%</i>	<i>9.0%</i>	<i>4.9%</i>	<i>9.2%</i>
<b>Traditional Enterprise</b>	<b>6,138</b>	<b>6,391</b>	<b>6,285</b>	<b>5,112</b>	<b>5,214</b>	<b>5,318</b>	<b>5,425</b>	<b>5,479</b>	<b>5,588</b>
<i>Yoy growth (%)</i>	-6.6%	4.1%	-1.7%	-18.7%	2.0%	2.0%	2.0%	1.0%	2.0%
<i>% of total</i>	54%	49%	50%	40%	39%	35%	33%	32%	30%
<b>Hyperscalers</b>	<b>5,314</b>	<b>6,560</b>	<b>6,300</b>	<b>7,803</b>	<b>8,247</b>	<b>9,847</b>	<b>11,103</b>	<b>11,856</b>	<b>13,336</b>
<i>Yoy growth (%)</i>	15.4%	23.5%	-4.0%	23.9%	5.7%	19.4%	12.8%	6.8%	12.5%
<i>% of total</i>	46%	51%	50%	60%	61%	65%	67%	68%	70%
<b>Light-load servers</b>	<b>5,101</b>	<b>6,101</b>	<b>5,733</b>	<b>6,945</b>	<b>7,258</b>	<b>8,567</b>	<b>9,548</b>	<b>10,078</b>	<b>11,202</b>
<i>Yoy growth (%)</i>	14.3%	19.6%	-6.0%	21.1%	4.5%	18.0%	11.5%	5.5%	11.2%
<i>% of total</i>	96%	93%	91%	89%	88%	87%	86%	85%	84%
<b>AI/ML/database servers</b>	<b>213</b>	<b>459</b>	<b>567</b>	<b>858</b>	<b>990</b>	<b>1,280</b>	<b>1,554</b>	<b>1,778</b>	<b>2,134</b>
<i>Yoy growth (%)</i>	53.9%	116.0%	23.5%	51.4%	15.3%	29.3%	21.4%	14.4%	20.0%
<i>% of total</i>	4%	7%	9%	11%	12%	13%	14%	15%	16%

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

## Total Server Shipments by Top 7 Hyperscalers

Unit: K unit	2017	2018	2019	2020	2021E	2022E	2023E	2024E	2025E
Google	834	929	602	771	948	1,180	1,298	1,363	1,567
Amazon	1,098	907	1,116	1,327	1,493	1,750	2,100	2,310	2,657
Microsoft	576	823	801	1,081	1,142	1,490	1,743	1,830	2,014
Facebook	828	1,300	1,276	1,798	1,803	2,340	2,574	2,703	3,108
Baidu	89	121	65	52	96	110	121	133	146
Alibaba	145	376	326	391	393	440	528	607	698
Tencent	222	288	263	328	266	300	345	397	456
<b>Total Top 7</b>	<b>3,792</b>	<b>4,745</b>	<b>4,449</b>	<b>5,748</b>	<b>6,140</b>	<b>7,610</b>	<b>8,709</b>	<b>9,343</b>	<b>10,646</b>
<i>YoY %</i>									
<i>QoQ %</i>									
<b>Other hyperscaler</b>	<b>1,522</b>	<b>1,815</b>	<b>1,851</b>	<b>2,055</b>	<b>2,107</b>	<b>2,237</b>	<b>2,394</b>	<b>2,513</b>	<b>2,689</b>
IBM	151	144	82	138	94	118			
Apple	132	174	122	105	144	148			
Oracle	118	82	78	89	141	201			
Other	1,120	1,416	1,569	1,722	1,728	1,770			
<b>Total Hyperscalers</b>	<b>5,314</b>	<b>6,560</b>	<b>6,300</b>	<b>7,803</b>	<b>8,247</b>	<b>9,847</b>	<b>11,103</b>	<b>11,856</b>	<b>13,336</b>

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

# Server DRAM growth driven primarily by content

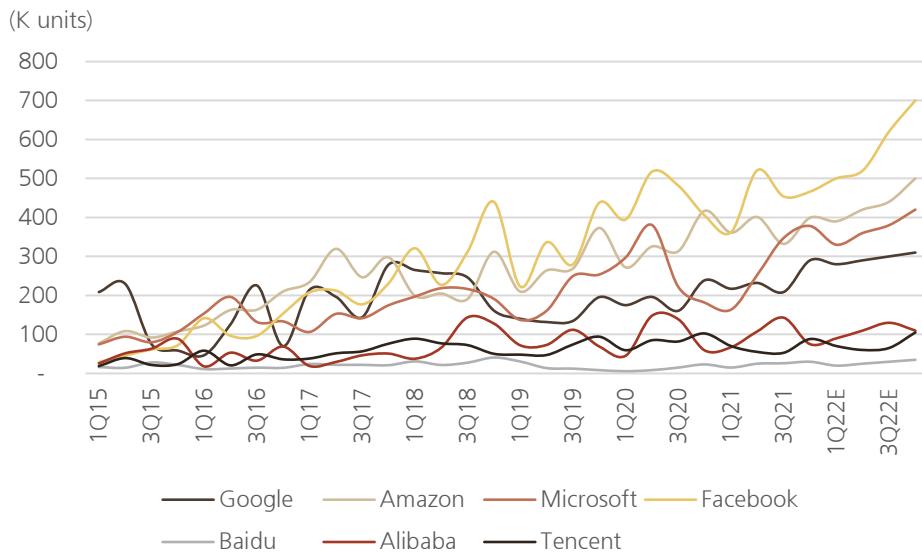
## Server DRAM Long Term Model

	2017	2018	2019	2020	2021E	2022E	2023E	2024E	2025E
<b>Avg. DRAM content (GB)</b>	<b>194.2</b>	<b>237.8</b>	<b>296.5</b>	<b>409.8</b>	<b>499.5</b>	<b>609.1</b>	<b>752.5</b>	<b>902.4</b>	<b>1,101.7</b>
Yoy growth (%)	42.1%	22.5%	24.7%	38.2%	21.9%	21.9%	23.6%	19.9%	22.1%
<b>Traditional enterprise</b>	<b>175</b>	<b>192</b>	<b>236</b>	<b>306</b>	<b>367</b>	<b>426</b>	<b>498</b>	<b>573</b>	<b>670</b>
Yoy growth (%)	35.4%	9.9%	23.0%	29.5%	20.0%	16.0%	17.0%	15.0%	17.0%
<b>Hyperscalers Blended</b>	<b>217</b>	<b>283</b>	<b>357</b>	<b>478</b>	<b>583</b>	<b>708</b>	<b>877</b>	<b>1,055</b>	<b>1,283</b>
Yoy growth (%)	46.7%	30.3%	26.2%	34.0%	22.0%	21.4%	23.8%	20.3%	21.6%
<b>Light-load servers</b>	<b>205</b>	<b>262</b>	<b>328</b>	<b>433</b>	<b>520</b>	<b>627</b>	<b>771</b>	<b>918</b>	<b>1,102</b>
Yoy growth (%)	46.4%	28.0%	24.9%	32.2%	19.9%	20.7%	23.0%	19.0%	20.0%
<b>AI/ML/database servers</b>	<b>500</b>	<b>550</b>	<b>650</b>	<b>840</b>	<b>1,050</b>	<b>1,250</b>	<b>1,525</b>	<b>1,830</b>	<b>2,233</b>
Yoy growth (%)	25.0%	10.0%	18.2%	29.2%	25.0%	19.0%	22.0%	20.0%	22.0%
<b>Total DRAM Demand (mn Gb)</b>	<b>17,789</b>	<b>24,641</b>	<b>29,849</b>	<b>42,341</b>	<b>53,788</b>	<b>73,892</b>	<b>99,501</b>	<b>125,148</b>	<b>166,783</b>
Yoy growth (%)	45.6%	38.5%	21.1%	41.8%	27.0%	37.4%	34.7%	25.8%	33.3%
<b>Traditional enterprise</b>	<b>8,573</b>	<b>9,815</b>	<b>11,873</b>	<b>12,502</b>	<b>15,302</b>	<b>18,105</b>	<b>21,607</b>	<b>25,096</b>	<b>29,950</b>
Yoy growth (%)	26.5%	14.5%	21.0%	5.3%	22.4%	18.3%	19.3%	16.2%	19.3%
% of total	48.2%	39.8%	39.8%	29.5%	28.4%	24.5%	21.7%	20.1%	18.0%
<b>Hyperscalers</b>	<b>9,216</b>	<b>14,827</b>	<b>17,977</b>	<b>29,840</b>	<b>38,486</b>	<b>55,786</b>	<b>77,894</b>	<b>100,052</b>	<b>136,833</b>
Yoy growth (%)	69.3%	60.9%	21.2%	66.0%	29.0%	45.0%	39.6%	28.4%	36.8%
<b>Light-load servers</b>	8,366	12,806	15,028	24,072	30,173	42,985	58,930	74,015	98,724
Yoy growth (%)	67.3%	53.1%	17.4%	60.2%	25.3%	42.5%	37.1%	25.6%	33.4%
% of total	47.0%	52.0%	50.3%	56.9%	56.1%	58.2%	59.2%	59.1%	59.2%
<b>AI/ML/database servers</b>	850	2,020	2,948	5,768	8,313	12,801	18,964	26,037	38,110
Yoy growth (%)	92.4%	137.6%	45.9%	95.6%	44.1%	54.0%	48.1%	37.3%	46.4%
% of total	4.8%	8.2%	9.9%	13.6%	15.5%	17.3%	19.1%	20.8%	22.8%

Source: Gartner, Company data, UBS estimates

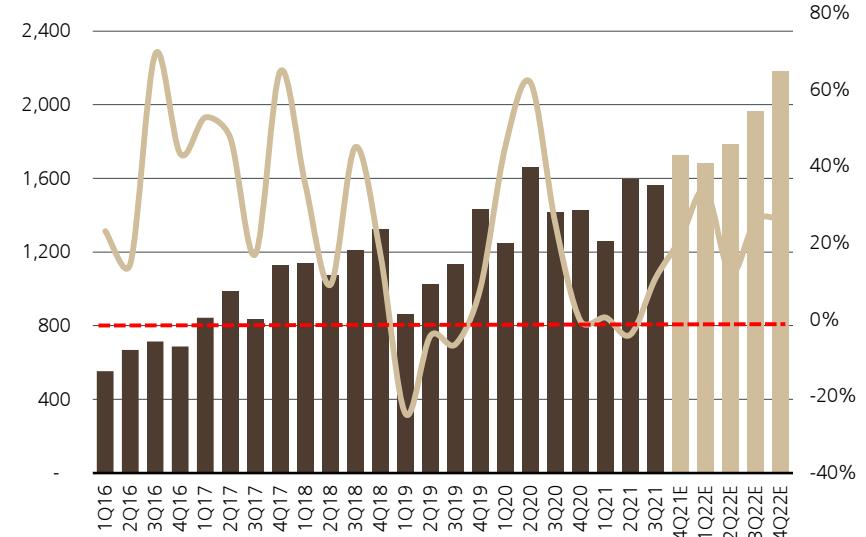
# Server Shipment Forecast - Details

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

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# Smartphone

# Key Messages

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- We model smartphone units to grow ~5% in 2021E followed by another solid year of ~2% growth in 2022E, however, the mix should start to normalize and ASP should not grow nearly as much in 2022 as was the case in 2021
- We see ~700MM 5G units for C2022E which implies ~49% 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
- Per the most recent UBS Evidence Lab survey, smartphone purchase intent is softening versus last year – especially in China though US bucks the downward trend
  - iPhone 13 interest holding up well and skewed towards the higher end models
  - Battery life and price are far more important factors for purchase considerations while 5G is more accretive to smartphone ASP

# We model ~5% smartphone unit growth in '21E and ~2% in '22E. Huawei will have lost the vast majority of share by YE21

## Device Market Model – Smartphone Units (MM)

Smartphone volume (m)	FY '20	Q1 '21	Q2 '21	Q3 '21	Q4 '21E	FY '21E	Q1 '22E	Q2 '22E	Q3 '22E	Q4 '22E	FY '22E	Q1 '23E	Q2 '23E	Q3 '23E	Q4 '23E	FY '23E
Samsung	253	76	57	69	68	270	70	72	74	69	284	72	72	77	69	290
% YoY	-14.3%	31.0%	5.6%	-13.7%	11.5%	6.7%	-7.9%	25.4%	6.5%	0.7%	5.0%	2.9%	0.7%	4.8%	0.7%	2.3%
% QoQ	19.6%	24.6%	-25.0%	21.1%	-1.4%		2.9%	2.1%	2.8%	-6.8%		5.1%	0.0%	6.9%	-10.4%	
% of total	22.0%	18.2%	18.2%	20.9%	18.2%	19.8%	22.0%	21.9%	20.7%	17.4%	20.3%	21.7%	21.1%	20.8%	16.9%	20.0%
Apple	200	56	46	48	80	230	52	46	52	81	231	52	46	51	81	230
% YoY	3.6%	36.9%	19.8%	18.2%	0.0%	15.1%	-6.7%	0.0%	7.8%	0.6%	0.2%	0.0%	0.0%	-1.0%	0.0%	-0.2%
% QoQ	-30.0%	-17.9%	4.3%	66.7%			-34.7%	-12.0%	12.5%	55.6%		-35.1%	-12.0%	11.4%	57.1%	
% of total	15.5%	16.2%	14.7%	14.6%	21.4%	16.9%	16.4%	14.1%	14.6%	20.5%	16.5%	15.7%	13.5%	13.8%	19.8%	15.9%
Huawei	189	15	12	6	5	38	4	2	1	0	7					
% YoY	-21.5%	-69.4%	-78.9%	-88.4%	-84.5%	-80.0%	-73.3%	-83.1%	-83.3%	NM	-81.5%					
% QoQ	-53.6%	-21.3%	-49.2%	-16.7%		-20.0%	-50.0%	-50.0%	NM							
% of total	14.6%	4.3%	3.8%	1.8%	1.3%	2.8%	1.3%	0.6%	0.3%	0.0%	0.5%					
OPPO*	111	38	33	33	36	140	36	37	39	37	149	36	39	43	40	158
% YoY	-1.4%	67.4%	36.7%	7.1%	6.5%	25.4%	-4.0%	12.8%	17.5%	2.8%	6.8%	0.0%	5.4%	10.3%	8.1%	6.0%
% QoQ	10.9%	-12.5%	1.2%	8.4%		0.0%	2.8%	5.4%	-5.1%		-2.7%	8.3%	10.3%	-7.0%		
% of total	8.6%	10.9%	10.5%	10.1%	9.6%	10.2%	11.3%	11.3%	11.0%	9.4%	10.7%	10.8%	11.4%	11.6%	9.8%	10.9%
Vivo	112	35	31	33	36	135	35	36	38	35	144	36	38	40	38	152
% YoY	11.5%	40.7%	31.6%	5.7%	12.1%	20.8%	0.3%	15.4%	14.1%	-2.8%	6.4%	2.9%	5.6%	5.3%	8.6%	5.6%
% QoQ	8.7%	8.7%	-10.6%	6.7%	8.1%		-2.8%	2.9%	5.6%	-7.9%		2.9%	5.6%	5.3%	-5.0%	
% of total	10.1%	10.0%	10.1%	9.6%		9.9%	11.0%	11.0%	10.7%	8.9%	10.3%	10.8%	11.2%	10.8%	9.3%	10.5%
Xiaomi	146	49	53	44	45	192	43	49	57	61	210	47	54	60	64	225
% YoY	17.0%	69.2%	87.6%	-5.0%	7.1%	31.1%	-12.0%	-8.1%	28.1%	35.2%	9.5%	8.4%	11.5%	5.6%	4.6%	7.3%
% QoQ	16.8%	7.1%	-16.4%	2.4%		-4.1%	11.9%	16.7%	8.0%		-23.1%	15.1%	10.5%	6.9%		
% of total	11.3%	14.3%	16.9%	13.4%	12.1%	14.1%	13.6%	14.9%	16.0%	15.6%	15.1%	14.2%	15.9%	16.2%	15.7%	15.5%
Transsion	61	18	19	21	25	83	20	22	26	29	96	25	28	32	35	119
% YoY	52.8%	106.6%	52.0%	13.7%	16.7%	36.1%	10.2%	15.0%	22.6%	16.3%	16.2%	25.9%	26.1%	23.5%	21.2%	23.9%
% QoQ	-13.1%	3.9%	9.7%	17.8%		-18.0%	8.5%	17.0%	11.8%		-11.2%	8.7%	14.5%	9.6%		
% of total	4.0%	4.5%	5.5%	5.5%	5.9%	5.3%	5.6%	6.0%	6.5%	6.6%	6.2%	6.9%	7.3%	7.8%	7.8%	7.5%
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	2.1%	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%	3.3%	3.2%	2.8%	3.1%	3.4%	3.0%	3.1%	2.8%	2.9%	3.4%	3.0%	3.0%
Honor		8	15	18	40	16	17	18	14	65	15	18	18	17	68	
% YoY						120.8%	24.1%	-22.2%		61.7%	5.9%	0.0%	21.4%		4.6%	
% QoQ						-11.1%	6.3%	5.9%	-22.2%		7.1%	20.0%	0.0%	-5.6%		
% of total						2.5%	4.4%	4.8%	2.9%	4.7%	4.5%	5.3%	4.9%	4.2%	4.7%	
Other	160	43	39	46	49	176	33	37	39	57	166	39	36	37	52	164
% YoY	-18.2%	37.3%	43.1%	26.9%	-25.7%	10.0%	-22.5%	-5.9%	-14.5%	16.3%	-5.9%	18.2%	-2.7%	-5.1%	-8.8%	-1.2%
% QoQ	-35.5%	-7.7%	16.0%	7.5%		-32.7%	12.1%	5.4%	46.2%		-31.6%	-7.7%	2.8%	40.5%		
% of total	12.4%	12.3%	12.5%	13.8%	13.1%	12.9%	10.4%	11.3%	11.0%	14.5%	11.9%	11.7%	10.6%	10.0%	12.8%	11.3%
Total smartphone volumes (m)	1,294	346	313	330	374	1,363	319	327	355	394	1,394	332	341	370	407	1,450
% YoY	-5.6%	25.3%	12.6%	-6.7%	-3.1%	5.3%	-7.7%	4.4%	7.5%	5.2%	2.3%	4.1%	4.2%	4.4%	3.5%	4.0%
% QoQ	-10.5%	-9.3%	5.3%	13.4%		-14.8%	2.6%	8.4%	11.0%		-15.7%	2.6%	8.6%	10.0%		
% of total volumes	85.6%	84.8%	90.3%	87.5%	90.2%	88.1%	89.1%	90.0%	90.1%	91.3%	90.2%	89.9%	91.0%	91.4%	92.1%	91.2%

Source: Company data, Gartner, UBS estimates



# We model mobile revenue to grow ~12% in '21E and ~3% in '22E

## Device Market Model – Total Revenues (\$MM)

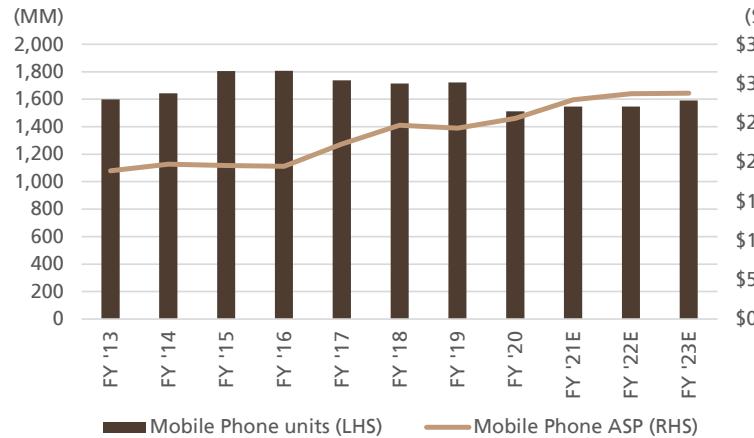
Total revenues (US\$M)	FY '20	Q1 '21	Q2 '21	Q3 '21	Q4 '21E	FY '21E	Q1 '22E	Q2 '22E	Q3 '22E	Q4 '22E	FY '22E	Q1 '23E	Q2 '23E	Q3 '23E	Q4 '23E	FY '23E	
Samsung	64,596	19,906	14,168	18,110	18,378	70,562	20,194	19,002	18,547	17,333	75,077	20,025	18,022	21,201	18,999	78,247	
% YoY	-12.7%	15.1%	8.5%	-11.0%	32.2%	9.2%	1.4%	34.1%	2.4%	-5.7%	6.4%	-0.8%	-5.2%	14.3%	9.6%	4.2%	
% QoQ	43.2%	-28.8%	27.8%	1.5%		9.9%	-5.9%	-2.4%	-6.5%		15.5%	-10.0%	17.6%	-10.4%			
% of total	16.7%	18.1%	15.3%	18.2%	14.2%	16.3%	19.5%	19.3%	17.1%	13.0%	16.9%	19.2%	18.0%	18.8%	13.6%	17.1%	
Apple	147,421	47,938	39,570	38,868	67,795	194,171	44,357	38,302	43,719	69,700	196,078	44,306	38,494	42,887	71,703	197,391	
% YoY	0.7%	65.5%	49.8%	47.0%	3.4%	31.7%	-7.5%	-3.2%	12.5%	2.8%	1.0%	-0.1%	0.5%	-1.9%	2.9%	0.7%	
% QoQ	-26.9%	-17.5%	-1.8%	74.4%		-34.6%	-13.6%	14.1%	59.4%		-36.4%	-13.1%	11.4%	67.2%			
% of total	38.1%	43.5%	42.8%	39.0%	52.2%	44.9%	42.9%	39.0%	40.2%	52.2%	44.2%	42.4%	38.5%	38.0%	51.2%	43.1%	
Huawei	46,654	3,751	2,890	1,576	1,340	9,557	1,000	490	263	0	1,753						
% YoY	-22.7%	-67.3%	-78.2%	-88.2%	-84.4%	-79.5%	-73.3%	-83.1%	-83.3%	NM	-81.7%						
% QoQ	-56.2%	-23.0%	-45.5%	-15.0%		-25.3%	-51.0%	-46.4%	NM								
% of total	12.1%	3.4%	3.1%	1.6%	1.0%	2.2%	1.0%	0.5%	0.2%	0.0%	0.4%						
OPPO*	26,391	9,347	8,433	8,687	9,047	35,515	9,063	9,609	10,307	9,392	38,370	9,063	10,128	11,364	10,153	40,708	
% YoY	-2.0%	81.9%	55.1%	12.5%	11.8%	34.6%	-3.0%	13.9%	18.6%	3.8%	8.0%	0.0%	5.4%	10.3%	8.1%	6.1%	
% QoQ	15.5%	-9.8%	3.0%	4.1%		0.2%	6.0%	7.3%	-8.9%		-3.5%	11.8%	12.2%	-10.7%			
% of total	6.8%	8.5%	9.1%	8.7%	7.0%	8.2%	8.8%	9.8%	9.5%	7.0%	8.6%	8.7%	10.1%	10.1%	7.2%	8.9%	
Vivo	24,899	8,562	7,942	8,355	8,567	33,426	8,759	9,347	9,725	8,495	36,326	9,189	10,064	10,441	9,408	39,102	
% YoY	8.9%	57.9%	60.5%	13.1%	20.0%	34.2%	2.3%	17.7%	16.4%	-0.8%	8.7%	4.9%	7.7%	7.4%	10.7%	7.6%	
% QoQ	19.9%	-7.2%	5.2%	2.5%		2.2%	6.7%	4.0%	-12.6%		8.2%	9.5%	3.8%	-9.9%			
% of total	6.4%	7.8%	8.6%	8.4%	6.6%	7.7%	8.5%	9.5%	9.0%	6.4%	8.2%	8.8%	10.1%	9.2%	6.7%	8.5%	
Xiaomi	22,126	7,947	9,146	7,686	6,963	31,741	7,183	8,386	9,888	10,438	35,896	7,867	9,449	10,554	11,028	38,899	
% YoY	25.6%	82.9%	104.7%	11.7%	8.2%	43.5%	-9.6%	-8.3%	28.7%	49.9%	13.1%	9.5%	12.7%	6.7%	5.7%	8.4%	
% QoQ	23.5%	15.1%	-16.0%	-9.4%		3.2%	16.7%	17.9%	5.6%		-24.6%	20.1%	11.7%	4.5%			
% of total	5.7%	7.2%	9.9%	7.7%	5.4%	7.3%	6.9%	8.5%	9.1%	7.8%	8.1%	7.5%	9.4%	9.3%	7.9%	8.5%	
Transsion	5,198	1,674	1,721	1,877	2,209	7,480	1,881	2,012	2,439	2,703	9,035	2,580	2,527	2,906	3,146	11,151	
% YoY	51.5%	116.3%	65.6%	20.3%	18.7%	43.9%	12.4%	17.0%	29.9%	22.4%	20.8%	37.1%	25.6%	19.2%	16.4%	23.4%	
% QoQ	-10.1%	2.8%	9.1%	17.7%		-14.8%	7.0%	21.2%	10.8%		-4.6%	-2.0%	15.0%	8.2%			
% of total	1.3%	1.5%	1.9%	1.9%	1.7%	1.7%	1.8%	2.0%	2.2%	2.0%	2.0%	2.5%	2.5%	2.6%	2.2%	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%	1.7%	1.8%	1.5%	1.6%	1.3%	1.6%	1.8%	1.4%	1.5%	1.4%	1.6%	1.7%	1.4%	1.5%	
Honor				2,125	3,801	4,483	10,408	3,969	4,216	4,464	3,472	16,121	3,796	4,553	4,553	4,300	17,202
% YoY				78.9%	17.9%			98.4%	17.4%	-22.5%	54.9%	8.0%	2.0%	23.9%	6.7%		
% QoQ				2.3%	3.8%	3.5%	2.4%	3.8%	4.3%	4.1%	2.6%	3.6%	4.6%	4.0%	3.1%	3.8%	
Other	29,654	7,523	4,093	7,073	7,560	26,249	4,701	4,157	5,979	8,472	23,309	5,355	4,041	5,689	7,862	22,947	
% YoY	-36.6%	-6.2%	-33.2%	13.9%	-18.6%	-11.5%	-37.5%	1.5%	-15.5%	12.1%	-11.2%	13.9%	-2.8%	-4.9%	-7.2%	-1.6%	
% QoQ	-19.0%	-45.6%	72.8%	6.9%		-37.8%	-11.6%	43.8%	41.7%		-36.8%	-24.5%	40.8%	38.2%			
% of total	7.7%	6.8%	4.4%	7.1%	5.8%	6.1%	4.5%	4.2%	5.5%	6.3%	5.3%	5.1%	4.0%	5.0%	5.6%	5.0%	
Total mobile revs (US\$M)	386,627	110,228	92,431	99,670	129,874	432,203	103,379	98,310	108,650	133,479	443,818	104,517	100,037	112,964	140,136	457,653	
% YoY	-7.6%	29.1%	16.3%	4.6%	2.6%	11.8%	-6.2%	6.4%	9.0%	2.8%	2.7%	1.1%	1.8%	4.0%	5.0%	3.1%	
% QoQ	-12.9%	-16.1%	7.8%	30.3%		-20.4%	-4.9%	10.5%	22.9%		-21.7%	-4.3%	12.9%	24.1%			

Source: Company data, Gartner, UBS estimates

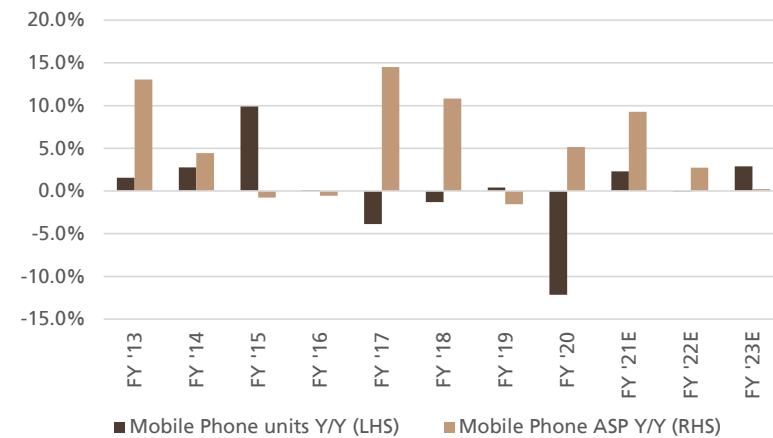


# Mobile Phone: Units and ASP

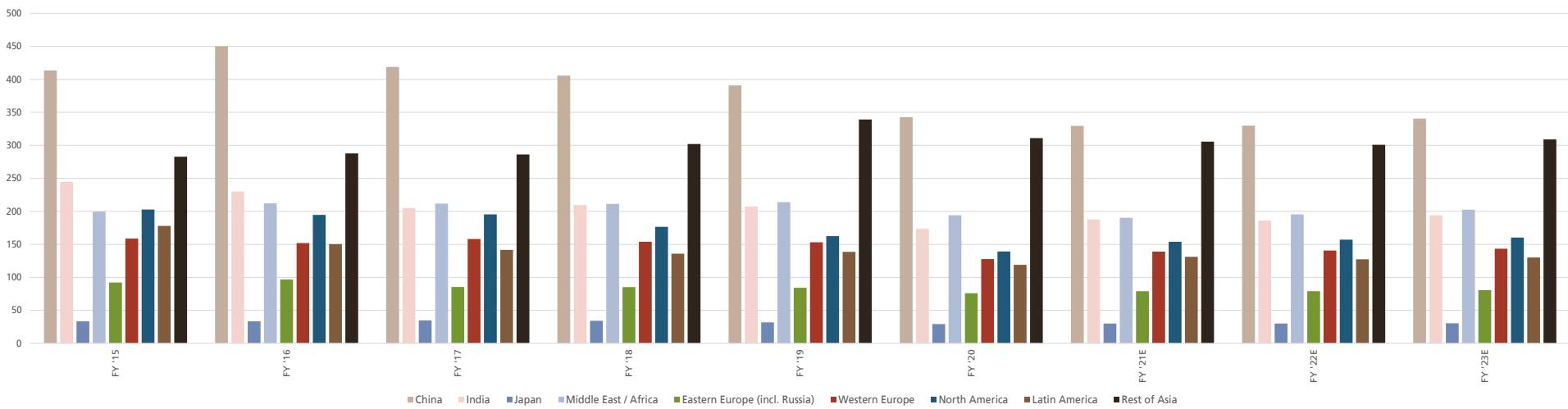
Mobile Phone Units and ASP



Mobile Phone Units and ASP Y/Y Growth



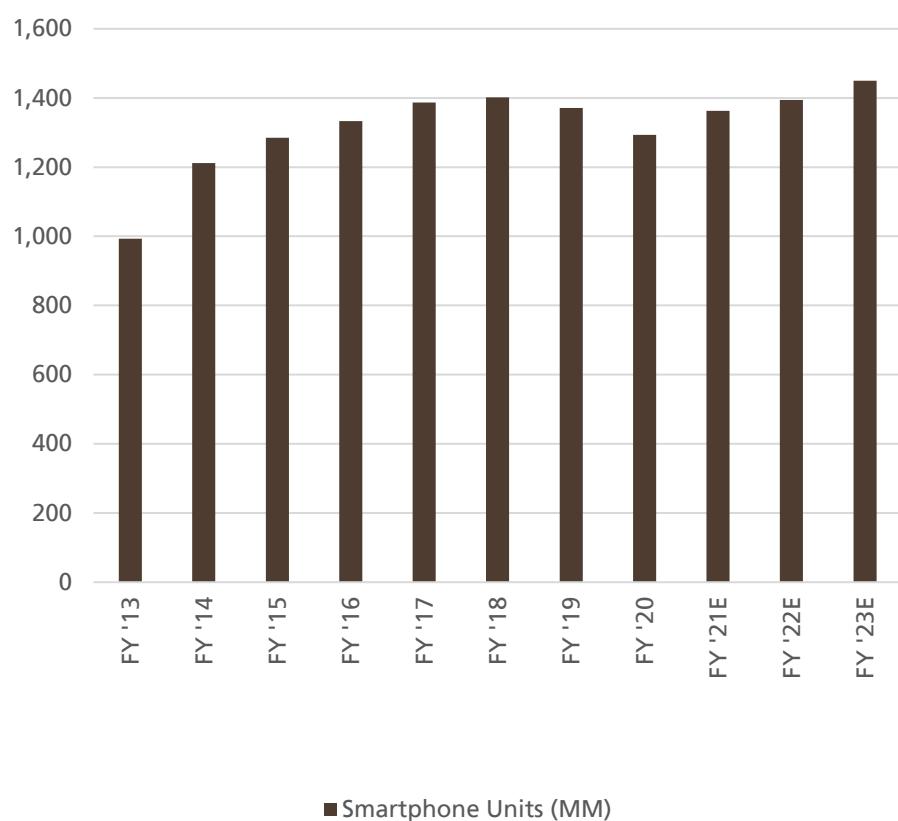
Mobile Phone Units (MM) – By region



Source: UBS estimates

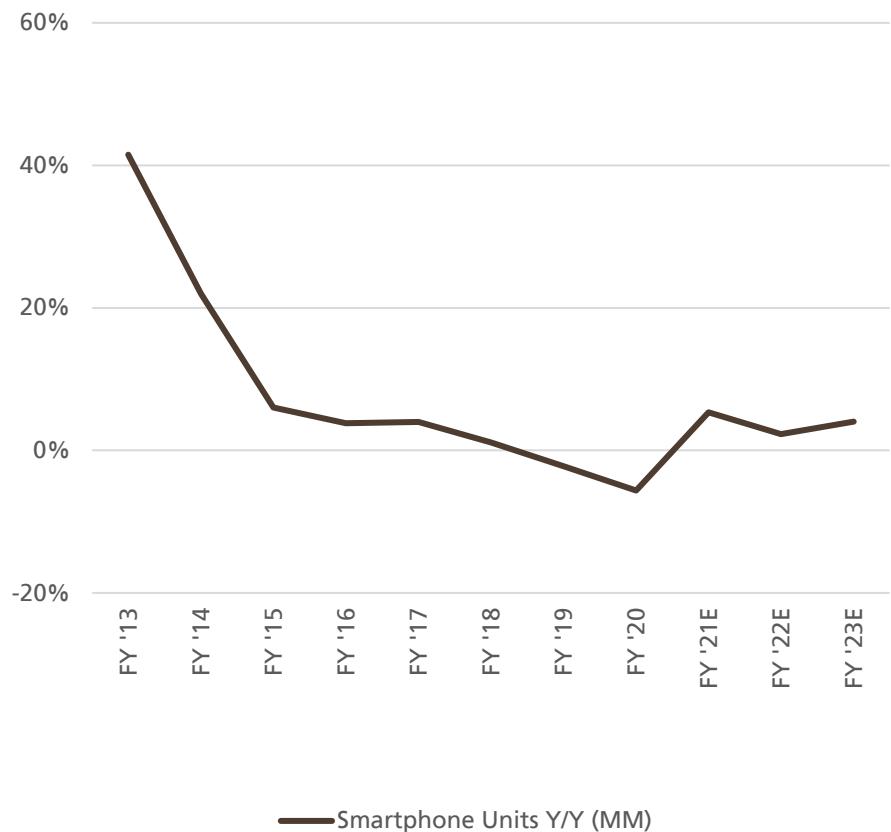
# Smartphone: Units and Y/Y Growth

Smartphone Units



Source: UBS estimates

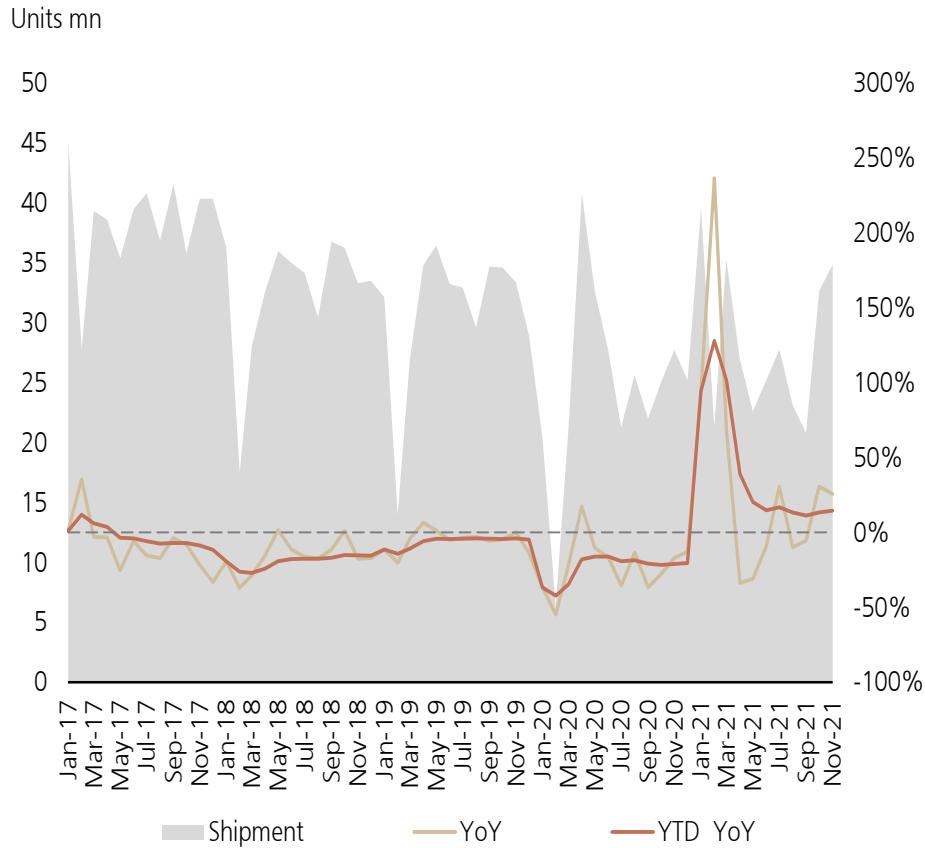
Smartphone Units Y/Y Growth



Source: UBS estimates

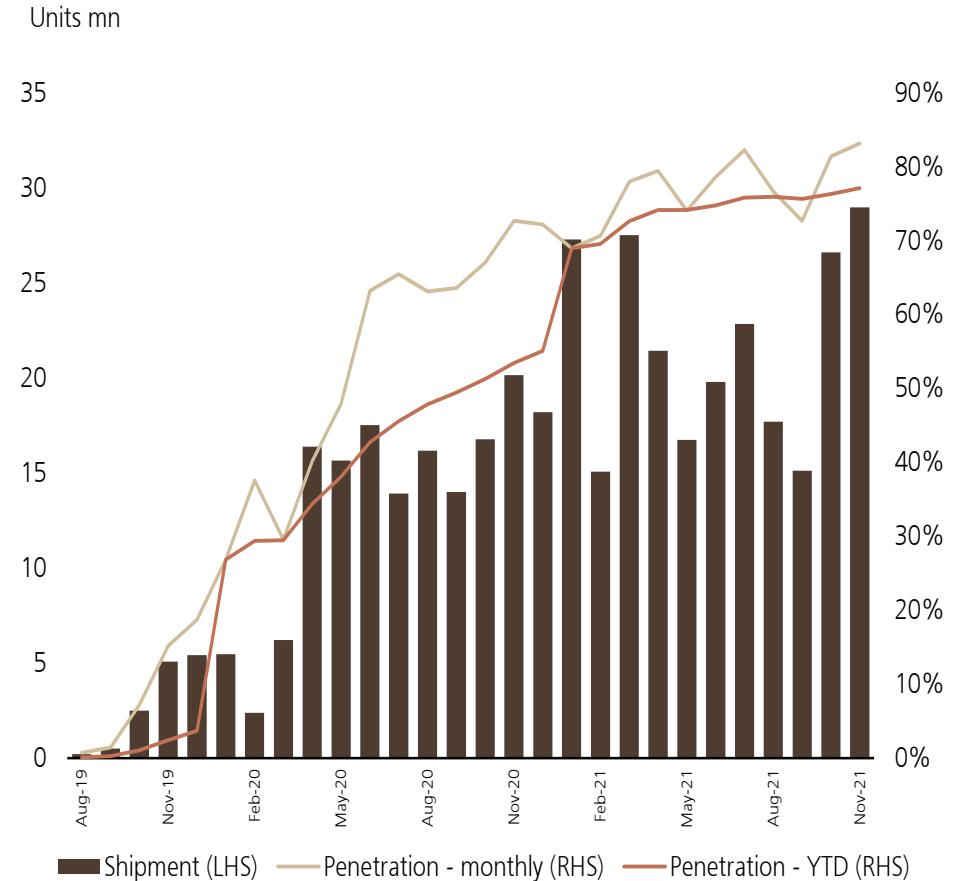
# China Smartphone Shipments: Sell-in remains solid...

China Smartphone Shipment



Source: CAICT Data, UBS

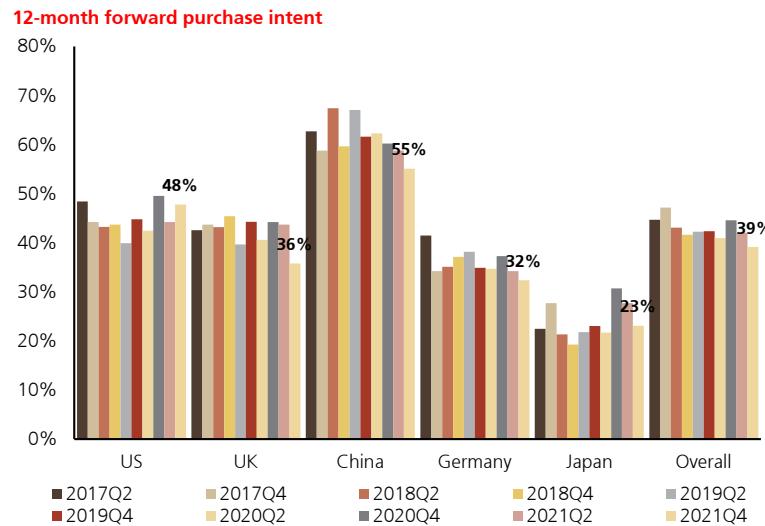
China 5G Smartphone Shipment



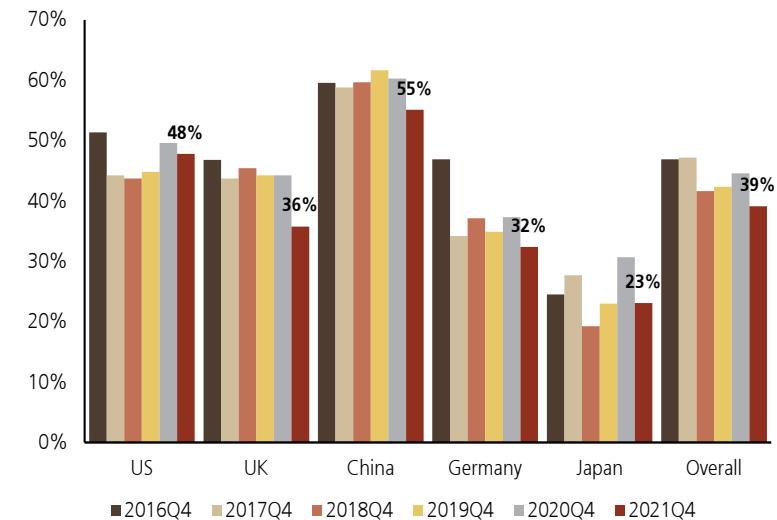
Source: CAICT Data, UBS

# ...but future purchase intent down in all regions, especially China

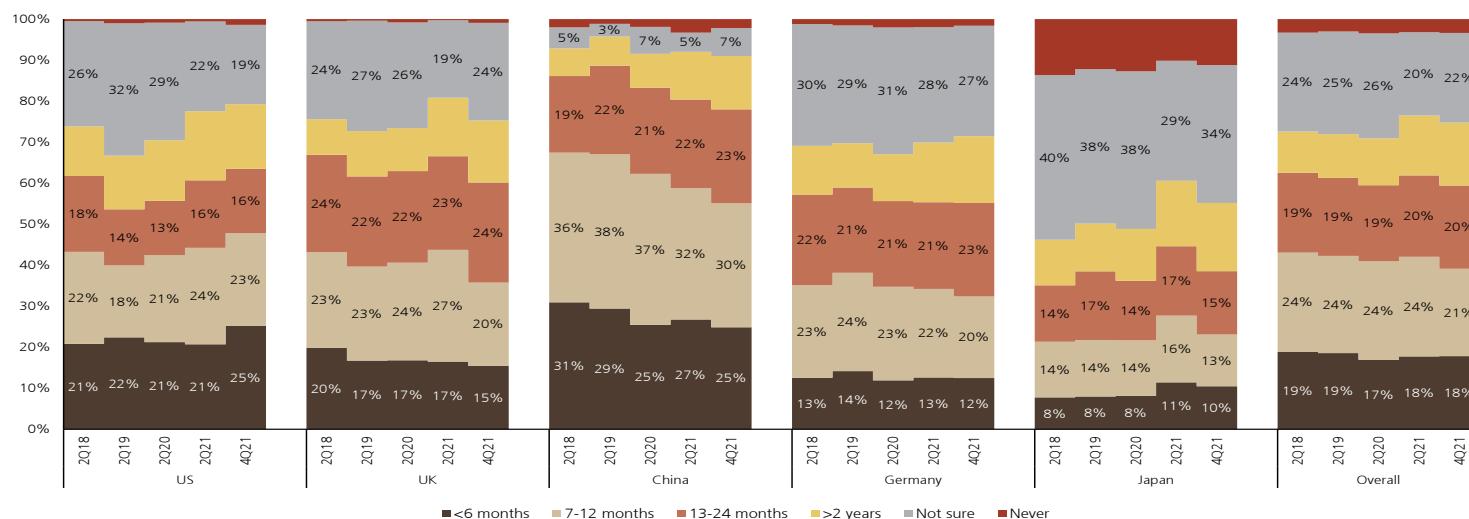
12-month Forward Purchasing Intent (HoH)



12-month Forward Purchase Intent (YoY)



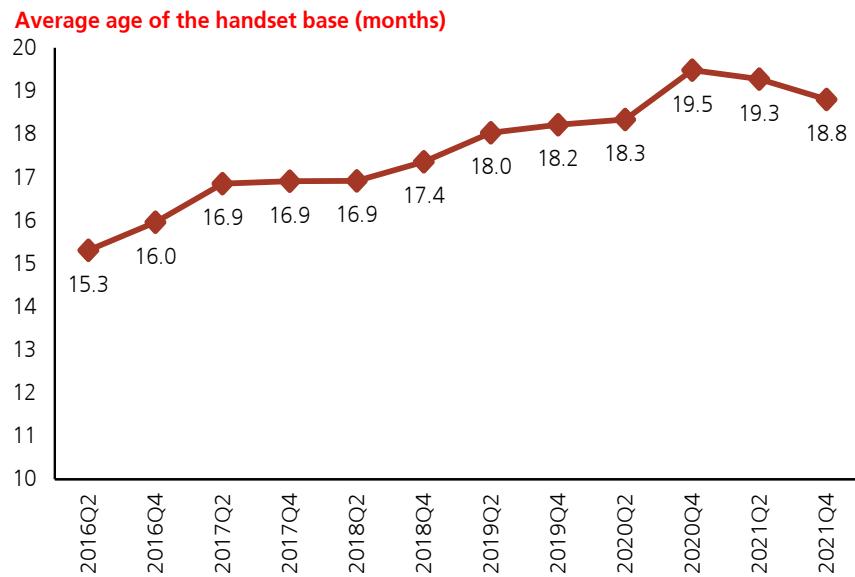
Response Breakdown of Plan Until Next Smartphone Purchase



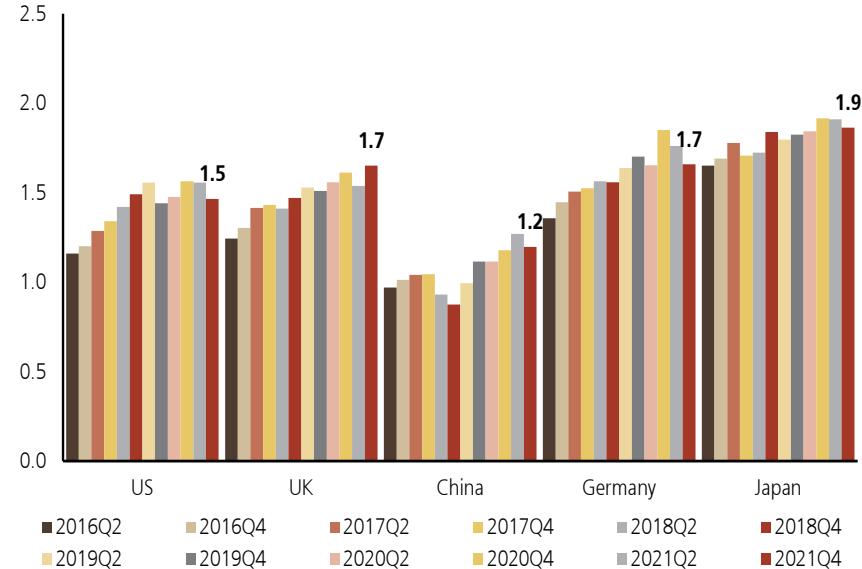
Source: UBS Evidence Lab

# ...possibly due to upgrades having been pulled forward during COVID as age of base is declining for first time in years

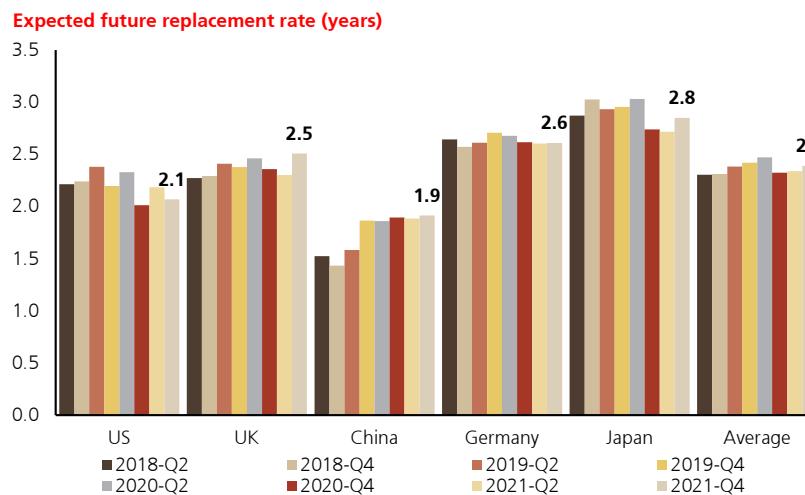
Average Age of Smartphone Installed Base (Months)



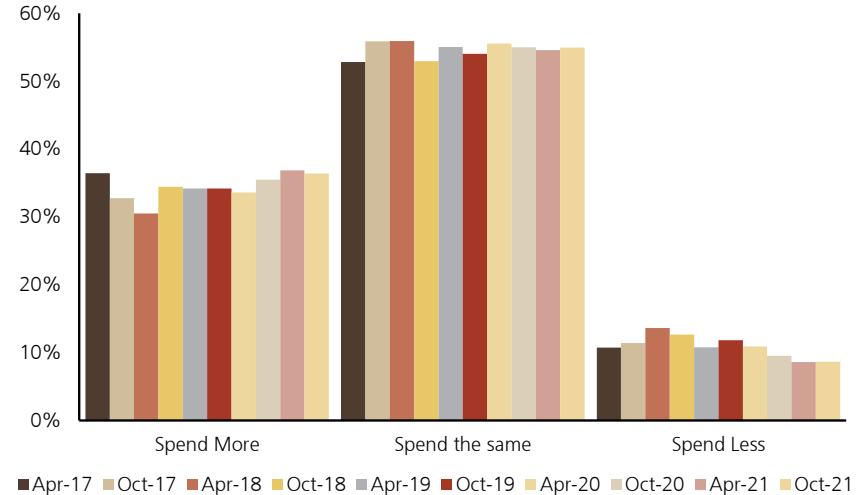
Average Age of Installed Base by Region (Years)



Planned Replacement Cycle by Region (Years)



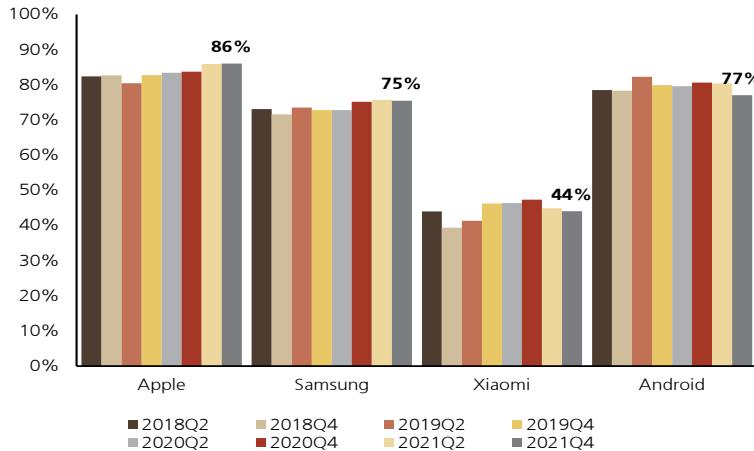
Customers' Willingness to Spend More/Same/Less



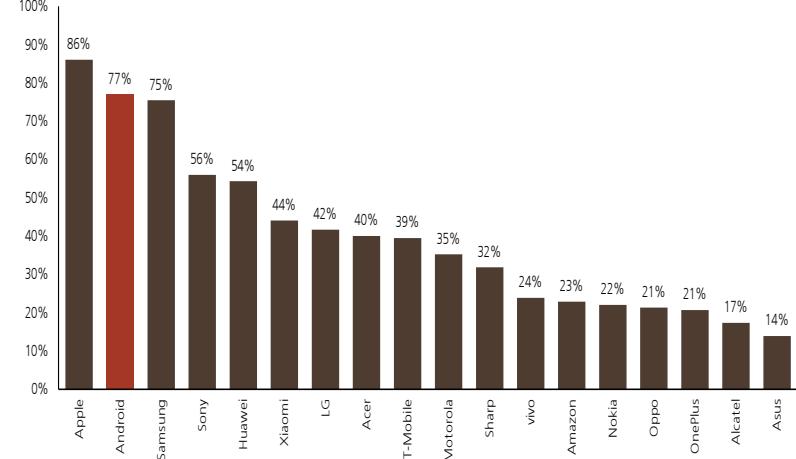
Source: UBS Evidence Lab

# UBS Evidence Lab – iPhone retention remains highest

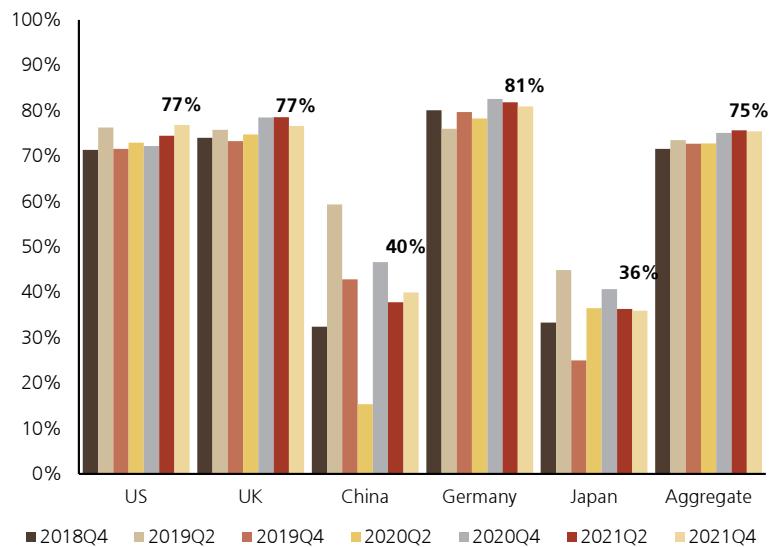
Smartphones Retention Rates by Vendor/OS



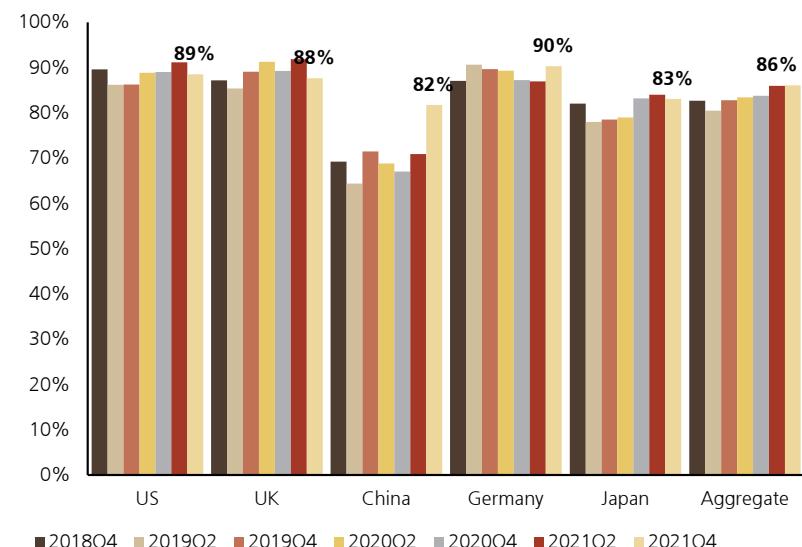
Unweighted OEM/OS Retention Rates for 4Q21



Samsung Smartphones Retention Rate by Region



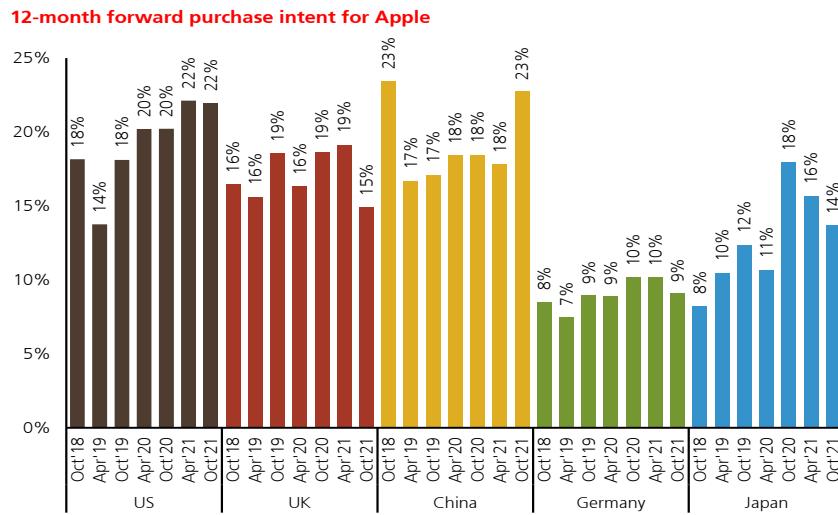
Apple Retention Rate by Region



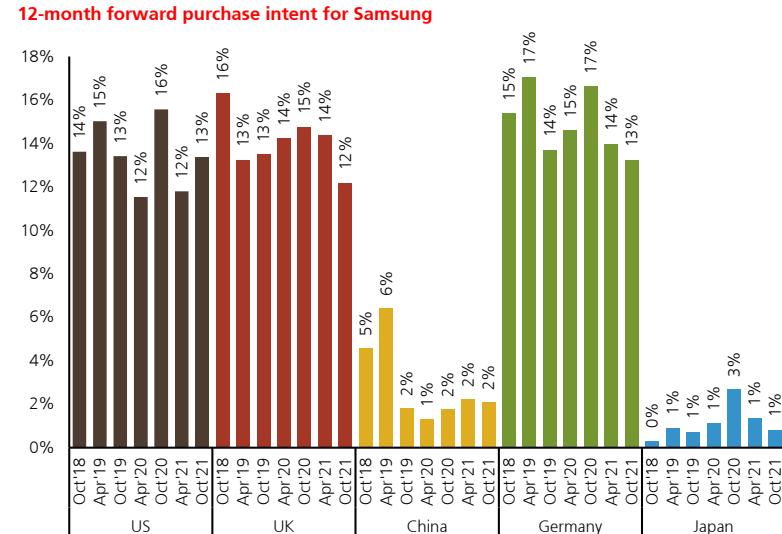
Source: UBS Evidence Lab

# UBS Evidence Lab – Smartphones Survey 4Q21

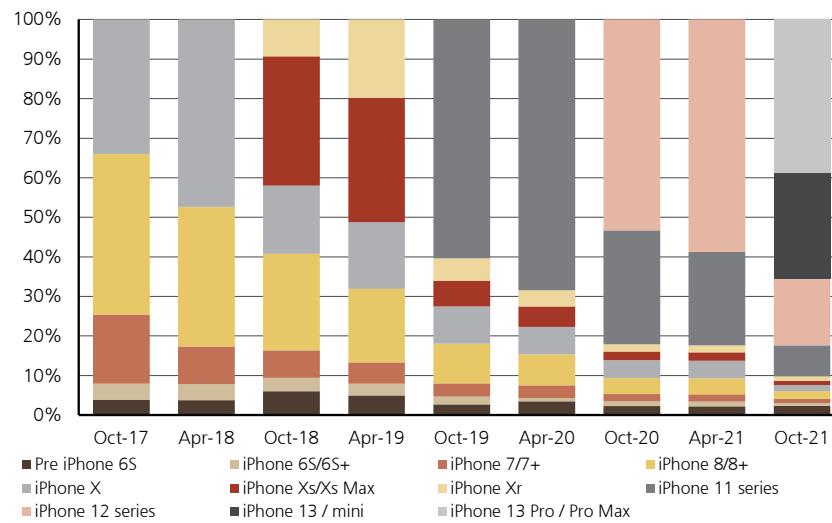
## Apple Purchase Intent by Region



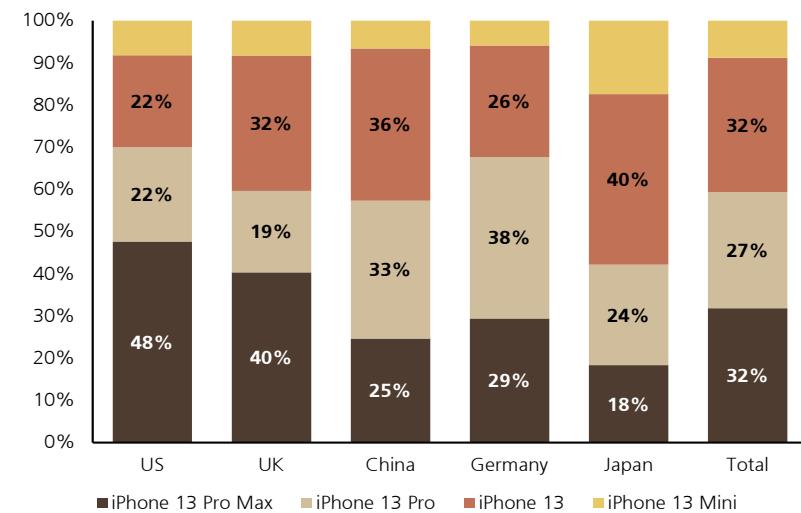
## Samsung Purchase Intent by Region



## Apple Device Purchase Intent by Model



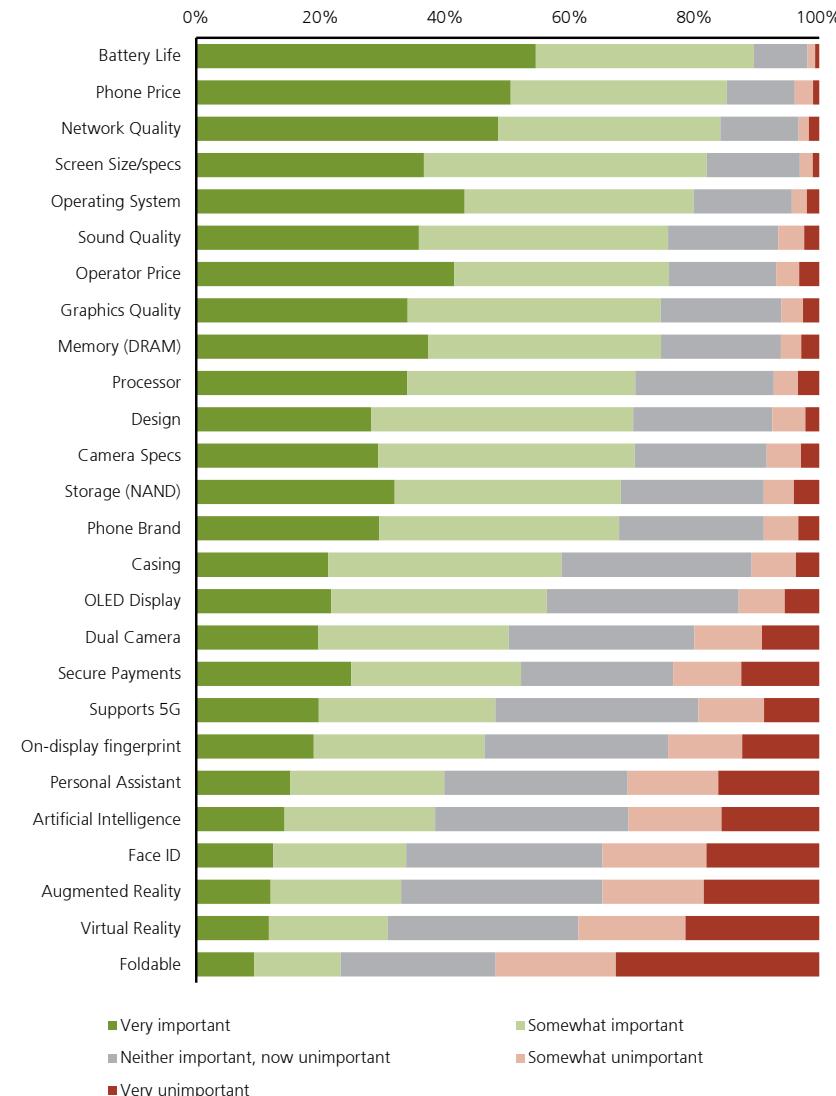
## Breakdown of iPhone 13 series purchase intent by model



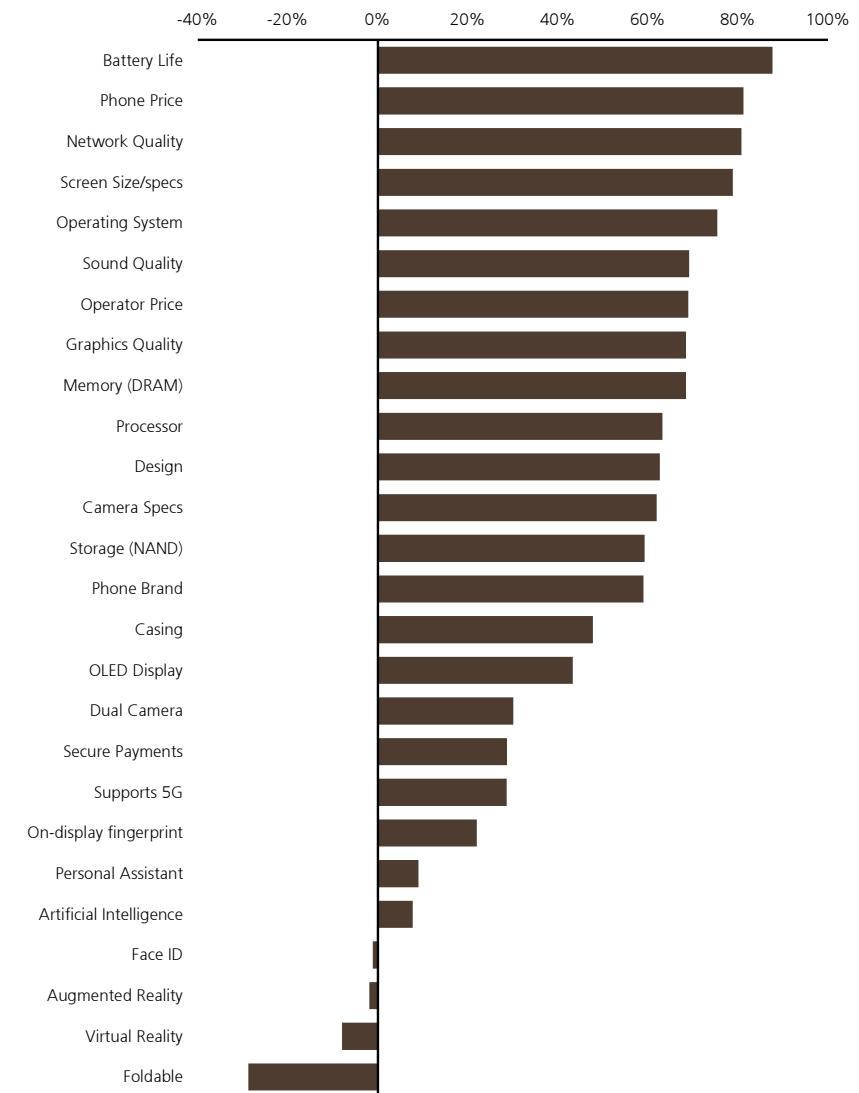
Source: UBS Evidence Lab

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

Ranking of Importance of Handset Features



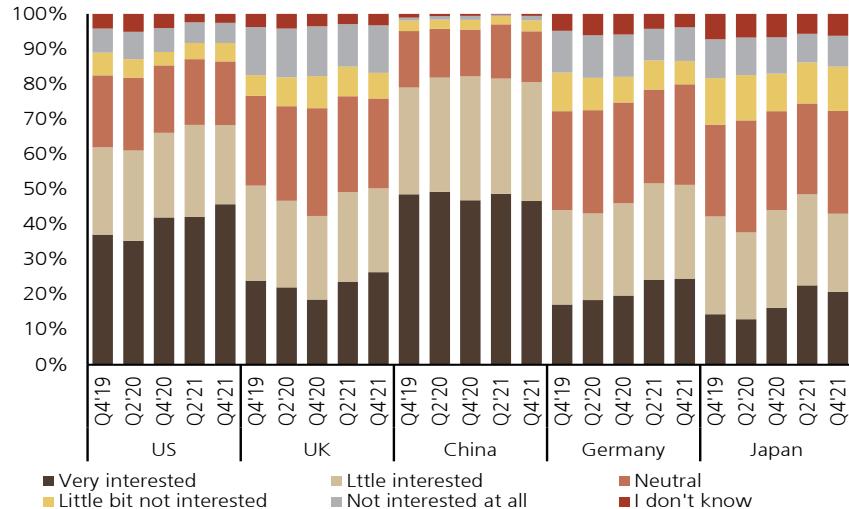
Ranking of Net Importance of Handset Features



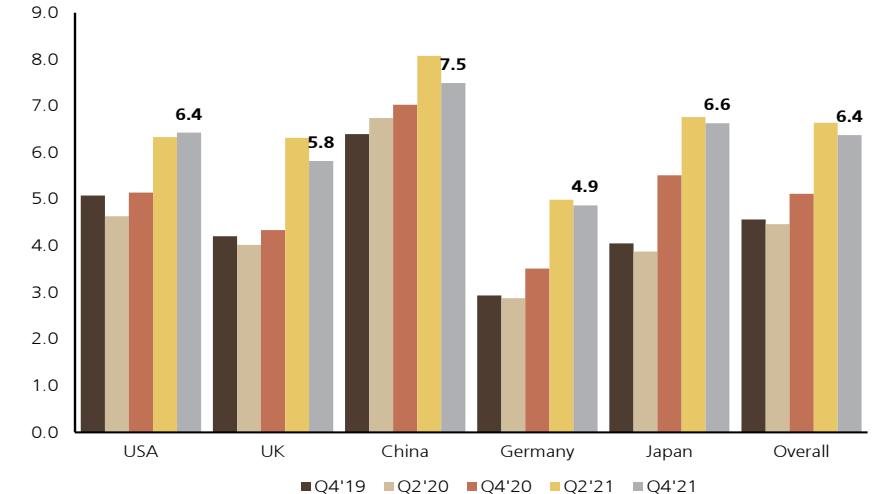
Source: UBS Evidence Lab

# UBS Evidence Lab – Smartphones Survey 4Q21

Consumer Interest in 5G by Region



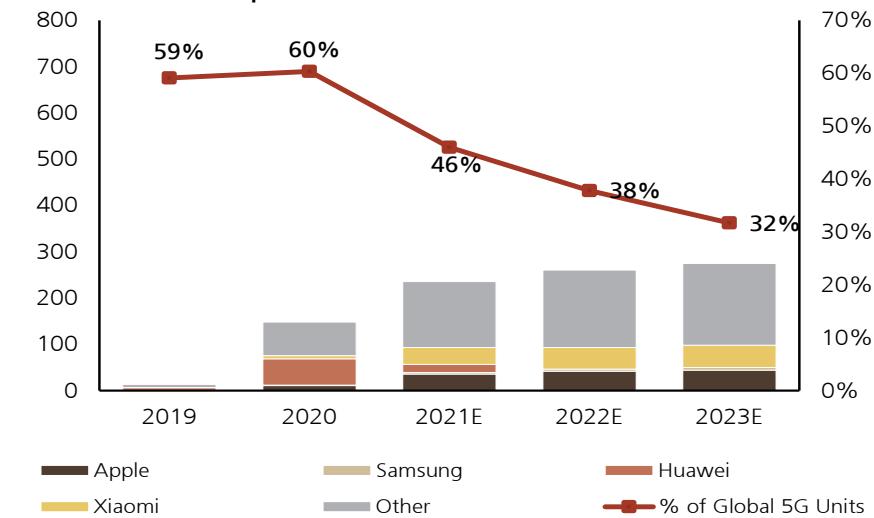
Willingness to Pay for 5G



UBS 5G Bottom-up Smartphone Forecasts (m)

5G - Global	2019	2020	2021E	2022E	2023E
Apple	0	60	176	213	224
Samsung	7	27	70	122	190
Huawei	7	67	23	0	0
Xiaomi	1	13	44	74	100
LGE	1	2	2	0	0
Other Android	7	76	198	279	352
<b>Total</b>	<b>23</b>	<b>245</b>	<b>512</b>	<b>688</b>	<b>867</b>
% total	2%	19%	38%	49%	60%
5G - China domestic	2019	2020E	2021E	2022E	2023E
Apple	0	11	36	42	44
Samsung	0	1	3	5	6
Huawei	6	57	17	0	0
Xiaomi	1	7	36	46	49
Other	6	73	142	169	179
<b>Total</b>	<b>13</b>	<b>148</b>	<b>235</b>	<b>262</b>	<b>277</b>
% of total 5G	59%	60%	46%	38%	31%

China 5G Smartphone Sell-in Ests



Source: UBS Evidence Lab

# Global Telecom Operator Capex: Model

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UBS Global Carrier Capex Model – Wireless and Wired

(US\$m)	2015	2016	2017	2018	2019	2020	2021E	2022E
<b>Global Wireless Capex</b>	<b>149,468</b>	<b>130,941</b>	<b>126,509</b>	<b>120,690</b>	<b>127,664</b>	<b>132,295</b>	<b>143,788</b>	<b>150,753</b>
% y-o-y	0.0%	-12.4%	-3.4%	-4.6%	5.8%	3.6%	8.7%	4.8%
% y-o-y const. currency	6.9%	-11.1%	-3.2%	-5.6%	8.0%	4.2%	4.7%	3.8%
<b>Global Wireline Capex</b>	<b>102,335</b>	<b>93,437</b>	<b>89,713</b>	<b>92,292</b>	<b>93,485</b>	<b>85,370</b>	<b>92,471</b>	<b>99,717</b>
% y-o-y	-1.5%	-8.7%	-4.0%	2.9%	1.3%	-8.7%	8.3%	7.8%
% y-o-y const. currency	5.6%	-6.6%	-3.6%	1.3%	3.7%	-8.4%	3.6%	6.7%
<b>Total Global Capex</b>	<b>268,403</b>	<b>241,938</b>	<b>235,276</b>	<b>233,027</b>	<b>239,143</b>	<b>235,650</b>	<b>257,109</b>	<b>271,074</b>
% y-o-y	-0.6%	-9.9%	-2.8%	-1.0%	2.6%	-1.5%	9.1%	5.4%
% y-o-y const. currency	6.1%	-8.6%	-2.8%	-2.4%	4.6%	-1.4%	4.6%	4.1%

Source: Company reports, UBS estimates

# Global Wireless Capex: Model

UBS Global Wireless Capex Model

Global Wireless Capex (US\$m)	2015	2016	2017	2018	2019	2020	2021E	2022E
<b>North America</b>	<b>31,132</b>	<b>27,820</b>	<b>29,506</b>	<b>27,440</b>	<b>28,127</b>	<b>32,353</b>	<b>35,734</b>	<b>42,436</b>
% y-o-y	-7.1%	-10.6%	6.1%	-7.0%	2.5%	15.0%	10.5%	18.8%
% y-o-y const. currency	-7.1%	-10.6%	6.1%	-7.0%	2.5%	15.0%	10.5%	18.8%
<b>Europe</b>	<b>19,501</b>	<b>18,706</b>	<b>18,644</b>	<b>20,070</b>	<b>19,614</b>	<b>20,076</b>	<b>23,280</b>	<b>23,253</b>
% y-o-y	-9.8%	-4.1%	-0.3%	7.7%	-2.3%	2.4%	16.0%	-0.1%
% y-o-y const. currency	7.2%	-6.9%	-1.6%	3.2%	3.4%	1.0%	7.1%	-1.8%
<b>China</b>	<b>43,137</b>	<b>32,061</b>	<b>27,456</b>	<b>21,823</b>	<b>25,257</b>	<b>29,402</b>	<b>31,224</b>	<b>30,409</b>
% y-o-y	44.2%	-25.7%	-14.4%	-20.5%	15.7%	16.4%	6.2%	-2.6%
% y-o-y const. currency	47.0%	-21.4%	-12.9%	-22.2%	20.9%	16.3%	-1.1%	-3.1%
<b>Japan</b>	<b>10,796</b>	<b>11,331</b>	<b>11,390</b>	<b>11,657</b>	<b>13,475</b>	<b>14,169</b>	<b>15,234</b>	<b>15,726</b>
% y-o-y	-28.5%	5.0%	0.5%	2.3%	15.6%	5.2%	7.5%	3.2%
% y-o-y const. currency	-18.3%	-5.6%	3.6%	0.8%	14.1%	3.0%	6.5%	-0.9%
<b>Asia ex. China/Japan</b>	<b>16,240</b>	<b>16,041</b>	<b>15,209</b>	<b>16,387</b>	<b>19,277</b>	<b>16,963</b>	<b>18,543</b>	<b>18,596</b>
% y-o-y	2.7%	-1.2%	-5.2%	7.7%	17.6%	-12.0%	9.3%	0.3%
% y-o-y const. currency	10.2%	1.9%	-6.5%	8.3%	19.6%	-10.1%	5.9%	-0.5%
<b>LatAm</b>	<b>15,245</b>	<b>13,454</b>	<b>12,067</b>	<b>11,435</b>	<b>10,558</b>	<b>8,918</b>	<b>9,106</b>	<b>9,445</b>
% y-o-y	-10.1%	-11.7%	-10.3%	-5.2%	-7.7%	-15.5%	2.1%	3.7%
% y-o-y const. currency	6.2%	-4.9%	-11.5%	-3.9%	-5.0%	-7.9%	-3.4%	2.0%
<b>Rest of world</b>	<b>13,418</b>	<b>11,528</b>	<b>12,238</b>	<b>11,877</b>	<b>11,356</b>	<b>10,413</b>	<b>10,667</b>	<b>10,889</b>
% y-o-y	-18.7%	-14.1%	6.2%	-2.9%	-4.4%	-8.3%	2.4%	2.1%
<b>Total Global Wireless Capex</b>	<b>149,468</b>	<b>130,941</b>	<b>126,509</b>	<b>120,690</b>	<b>127,664</b>	<b>132,295</b>	<b>143,788</b>	<b>150,753</b>
% y-o-y	0.0%	-12.4%	-3.4%	-4.6%	5.8%	3.6%	8.7%	4.8%
% y-o-y const. currency	6.9%	-11.1%	-3.2%	-5.6%	8.0%	4.2%	4.7%	3.8%
<b>Total Global Wireless (ex-China)</b>	<b>106,331</b>	<b>98,880</b>	<b>99,053</b>	<b>98,867</b>	<b>102,407</b>	<b>102,893</b>	<b>112,564</b>	<b>120,344</b>
% y-o-y	-11.0%	-7.0%	0.2%	-0.2%	3.6%	0.5%	9.4%	6.9%
% y-o-y const. currency	-3.8%	-7.2%	-0.1%	-0.9%	5.2%	1.2%	6.4%	5.7%

Source: Company reports, UBS estimates



# Global Wireline Capex: Model

## UBS Global Wireline Capex Model

Global Wireline Capex (US\$m)	2015	2016	2017	2018	2019	2020	2021E	2022E
<b>North America</b>	<b>21,234</b>	<b>20,499</b>	<b>19,917</b>	<b>21,001</b>	<b>20,644</b>	<b>17,798</b>	<b>20,633</b>	<b>24,522</b>
% y-o-y	-4.0%	-3.5%	-2.8%	5.4%	-1.7%	-13.8%	15.9%	18.8%
% y-o-y const. currency	-4.0%	-3.5%	-2.8%	5.4%	-1.7%	-13.8%	15.9%	18.8%
<b>Europe</b>	<b>22,427</b>	<b>21,950</b>	<b>22,463</b>	<b>22,993</b>	<b>22,248</b>	<b>21,959</b>	<b>24,219</b>	<b>25,842</b>
% y-o-y	-4.6%	-2.1%	2.3%	2.4%	-3.2%	-1.3%	10.3%	6.7%
% y-o-y const. currency	10.8%	0.6%	1.8%	-1.5%	1.9%	-2.9%	1.8%	4.8%
<b>China</b>	<b>32,157</b>	<b>24,482</b>	<b>20,208</b>	<b>19,766</b>	<b>17,959</b>	<b>18,241</b>	<b>19,055</b>	<b>20,543</b>
% y-o-y	17.2%	-23.9%	-17.5%	-2.2%	-9.1%	1.6%	4.5%	7.8%
% y-o-y const. currency	19.5%	-19.5%	-16.0%	-4.3%	-5.1%	1.5%	-2.7%	7.3%
<b>Japan</b>	<b>7,791</b>	<b>8,600</b>	<b>8,762</b>	<b>9,525</b>	<b>9,037</b>	<b>8,210</b>	<b>8,189</b>	<b>8,663</b>
% y-o-y	-23.0%	10.4%	1.9%	8.7%	-5.1%	-9.1%	-0.3%	5.8%
% y-o-y const. currency	-12.0%	-0.8%	5.0%	7.1%	-6.3%	-11.0%	-1.2%	1.6%
<b>Asia ex. China/Japan</b>	<b>6,726</b>	<b>6,985</b>	<b>7,089</b>	<b>7,258</b>	<b>11,979</b>	<b>9,010</b>	<b>10,333</b>	<b>10,239</b>
% y-o-y	4.3%	3.9%	1.5%	2.4%	65.0%	-24.8%	14.7%	-0.9%
% y-o-y const. currency	12.5%	6.6%	0.4%	2.2%	67.5%	-23.1%	10.7%	-1.4%
<b>LatAm</b>	<b>6,824</b>	<b>6,138</b>	<b>6,323</b>	<b>6,382</b>	<b>6,777</b>	<b>5,809</b>	<b>5,754</b>	<b>5,574</b>
% y-o-y	-16.2%	-10.0%	3.0%	0.9%	6.2%	-14.3%	-1.0%	-3.1%
% y-o-y const. currency	2.2%	-1.3%	1.8%	2.6%	9.2%	-5.3%	-6.0%	-4.9%
<b>Rest of world</b>	<b>5,177</b>	<b>4,783</b>	<b>4,951</b>	<b>5,367</b>	<b>4,841</b>	<b>4,342</b>	<b>4,289</b>	<b>4,334</b>
% y-o-y	-15.8%	-7.6%	3.5%	8.4%	-9.8%	-10.3%	-1.2%	1.1%
<b>Total Global Wireline Capex</b>	<b>102,335</b>	<b>93,437</b>	<b>89,713</b>	<b>92,292</b>	<b>93,485</b>	<b>85,370</b>	<b>92,471</b>	<b>99,717</b>
% y-o-y	-1.5%	-8.7%	-4.0%	2.9%	1.3%	-8.7%	8.3%	7.8%
% y-o-y const. currency	5.6%	-6.6%	-3.6%	1.3%	3.7%	-8.4%	3.6%	6.7%
<b>Total Global Wireline (ex-China)</b>	<b>70,178</b>	<b>68,955</b>	<b>69,506</b>	<b>72,526</b>	<b>75,526</b>	<b>67,128</b>	<b>73,416</b>	<b>79,174</b>
% y-o-y	-8.3%	-1.7%	0.8%	4.3%	4.1%	-11.1%	9.4%	7.8%
% y-o-y const. currency	0.2%	-1.0%	0.8%	3.0%	6.1%	-10.7%	5.4%	6.5%

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	2021e	2022e	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e	2031e
By operator																
2/3G			1,440	1,340	1,470	1,460	1,440	1,420	1,400	1,380	1,360	1,340	1,320	1,300	1,280	1,260
4G	1,510	1,870	2,410	3,090	3,280	3,330	3,330	3,330	3,330	3,330	3,330	3,330	3,330	3,330	3,330	3,330
5G (incl. co-build with CBN)	-	-	-	50	390	690	990	1,290	1,590	1,890	2,090	2,290	2,490	2,690	2,890	3,090
<b>CM Total</b>			<b>3,850</b>	<b>4,480</b>	<b>5,140</b>	<b>5,480</b>	<b>5,760</b>	<b>6,040</b>	<b>6,320</b>	<b>6,600</b>	<b>6,780</b>	<b>6,960</b>	<b>7,140</b>	<b>7,320</b>	<b>7,500</b>	<b>7,680</b>
2/3G					310	310	300	290	280	270	260	250	240	230	220	210
4G	890	1,172	1,380	1,590	1,610	1,610	1,630	1,650	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670
5G (incl. co-build with CU)	-	-	-	60	380	680	980	1,280	1,580	1,880	2,080	2,280	2,480	2,680	2,880	3,080
<b>CT Total</b>					<b>2,300</b>	<b>2,600</b>	<b>2,910</b>	<b>3,220</b>	<b>3,530</b>	<b>3,820</b>	<b>4,010</b>	<b>4,200</b>	<b>4,390</b>	<b>4,580</b>	<b>4,770</b>	<b>4,960</b>
2/3G					917	897	887	877	867	857	847	837	827	817	807	797
4G	736	850	990	1,410	1,503	1,603	1,623	1,643	1,663	1,663	1,663	1,663	1,663	1,663	1,663	1,663
5G (incl. co-build with CT)	-	-	-	60	380	680	980	1,280	1,580	1,880	2,080	2,280	2,480	2,680	2,880	3,080
<b>CU Total</b>					<b>2,800</b>	<b>3,180</b>	<b>3,490</b>	<b>3,800</b>	<b>4,110</b>	<b>4,400</b>	<b>4,590</b>	<b>4,780</b>	<b>4,970</b>	<b>5,160</b>	<b>5,350</b>	<b>5,540</b>
By technology																
2/3G					2,697	2,667	2,627	2,587	2,547	2,507	2,467	2,427	2,387	2,347	2,307	2,267
4G	3,136	3,892	4,780	6,090	6,393	6,543	6,583	6,623	6,663	6,663	6,663	6,663	6,663	6,663	6,663	6,663
5G	-	-	-	110	770	1,370	1,970	2,570	3,170	3,770	4,170	4,570	4,970	5,370	5,770	6,170
Total					9,860	10,580	11,180	11,780	12,380	12,940	13,300	13,660	14,020	14,380	14,740	15,100

Source: UBS estimates

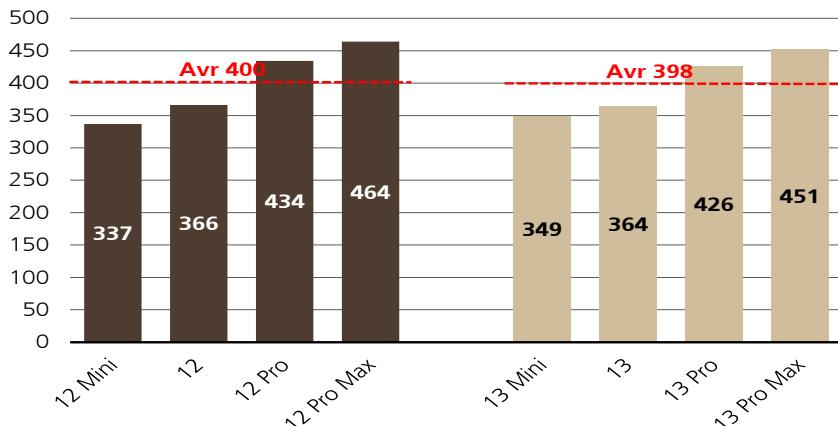
Total Telco Capex (RMB MM)

CM Capex (Rmb mn)	2018	2019	2020	2021e	2022e	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e	2031e	
<b>Total capex</b>															
Mobile network	116,816	146,648	187,834	169,936	173,918	163,908	164,454	163,154	161,333	157,568	157,045	156,523	154,650	152,753	
Transmission/broadband	89,086	72,597	63,954	71,985	76,895	81,105	84,514	87,303	90,248	93,160	96,177	99,300	102,535	105,885	
Other (incl. industrial digitalization)	81,008	80,675	81,262	98,679	108,868	117,219	123,263	128,683	134,297	139,604	145,118	150,846	156,797	162,980	
<b>Total capex</b>	<b>286,910</b>	<b>299,920</b>	<b>333,050</b>	<b>340,600</b>	<b>359,680</b>	<b>362,232</b>	<b>372,231</b>	<b>379,139</b>	<b>385,878</b>	<b>390,332</b>	<b>398,339</b>	<b>406,669</b>	<b>413,982</b>	<b>421,619</b>	
%change	-7.0%	4.5%	11.0%	2.3%	5.6%	0.7%	2.8%	1.9%	1.8%	1.2%	2.1%	2.1%	1.8%	1.8%	
as % of service revenue (RHS)	22.3%	23.1%	24.8%	23.4%	23.1%	22.1%	22.0%	21.8%	21.7%	21.6%	21.6%	21.7%	21.7%	21.7%	
Total service revenue	1,285,024	1,296,388	1,345,304	1,452,963	1,555,266	1,636,970	1,695,597	1,738,361	1,780,202	1,811,121	1,843,104	1,876,157	1,910,290	1,945,514	

Source: UBS estimates

# Smartphone: iPhone 13 Series BOM Comparison

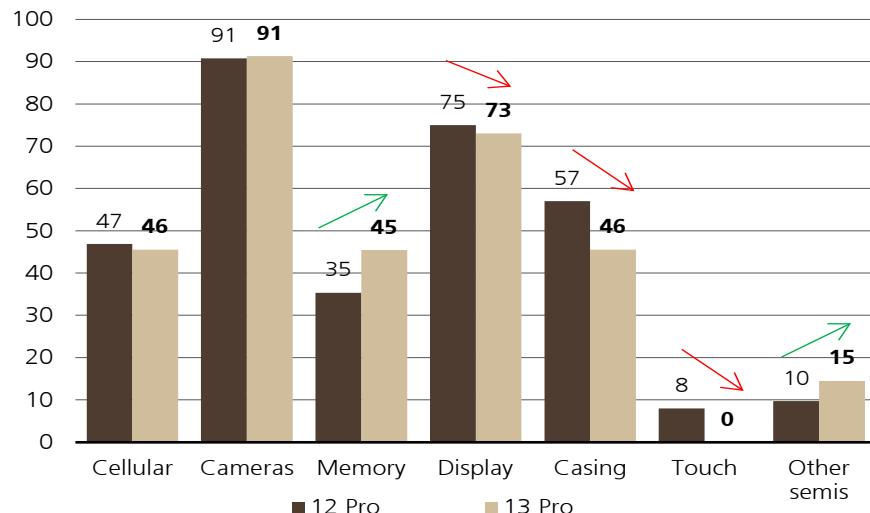
iPhone 13 Series BOM costs (US\$)



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

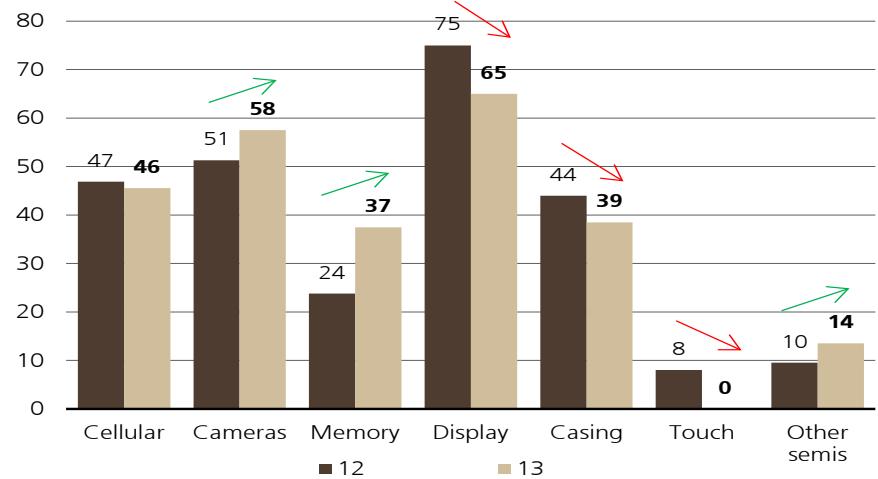
Source: Fomalhaut Techno Solution, UBS

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



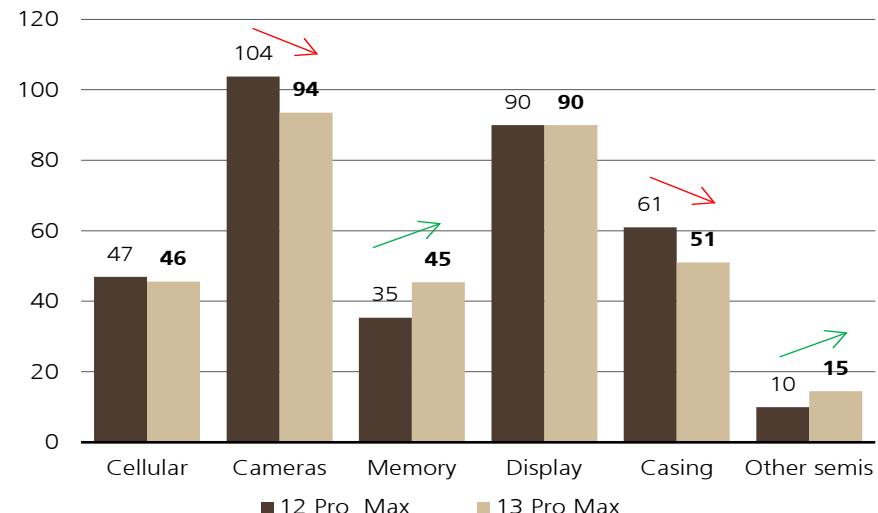
Source: Fomalhaut Techno Solution, UBS

iPhone 13 vs 12 Key Components



Source: Fomalhaut Techno Solution, UBS

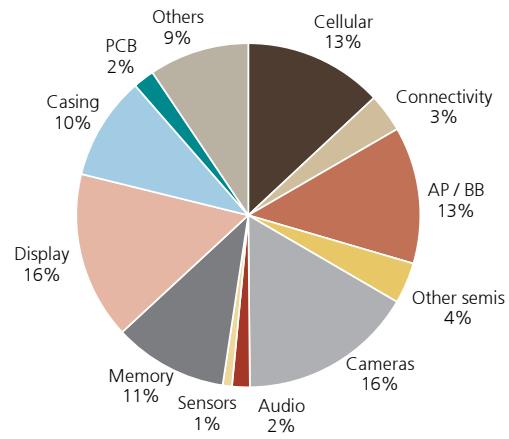
iPhone 13 Pro Max vs 12 Pro Max Key Components



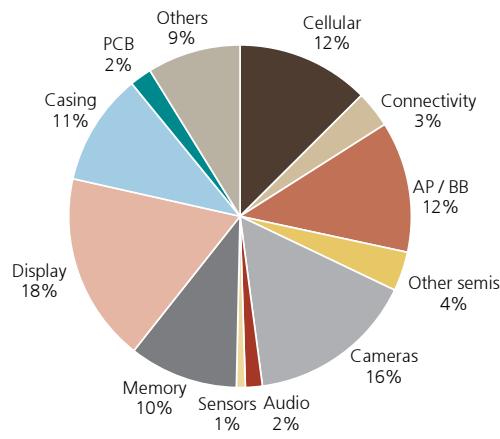
Source: Fomalhaut Techno Solution, UBS

# iPhone 13 Series Content by Component

IP13 Mini Content by Component

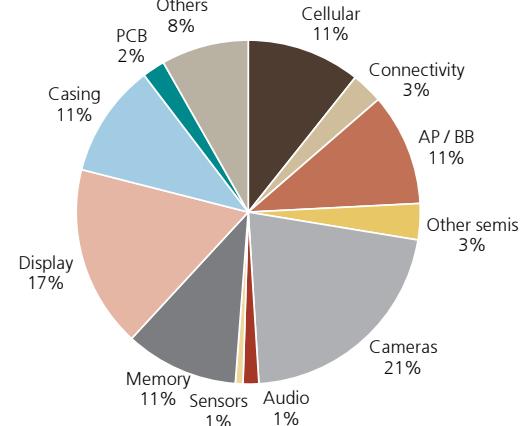


IP13 Content by Component



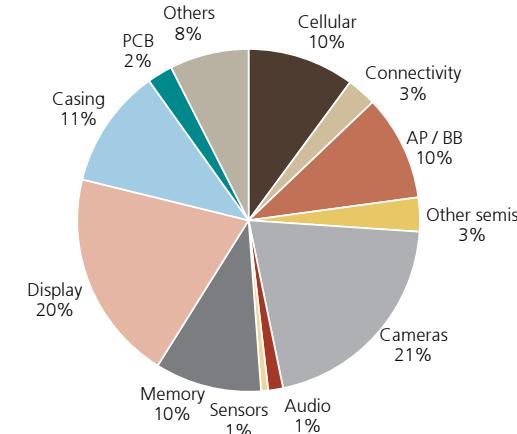
Source: Fomalhaut Techno Solution, UBS

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	<b>Rear dual camera module</b>			<b>38.5</b>	<b>11.5%</b>	
	12MP Wide camera		<b>25.0</b>			
	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		<b>10.0</b>			
	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	<b>3.5</b>			
	<b>Front single camera module</b>		<b>6.0</b>	<b>6.0</b>	<b>1.8%</b>	
	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			
	<b>Face ID</b>		<b>13.0</b>	<b>13.0</b>	<b>3.9%</b>	
	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	<b>0.8</b>	<b>5.8</b>	<b>1.7%</b>	
	Speaker	Goertek, AAC, Luxshare	<b>5.0</b>			

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-ion 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			
<b>Total</b>			<b>336.1</b>	<b>336.1</b>		
<i>Fomalhaut</i>						

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 ALSO 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	1.0		
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 increase 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	<b>Rear dual camera module</b>			<b>38.5</b>	<b>11.0%</b>	
	12MP Wide camera		<b>25.0</b>			
	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		<b>10.0</b>			
	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	<b>3.5</b>			
	<b>Front single camera module</b>		<b>6.0</b>	<b>6.0</b>	<b>1.7%</b>	
	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			
	<b>Face ID</b>		<b>13.0</b>	<b>13.0</b>	<b>3.7%</b>	
	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	<b>0.8</b>	<b>5.8</b>	<b>1.7%</b>	
	Speaker	Goertek, AAC, Luxshare	<b>5.0</b>			

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
<b>Sensor</b>	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		
<b>Memory</b>	DRAM	Samsung	19.0	37.4	10.7% LPDDR4, 4GBYTE 128GBYTE
	NAND flash memory	Kioxia	18.5		
<b>Display</b>	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		
<b>Casing</b>	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		
<b>PCB</b>	PCB	AT&S	3.0	7.6	2.2%
	FPC	CPQ, MK, MFC, MYC, Sumitomo, Avary, Dongshan	4.6		
<b>Antenna</b>	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		
<b>Small components</b>	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		
<b>Other</b>	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		
<b>Total</b>			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, LTE, WCDMA, CDMA, GSM Sub-6, 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	3.1% 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	10.9% TSMC 5nm, avr 20% die size increases ANALOG & DIGITAL BB
	Baseband	Qualcomm (foundry Samsung)	15.0		
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
<b>Camera</b>	<b>Rear triple camera module</b>			<b>58.3</b>	<b>14.1%</b>	
	12MP Wide camera		<b>28.0</b>			
	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		<b>14.0</b>			
	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		<b>11.0</b>			
	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	<b>5.3</b>			
	<b>Rear ToF (LiDAR) module</b>		<b>14.0</b>	<b>14.0</b>	<b>3.4%</b>	
	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			
	<b>Front single camera module</b>		<b>6.0</b>	<b>6.0</b>	<b>1.5%</b>	
	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			
	<b>Face ID</b>		<b>13.0</b>	<b>13.0</b>	<b>3.1%</b>	
	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			
<b>Audio</b>	Microphone	GoerTek, Knowles Acoustics	<b>0.8</b>	<b>6.3</b>	<b>1.5%</b>	
	Speaker	Goertek, AAC, Luxshare	<b>5.5</b>			

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
<b>Sensor</b>	Accelerometer/Gyroscope	Bosch Sensortec	1.3	3.1	<b>0.7%</b> ALSO GYROSCOPE
	Digital compass	Alps	0.5		
	Barometer		0.8		
	Light sensor/Proximity sensor	STM, ams	0.5		ALSO PROXIMITY SENSOR
<b>Memory</b>	DRAM	Samsung	27.0	45.4	<b>11.0%</b> LPDDR4, 6GBYTE
	NAND flash memory	Kioxia	18.5		128GBYTE
<b>Display</b>	Main display	Samsung Display	64.5	73.0	<b>17.7%</b> 6.1" FHD+ OLED, Y-OCTA, LTPO
	Cover glass	Lens Tech, Biel Crystal (Corning glass)	5.5		
	Touch panel controller	Apple	3.0		
<b>Casing</b>	Center panel	Foxconn Industrial Internet, Foxconn Tech	35.0	45.5	<b>11.0%</b> Stainless
	Rear cover	Lens Tech, Biel Crystal (Corning glass)	6.5		
	Keypad buttons	Casetek	1.0		
	Waterproof	Jabil, Tongda	3.0		IP68
<b>PCB</b>	PCB	AT&S	3.5	9.1	<b>2.2%</b>
	FPC	FM, MK, Sumitomo, Fujikura, Avary, Dongshan	5.6		
<b>Antenna</b>	Cellular/GPS		0.2	3.3	<b>0.8%</b> 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		
<b>Small components</b>	Chip capacitor	Murata, Taiyo Yuden, SEMCO	4.8	7.0	<b>1.7%</b>
	Chip resistor		0.3		
	Chip inductor		0.0		
	Chip diode		0.0		
	Chip filter		0.5		
	Power inductor	Taiyo Yuden, Murata, Cyntec	1.4		
<b>Other</b>	Li-on polymer battery	Huizhou Desay (cells from TDK/ATL, LGC)	7.5	22.1	<b>5.4%</b> 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		
<b>Total</b>			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	<b>Rear triple camera module</b>			<b>58.3</b>	<b>13.2%</b>	
	12MP Wide camera		<b>28.0</b>			
	CMOS image sensor	Sony	6.5			12MP CMOS
	Module assembly	LG Innotek, Sharp	4.2			
	Lens	Lagan, Genius, Sunny Optical	2.0			
	OIS actuator	Alps, Mitsumi	12.0			SENSOR SHIFT
	TMR sensor	TDK	1.5			
	Other		1.8			
	12MP Telephoto		<b>14.0</b>			
	CMOS image sensors	Sony	2.7			12MP CMOS
	Module assembly	LG Innotek	2.1			
	Lens	Lagan, Genius	1.7			
	OIS actuator		3.0			
	Other		4.6			
	12MP Ultra-wide		<b>11.0</b>			
	CMOS image sensors	Sony	2.7			12MP CMOS
	Module assembly	LG Innotek, Sharp	1.7			
	Lens	Lagan, Genius	1.1			
	Voice coil motor	Alps	1.0			
	Other		4.6			
	Rear module assembly	Hon Hai	<b>5.3</b>			
	<b>Rear ToF (LiDAR) module</b>		<b>14.0</b>	<b>14.0</b>	<b>3.2%</b>	
	ToF image sensor		2.1			
	Module assembly	LG Innotek	2.7			
	Lens	Lagan, Genius	1.0			
	VCSEL		2.0			
	LiDAR processor		2.0			
	Other		4.2			
	<b>Front single camera module</b>		<b>6.0</b>	<b>6.0</b>	<b>1.4%</b>	
	CMOS image sensors	Sony	2.8			12MP CMOS
	Module assembly	Cowell, Hon Hai	1.0			
	Lens	Lagan, Genius	0.8			
	Other		1.4			
	<b>Face ID</b>		<b>13.0</b>	<b>13.0</b>	<b>2.9%</b>	
	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	Goertek, Knowles Acoustics	<b>0.8</b>	<b>6.3</b>	<b>1.4%</b>	
	Speaker	Goertek, AAC, Luxshare	<b>5.5</b>			

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			
<b>Total</b>						<b>442.6</b>
Fomalhaut						<b>442.6</b>

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
<b>Camera</b>	<b>Rear triple camera module</b>			<b>60.5</b>	<b>13.8%</b>	
	12MP Wide camera		<b>28.0</b>			
	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		<b>15.0</b>			
	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		<b>12.0</b>			
	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	<b>5.5</b>			
	<b>Rear ToF (LiDAR) module</b>		<b>14.0</b>	<b>14.0</b>	<b>3.2%</b>	
	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			
	<b>Front single camera module</b>		<b>6.0</b>	<b>6.0</b>	<b>1.4%</b>	
	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			
	<b>Face ID</b>		<b>13.0</b>	<b>13.0</b>	<b>3.0%</b>	
	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			
<b>Audio</b>	Microphone	GoerTek, Knowles Acoustics	<b>0.8</b>	<b>6.3</b>	<b>1.4%</b>	
	Speaker	Goertek, AAC, Luxshare	<b>5.5</b>			

Source: Fomalhaut Techno Solution, UBS estimates

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

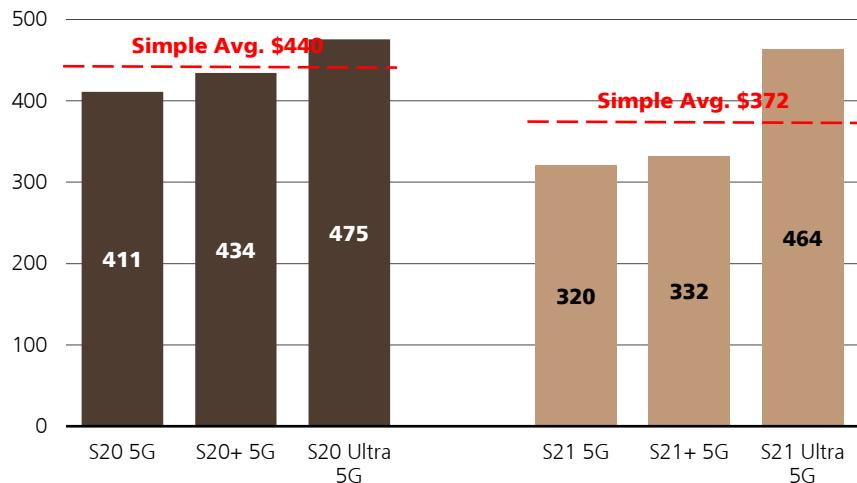
## iPhone 13 Pro Max (Sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	Subtotal	% Remark
<b>Sensor</b>	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
<b>Memory</b>	DRAM	Samsung	27.0	45.4	10.4% LPDDR4, 6GBYTE
	NAND flash memory	Kioxia	18.5		128GBYTE
<b>Display</b>	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		
<b>Casing</b>	Center panel	Foxconn Industrial Internet, Foxconn Tech	40.0	51.0	11.6% Stainless
	Rear cover	Lens Tech, Biel Crystal (Corning glass)	7.0		
	Keypad buttons	Casetek	1.0		
	Waterproof	Jabil, Tongda	3.0		IP68
<b>PCB</b>	PCB	AM	3.5	10.8	2.5%
	FPC	FM, MK, Sumitomo, Fujikura, Avary, Dongshan	7.3		
<b>Antenna</b>	Cellular/GPS		0.2	0.8	0.2% 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
<b>Small components</b>	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		
<b>Other</b>	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		
<b>Total</b>				438.2	
<i>Fomalhaut</i>				438.2	

Source: Fomalhaut Techno Solution, UBS estimates

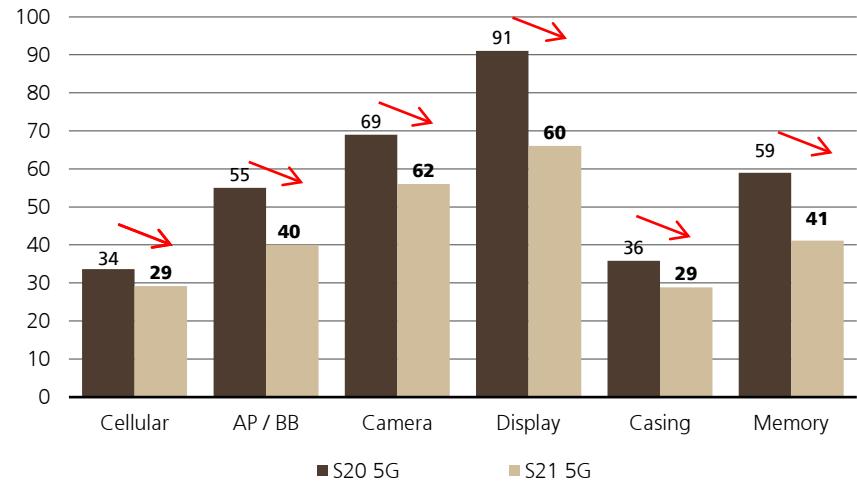
# Smartphone: Galaxy S21 Series BOM Comparison

Galaxy S21 Series BOM Costs (US\$)



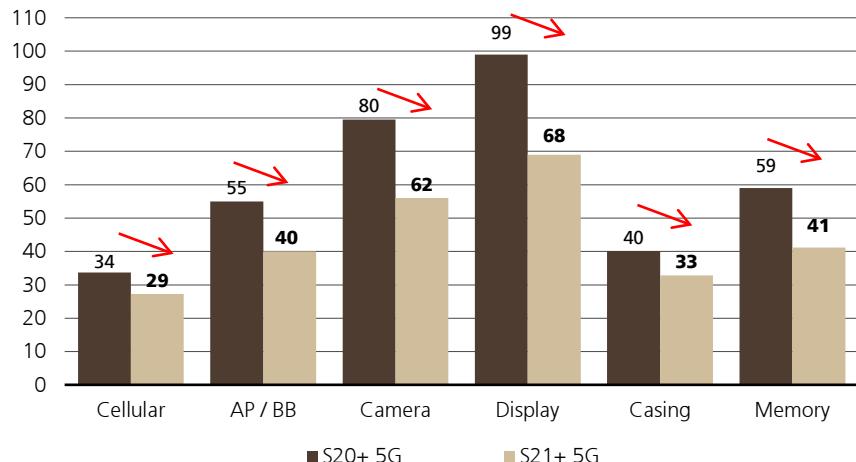
Source: Fomalhaut Techno Solution, UBS

Galaxy S21 vs S20 Key Components



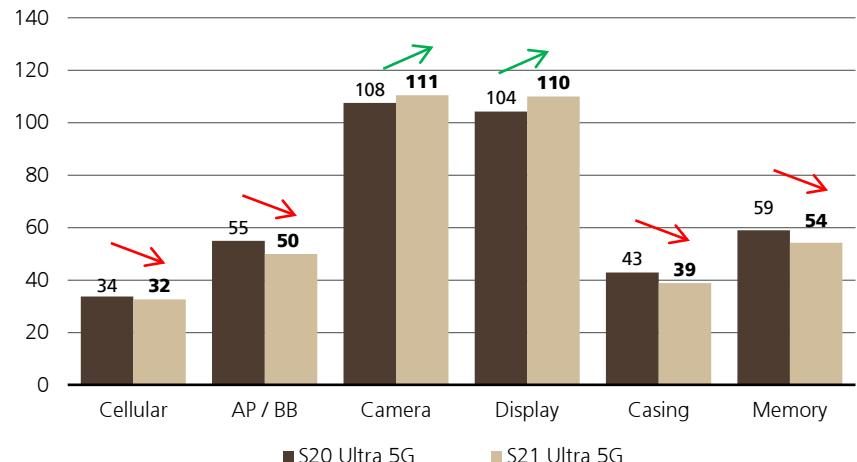
Source: Fomalhaut Techno Solution, UBS

Galaxy S21+ vs S20+ Key Components (US\$)



Source: Fomalhaut Techno Solution, UBS

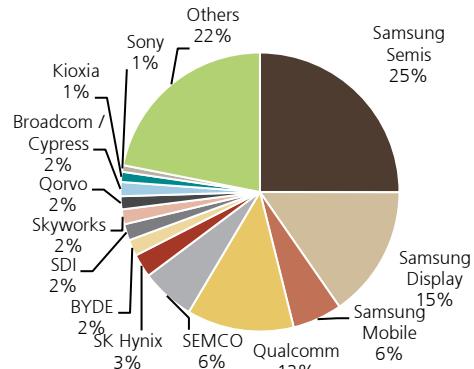
Galaxy S21 Ultra vs S20 Ultra Key Components



Source: Fomalhaut Techno Solution, UBS

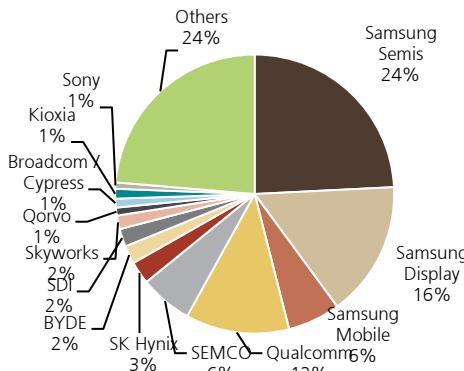
# Galaxy S21 Content per Vendor and Component

S21 Content by Vendor



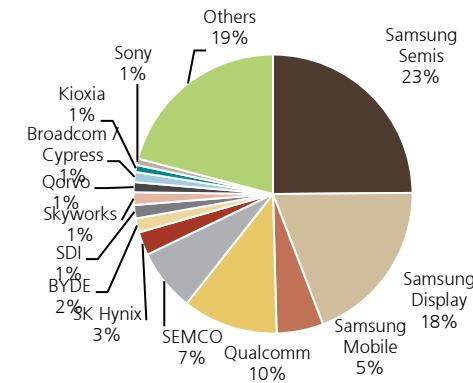
Source: Fomalhaut, UBS estimates

S21+ Content by Vendor



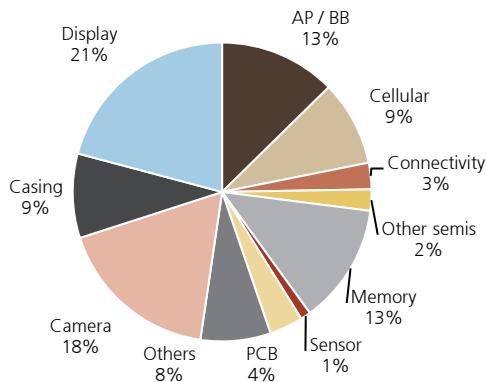
Source: Fomalhaut, UBS estimates

S21 Ultra Content by Vendor



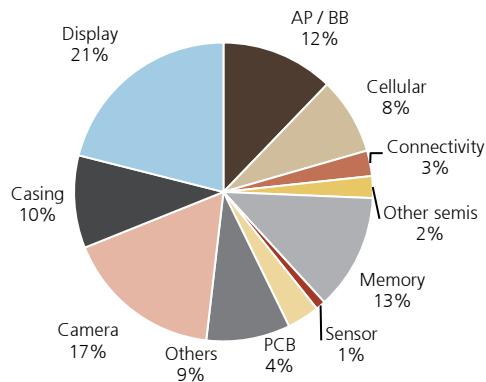
Source: Fomalhaut, UBS estimates

S21 Content by Component



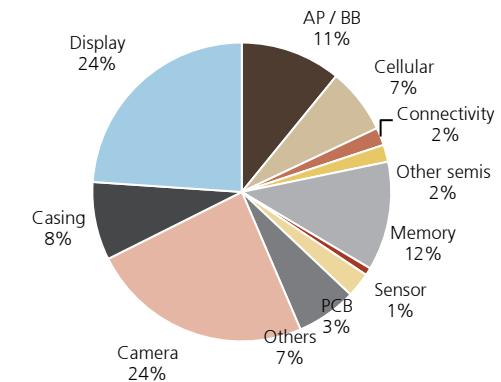
Source: Fomalhaut, UBS estimates

S21+ Content by Component



Source: Fomalhaut, UBS estimates

S21 Ultra Content by Component



Source: Fomalhaut, UBS estimates

# Galaxy S21 5G Exynos (Sub-6) Teardown – Part 1

## Galaxy S21 5G Exynos (sub-6) Teardown

Category	Function	Manufacturer	UBS			Remark
			Price (US\$)	Subtotal	% of total	
Cellular	RF Transceivers	Samsung	4.0	29.2	9.2%	
	2G: GSM TX/RX	Samsung	0.0			IN WCDMA TX/RX
	3G: WCDMA TX/RX	Samsung	4.0			ALSO GSM, CDMA, LTE, SUB-6
	4G: LTE TX/RX	Samsung	0.0			IN WCDMA TX/RX
	5G: SUB-6GHz TX/RX	Samsung	0.0			IN WCDMA TX/RX
	Power amplifiers	Qualcomm (2G /3G /4G /5G), Qorvo (5G)	16.0			
	2G: GSM PAM	Qualcomm	0.0			IN WCDMA PAM
	3G: WCDMA PAM	Qualcomm	5.0			ALSO LTE, CDMA, GSM, ASSUMPTION
	4G: LTE PAM	Qualcomm	0.0			IN WCDMA PAM
	4G: LTE PAM	Qualcomm	0.0			IN SUB-6GHz PAM
	5G: SUB-6GHz PAM	Qualcomm	5.0			ALSO LTE, ASSUMPTION
	5G: SUB-6GHz PAM	Qorvo	3.0			ASSUMPTION
	5G: SUB-6GHz PAM	Qorvo	3.0			ASSUMPTION
	Diversity receiver	Qualcomm	5.0			
	Antenna switch		2.0			
	Filter	Murata, Wisol	0.2			
	Duplexer bank	Murata, Wisol	0.5			
	Duplexer	TDK	0.3			
	Envelope tracker	Samsung	0.7			
	RF switch		0.5			
Connectivity	WLAN/Bluetooth	Samsung	4.5	9.1	2.9%	WLAN ALSO BT
	GPS	Cypress /Broadcom	1.3			
	NFC	NXP	1.3			
	Wireless charger	IDT	2.0			
AP / BB	Application processor/baseband	Samsung, Qualcomm	40.0	40.0	12.6%	Analog and digital BB, 5G BB, image processor, USB and display controller
Other semis	Audio power amplifier	Cirrus Logic	0.9	7.3	2.3%	
	Power management	Samsung, Maxim	3.1			Also AUDIO PROCESSOR /AUDIO CODEC
	Quick charger	NXP	0.5			
	Display power supply	Silicon Mitus	0.3			ALSO AUDIO PROCESSOR
	Touch panel controller	Samsung	2.3			
	MST driver	Samsung	0.3			

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21 5G Exynos (Sub-6) Teardown – Part 2

## Galaxy S21 5G Exynos (sub-6) Teardown

Category	Function	Manufacturer	UBS <sup>e</sup>			Remark
			Price (US\$)	Subtotal	% of total	
Camera	<b>Main camera module</b>		<b>48.0</b>	<b>56.0</b>	<b>17.7%</b>	
	12MP Wide camera		<b>18.0</b>			
	Image sensor	Samsung LSI	8.0			12MP CMOS
	Lens	SEMCO	3.0			
	Actuator	SEMCO	2.0			
	Module assembly	SEMCO	3.6			
	Other		1.4			
	64MP Tele camera		<b>21.0</b>			
	Image sensor	Samsung LSI	11.0			64MP CMOS
	Lens	SEMCO	3.0			
	Actuator	SEMCO	2.0			
	Module assembly	SEMCO	4.2			
	Other		0.8			
	12MP Ultra-wide camera		<b>9.0</b>			
	Image sensor	Samsung LSI, Sony	4.5			12MP CMOS
	Lens		2.0			
	Module assembly	Cammsys, Power Logics	1.4			
	Other		1.2			
	<b>Front camera module</b>		<b>8.0</b>			
	Image sensor	Samsung LSI, Sony	3.5			10MP CMOS
	Lens		2.0			
	Module assembly	Cammsys, Partron, Sunny Optical	1.2			
	Other		1.3			
Audio	Microphone	GoerTek	<b>0.6</b>	<b>2.6</b>	<b>0.8%</b>	
	Speaker		<b>2.0</b>			
Sensors	Accelerometer / gyroscope	STM	<b>1.3</b>	<b>3.5</b>	<b>1.1%</b>	ALSO GYROSCOPE
	Digital compass	Asahi Kasei	0.5			
	Barometer	STM	0.8			
	Light / proximity sensor		<b>0.9</b>			ALSO PROXIMITY SENSOR

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21 5G Exynos (Sub-6) Teardown – Part 3

## Galaxy S21 5G Exynos (sub-6) Teardown

Category	Function	Manufacturer	UBS <sup>e</sup>		
			Price (US\$)	Subtotal	% of total
<b>Memory</b>	DRAM	Samsung	<b>28.7</b>	<b>41.1</b>	<b>13.0%</b> LPDDR5, 8GBYTE
	NAND	Samsung	<b>12.4</b>		<b>128GBYTE</b>
<b>Display</b>	Display panel	Samsung Display	<b>48.5</b>	<b>66.0</b>	<b>20.9%</b> 6.2" FHD+ OLED
	Cover glass	Corning	<b>6.0</b>		
	Touch panel		<b>4.0</b>		
	Ultrasonic fingerprint	Qualcomm	<b>7.5</b>		
<b>Casing</b>	Center panel		<b>20.0</b>	<b>28.9</b>	<b>9.1%</b> ALUMINUM ALLOY
	Keypad buttons		<b>0.4</b>		
	Inner cover		<b>1.0</b>		
	Rear cover glass		<b>4.0</b>		PLASTIC
	Waterproof		<b>3.5</b>		IP68
<b>PCB</b>	PCB	DAP, MDK	<b>3.5</b>	<b>11.5</b>	<b>3.6%</b>
	FPC	SEMCO	<b>8.0</b>		
<b>Antenna</b>	Cellular/WLAN /bluetooth		<b>1.0</b>	<b>3.0</b>	<b>0.9%</b> 2G,3G,4G,5G,GPS
	NFC /wireless charger		<b>2.0</b>		ALSO NFC /WIRELESS CHARGER
<b>Small components</b>	Chip capacitor		<b>1.9</b>	<b>3.2</b>	<b>1.0%</b> 6332 (05025 (03216 (02012 (01608 (7)1005 (184)0603 (277)0402 (9)OTHER ()
	Chip resistor		<b>0.2</b>		6332 (05025 (03216 (02012 (01608 (17)1005 (13)0603 (125)0402 (38)OTHER ()
	Chip inductor		<b>0.5</b>		6332 (05025 (03216 (10)2012 (26)1608 (7)1005 (4)0603 (107)0402 (0)OTHER ()
	Chip diode		<b>0.1</b>		6332 (05025 (03216 (02012 (7)1608 (1)1005 (4)0603 (8)0402 (0)OTHER ()
	Chip filter		<b>0.3</b>		6332 (05025 (03216 (02012 (01608 (6)1005 (22)0603 (74)0402 (0)OTHER ()
	Power inductor		<b>0.3</b>		
<b>Other</b>	Li-on polymer battery		<b>7.5</b>	<b>15.2</b>	<b>4.8%</b> 4000MAH
	Connectors	Hirose	<b>3.2</b>		
	Timing device	River, Kyocera	<b>0.5</b>		
	SIM	Hirose	<b>0.2</b>		
	Vibrator		<b>0.2</b>		
	ID sticker		<b>0.0</b>		
	EMI shield tapes		<b>0.1</b>		
	EMI shield metal cap		<b>0.5</b>		
	Screw		<b>0.3</b>		
	Unidentified large IC		<b>2.8</b>		
<b>Total BOM cost</b>			<b>316.49</b>		<b>100.0%</b>

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21+ 5G Exynos (Sub-6) Teardown – Part 1

## Galaxy S21 Plus 5G Exynos (sub-6) Teardown

Category	Function	Manufacturer	Price (US\$)	UBSe		
				Subtotal	% of total	Remark
Cellular	RF Transceivers	Samsung, Qualcomm	4.0	27.3	8.3%	
	2G: GSM TX/RX	Samsung	0.0			IN WCDMA TX/RX
	3G: WCDMA TX/RX	Samsung	4.0			ALSO GSM, CDMA, LTE, SUB-6
	4G: LTE TX/RX	Samsung	0.0			IN WCDMA TX/RX
	5G: SUB-6GHz TX/RX	Samsung	0.0			IN WCDMA TX/RX
	Power amplifiers	Skyworks (2G), Broadcom (3G / 4G / 5G), Qorvo (5G)	10.0			Difference vs S21
	2G: GSM PAM	Skyworks	1.0			IN WCDMA PAM
	3G: CDMA PAM	Broadcom	0.0			IN WCDMA PAM
	3G: WCDMA PAM	Broadcom	6.0			ALSO LTE, CDMA, ASSUMPTION
	4G: LTE PAM	Broadcom	0.0			IN WCDMA PAM
Connectivity	5G: SUB-6GHz PAM	Broadcom	0.0			IN WCDMA PAM
	5G: SUB-6GHz PAM	Qorvo	3.0			ASSUMPTION
	Diversity receiver	Qualcomm, Skyworks	7.0			
	Antenna switch	Murata, Unknown	4.0			ASSUMPTION
	Filter	Murata, Wisol	0.5			
	Duplexer bank	Murata	0.5			ASSUMPTION
	Duplexer	TDK, Wisol	0.3			
	Envelope tracker	Samsung	1.1			
	WLAN / Bluetooth	Samsung	4.5	9.1	2.8%	WLAN ALSO BT
	GPS	Cypress / Broadcom	1.3			
AP / BB	NFC	NXP	1.3			
	Wireless charger	IDT	2.0			
	Application processor / baseband	Samsung, Qualcomm	40.0	40.0	12.2%	Analog and digital BB, 5G BB, image processor, USB and display controller
	Audio power amplifier	Cirrus Logic	1.4	7.8	2.4%	
	Power management	Samsung, Maxim	3.1			Also audio processor / audio codec
	Quick charger	NXP	0.5			
Other semis	Display power supply	Silicon Mitus	0.3			
	Touch panel controller	Samsung	2.3			
	MST driver	Samsung	0.3			

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21+ 5G Exynos (Sub-6) Teardown – Part 2

## Galaxy S21 Plus 5G Exynos (sub-6) Teardown

Category	Function	Manufacturer	UBSe		
			Price (US\$)	Subtotal	% of total
Camera	<b>Main camera module</b>				
	12MP Wide camera		48.0	56.0	17.1%
	Image sensor	Samsung LSI	18.0		
	Lens	SEMCO	8.0		12MP CMOS
	Actuator	SEMCO	3.0		
	Module assembly	SEMCO	2.0		
	Other	SEMCO	3.6		
	Other		1.4		
	64MP Tele camera		21.0		
	Image sensor	Samsung LSI	11.0		64MP CMOS
	Lens	SEMCO	3.0		
	Actuator	SEMCO	2.0		
	Module assembly	SEMCO	4.2		
	Other		0.8		
	12MP Ultra-wide camera		9.0		
	Image sensor	Samsung LSI, Sony	4.5		12MP CMOS
	Lens		2.0		
	Module assembly	Cammsys, Power Logics	1.4		
	Other		1.2		
	<b>Front camera module</b>		8.0		
	Image sensor	Samsung LSI, Sony	3.5		10MP CMOS
	Lens		2.0		
	Module assembly	Cammsys, Partron, Sunny Optical	1.2		
	Other		1.3		
Audio	Microphone	GoerTek	0.6	2.6	0.8%
	Speaker		2.0		
Sensors	Accelerometer / gyroscope	STM	1.3	3.5	1.1% ALSO GYROSCOPE
	Digital compass	Asahi Kasei	0.5		
	Barometer	STM	0.8		
	Light / proximity sensor		0.9		ALSO PROXIMITY SENSOR

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21+ 5G Exynos (Sub-6) Teardown – Part 3

## Galaxy S21 Plus 5G Exynos (sub-6) Teardown

UBSe					
Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total
<b>Memory</b>	DRAM	Samsung	28.7	41.1	12.5% LPDDR5, 8GBYTE
	NAND	Samsung	12.4		128GBYTE
<b>Display</b>	Display panel	Samsung Display	51.5	69.0	21.0% 6.7" FHD+ OLED
	Cover glass	Corning	6.0		
	Touch panel		4.0		
	Ultrasonic fingerprint	Qualcomm	7.5		
<b>Casing</b>	Center panel		23.0	32.9	10.0% ALUMINUM ALLOY
	Keypad buttons		0.4		
	Inner cover		1.0		
	Rear cover glass		5.0		PLASTIC
	Waterproof		3.5		IP68
<b>PCB</b>	PCB	IEB, MDK	3.5	11.5	3.5%
	FPC	SEMCO	8.0		
<b>Antenna</b>	Cellular/WLAN /bluetooth		1.0	5.0	1.5% 2G,3G,4G,5G,GPS
	NFC /Wireless charger		2.0		ALSO NFC /WIRELESS CHARGER
	UWM		2.0		
<b>Small components</b>	Chip capacitor		2.5	3.6	1.1% 5025 ()
	Chip resistor		0.1		6332 (5025 (3216 (2012 (1608 (1005 (15)0603 (122)0402 (47)OTHER ()
	Chip inductor		0.2		6332 (5025 (3216 (10)2012 (29)1608 (7)1005 (4)0603 (9)0402 (0)OTHER ()
	Chip diode		0.1		6332 (5025 (3216 (2012 (8)1608 (1005 (5)0603 (8)0402 (0)OTHER ()
	Chip filter		0.4		6332 (5025 (3216 (2012 (1608 (3)1005 (25)0603 (91)0402 (0)OTHER ()
	Power inductor		0.3		
<b>Other</b>	Li-on polymer battery		8.5	18.6	5.7% 4800MAH
	Connectors	Hirose	3.3		
	Timing device	River, Kyocera	0.6		
	SIM	Hirose	0.2		USB TYPE-C
	Vibrator		0.2		
	ID sticker		0.0		
	EMI shield tapes		0.1		
	EMI shield metal cap		0.5		
	Screw		0.3		
Unidentified large IC					
<b>Total BOM cost</b>				<b>327.80</b>	<b>100.0%</b>

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21 Ultra 5G Snapdragon (mmW) Teardown – Part 1

## Galaxy S21 Ultra 5G Snapdragon (mmw) Teardown

UBSe						
Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total	Remark
Cellular	RF Transceivers	Qualcomm	5.0	72.7	14.5%	
	2G: GSM TX/RX	Qualcomm	0.0			IN WCDMA TX/RX
	3G: CDMA TX/RX	Qualcomm	0.0			
	3G: WCDMA TX/RX	Qualcomm	5.0			ALSO GSM, CDMA, LTE, SUB-6, GPS
	4G: LTE TX/RX	Qualcomm	0.0			IN WCDMA TX/RX
	5G: SUB-6GHz TX/RX	Qualcomm	0.0			
	5G: MILLIMETER WAVE TX/RX	Qualcomm	0.0			IN MILLIMETER WAVE TX/RX
	Power amplifiers		48.0			
	2G: GSM PAM	Skyworks	1.0			
	3G: CDMA PAM	Broadcom	0.0			
	3G: WCDMA PAM	Broadcom	8.0			ALSO SUB-6, LTE, CDMA
	4G: LTE PAM	Broadcom	0.0			IN WCDMA PAM
	4G: LTE PAM	Qualcomm	3.0			ALSO SUB-6
	4G: LTE PAM	Qorvo	3.0			ALSO SUB-6
	5G: SUB-6GHz PAM	Broadcom	0.0			IN WCDMA PAM
	5G: SUB-6GHz PAM	Qualcomm	0.0			IN LTE PAM
	5G: SUB-6GHz PAM	Qorvo	0.0			IN LTE PAM
	5G: SUB-6GHz PAM	Qorvo	3.0			
	5G: MILLIMETER WAVE PAM	Qualcomm	30.0			AS AIP (TX/RX/FQ CVT + PMIC + ANT)
	5G: IF CONVERTER	Qualcomm	5.0			
Connectivity	Diversity receiver	Qualcomm	7.0			
	Antenna switch		2.0			
	Filter	Murata, WISOL	0.5			
	Duplexer	TDK	0.2			
	Envelope tracker	Qualcomm	1.1			
	UWB transceiver	NXP	4.0			
	WLAN/Bluetooth	Samsung	5.5	8.8	1.8%	ALSO BT
AP / BB Other semis	NFC	NXP	1.3			
	Wireless charger	IDT	2.0			
	Application processor /baseband	Qualcomm	50.0	50.0	10.0%	Analog and digital BB, 5G BB, image processor, USB and display controller
	Audio power amplifier	Cirrus Logic	1.4	8.5	1.7%	
	Power management	Qualcomm, Maxim, Samsung	3.4			ALSO AUDIO PROCESSOR
	Quick charger	NXP	0.5			
	Display power supply	Silicon Mitus	0.3			
	Touch panel controller	Samsung	2.3			
	S-Pen controller	Wacom	0.5			
	Voltage regulator	On Semi	0.3			

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21 Ultra 5G Snapdragon (mmW) Teardown – Part 2

## Galaxy S21 Ultra 5G Snapdragon (mmw) Teardown

Category	Function	Manufacturer	UBSe			Remark
			Price (US\$)	Subtotal	% of total	
Camera	<b>Main camera module</b>					
	108MP Wide camera		97.0	110.5	22.1%	
	Image sensor	Samsung LSI	36.0			
	Lens	SEMCO	22.0			108MP CMOS
	OIS	SEMCO	4.0			
	Module assembly	SEMCO	2.0			
	Other	SEMCO	7.2			
	Other		0.8			
	10MP Folded Telephoto camera		43.0			
	Image sensor	Samsung LSI	9.0			10MP CMOS
	Lens	SEMCO	4.0			
	OIS	SEMCO	5.0			
	Module assembly	SEMCO	8.6			
	Other		16.4			
	10MP 2nd Telephoto camera		9.0			
	Image sensor	Samsung LSI	3.7			10MP CMOS
	Lens		1.0			
	Actuator		0.5			
	Module assembly		1.4			
	Other		2.5			
	12MP Ultrawide camera		9.0			
	Image sensor	Samsung LSI	4.5			12MP CMOS
	Lens		2.0			
	Module assembly	MCNex, Partron	1.4			
	Other		1.2			
	<b>Front camera module</b>		13.5			
	Image sensor	Samsung LSI, Sony	7.0			40MP CMOS
	Lens		1.5			
	Module assembly	MCNex, Namuga	2.0			
	Other		3.0			
Audio	Microphone	Goertek	0.6	2.1	0.4%	
	Speaker		1.5			
Sensors	Accelerometer/gyroscope	STM	1.3	3.8	0.8%	ALSO GYROSCOPE
	Digital compass	Asahi Kasei	0.5			
	Barometer	STM	0.8			
	Light/proximity sensor		0.5			ALSO PROXIMITY SENSOR
	Laser sensor	STM	0.7			

Source: Fomalhaut Techno Solution, UBS estimates

# Galaxy S21 Ultra 5G Snapdragon (mmW) Teardown – Part 3

## Galaxy S21 Ultra 5G Snapdragon (mmw) Teardown

UBSe					
Category	Function	Manufacturer	Price (US\$)	Subtotal	% of total
<b>Memory</b>	DRAM	Samsung	41.8	54.2	10.9% LPDDR5, 12GBYTE
	NAND	Samsung	12.4		128GBYTE
<b>Display</b>	Display panel	Samsung Display	89.2	110.0	22.0% 6.8" QHD+ OLED
	Cover glass	Corning	9.0		
	Touch panel		4.3		
	Ultrasonic fingerprint	Qualcomm	7.5		
<b>Casing</b>	Center panel		25.0	38.9	7.8%
	Keypad buttons		0.4		
	Inner cover		1.0		
	Rear cover glass		9.0		
	Waterproof		3.5		IP768
<b>PCB</b>	PCB	IEB	3.8	12.3	2.5%
	FPC	MDK, SEMCO	8.5		
<b>Antenna</b>	Cellular/WLAN /bluetooth		1.0	3.0	0.6% 2G,3G,4G,5G,GPS
	NFC /Wireless charger		2.0		ALSO WIRELESS CHARGER
<b>Small components</b>	Chip capacitor		3.3	4.4	0.9% 6332 (5025 (3216 (2012 (3)1608 (29)1005 (179)0603 (503)0402 (106)OTHER ()
	Chip resistor		0.1		6332 (5025 (3216 (2012 (1608 (1005 (11)0603 (154)0402 (14)OTHER ()
	Chip inductor		0.2		6332 (5025 (3216 (10)2012 (17)1608 (4)1005 (18)0603 (2)0402 (1)OTHER ()
	Chip diode		0.1		6332 (5025 (3216 (2012 (5)1608 (1005 (5)0603 (11)0402 (1)OTHER ()
	Chip filter		0.4		6332 (5025 (3216 (2012 (1608 (1005 (26)0603 (96)0402 (1)OTHER ()
	Power inductor		0.4		
<b>Other</b>	Li-on polymer battery	Ningde Amperex	9.0	20.5	4.1% 5000MAH
	Connectors	Hirose, IPX, JNTC	3.7		
	Timing device	Kyocera, Epson	0.4		
	SIM	Hirose	0.2		
	Vibrator		0.2		
	ID sticker		0.0		
	EMI shield tapes		0.2		
	EMI shield metal cap		1.0		
	Screw		0.3		
Unidentified large IC					
<b>Total BOM cost</b>			<b>499.6</b>	<b>85.5%</b>	

Source: Fomalhaut Techno Solution, UBS estimates

## Section 7

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### Auto-Industrial

# Key Messages

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- We see the Auto/Industrial complex rebounding in Q4:21
  - Despite the production hiccup in Q3, UBS Autos team sees global auto production to rebound in Q4 (+21% Q/Q) and maintain this momentum in 2022E (+15% Y/Y) as chip supply improves
  - October data is suggesting strong improvement in 2-Y growth for industrial end markets globally
- We expect a double digit revenue growth in C2022 for the Auto/Industrial Analog Semis as supply constraints gradually ease amid a robust demand backdrop
  - Expectations for auto semis for '22 and '23 look reasonable, and if anything, even conservative
- **UBS Evidence Lab: Big Data Nowcasting**
  - Most industrial end-markets are improving from Q3 to Q4 on a 2Y basis, with higher improvements in US autos, and machinery
  - The Nowcasting team expects the improvements seen in October to sustain through the rest of the quarter
  - Asia end markets showing better 2Y growth, especially in autos, general industrials, mining, machinery, and chemicals

# UBS estimates auto production run-rate declined ~20% from CQ1 to CQ3:21, but expects a big snap-back in CQ4 as shortages have eased

## Global Auto Production Estimates

(Production, m units)	2016	2017	2018	2019	2020	Q121	Q221	Q321	Q421	2021E	2022E	2023E	2024E	2025E
Western Europe	14.7	14.9	14.3	13.4	10.1	2.9	2.4	2.0	2.5	9.9	12.0	13.2	13.2	13.2
% growth	3.5%	1.4%	-4.3%	-6.4%	-24.7%	-0.2%	92.8%	-24.3%	-22.6%	-2.0%	22.0%	10.0%	0.0%	0.0%
Eastern Europe	6.8	7.4	7.7	7.7	6.5	1.8	1.7	1.4	1.5	6.5	7.8	7.9	8.1	8.1
% growth	1.3%	8.6%	3.8%	0.1%	-15.4%	2.3%	75.1%	-17.0%	-24.1%	0.0%	20.0%	1.5%	1.5%	0.0%
<b>Europe</b>	<b>21.5</b>	<b>22.3</b>	<b>22.0</b>	<b>21.1</b>	<b>16.6</b>	<b>4.7</b>	<b>4.2</b>	<b>3.4</b>	<b>4.0</b>	<b>16.4</b>	<b>19.9</b>	<b>21.2</b>	<b>21.3</b>	<b>21.3</b>
% growth	2.8%	3.7%	-1.6%	-4.1%	-21%	0.7%	85.1%	-21.4%	-23.2%	-1.2%	21.2%	6.7%	0.6%	0.0%
<b>North America</b>	<b>17.8</b>	<b>17.1</b>	<b>17.0</b>	<b>16.3</b>	<b>13.0</b>	<b>3.6</b>	<b>3.2</b>	<b>3.1</b>	<b>3.3</b>	<b>13.2</b>	<b>16.4</b>	<b>17.3</b>	<b>17.3</b>	<b>17.3</b>
% growth	2.0%	-3.9%	-1.0%	-4.0%	-20.0%	-4.5%	131.6%	-23.2%	-15.0%	1.0%	25.0%	5.0%	0.0%	0.0%
<b>South America</b>	<b>2.7</b>	<b>3.3</b>	<b>3.4</b>	<b>3.3</b>	<b>2.2</b>	<b>0.7</b>	<b>0.6</b>	<b>0.6</b>	<b>0.6</b>	<b>2.5</b>	<b>2.7</b>	<b>2.9</b>	<b>2.9</b>	<b>2.9</b>
% growth	-11.5%	20.3%	4.1%	-4.4%	-31.5%	3.4%	300.8%	-13.8%	-23.5%	10.0%	10.0%	5.0%	0.0%	0.0%
of which: Brazil	2.1	2.6	2.8	2.8	1.9	0.6	0.5	0.4	0.5	2.0	2.1	2.2	2.2	2.2
% growth	-11.1%	26.1%	5.2%	0.9%	-32.1%	0.8%	286.9%	-22.8%	-26.6%	4.0%	5.0%	5.0%	0.0%	0.0%
<b>Asia</b>	<b>48.7</b>	<b>50.0</b>	<b>49.2</b>	<b>46.1</b>	<b>41.0</b>	<b>11.1</b>	<b>10.3</b>	<b>9.4</b>	<b>12.0</b>	<b>42.8</b>	<b>47.1</b>	<b>49.2</b>	<b>50.3</b>	<b>51.2</b>
% growth	7.6%	2.6%	-1.4%	-6.4%	-11.1%	34.7%	20.3%	-15.1%	-8.7%	4.3%	10.0%	4.6%	2.3%	0.0%
of which: Japan	8.8	9.2	9.2	9.2	7.8	2.2	1.9	1.6	1.9	7.5	8.6	9.1	9.1	9.1
% growth	-5.7%	5.2%	0.3%	-0.3%	-15.8%	-4.9%	54.1%	-18.6%	-17.6%	-3.0%	15.0%	5.0%	0.5%	0.0%
of which: China	27.1	27.6	26.6	24.3	23.3	5.8	5.7	5.3	7.3	24.1	26.0	26.8	27.3	27.8
% growth	14.3%	2.1%	-3.7%	-8.5%	-4.1%	80.4%	-5.0%	-17.1%	-6.3%	3.0%	8.0%	3.0%	2.0%	2.0%
of which: South Korea	4.2	4.2	4.0	3.9	3.5	0.9	0.9	0.8	0.9	3.4	3.8	3.9	3.9	3.9
% growth	-7.2%	0.1%	-4.7%	-1.9%	-11.1%	12.2%	10.9%	-17.4%	-6.5%	-1.0%	10.0%	3.0%	0.5%	0.0%
of which: India	4.2	4.4	4.7	4.2	3.3	1.3	0.9	1.0	1.2	4.4	4.8	5.3	5.6	5.9
% growth	9.7%	6.0%	6.7%	-11.0%	-22.6%	32.0%	469.5%	5.1%	0.2%	35.0%	10.0%	10.0%	5.0%	5.0%
of which: ASEAN	3.9	3.9	4.2	4.0	2.8	0.9	0.8	0.6	0.7	3.1	3.6	3.9	4.2	4.2
% growth	3.0%	0.3%	7.7%	-3.9%	-30.5%	0.5%	181.8%	-8.9%	-19.1%	10.0%	15.0%	10.0%	6.1%	0.0%
Other	0.7	0.6	0.5	0.4	0.4	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3
% growth	180.8%	-5.5%	-19.3%	-15.7%	-17.5%	-19.9%	4.9%	-35.7%	-21.4%	-20.0%	0.0%	0.0%	0.0%	0.0%
<b>ROW</b>	<b>2.3</b>	<b>2.6</b>	<b>2.6</b>	<b>2.0</b>	<b>1.8</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>2.0</b>	<b>2.3</b>	<b>2.5</b>	<b>2.7</b>	<b>3.0</b>
% growth	15.7%	12.2%	0.3%	-22.3%	-12.0%	7.2%	62.8%	6.3%	1.9%	15.0%	15.0%	8.2%	8.2%	8.2%
<b>Total</b>	<b>93.1</b>	<b>95.3</b>	<b>94.2</b>	<b>88.7</b>	<b>74.6</b>	<b>20.6</b>	<b>18.8</b>	<b>16.9</b>	<b>20.4</b>	<b>76.8</b>	<b>88.4</b>	<b>93.0</b>	<b>94.5</b>	<b>95.5</b>
% growth	4.9%	2.3%	-1.2%	-5.8%	-15.9%	15.6%	48.5%	-17.5%	-13.2%	2.9%	15.1%	5.2%	1.5%	0.0%

Source: UBS estimates



# ...and global auto sales should continue to rebound in '22E

## Global Auto Sales Estimates

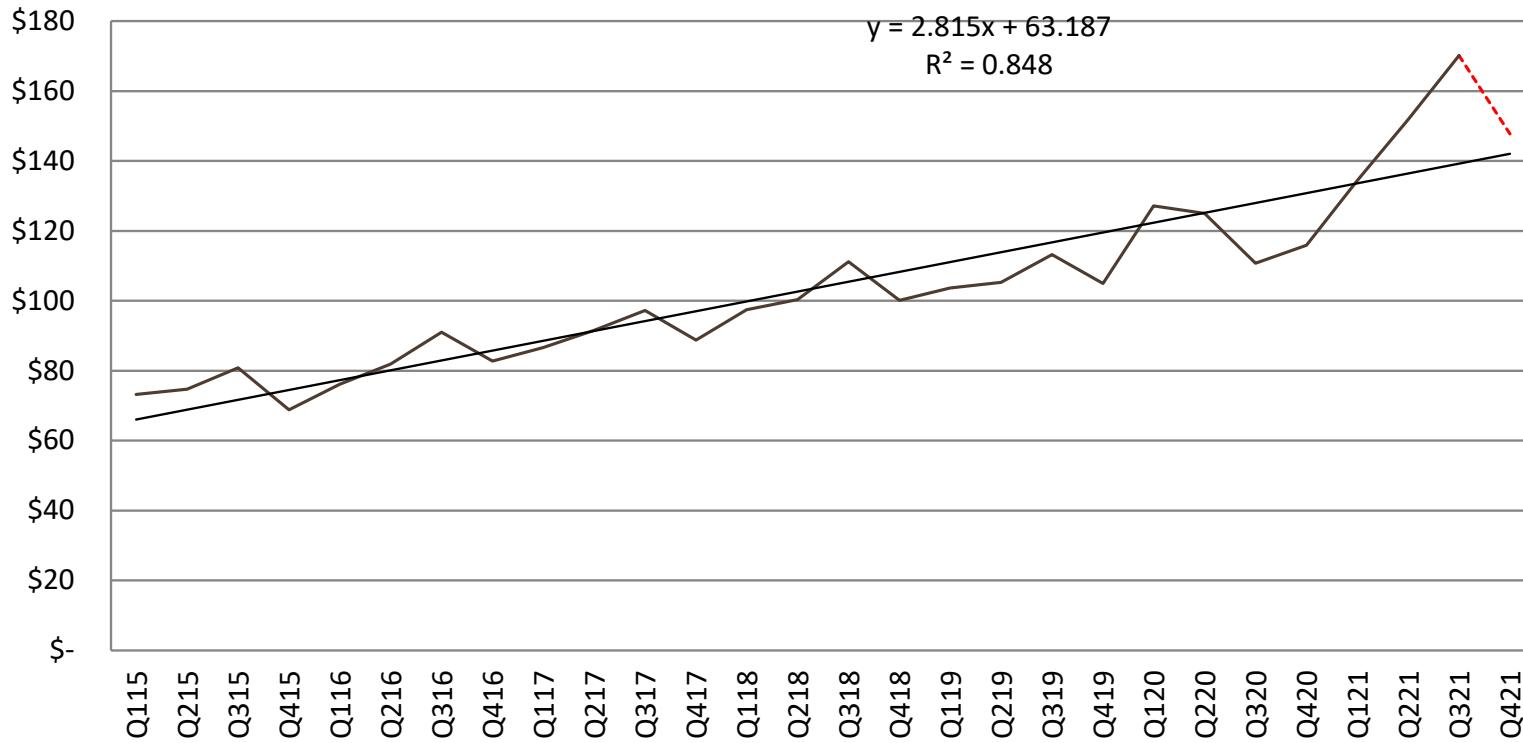
Sales, m units	2016	2017	2018	2019	2020	Q121	Q221	Q321	Q421	2021E	2022E	2023E	2024E	2025E
<b>Western Europe</b>	<b>15.9</b>	<b>16.3</b>	<b>16.2</b>	<b>16.4</b>	<b>12.5</b>	3.3	3.6	3.4	2.7	<b>12.9</b>	<b>14.6</b>	<b>15.1</b>	<b>15.1</b>	<b>15.1</b>
% growth	6.6%	2.4%	-0.2%	0.9%	-23.8%	4.3%	66.3%	-7.6%	-25.0%	3.2%	13.5%	3.5%	0.0%	0.0%
of which: Germany	3.6	3.7	3.7	3.9	3.2	0.7	0.8	0.9	0.6	3.0	3.5	3.6	3.6	3.6
% growth	4.8%	2.5%	0.6%	5.1%	-18.5%	-5.5%	43.8%	-3.8%	-34.3%	-5.0%	15.0%	3.0%	0.0%	0.0%
of which: France	2.4	2.5	2.6	2.7	2.1	0.6	0.6	0.5	0.5	2.2	2.4	2.5	2.5	2.5
% growth	5.6%	4.3%	4.1%	2.3%	-23.9%	23.9%	37.6%	-15.4%	-14.0%	5.0%	12.0%	5.0%	0.0%	0.0%
of which: Italy	2.0	2.2	2.1	2.1	1.5	0.5	0.5	0.3	0.5	1.8	2.0	2.0	2.0	2.0
% growth	19.8%	6.2%	-4.0%	0.8%	-27.3%	30.0%	78.1%	-28.7%	6.5%	15.0%	12.0%	0.0%	0.0%	0.0%
<b>Eastern Europe</b>	<b>4.0</b>	<b>4.3</b>	<b>4.3</b>	<b>4.3</b>	<b>4.0</b>	1.0	1.1	1.0	0.9	<b>4.0</b>	<b>4.2</b>	<b>4.2</b>	<b>4.3</b>	<b>4.3</b>
% growth	-0.8%	8.8%	0.4%	-1.5%	-6.7%	6.6%	67.2%	-12.0%	-29.1%	0.5%	8.0%	8.0%	8.0%	0.0%
<b>Europe</b>	<b>19.8</b>	<b>20.6</b>	<b>20.6</b>	<b>20.6</b>	<b>16.5</b>	4.3	4.7	4.3	3.5	<b>16.9</b>	<b>18.8</b>	<b>19.4</b>	<b>19.4</b>	<b>19.4</b>
% growth	5.0%	3.7%	-0.1%	0.4%	-20.3%	4.8%	66.5%	-8.6%	-26.0%	2.6%	11.4%	3.0%	0.3%	0.0%
<b>North America</b>	<b>21.1</b>	<b>20.8</b>	<b>20.7</b>	<b>20.3</b>	<b>17.1</b>	4.6	5.1	4.8	3.8	<b>18.3</b>	<b>20.5</b>	<b>20.9</b>	<b>20.9</b>	<b>20.9</b>
% growth	1.7%	-1.5%	-0.2%	-2.0%	-15.9%	10.0%	51.7%	3.7%	-23.4%	7.0%	12.0%	2.0%	0.0%	0.0%
of which: USA	17.6	17.2	17.3	17.1	14.6	3.9	4.4	4.1	3.2	15.6	17.5	17.8	17.8	17.8
% growth	0.4%	-2.1%	0.8%	-1.3%	-14.6%	11.9%	49.4%	3.6%	-23.7%	7.0%	12.0%	2.0%	0.0%	0.0%
<b>South America</b>	<b>3.9</b>	<b>4.4</b>	<b>4.7</b>	<b>4.5</b>	<b>3.3</b>	0.9	0.9	1.0	0.8	<b>3.6</b>	<b>4.0</b>	<b>4.1</b>	<b>4.3</b>	<b>4.3</b>
% growth	-10.9%	12.7%	6.5%	-3.6%	-28.0%	3.2%	117.4%	7.7%	-22.9%	10.0%	12.0%	3.0%	3.0%	0.0%
<b>Asia</b>	<b>41.3</b>	<b>42.6</b>	<b>42.1</b>	<b>39.0</b>	<b>35.8</b>	9.6	8.9	9.4	10.3	<b>38.2</b>	<b>40.8</b>	<b>42.3</b>	<b>43.5</b>	<b>44.0</b>
% growth	8.7%	3.0%	-1.0%	-7.3%	-8.2%	42.6%	11.2%	-2.9%	-9.8%	6.6%	6.9%	6.9%	6.9%	0.0%
of which: Japan	4.8	5.1	5.2	5.1	4.5	1.4	1.0	1.2	1.1	4.7	4.9	4.8	4.8	4.8
% growth	-2.0%	5.9%	0.5%	-1.3%	-11.5%	4.4%	25.2%	4.6%	-7.9%	5.0%	3.0%	-1.0%	-1.0%	0.0%
of which: China	27.6	28.0	27.0	24.7	23.6	5.9	6.0	6.1	6.9	24.8	26.6	27.4	27.9	28.5
% growth	12.8%	1.6%	-3.5%	-8.6%	-4.3%	73.0%	-2.0%	-4.9%	-11.1%	5.0%	7.0%	3.0%	2.0%	2.0%
of which: India	3.4	3.7	4.0	3.5	2.8	1.1	0.8	0.9	1.0	3.7	4.1	4.5	5.0	5.0
% growth	8.2%	9.1%	7.3%	-11.6%	-21.6%	38.4%	312.2%	15.2%	-2.2%	35.0%	10.0%	10.0%	10.0%	0.0%
of which: South Korea	1.8	1.8	1.8	1.7	1.9	0.4	0.5	0.4	0.5	1.7	1.8	1.8	1.8	1.8
% growth	-1.0%	-1.6%	1.4%	-3.3%	8.3%	10.5%	-13.9%	-16.8%	-7.8%	-8.0%	5.0%	2.0%	0.5%	0.0%
<b>ROW</b>	<b>6.1</b>	<b>6.2</b>	<b>5.6</b>	<b>4.9</b>	<b>4.2</b>	1.3	1.2	1.1	0.9	<b>4.6</b>	<b>4.7</b>	<b>4.9</b>	<b>5.0</b>	<b>5.2</b>
% growth	-2.3%	1.9%	-10.0%	-11.4%	-15.6%	17.8%	67.2%	17.8%	-17.9%	10.0%	3.0%	3.0%	3.0%	3.0%
<b>Total</b>	<b>92.2</b>	<b>94.5</b>	<b>93.7</b>	<b>89.5</b>	<b>76.8</b>	<b>20.6</b>	<b>20.9</b>	<b>20.7</b>	<b>19.3</b>	<b>81.5</b>	<b>88.8</b>	<b>91.5</b>	<b>93.0</b>	<b>93.8</b>
% growth	4.5%	2.5%	-0.9%	-4.5%	-14.1%	21.8%	35.7%	-1.3%	-17.0%	6.1%	9.0%	3.1%	1.6%	0.0%

Source: UBS estimates



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

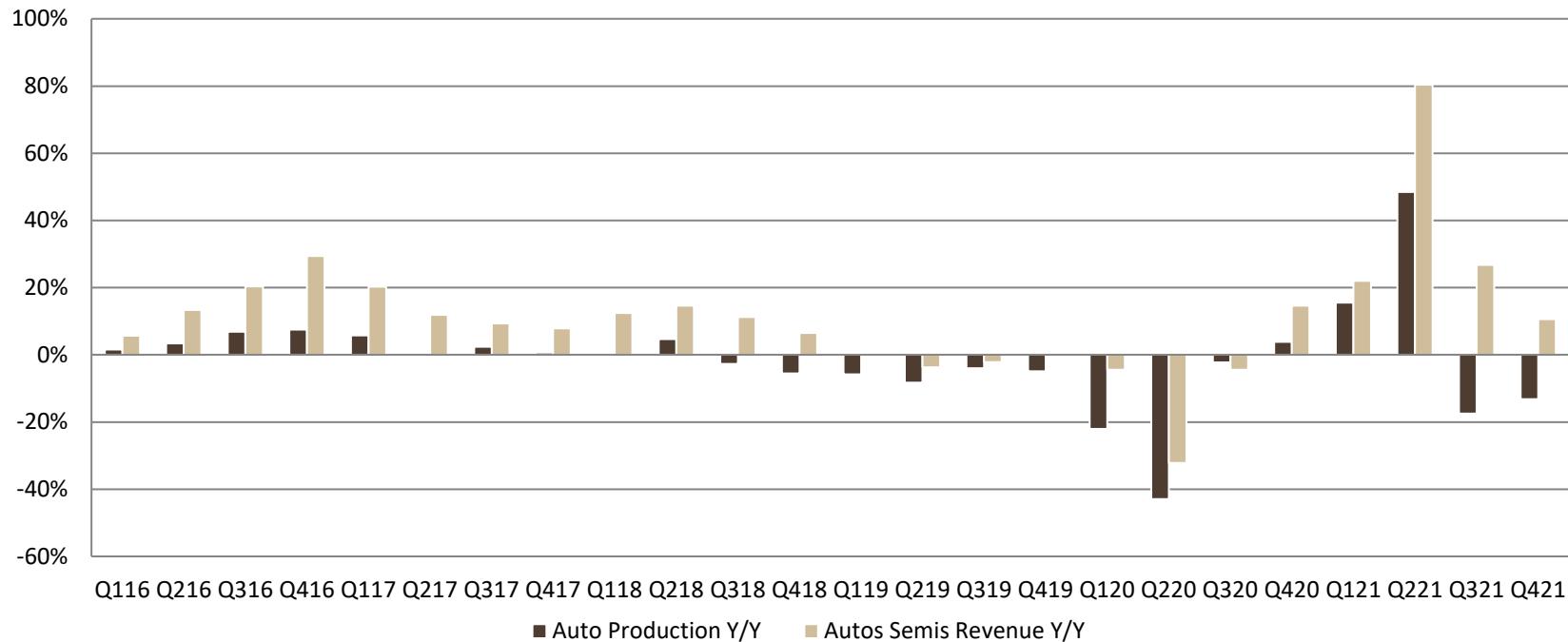
Auto Semis Revenue/Auto Production unit



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, if not conservative, for '22 and likely even '23

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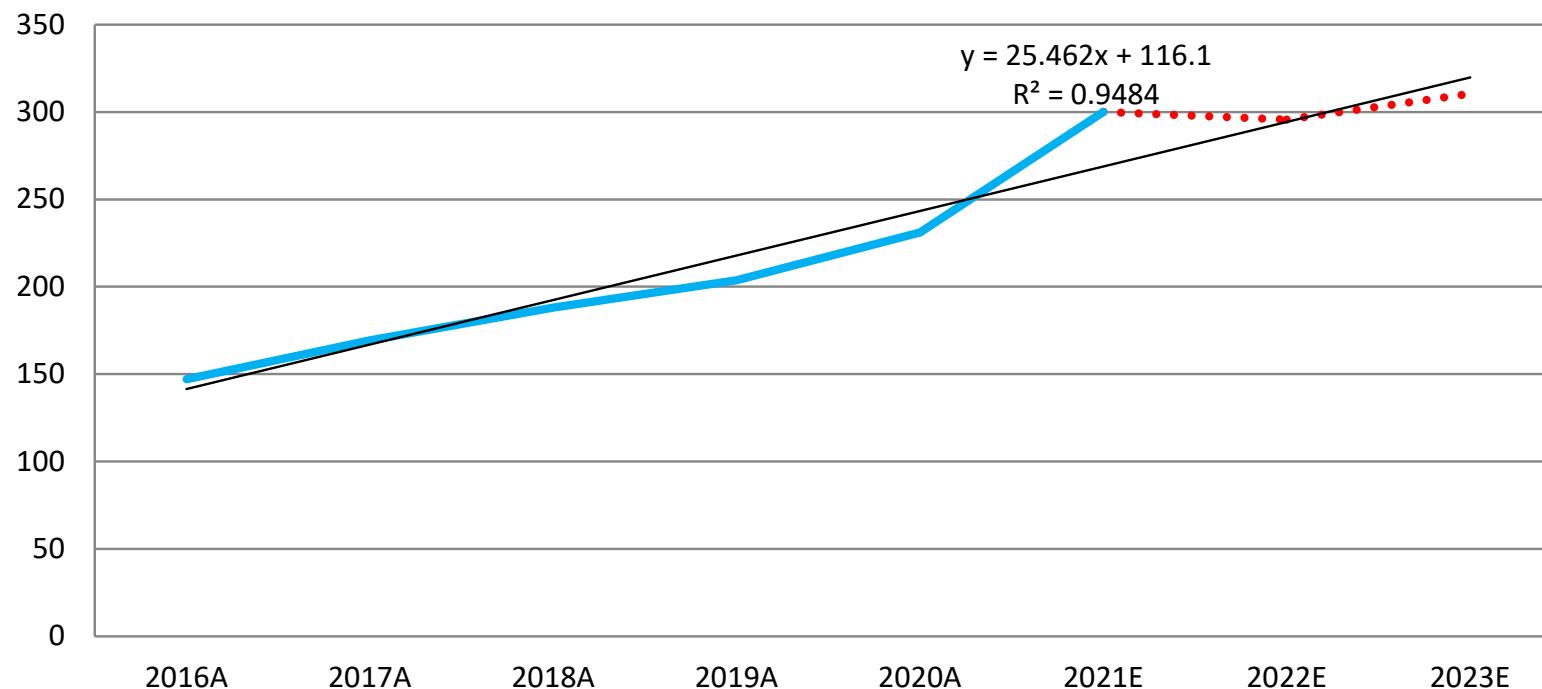
Auto Consensus Forecasts	2016A	2017A	2018A	2019A	2020A	2021E	2022E	2023E
ON	1337	1666	1834	1809	1677	2234	2490	2833
NXPI	3379	3762	3953	4212	3825	5476	6390	7084
IFX(sept)	2796	3512	3695	3858	4187	5576	6410	7145
ST	2813	3059	3556	3606	3284	4253	4933	5503
MXIM	414.4	482.2	532.2	555.8	627.7			
ADI (Oct)	541	783	989	993	779	1924	2172	2348
TI	2,407	2,843	3,157	3,041	2,852	3,587	3,742	3,969
Auto Sems Revenue (\$MM) - Street	13,687	16,107	17,716	18,075	17,232	23,050	26,137	28,882
	YY		18%	10%	2%	-5%	34%	13%
								11%

Source: Factset, Visible Alpha, UBSe

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

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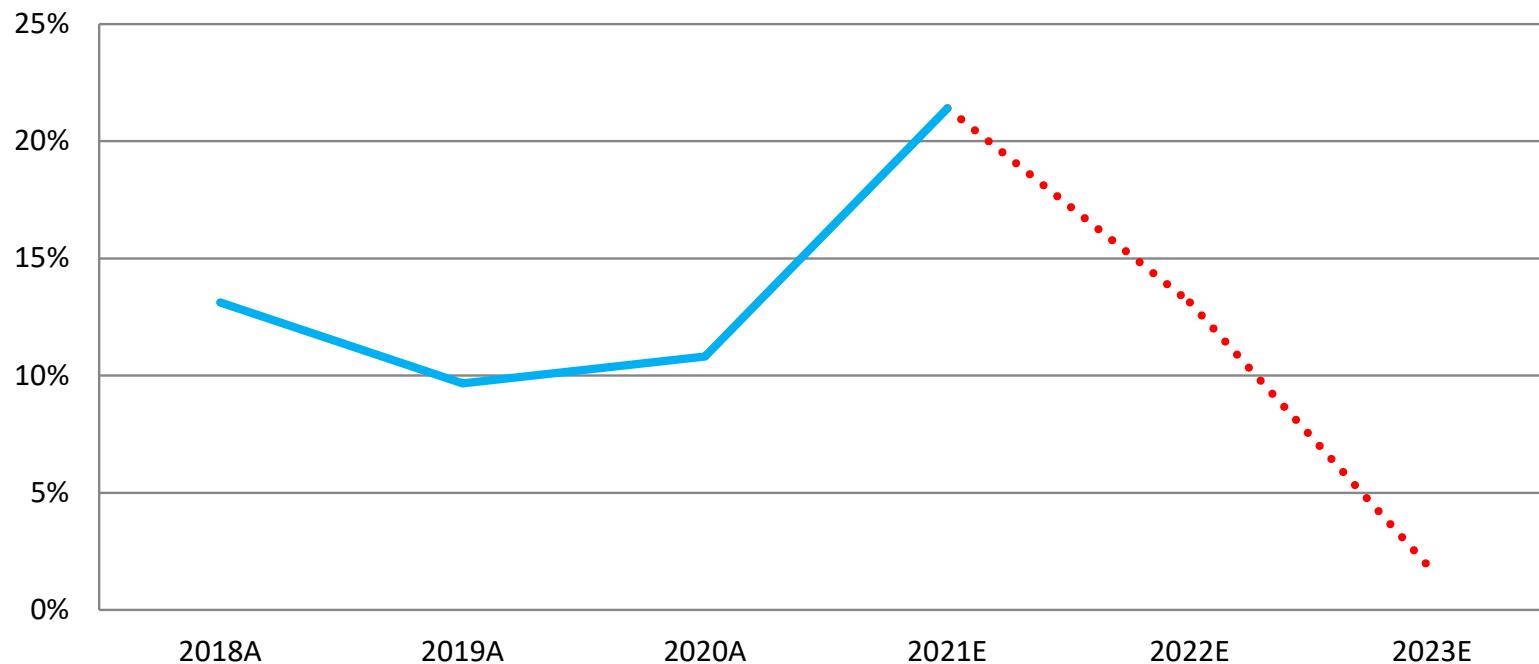
Auto Semis Revs \$/Auto Unit Production



Source: Company Reports, Factset, UBS estimates

# 2 Year CAGR suggests a relatively low growth rate in C2023E

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



Source: Company reports, Factset, UBS estimates

# North America: Most industrial end markets are better on 2Y basis

## North America End Markets

North America	Quarterly Trend	Organic Growth (Y/Y)				2-Yr. Organic Growth*			
		CQ1 2021	CQ2 2021	CQ3 2021	CQ4 2021	CQ1 2021	CQ2 2021	CQ3 2021	CQ4 2021
Construction		-4%	6%	1 %	-1 %	0%	-2%	-2%	-1 %
Autos		-3%	46%	-2%	0%	-4%	-7%	-9%	-1 %
General Industrials		-4%	17%	6%	3%	-5%	-2%	0%	1 %
Mining, Oil, and Gas		-16%	15%	19%	18%	-19%	-12%	-7%	-2%
Machinery		-1 %	25%	16%	13%	-8%	-2%	1 %	4%
Chemicals		0%	21%	23%	16%	-1 %	7%	13%	9%
Commercial Vehicles		-2%	82%	-10%	-22%	-17%	-31%	-37%	-35%
Electrical Equipment		5%	16%	12%	10%	5%	5%	6%	4%
Foods		2%	12%	9%	7%	4%	4%	7%	6%
Healthcare		4%	12%	6%	4%	4%	7%	6%	5%
HVAC		7%	32%	10%	5%	7%	9%	10%	8%
Autos Aftermarket		0%	24%	16%	17%	2%	4%	6%	14%
Metals		-6%	30%	17%	11%	-9%	2%	3%	7%
Aerospace		-17%	-5%	4%	-2%	-23%	-22%	-21%	-22%
Electronics		11 %	17%	15%	13%	8%	9%	7%	7%
Consumption		-1 %	24%	12%	10%	-1 %	1 %	4%	4%
Power Generation		2%	4%	-2%	-3%	1 %	0%	1 %	-8%
Other		15%	13%	0%	3%	3%	-6%	-9%	5%
<b>Overall</b>		<b>-2%</b>	<b>21%</b>	<b>8%</b>	<b>5%</b>	<b>-4%</b>	<b>-3%</b>	<b>-3%</b>	<b>0%</b>

Source: UBS Evidence Lab

# Europe End Markets: Most are improving on 2Y basis

## Europe End Markets

Europe	Quarterly Trend	Organic Growth (Y/Y)				2-Yr. Organic Growth*			
		CQ1 2021	CQ2 2021	CQ3 2021	CQ4 2021	CQ1 2021	CQ2 2021	CQ3 2021	CQ4 2021
Construction		-3%	28%	1%	2%	1%	3%	2%	5%
Autos		-9%	135%	-11%	-15%	-14%	-14%	-25%	-13%
General Industrials		-2%	37%	12%	9%	-4%	1%	3%	7%
Mining, Oil, and Gas		-2%	9%	-10%	-12%	-7%	-12%	-19%	-14%
Machinery		0%	11%	-2%	-2%	-2%	-5%	-2%	1%
Chemicals		1%	19%	9%	4%	0%	1%	3%	9%
Commercial Vehicles		-1%	53%	-12%	-31%	-16%	-30%	-20%	-34%
Electrical Equipment		1%	29%	15%	11%	2%	2%	8%	12%
Foods		-5%	10%	2%	3%	-1%	-1%	0%	4%
Healthcare		5%	16%	1%	0%	7%	9%	9%	8%
HVAC		-3%	30%	8%	4%	-6%	5%	-1%	5%
Autos Aftermarket		-4%	62%	5%	5%	-8%	-2%	-7%	0%
Metals		-3%	43%	24%	15%	-9%	-5%	2%	13%
Aerospace		-28%	-7%	10%	7%	-25%	-23%	-23%	-17%
Electronics		6%	24%	15%	12%	10%	8%	12%	11%
Consumption		-6%	9%	7%	9%	-5%	-8%	0%	8%
Power Generation		-1%	13%	2%	2%	-3%	-2%	-3%	5%
Other		-4%	20%	5%	5%	-2%	-10%	-4%	1%
<b>Overall</b>		<b>-3%</b>	<b>34%</b>	<b>1%</b>	<b>-3%</b>	<b>-5%</b>	<b>-5%</b>	<b>-6%</b>	<b>-2%</b>

Source: UBS Evidence Lab

# Asia End Markets: Showing better 2Y growth

## Asia End Markets

Asia	Quarterly Trend	CQ1 2021	CQ2 2021	CQ3 2021	CQ4 2021	CQ1 2021	CQ2 2021	CQ3 2021	CQ4 2021
Construction		4%	19%	4%	-4%	4%	5%	-3%	-12%
Autos		21 %	20%	2%	-2%	1 %	0%	-3%	4%
General Industrials		7%	16%	6%	6%	6%	9%	5%	11 %
Mining, Oil, and Gas		1 %	28%	39%	32%	7%	12%	20%	28%
Machinery		34%	20%	6%	1%	21 %	21%	10%	14%
Chemicals		7%	23%	20%	17%	-2%	6%	6%	19%
Commercial Vehicles		53%	-5%	-8%	-21%	24%	20%	10%	-13%
Electrical Equipment		11 %	27%	9%	0%	3%	8%	5%	8%
Foods		10%	14%	10%	8%	4%	13%	6%	16%
Healthcare		19%	17%	22%	16%	32%	24%	20%	19%
HVAC		42%	33%	4%	6%	14%	30%	10%	5%
Autos Aftermarket		50%	23%	0%	-8%	28%	17%	6%	1%
Metals		11 %	32%	19%	19%	10%	23%	24%	30%
Aerospace		-21 %	21%	43%	25%	-37%	-30%	-25%	-19%
Electronics		19%	29%	20%	20%	25%	30%	30%	24%
Consumption		5%	15%	7%	7%	4%	8%	2%	10%
Power Generation		17%	25%	13%	9%	25%	35%	25%	25%
Other		0%	9%	7%	4%	-15%	-7%	-7%	-8%
<b>Overall</b>		<b>17%</b>	<b>21%</b>	<b>11%</b>	<b>7%</b>	<b>9%</b>	<b>13%</b>	<b>8%</b>	<b>10%</b>

Source: UBS Evidence Lab

## Section 8

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# Semiconductor Capital Equipment

# Key Messages

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- We see WFE growing ~14% again in '22E to ~\$96.5B (vs. \$84.5B in '21) before moderating slightly – but not significantly – in '23E
- WFE “run-rate” should continue to grow from ~\$90B in 2H:21E to ~\$100B by 2H:22E before capacity starts to get absorbed and the run-rate starts to decline
  - This should become more of a headwind for stocks as we move through '22 so we remain generally Neutral on SPE
- All of the growth in '22E WFE will be foundry/logic
  - However, NAND WFE should inflect higher moving through '22E (good for LRCX) with the opposite trend in DRAM (relative headwind for AMAT)
  - NAND industry capex will remain above EBITDA in '22E and '23E, but the industry does not appear likely to cut capex
- We expect WFE intensity to be up again from 15.4% this year to 15.7% in '22E with moderation likely in '23 as supply starts to catch up with demand, backlogs normalize, inventory builds to structurally higher levels, and the cycle starts to move the other way through '23E.
- ASML has gained ~600bps of WFE share since 2016, but this should start to level off moving forward
- LRCX is our top pick in US SPE given the trajectory of NAND spending, the “stickiest” business among all suppliers, and the fastest growing service business

# We see ~\$84.5B WFE in '21E (up ~41%), ~\$96.5B in '22E (up ~14%) and '23E looks flat to down slightly given subsidies

## Semis Capex Forecast / Capital Intensity

### Semis Capex

SMM	2016	2017	2018	2019	2020	2021E	2022E	2023E
Memory Total	28,639	43,205	55,225	41,189	47,010	57,634	51,758	52,887
DRAM	9,398	16,364	25,053	17,816	23,790	26,657	26,612	26,541
NAND/non-volatile	19,241	26,840	30,172	23,373	23,221	30,977	25,146	26,346
other								
Large non Memory IDMs	10,761	12,885	14,692	18,960	16,384	22,850	33,972	35,291
Tier-one/two foundries	20,475	23,627	20,137	25,340	35,125	50,976	64,286	65,859
Other & SATS	10,517	12,365	16,746	17,044	19,049	27,012	31,745	31,616
<b>Total</b>	<b>70,392</b>	<b>92,082</b>	<b>106,800</b>	<b>102,533</b>	<b>117,569</b>	<b>158,472</b>	<b>181,761</b>	<b>185,654</b>

### Capex YoY %

Memory Total	11.3%	50.9%	27.8%	-25.4%	14.1%	22.6%	-10.2%	2.2%
DRAM	-24.3%	74.1%	53.1%	-28.9%	33.5%	12.1%	-0.2%	-0.3%
NAND/non-volatile	44.6%	39.5%	12.4%	-22.5%	-0.7%	33.4%	-18.8%	4.8%
other								
Large non Memory IDMs	-7.0%	19.7%	14.0%	29.1%	-13.6%	39.5%	48.7%	3.9%
Tier-one/two foundries	7.3%	15.4%	-14.8%	25.8%	38.6%	45.1%	26.1%	2.4%
<b>Total</b>	<b>8.8%</b>	<b>30.8%</b>	<b>16.0%</b>	<b>-4.0%</b>	<b>14.7%</b>	<b>34.8%</b>	<b>14.7%</b>	<b>2.1%</b>

### Segment % of total

Memory Total	40.7%	46.9%	51.7%	40.2%	40.0%	36.4%	28.5%	28.5%
DRAM	13.4%	17.8%	23.5%	17.4%	20.2%	16.8%	14.6%	14.3%
NAND/non-volatile	27.3%	29.1%	28.3%	22.8%	19.8%	19.5%	13.8%	14.2%
other								
Logic	15.3%	14.0%	13.8%	18.5%	13.9%	14.4%	18.7%	19.0%
Foundries ex DRAM	29.1%	25.7%	18.9%	24.7%	29.9%	32.2%	35.4%	35.5%

### Semis revenue, \$MM

Memory Total	76,769	123,974	157,967	106,432	117,482	154,130	171,289	176,867
DRAM	41,179	72,802	99,308	62,475	64,324	90,390	106,257	121,067
NAND/non-volatile	32,023	47,227	54,227	40,180	49,390	59,138	60,302	51,205
other	3,573	3,944	4,273	3,777	3,769	4,602	4,730	4,595
Non-memory	262,057	288,111	310,812	305,670	322,907	395,585	442,254	467,973
<b>Total</b>	<b>338,826</b>	<b>412,085</b>	<b>468,778</b>	<b>412,101</b>	<b>440,389</b>	<b>549,715</b>	<b>613,543</b>	<b>644,841</b>
% YoY	1.1%	21.6%	13.8%	-12.1%	6.9%	24.8%	11.6%	5.1%

### IC revenue, \$MM

Memory Total	76,769	123,974	157,967	106,432	117,482	154,130	171,289	176,867
DRAM	41,179	72,802	99,308	62,475	64,324	90,390	106,257	121,067
NAND/non-volatile	32,023	47,227	54,227	40,180	49,390	59,138	60,302	51,205
other	3,573	3,944	4,273	3,777	3,769	4,602	4,730	4,595
Non-memory	199,926	219,036	235,321	226,725	243,743	302,964	343,149	364,904
<b>Total</b>	<b>276,695</b>	<b>343,010</b>	<b>393,288</b>	<b>333,157</b>	<b>361,226</b>	<b>457,094</b>	<b>514,438</b>	<b>541,772</b>
% YoY	0.8%	24.0%	14.7%	-15.3%	8.4%	26.5%	12.5%	5.3%

### Capex Intensity %

Memory Total	37.3%	34.8%	35.0%	38.7%	40.0%	37.4%	30.2%	29.9%
DRAM	22.8%	22.5%	25.2%	28.5%	37.0%	29.5%	25.0%	21.9%
NAND	60.1%	56.8%	55.6%	58.2%	47.0%	52.4%	41.7%	51.5%
Non-memory	15.9%	17.0%	16.6%	20.1%	21.9%	25.5%	29.4%	28.4%
<b>Total</b>	<b>20.8%</b>	<b>22.3%</b>	<b>22.8%</b>	<b>24.9%</b>	<b>26.7%</b>	<b>28.8%</b>	<b>29.6%</b>	<b>28.8%</b>
<b>Total (excluding discretes)</b>	<b>25.4%</b>	<b>26.8%</b>	<b>27.2%</b>	<b>30.8%</b>	<b>32.5%</b>	<b>34.7%</b>	<b>35.3%</b>	<b>34.3%</b>

Source: Company reports, UBS estimates

## WFE Forecast / Capital Intensity

### WFE

SMM	2016	2017	2018	2019	2020	2021E	2022E	2023E
Memory Total	16,977	26,400	34,350	22,850	29,050	40,050	37,000	36,600
DRAM	6,100	9,100	15,550	10,250	13,200	18,600	18,300	17,500
NAND	10,877	17,300	18,800	12,600	15,850	21,450	18,700	19,100
Non-memory Total	18,323	20,750	19,500	28,050	30,950	44,450	59,500	58,900
Logic	5,800	5,500	6,750	9,900	8,200	12,400	17,500	18,700
Foundry	12,523	15,250	12,750	18,150	22,750	32,050	42,000	40,200
<b>Total</b>	<b>35,300</b>	<b>47,150</b>	<b>53,850</b>	<b>50,900</b>	<b>60,000</b>	<b>84,500</b>	<b>96,500</b>	<b>95,500</b>

### YoY %

Memory Total	6.0%	55.5%	30.1%	-33.5%	27.1%	37.9%	-7.6%	-1.1%
DRAM	-30.5%	49.2%	70.9%	-34.1%	28.8%	40.9%	-1.6%	-4.4%
NAND	50.3%	59.0%	8.7%	-33.0%	25.8%	35.3%	-12.8%	2.1%
Non-memory Total	6.3%	13.2%	-6.0%	43.8%	10.3%	43.6%	33.9%	-1.0%
Logic	2.8%	-5.2%	22.7%	46.7%	-17.2%	51.2%	41.1%	6.9%
Foundry	8.0%	21.8%	-16.4%	42.4%	25.3%	40.9%	31.0%	-4.3%
<b>Total</b>	<b>6.1%</b>	<b>33.6%</b>	<b>14.2%</b>	<b>-5.5%</b>	<b>17.9%</b>	<b>40.8%</b>	<b>14.2%</b>	<b>-1.0%</b>

### Segment % of total

Memory Total	48.1%	56.0%	63.8%	44.9%	48.4%	47.4%	38.3%	38.3%
DRAM	17.3%	19.3%	28.9%	20.1%	22.0%	22.0%	19.0%	18.3%
NAND	30.8%	36.7%	34.9%	24.8%	26.4%	25.4%	19.4%	20.0%
Non-memory Total	51.9%	44.0%	36.2%	55.1%	51.6%	52.6%	61.7%	61.7%
Logic	16.4%	11.7%	12.5%	19.4%	13.7%	14.7%	18.1%	19.6%
Foundry	35.5%	32.3%	23.7%	35.7%	37.9%	37.9%	43.5%	42.1%
<b>Total</b>	<b>100.0%</b>							

### WFE Intensity %

Memory Total	22.1%	21.3%	21.7%	21.5%	24.7%	26.0%	21.6%	20.7%
DRAM	14.8%	12.5%	15.7%	16.4%	20.5%	20.6%	17.2%	14.5%
NAND	34.0%	36.6%	34.7%	31.4%	32.1%	36.3%	31.0%	37.3%
Non-memory	7.0%	7.2%	6.3%	9.2%	9.6%	11.2%	13.5%	12.6%
<b>Total</b>	<b>10.4%</b>	<b>11.4%</b>	<b>11.5%</b>	<b>12.4%</b>	<b>13.6%</b>	<b>15.4%</b>	<b>15.7%</b>	<b>14.8%</b>
<b>Total (excluding discretes)</b>	<b>12.8%</b>	<b>13.7%</b>	<b>13.7%</b>	<b>15.3%</b>	<b>16.6%</b>	<b>18.5%</b>	<b>18.8%</b>	<b>17.6%</b>

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	2021E	% YoY	2022E	% YoY	2023E
<b>N.America</b>																					
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%	18,500	30,000	32,000		
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%	16,500	28,000	30,000		
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		
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%	10,892	11,400	13,750		
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%	5,991	6,840	8,250		
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%	4,901	4,560	5,500		
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%	1,467	1,422	1,219		
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%	1,450	2,500	2,750		
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%	1,612	1,750	1,750		
<b>Europe</b>																					
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%	2,154	82.1%	2,176	1.0%	1,642
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%	1,346	19.2%	1,596	18.6%	1,449
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%	721	58.8%	842	16.9%	770
<b>Korea</b>																					
Samsung	11,643		12,961		12,929		11,178		23,547	110.7%	21,546	-8.9%	19,046		28,244		35,080	33,712	31,688		
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%	23,411	24.3%	20,576	-12.1%	18,129
DRAM	3,560	4,705	3,822	3,258	5,840	79.2%	10,184	74.4%	5,713	-43.9%	9,558				11,036		10,219	8,642			
NAND	3,560	5,751	5,733	5,645	11,672	106.8%	8,001	-31.4%	7,034	-12.1%	9,280				12,375		10,357	9,487			
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%	11,669	24.1%	13,136	12.6%	13,559
SK Hynix	3,412	-1.9%	4,668	36.8%	6,186	32.5%	5,337	-13.7%	8,698	63.0%	11,240	-20.9%	8,224	-26.8%	11,091	34.9%	13,807	24.5%	13,037		
DRAM	2,167	3,268	4,949	3,522	4,349	23.5%	6,842	57.3%	7,093	3.7%	5,609				7,209		7,805	7,405			
NAND	1,245	1,400	1,237	1,814	4,349	139.7%	7,364	69.3%	4,147	-43.7%	2,615				3,882		6,002	5,632			
<b>Japan</b>																					
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%	2,727	-28.6%	2,727
NAND	1,076		1,202		929		2,667		4,940	85.3%	3,942	-20.2%	3,150	-20.1%	3,818		3,818		2,727	2,727	
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%	2,850	57.2%	2,200	-22.8%	2,200
<b>Taiwan</b>																					
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%	30,000	75.2%	40,000	33.3%	42,000
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%	2,307	157.8%	2,900	25.7%	1,800
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%	421	68.6%	548	30.0%	494
<b>China</b>																					
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%	4,300	-24.6%	4,500	4.7%	4,500
Hua Hong															922		1,350	46.4%	1,440	6.7%	1,220
Shanghai Huali															600		1,500	150.0%	1,250	-16.7%	1,250
YMTC															3,000		3,250	4,000	1,500	3,250	
Memory															200	#DIV/0!	1,000	400.0%	2,000	100.0%	3,000
DRAM															1,000		2,000	3,000	3,250	4,000	1,500
NAND															1,000		2,000	3,000	4,000	1,500	3,000
Logic															—		—	NA	—	NA	—
Fujian Jinhua IC															1,000		2,000	100.0%	—	750	400
Chengdu Gaozhen															1,000		1,000	500	1,600	1,200	1,500
Changxin Memory (CXMT)															1,000		1,000	500	1,600	1,200	1,500
<b>Others</b>																					
Total	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%	158,472	34.8%	181,761	14.7%	185,654
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%	84,500	40.8%	96,500	14.2%	95,500

Source: Company reports, UBS estimates

# WFE Forecast Details

## WFE by Top Spenders

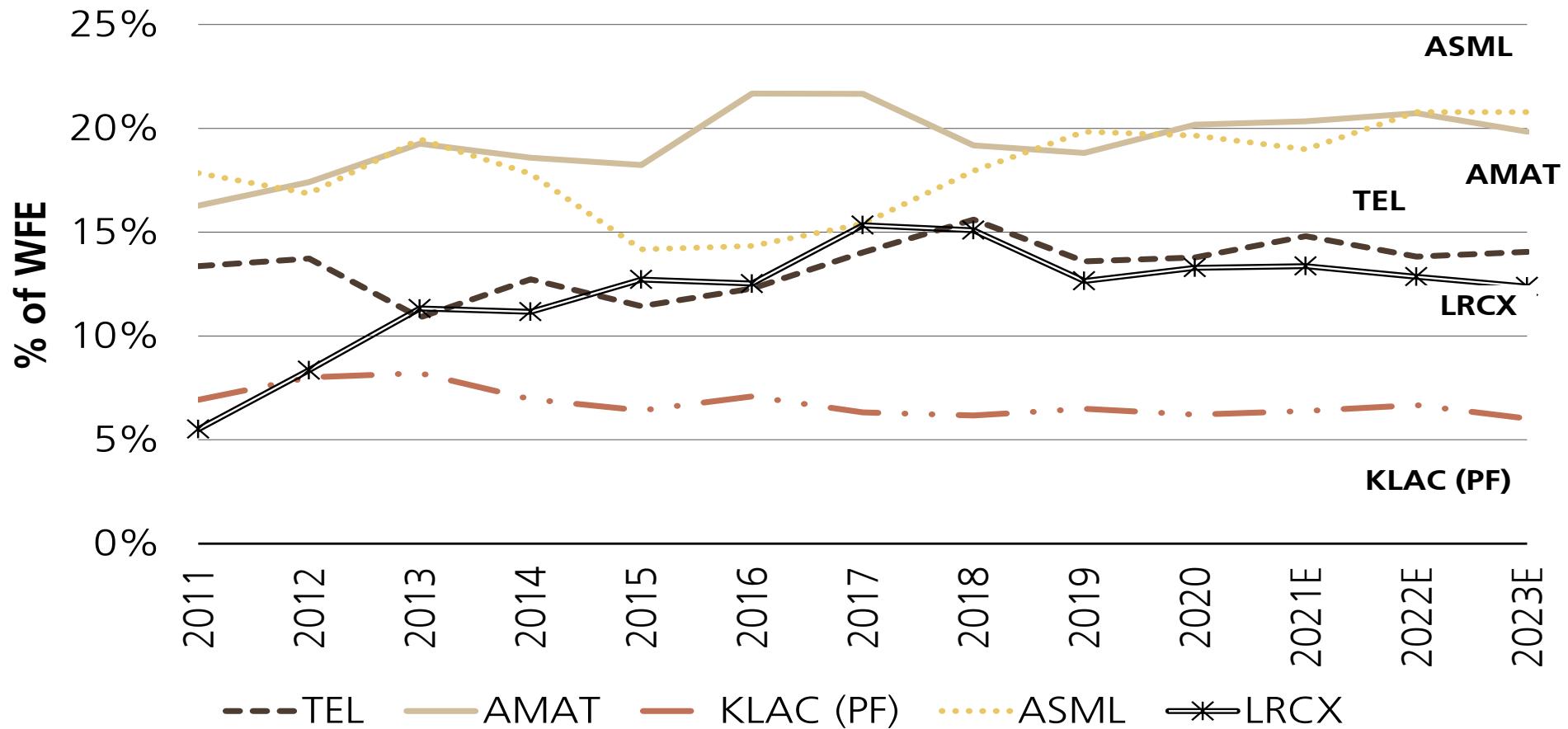
	2013	% YoY	2014	% YoY	2015	% YoY	2016	% YoY	2017	% YoY	2018	% YoY	2019	% YoY	2020	% YoY	2021E	% YoY	2022E	% YoY	2023E	% YoY	
Intel	6,130		5,150		5,000		5,975		6,014		8,350		8,828		7,742		10,588		16,000		17,000		
Logic/Foundry	6,130		5,150		5,000		5,000		4,639		5,875		7,941		6,742		9,488		15,000		16,000		
NAND							975		1,375		2,475		888		1,000		1,100		--		--		
NAND (pro-forma pending deal closure)																			1,000		1,000		
Micron	825		1,625		2,750		3,533		2,918		5,675		5,194		3,330		6,345		6,954		7,975		
DRAM	381		650		1,200		1,424		1,610		2,837		3,797		2,540		3,894		4,446		4,950		
NAND	444		975		1,550		2,110		1,309		2,837		1,397		790		2,451		2,508		3,025		
Texas Instruments																							
Logic																							
Global Foundries																							
Foundry	2,400		2,625		1,650		1,350		1,100		1,500		413		250		725		1,250		1,250		
Western Digital																							
Samsung	6,904		7,478		8,191		7,097		16,654		14,718		10,671		19,663		23,366		22,702		21,231		
Memory	3,738		5,725		5,828		5,505		12,430		12,366		6,262		13,079		15,781		14,164		12,146		
DRAM	1,869		2,705		2,675		2,118		4,330		7,256		1,822		6,679		7,221		7,009		5,790		
NAND	1,869		3,019		3,153		3,387		8,100		5,110		4,440		6,400		8,560		7,155		6,356		
Logic/Foundry	3,166		1,754		2,363		1,593		4,224		2,352		4,409		6,584		7,585		8,538		9,085		
SK Hynix	1,831		2,567		4,206		3,898		5,284		8,064		5,510		4,509		6,942		9,107		8,192		
DRAM	1,083		1,797		3,464		2,483		2,501		4,264		3,610		3,009		4,892		5,457		4,813		
NAND	747		770		742		1,415		2,783		3,800		1,900		1,500		2,050		3,650		3,379		
Kioxia	852		1,190		1,161		1,967		2,974		2,462		2,226		2,864		2,596		1,827		1,827		
NAND	619		721		557		1,533		2,841		2,365		2,205		2,864		2,596		1,827		1,827		
Logic/Other	233		469		604		433		133		97		21		--		--		--		--		
Sony	481		463		1,365		250		670		650		1,800		1,300		2,450		2,000		2,000		
TSMC	6,058		8,094		5,233		6,137		7,065		6,226		10,796		10,703		19,500		26,000		25,200		
UMC																							
Foundry	710		1,072		1,219		1,700		1,188		715		360		448		1,269		1,740		900		
Nanya																							
DRAM																							
SMIC	474		671		980		1,706		1,555		1,750		1,700		3,500		2,000		2,925		2,925		
Hua Hong																							
Shanghai Huali																							
YMTC																							
Memory	--		--		--		--		250		1,000		1,000		2,250		3,000		975		2,275		
DRAM	--		--		--		--		--		--		--		--		--		--		175		
NAND	--		--		--		--		250		1,000		1,000		2,250		3,000		975		2,100		
Logic	--		--		--		--		--		--		--		--		--		--		--		
Fujian Jinhua IC	DRAM	--	--		--		--		--		500		--		--		--		--		--		
Chengdu Gaozhen	DRAM	--	--		--		--		--		175		250		750		750		550		260		
Changxin Memory (CXMT)	DRAM	--	--		--		--		--		20,750		19,500		28,050		30,950		44,450		59,500		
OTHERS		208		313		555		387		183		322		379		212		644		468		465	
Total		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%	84,500	40.8%	96,500	14.2%	95,500	(1.0%)
Wafer Fab Equipment (\$MM)																							
Memory, SMM	9,325		12,720		16,017		16,977		26,400		34,350		22,850		29,050		40,050		37,000		36,600		
YoY	32%		36%		26%		6%		56%		30%		(33%)		27%		38%		(8%)		(1%)		
DRAM	4,111		6,309		8,780		6,100		9,100		15,550		10,250		13,200		18,600		18,300		17,500		
YoY	50%		53%		39%		(31%)		49%		71%		(34%)		29%		41%		(2%)		(4%)		
NAND/other	5,214		6,411		7,237		10,877		17,300		18,800		12,600		15,850		21,450		18,700		19,100		
YoY	20%		23%		13%		50%		59%		9%		(33%)		26%		35%		(13%)		2%		
Foundry, SMM	11,430		13,738		11,600		12,523		15,250		12,750		18,150		22,750		32,050		42,000		40,200		
YoY	(20%)		20%		(16%)		8%		22%		(16%)		42%		25%		41%		31%		(4%)		
Logic, SMM	6,718		5,495		5,640		5,800		5,500		6,750		9,900		8,200		12,400		17,500		18,700		
YoY	(18%)		(18%)		3%		3%		(5%)		23%		47%		(17%)		51%		41%		7%		
check											--		--		--		--		--		--		
Foundry + logic, SMM											20,750		19,500		28,050		30,950		44,450		59,500		
YoY											(6%)		44%		10%		44%		34%		(1%)		
% total																							
Memory	34%		40%		48%		48%		56%		64%		45%		48%		47%		38%		38%		
DRAM	15%		20%		26%		17%		19%		29%		20%		22%		22%		19%		18%		
NAND/other	19%		20%		22%		31%		37%		35%		25%		26%		25%		19%		20%		
Foundry	42%		43%		35%		35%		32%		24%		36%		38%		38%		44%		42%		
Logic	24%		17%		17%		16%		12%		13%		19%		14%		15%		18%		20%		
Total WFE	100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		

Source: Company reports, UBS estimates



# ASML has gained >500bps of WFE share in the past 5yrs

WFE Share by Company



Source: Company reports, UBS estimates

# Summary of WFE share by company

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## WFE Share by Company

	<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>2021E</u>	<u>2022E</u>	<u>2023E</u>
TEL	4,860	4,069	2,993	4,069	3,803	4,334	6,609	8,400	6,918	8,270	12,513	13,335	13,412
AMAT	5920.459	5161	5290	5940	6062	7650	10214	10324	9573	12,106	17,183	20,000	18,950
KLAC (PF)	2,518	2,373	2,255	2,221	2,133	2,500	2,981	3,320	3,303	3,728	5,393	6,440	5,745
ASML	6,491	4,996	5,350	5,692	4,711	5,061	7,258	9,666	10,097	11,790	16,043	20,052	19,850
LRCX	2,006	2,476	3,110	3,567	4,229	4,419	7,229	8,126	6,438	7,968	11,294	12,400	11,825
<b>WFE</b>	<b>36,387</b>	<b>29,644</b>	<b>27,473</b>	<b>31,953</b>	<b>33,258</b>	<b>35,300</b>	<b>47,150</b>	<b>53,850</b>	<b>50,900</b>	<b>60,000</b>	<b>84,500</b>	<b>96,500</b>	<b>95,500</b>

	<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>2021E</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%	14.8%	13.8%	14.0%
AMAT	16.3%	17.4%	19.3%	18.6%	18.2%	21.7%	21.7%	19.2%	18.8%	20.2%	20.3%	20.7%	19.8%
KLAC (PF)	6.9%	8.0%	8.2%	7.0%	6.4%	7.1%	6.3%	6.2%	6.5%	6.2%	6.4%	6.7%	6.0%
ASML	17.8%	16.9%	19.5%	17.8%	14.2%	14.3%	15.4%	18.0%	19.8%	19.7%	19.0%	20.8%	20.8%
LRCX	5.5%	8.4%	11.3%	11.2%	12.7%	12.5%	15.3%	15.1%	12.6%	13.3%	13.4%	12.8%	12.4%

Source: Company reports, UBS estimates

# Quarterly WFE: 2010-2016 Historicals

## WFE Data by Quarter and End Market (2010-2016)

Product	2010				2011				2012				2013				2014				2015				2016						
	1Q'10	2Q'10	3Q'10	4Q'10	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	\$874	\$1,173	\$1,328	\$1,782	\$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			
Euro FX																															
AMAT	\$1,608	\$1,675	\$1,742	\$1,779	\$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	\$577	\$521	\$608	\$673	\$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	\$349	\$430	\$551	\$619	\$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	\$890	\$871	\$1,330	\$1,119	\$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			
JPY FX																															
ex TEL	\$3,408	\$3,799	\$4,227	\$4,852	\$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	\$4,298	\$4,669	\$5,557	\$5,971	\$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			
WFE																															
Total	\$5,933	\$7,158	\$8,770	\$9,836	\$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	\$3,150	\$3,150	\$3,300	\$3,850	\$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%	30%	54%	49%	54%	47%	42%	57%	42%	35%	59%
DRAM	\$2,284	\$1,973	\$1,966	\$2,041	\$1,224	\$1,223	\$935	\$738	\$532	\$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	\$866	\$1,177	\$1,334	\$1,809	\$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)	73%	63%	60%	53%	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)	73%	63%	60%	53%	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)	27%	37%	40%	47%	66%	70%	67%	64%	75%	53%	57%	56%	47%	46%	60%	63%	57%	51%	53%	44%	34%	52%	55%	39%	62%	62%	66%	64%			
F/L	\$2,783	\$4,008	\$5,470	\$5,986	\$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			
Total					\$31,593				\$36,387				\$29,644				\$27,473				\$31,953				\$33,258				\$35,300		
Memory					\$13,464				\$12,547				\$7,082				\$9,325				\$12,720				\$16,017				\$16,977		
DRAM					\$8,264				\$4,120				\$2,732				\$4,111				\$6,309				\$8,780				\$6,100		
NAND/other					\$5,201				\$8,427				\$4,350				\$5,214				\$6,411				\$7,237				\$10,877		
F/L					\$18,129				\$23,840				\$22,562				\$18,148				\$19,233				\$17,241				\$18,323		

Source: Company reports, UBS

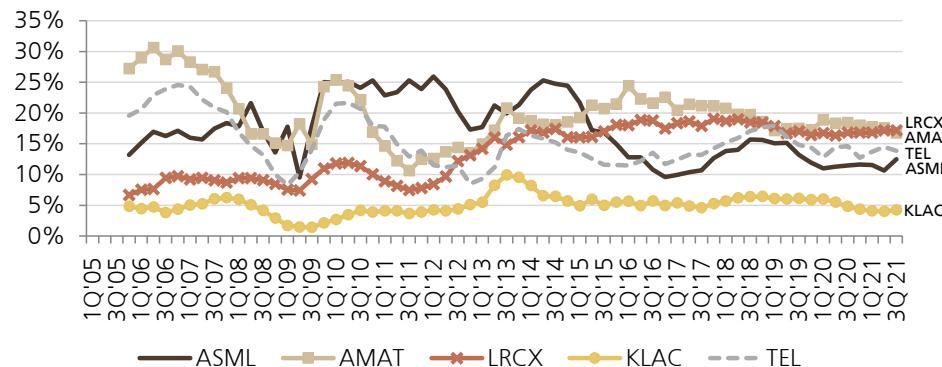
Quarterly WFE: Run-rate to grow from ~\$90B in 2H:21E to ~\$100B in 2H:22E but starts to moderate/decline from there

## WFE Data by Quarter and End Market (2016-2023E)

Source: Company reports, UBS estimates

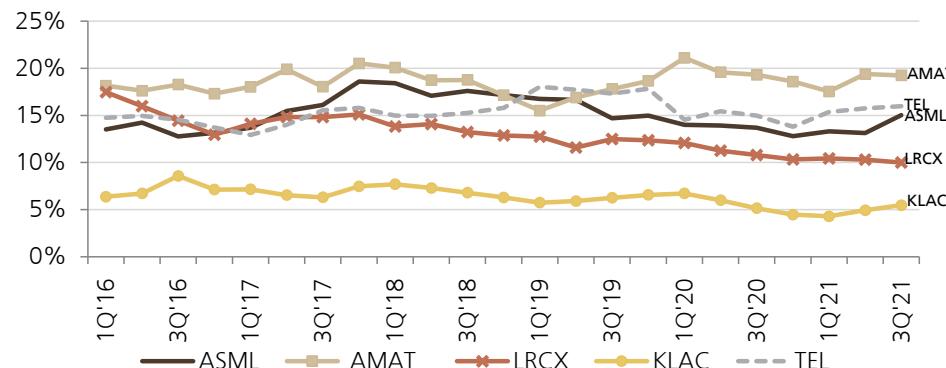
# AMAT Foundry & DRAM gains evident; LRCX nearly as strong in NAND as AMAT/ASML are in Foundry

Memory WFE Share TTM



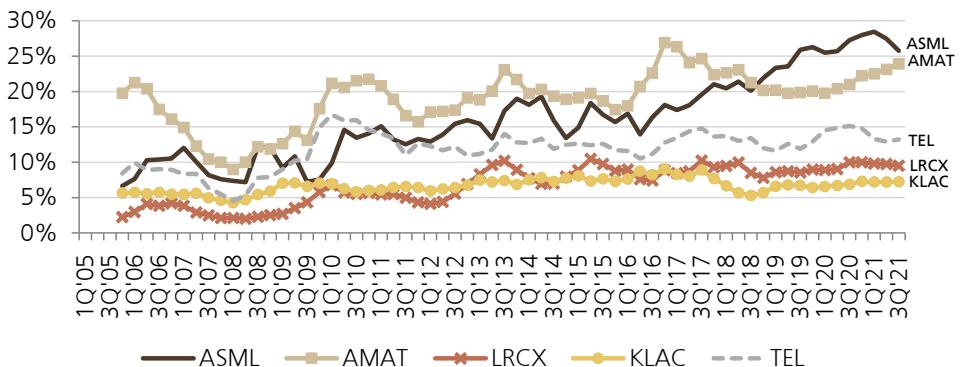
Source: Company reports, UBS estimates

DRAM WFE Share TTM



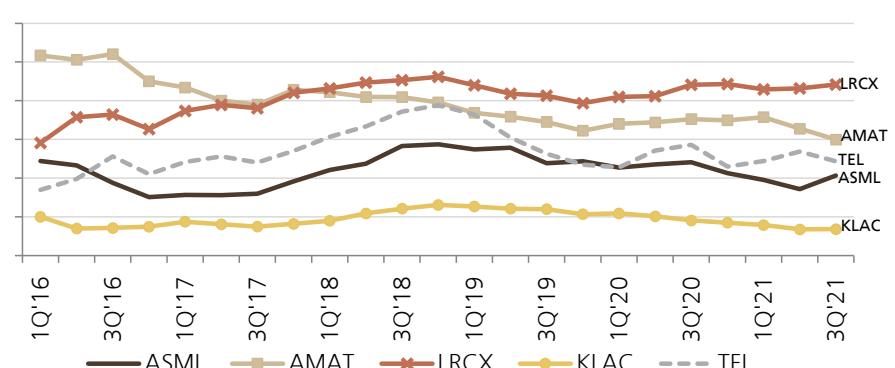
Source: Company reports, UBS estimates

Foundry/Logic WFE Share TTM



Source: Company reports, UBS estimates

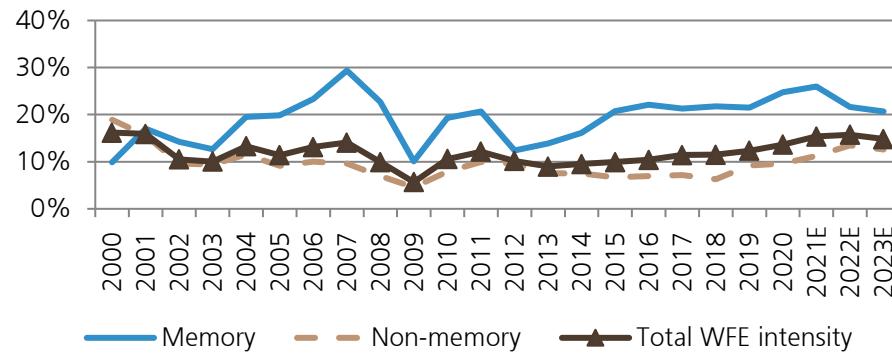
NAND WFE Share TTM



Source: Company reports, UBS estimates

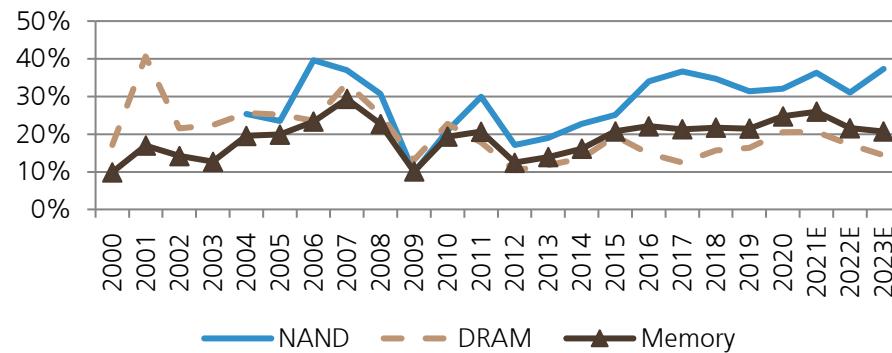
# WFE intensity is very elevated by historical standards; some is secular but a lot of this is cyclical

Total WFE Intensity by Segment



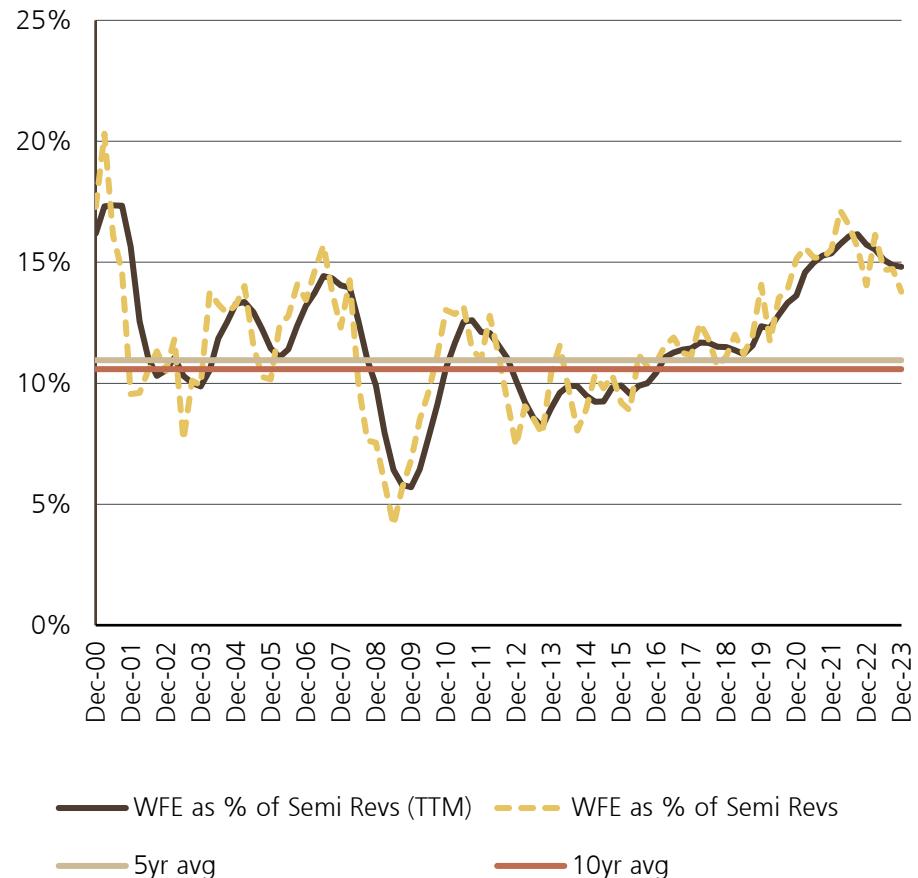
Source: Company reports, UBS estimates

Memory WFE Intensity



Source: Company reports, UBS estimates

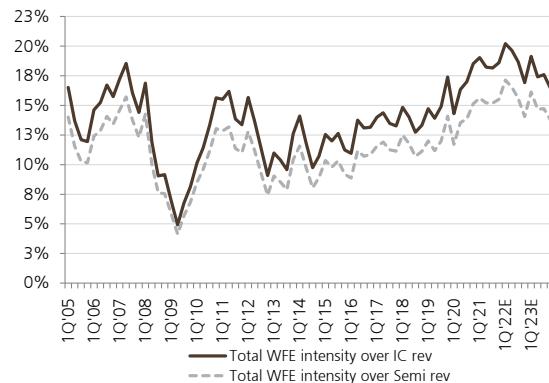
Total WFE Intensity TTM



Source: Company reports, UBS estimates

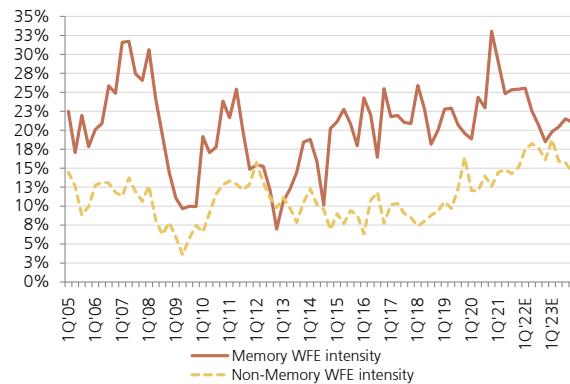
# The industry needs to digest current levels of WFE, which is driving a peak in WFE intensity

## WFE Intensity, Quarterly



Source: Company reports, UBS estimates

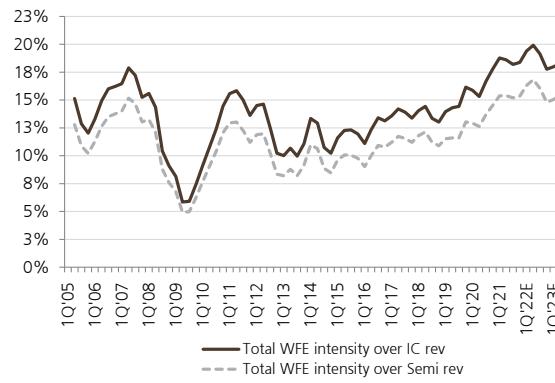
## WFE Intensity, Quarterly, by Segment



Source: Company reports, UBS estimates

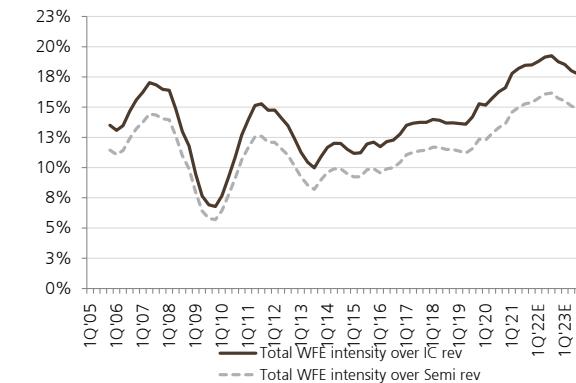
Note: Total WFE intensity over IC rev is calculated by WFE divided by UBS IC revenue forecast. Total WFE intensity over Semi rev is calculated by WFE divided by UBS Semi revenue forecast. Semi revenue includes IC as well as Discretes/Opto/Passive revenue.

## WFE Intensity, Trailing 6M



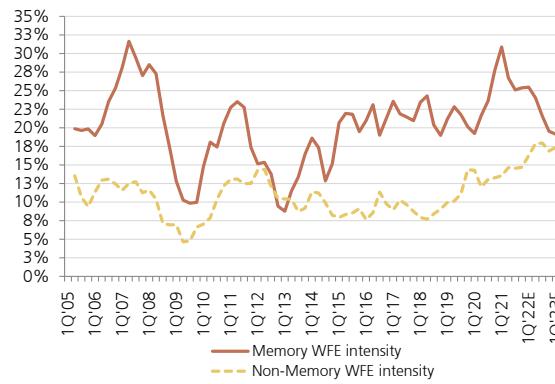
Source: Company reports, UBS estimates

## WFE Intensity, TTM



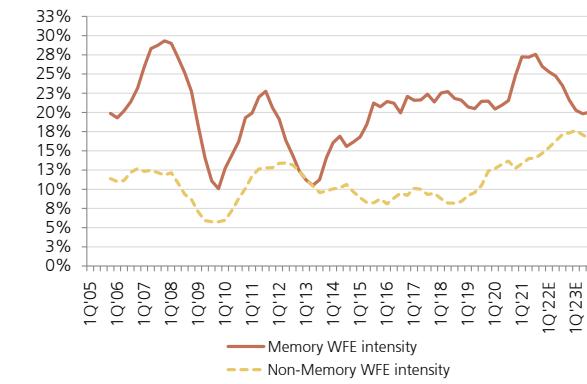
Source: Company reports, UBS estimates

## WFE Intensity, T6M, by Segment



Source: Company reports, UBS estimates

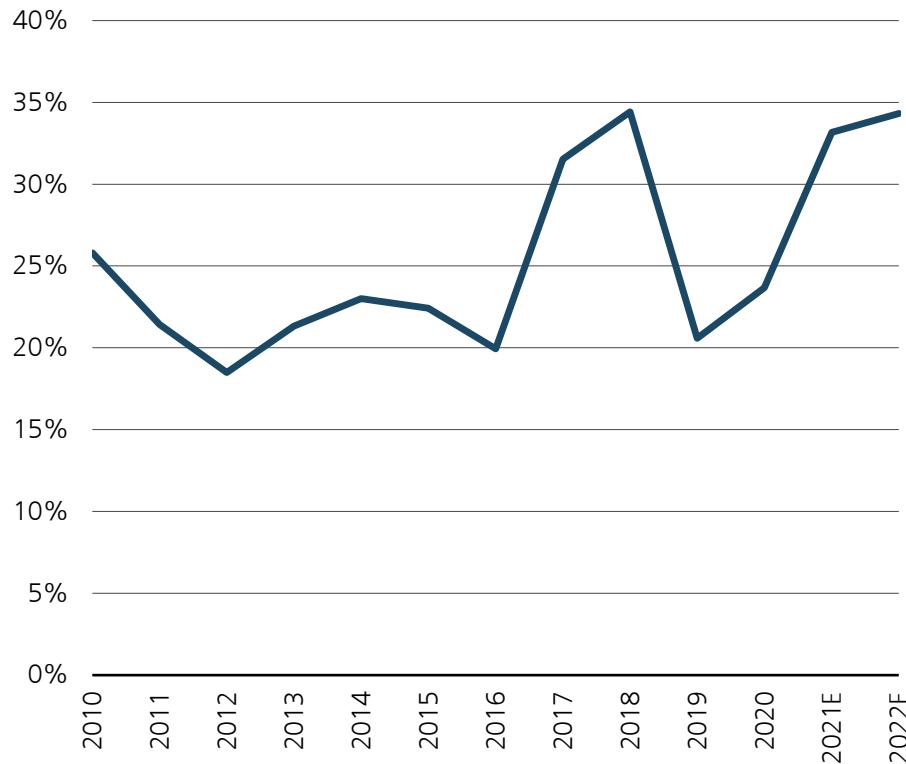
## WFE Intensity, TTM, by Segment



Source: Company reports, UBS estimates

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

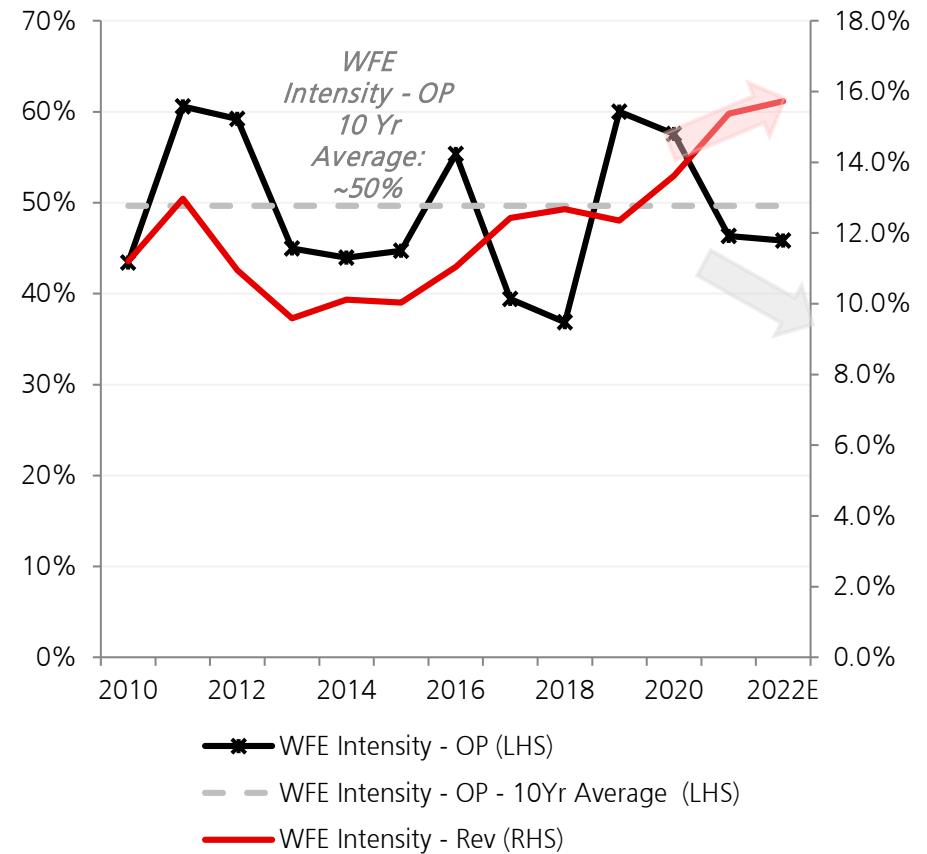
Semiconductor Industry OpM



Source: Factset, Company reports, UBS estimates.

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

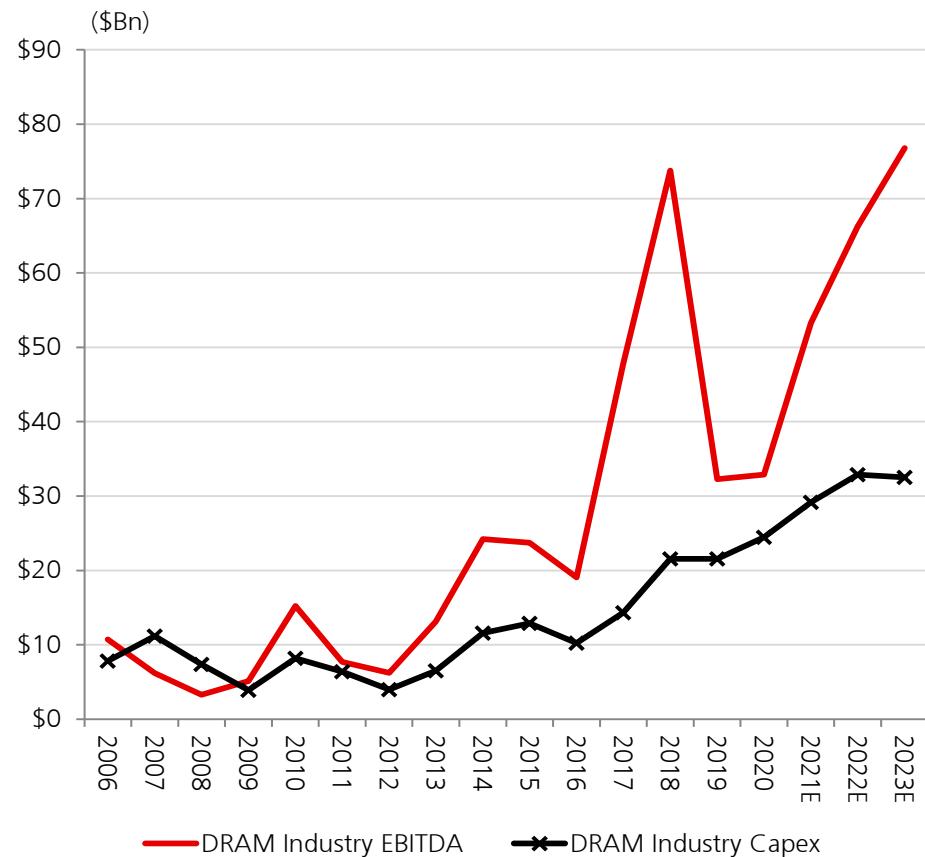
WFE Intensity – OpM & Rev



Source: Factset, Company reports, UBS estimates

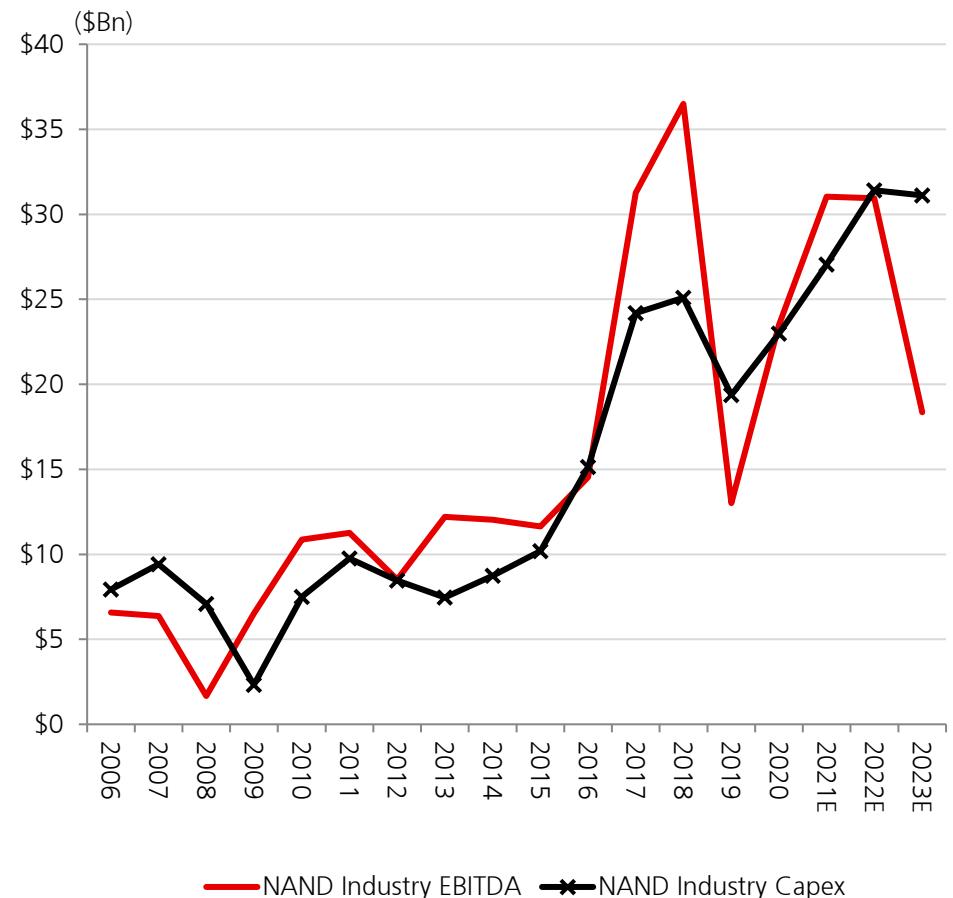
# DRAM capex supports strong fundamentals, NAND EBITDA likely below capex in '22/23

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

0.33 NA tools	2015	2016	2017	2018	2019	2020E	2021E	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
<b>Logic</b>																
TSMC	1	1	3	10	15	15	20	22	21	17	15					
Samsung Foundry	1	1	1	2	4	9	11	11	11	10	10					
Intel	2	2	2	3	3	2	2	8	9	5	6					
GF			1													
Others			1	1	2		1		1							
<b>DRAM</b>																
Samsung		1		1	1	4	7	8	8	18	16					
SK Hynix				1	1	1	1	3	4	5	5					
Micron		1		1			1	1	1	3	3					
<b>Total</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>19</b>	<b>26</b>	<b>31</b>	<b>43</b>	<b>53</b>	<b>55</b>	<b>58</b>	<b>55</b>	<b>49</b>	<b>46</b>	<b>41</b>	<b>36</b>	<b>30</b>
0.55 NA tools	2015	2016	2017	2018	2019	2020E	2021E	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
TSMC								1	0	3	3					
Samsung								1	1	1	2					
Intel								0	1	0	1					
<b>Total</b>								<b>2</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>7</b>	<b>11</b>	<b>17</b>	<b>21</b>	<b>26</b>

Source: UBS estimates

# KPIs: Rules of Thumb

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

IBM 2nm

	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 <sup>2</sup> )	333	180	327	315
TEN (TSMC equivalent node)	2.9	4.7	2.9	3.0
				500
				2.1

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

## Section 9

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### EDA

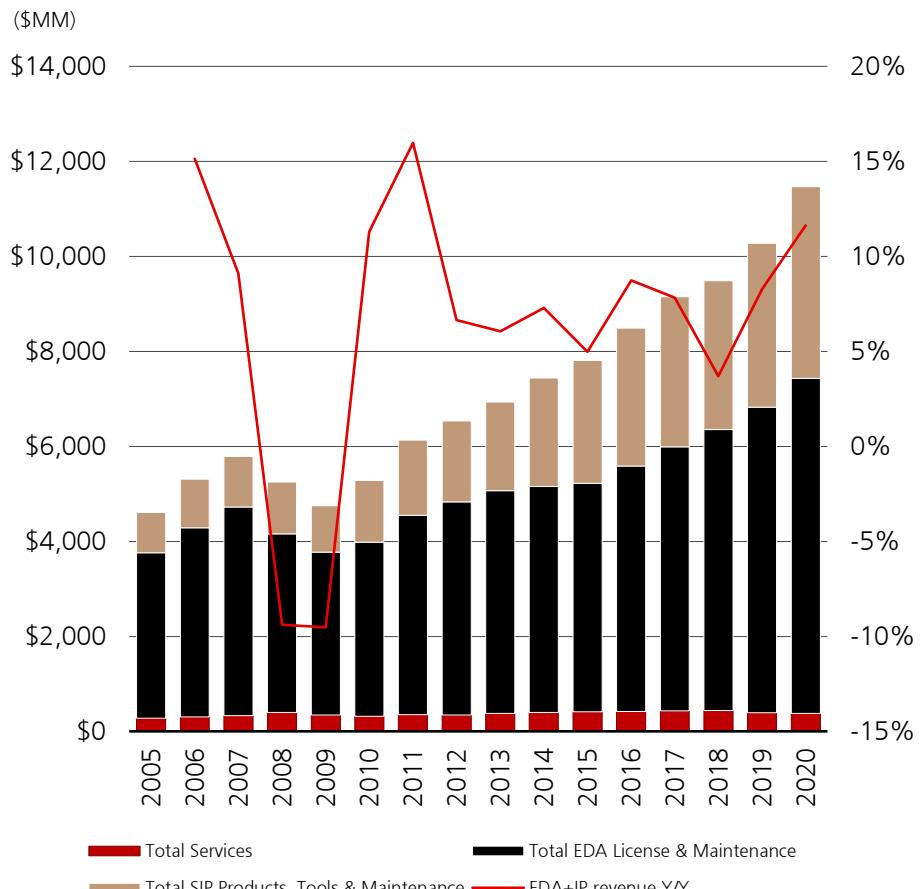
# Key Messages

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- We expect EDA+IP TAM to approach ~\$13B in C2021E
- For C2022E we see EDA+IP growth accelerating sustainably higher to >10% driven by...
  - Broadening of design activity into DPU, ARM based CPUs and Hyperscalers/Autos
  - Increasing chip complexity driving growth for Verification
  - IP growth
  - China
  - Increasing adoption of AI/ML in EDA
- We see China as a sustainable grower at ~25% +/- 5%
- We see both SNPS and CDNS as being well positioned to grow and we do not expect to see large and sustained shifts in market share
- We prefer SNPS as: 1) SNPS has stronger position in Digital at major semi customers; 2) Broader IP business; 3) Larger presence in China startup ecosystem; 4) Margin catchup opportunity (as CDNS invests in System Analysis)

# EDA has been a stable grower

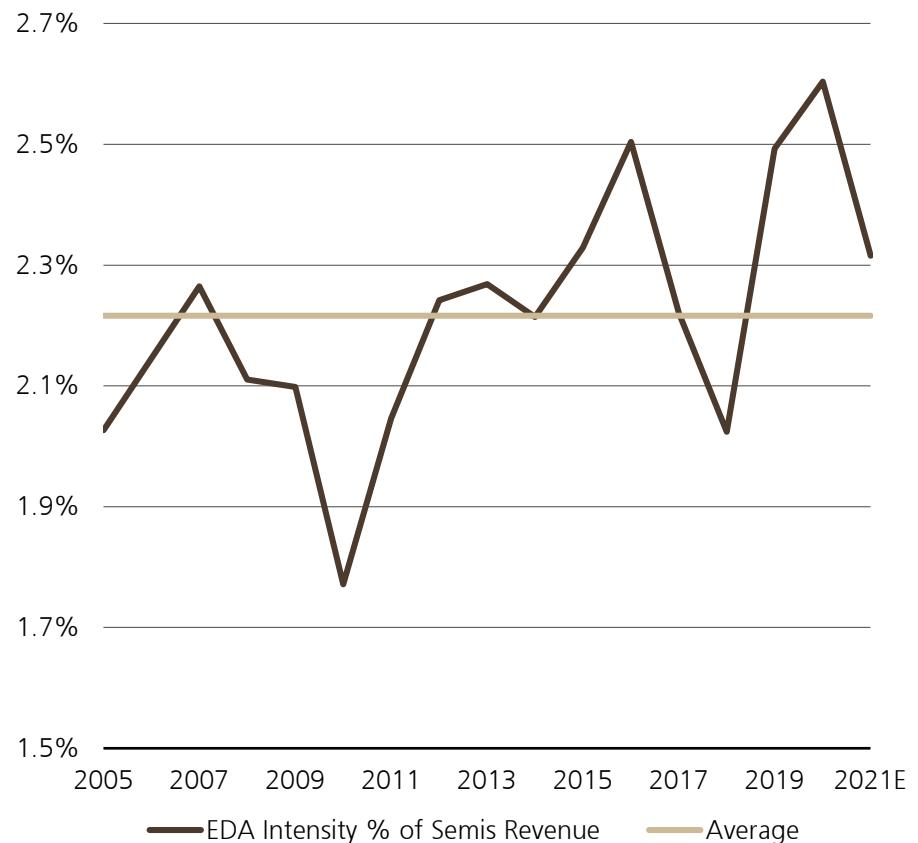
Worldwide EDA+IP revenue is ~\$11.5B (2020) opportunity growing at ~10%



Source: ESDA, UBS

EDA intensity has averaged ~2.2%

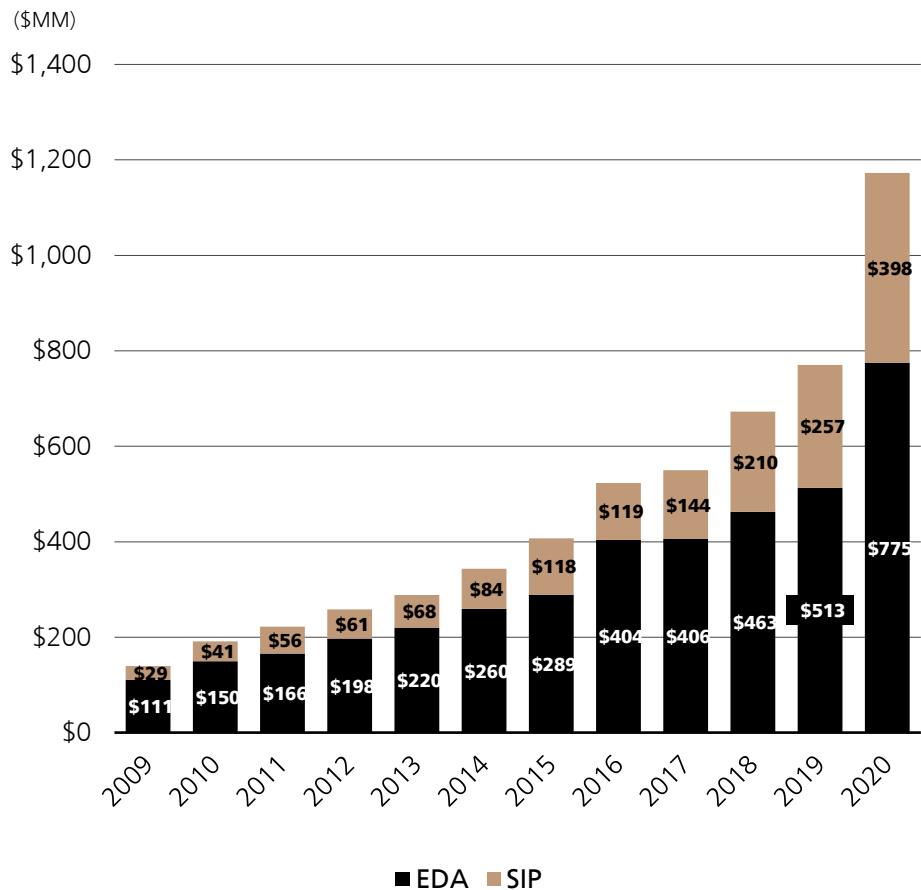
**EDA Intensity as % of Semis Revenue**



Source: ESDA, UBS estimates

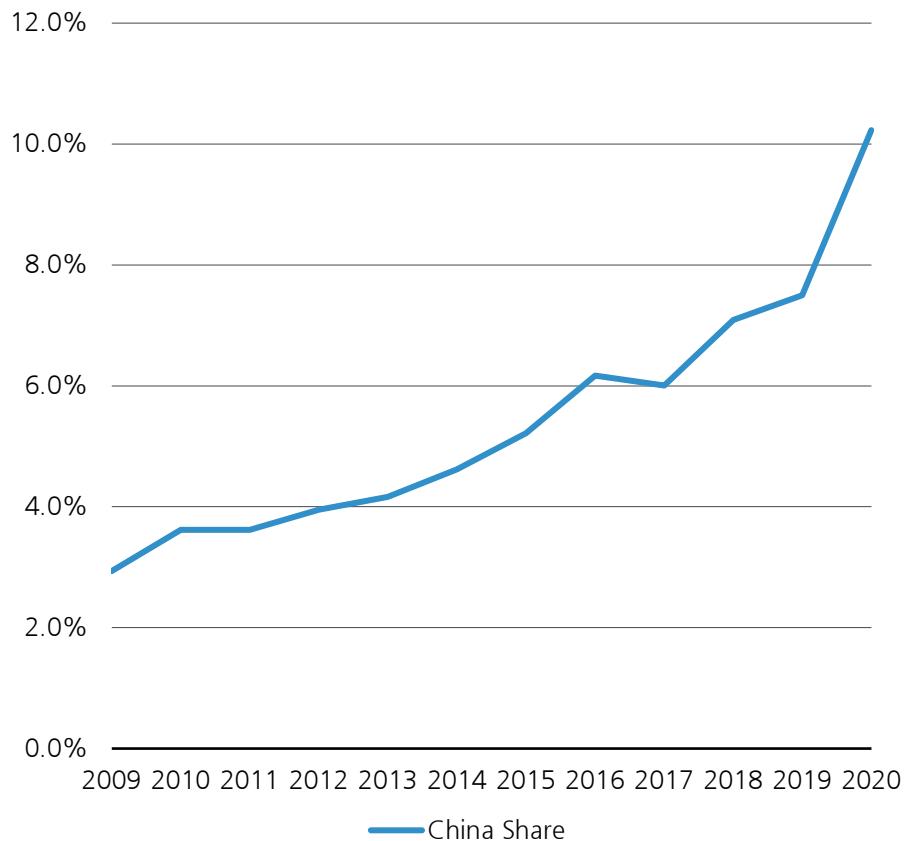
# China has become an important growth driver

China EDA+IP consumption



Source: ESDA, UBS

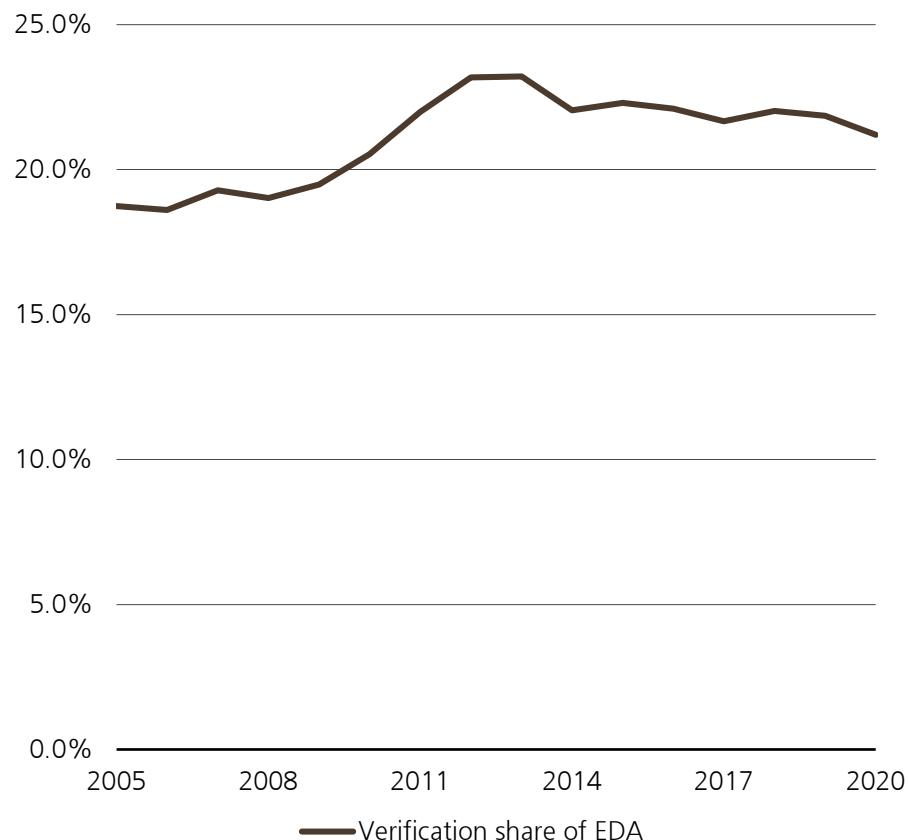
China share of worldwide EDA+IP has steadily gained share



Source: ESDA, UBS

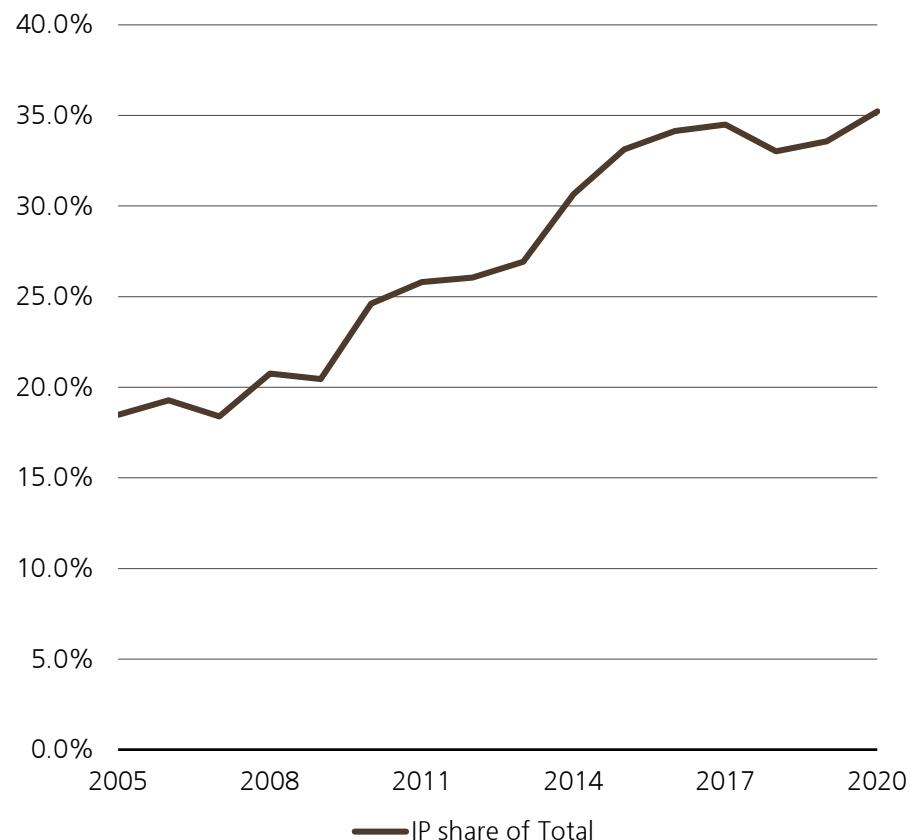
# Verification and IP are the other growth drivers

**Verification share of EDA**



Source: ESDA, UBS

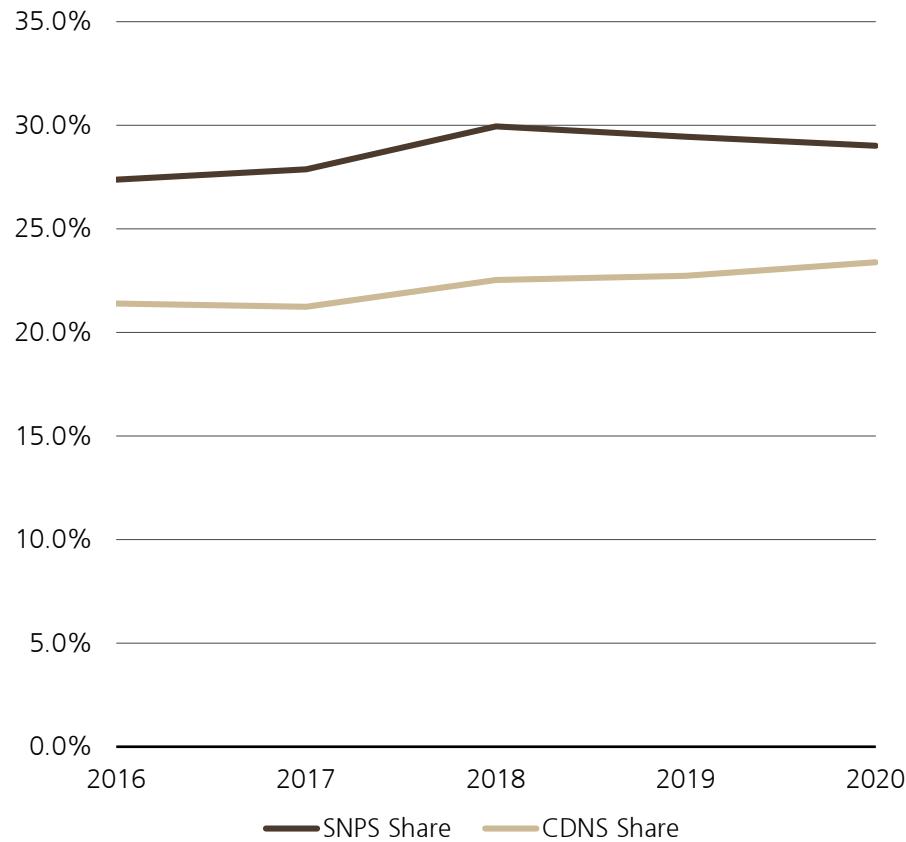
**IP share of total**



Source: ESDA, UBS

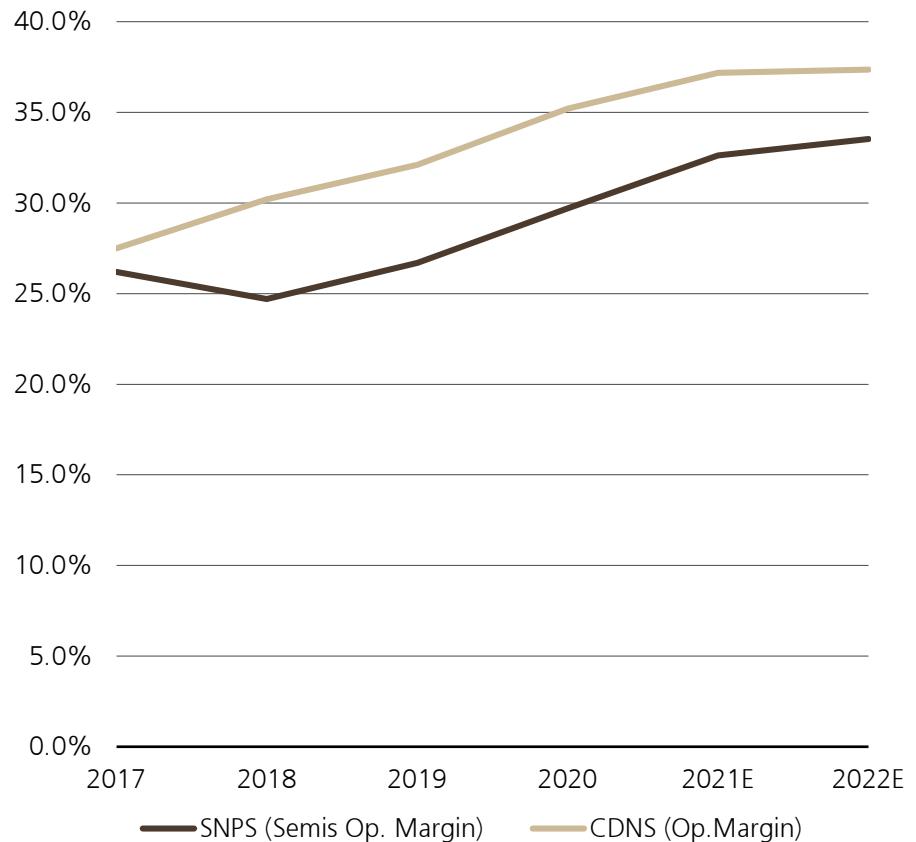
# Market share stable; SNPS has margin catchup potential

**SNPS/CDNS Share of total**



Source: ESDA, UBS

**SNPS has margin catchup**



Source: Company reports, UBS estimates

## Section 10

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# Company Summaries

# ADI: Analog Devices

## Investment Thesis/Risks

<b>Our thesis</b>	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 – that leave it well positioned for through-cycle growth. We see ADI as being well positioned to grow in multiple end markets as supply constraints gradually ease in 2022 and we view MXIM as a high quality R&D franchise that augments ADI's competitive position in Autos/Comms and ultimately opens up a degree of freedom to grow P&L in 2023. Beyond the numbers, when viewed via the lens of our decade's worth of Analog design experience, we see new growth verticals (Space, Autos, 5G) driving up demand for specialized Analog and playing to ADI's strength - a unique innovative culture + willingness to commit R&D \$ to drive growth. Buy, PT \$220.
<b>Risks to our thesis</b>	ADI is subject to macro cycles 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	2023/1F	2023/2F	2023/3F	2023/4F	F2023	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																			
UBS (new)			\$7,318	\$2,602	\$2,628	\$2,706	\$2,797	\$10,732	\$2,812	\$2,790	\$2,863	\$2,960	\$11,424			\$8,362	\$10,942	\$11,492	
UBS (PF old)			\$7,318	\$2,602	\$2,628	\$2,706	\$2,797	\$10,732	\$2,812	\$2,790	\$2,863	\$2,960	\$11,424			\$8,362	\$10,942	\$11,492	
UBS (ADI old)			\$6,757	\$1,760	\$1,783	\$1,883	\$1,938	\$7,365	\$1,906	\$1,927	\$2,001	\$2,048	\$7,881			\$6,959	\$7,511	\$7,975	
Consensus			\$7,318	\$2,578	\$2,619	\$2,681	\$2,730	\$10,607	\$2,743	\$2,813	\$2,895	\$2,970	\$11,421			\$8,338	\$10,773	\$11,598	
Delta				0.9%	0.3%	0.9%	2.5%	1.2%	2.5%	(0.8%)	(1.1%)	(0.3%)	0.0%			0.3%	1.6%	(0.9%)	
<b>EPS (non-GAAP)</b>																			
UBS (new)			\$6.46	\$1.78	\$1.82	\$1.89	\$2.03	\$7.51	\$2.06	\$2.04	\$2.15	\$2.31	\$8.57			\$6.76	\$7.80	\$8.69	
UBS (PF old)			\$6.46	\$1.78	\$1.82	\$1.89	\$2.03	\$7.51	\$2.06	\$2.04	\$2.15	\$2.31	\$8.57			\$6.76	\$7.80	\$8.69	
UBS (ADI old)			\$6.42	\$1.66	\$1.72	\$1.93	\$2.00	\$7.30	\$1.90	\$1.94	\$2.08	\$2.12	\$8.05			\$5.83	\$4.85	\$5.31	
Consensus			\$6.43	\$1.78	\$1.84	\$1.92	\$1.99	\$7.53	\$1.98	\$2.07	\$2.17	\$2.26	\$8.48			\$6.64	\$7.55	\$8.17	
Delta				(0.4%)	(1.1%)	(1.4%)	2.1%	(0.2%)	4.1%	(1.3%)	(0.8%)	2.2%	1.0%			\$6.77	\$7.73	\$8.76	

Source: Company reports, UBS estimates

# ADI: Model Summary

Analog Devices (ADI) - Key Metrics (in \$MM except EPS)	Estimates												FISCAL YEAR SUMMARY									
	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E
Revenue	\$5,690	\$6,199	\$5,754	\$5,858	\$1,661	\$1,759	\$2,340	\$2,602	\$8,362	\$2,628	\$2,706	\$2,797	\$2,812	\$10,942	\$11,492	\$5,108	\$6,225	\$5,991	\$5,603	\$7,318	\$10,732	\$11,424
Y/Y Growth	56%	9%	(7%)	2%	26%	21%						20%	8%			49%	22%	(4%)	(6%)			6%
Gross Profit (Non-GAAP)	\$4,073	\$4,399	\$3,999	\$4,067	\$1,177	\$1,259	\$1,660	\$1,850	\$5,946	\$1,874	\$1,935	\$2,014	\$2,027	\$7,849	\$8,295	\$3,608	\$4,431	\$4,189	\$3,870	\$5,186	\$7,672	\$8,246
Gross Margin	71.6%	71.0%	69.5%	69.4%	70.9%	71.6%	70.9%	71.1%	71.1%	71.3%	71.5%	72.0%	72.1%	71.7%	72.2%	70.6%	71.2%	69.9%	69.1%	70.9%	71.5%	72.2%
R&D	\$1,073	\$1,164	\$1,100	\$1,082	\$302	\$307	\$399	\$395	\$1,403	\$402	\$412	\$412	\$423	\$1,648	\$1,764	\$969	\$1,165	\$1,130	\$1,051	\$1,296	\$1,621	\$1,734
SG&A	\$737	\$686	\$680	\$646	\$207	\$206	\$317	\$318	\$1,048	\$323	\$331	\$331	\$321	\$1,306	\$1,197	\$691	\$696	\$648	\$660	\$915	\$1,303	\$1,222
Opex (Non-GAAP)	\$1,698	\$1,790	\$1,720	\$1,679	\$484	\$493	\$651	\$724	\$2,351	\$736	\$754	\$754	\$755	\$2,998	\$3,005	\$1,559	\$1,787	\$1,756	\$1,636	\$2,083	\$2,968	\$3,000
Y/Y Growth	49%	5%	(4%)	(2%)	24%	23%	51%	59%	40%	52%	53%	16%	4%	28%	0%	42%	15%	(2%)	(7%)	27%	43%	1%
Operating Income (Non-GAAP)	\$2,375	\$2,609	\$2,279	\$2,388	\$694	\$766	\$1,009	\$1,126	\$3,595	\$1,138	\$1,181	\$1,260	\$1,273	\$4,851	\$5,290	\$2,050	\$2,644	\$2,433	\$2,234	\$3,104	\$4,704	\$5,246
Operating Margin	41.7%	42.1%	39.6%	40.8%	41.7%	43.6%	43.1%	43.3%	43.0%	43.3%	43.6%	45.0%	45.3%	44.3%	46.0%	39.5%	42.5%	40.6%	39.9%	42.4%	43.8%	45.9%
Non-GAAP EPS	\$5.23	\$5.83	\$4.85	\$5.31	\$1.54	\$1.72	\$1.73	\$1.78	\$6.76	\$1.82	\$1.89	\$2.03	\$2.06	\$7.80	\$8.69	\$4.72	\$5.99	\$5.15	\$4.91	\$6.46	\$7.51	\$8.57
Free Cash Flow																						
CFFO	\$1,187	\$2,425	\$2,231	\$2,087	\$736	\$630	\$941	\$972	\$3,279	\$1,281	\$1,292	\$1,361	\$1,456	\$5,391	\$5,951	\$1,113	\$2,442	\$2,253	\$2,008	\$2,735	\$4,906	\$5,801
Capex	\$239	\$283	\$239	\$178	\$59	\$86	\$131	\$208	\$484	\$210	\$216	\$224	\$225	\$875	\$919	\$204	\$255	\$275	\$166	\$344	\$859	\$914
FCF	\$1,698	\$2,143	\$1,992	\$1,909	\$677	\$544	\$810	\$764	\$2,794	\$1,071	\$1,075	\$1,138	\$1,231	\$4,515	\$5,032	\$908	\$2,187	\$1,978	\$1,843	\$2,391	\$4,047	\$4,887
% revenue	30%	35%	35%	33%	41%	31%	35%	29%	33%	41%	40%	41%	44%	41%	44%	18%	35%	33%	33%	33%	38%	43%
Y/Y Growth	37%	26%	(7%)	(4%)	84%	1%	26%	112%	46%	58%	98%	40%	61%	62%	11%	(21%)	141%	(10%)	(7%)	30%	69%	21%
Segment Revenue																						
Industrial																				\$4,008	\$5,356	\$5,696
ADI Stand-alone	\$2,725	\$3,095	\$2,966	\$3,152	\$972	\$1,002	\$1,015													\$2,342	\$3,143	\$3,011
Q/Q Growth					14%	3%	1%												\$2,988	\$3,844		
Y/Y Growth	25%	14%	(4%)	6%	37%	29%	25%									20%	17%	(4%)	(1%)	29%		6%
Automotive																				\$1,246	\$2,152	\$2,271
ADI Stand-alone	\$923	\$991	\$896	\$820	\$258	\$290	\$267													\$803	\$1,010	\$931
Q/Q Growth					5%	13%	(8%)												\$779	\$1,060		
Y/Y Growth	8%	7%	(10%)	(8%)	41%	79%	16%									4%	9%	(8%)	(16%)	36%		6%
Communications																				\$1,198	\$1,628	\$1,760
ADI Stand-alone	\$1,000	\$1,238	\$1,187	\$1,234	\$277	\$289	\$285													\$917	\$1,151	\$1,295
Q/Q Growth					(1%)	4%	(1%)												\$1,196	\$1,132		
Y/Y Growth	2%	24%	(4%)	4%	0%	(21%)	(9%)									3%	10%	12%	(8%)	(5%)		8%
Consumer																				\$866	\$1,596	\$1,697
ADI Stand-alone	\$1,042	\$896	\$712	\$653	\$155	\$178	\$214													\$1,045	\$934	\$754
Q/Q Growth					(12%)	15%	20%												\$640	\$723		
Y/Y Growth	18%	(14%)	(21%)	(8%)	5%	14%	24%									42%	(11%)	(19%)	(15%)	13%		6%

Source: Company reports, UBS estimates

# AMD: Advanced Micro Devices

## Investment Thesis/Risks

<b>Our thesis</b>	We believe that AMD will gain ~400-500bps of total server CPU share this year and it could plausibly post similar gains in '22 before INTC rights the ship on the product roadmap in '23 with the recently inserted Emerald Rapids and Granite Rapids. However, the stock is pricing in very robust share gains even 3-4 years out. We think INTC is making significant progress on its node technology making it hard for us to underwrite a significant multiple on estimates this far out given what should be a narrower competitive window.
<b>Risks to our thesis</b>	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 AMD. Additionally, the XLNX deal – assuming it is approved by China - 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	2021/1F	2021/2F	2021/3F	2021/4F	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	2024	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	CY2024	
<b>Revenues (\$MM)</b>																							
UBS (new)	\$6,475	\$6,731	\$9,763	\$3,445	\$3,850	\$4,313	\$4,559	\$16,167	\$4,286	\$4,412	\$4,753	\$5,023	\$18,474	\$20,788	\$21,251	\$6,475	\$6,731	\$9,763	\$16,167	\$18,474	\$20,788	\$21,251	
UBS (old)								\$4,559	\$16,167	\$4,286	\$4,412	\$4,753	\$5,023	\$18,474	\$20,788	\$21,251				\$16,167	\$18,474	\$20,788	\$21,251
Consensus								\$4,517	\$16,111	\$4,327	\$4,644	\$5,138	\$5,233	\$19,229	\$21,758	\$21,687				\$16,111	\$19,229	\$21,758	\$21,687
Delta								0.9%	0.3%	(0.9%)	(5.0%)	(7.5%)	(4.0%)	(3.9%)	(4.5%)	(2.0%)				0.3%	(3.9%)	(4.5%)	(2.0%)
<b>EPS</b>																							
UBS (new)	\$0.44	\$0.64	\$1.28	\$0.52	\$0.63	\$0.73	\$0.77	\$2.65	\$0.73	\$0.76	\$0.87	\$0.94	\$3.30	\$3.94	\$4.05	\$0.44	\$0.64	\$1.28	\$2.65	\$3.30	\$3.94	\$4.05	
UBS (old)								\$0.77	\$2.65	\$0.73	\$0.76	\$0.87	\$0.94	\$3.30	\$3.94	\$4.05				\$2.65	\$3.30	\$3.94	\$4.05
Consensus								\$0.76	\$2.64	\$0.69	\$0.78	\$0.93	\$0.95	\$3.33	\$4.12	\$4.18				\$2.64	\$3.33	\$4.12	\$4.18
Delta								2.0%	0.4%	4.6%	(3.1%)	(6.6%)	(0.7%)	(1.0%)	(4.5%)	(3.1%)				0.4%	(1.0%)	(4.5%)	(3.1%)

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	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	FQ4E CQ4E	Estimates	F2021E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
Revenue	\$6,475	\$6,731	\$9,763	\$3,445	\$3,850	\$4,313	\$4,559	\$16,167	\$4,286	\$4,412	\$4,753	\$5,023	\$18,474	\$20,788	
Y/Y Growth	23%	4%	45%	93%	99%	54%	41%	66%	24%	15%	10%	10%	14%	13%	
Gross Profit (Non-GAAP)	\$2,496	\$2,874	\$4,352	\$1,588	\$1,832	\$2,087	\$2,257	\$7,764	\$2,121	\$2,193	\$2,377	\$2,537	\$9,228	\$10,618	
Gross Margin	38.5%	42.7%	44.6%	46.1%	47.6%	48.4%	49.5%	48.0%	49.5%	49.7%	50.0%	50.5%	49.9%	51.1%	
Semi-Custom GM (UBSe)			18%	18%	23%	24%	24%	25%	24%	25%	26%	27%	26%	28%	
Ex-Semi-Custom GM (UBSe)			47%	50%	52%	54%	54%	55%	55%	55%	55%	55%	55%	56%	
R&D (GAAP)	\$1,434	\$1,547	\$1,983	\$610	\$659	\$765	\$830	\$2,864	\$820	\$825	\$830	\$835	\$3,310	\$3,495	
SG&A (GAAP)	\$562	\$750	\$995	\$319	\$341	\$376	\$420	\$1,456	\$340	\$355	\$375	\$425	\$1,495	\$1,765	
Other & Non-GAAP Adjustment (GAAP)	--	--	(\$60)	--	(\$4)	(\$1)	(\$3)	--	(\$8)	--	--	--	--	--	--
Total Opex (Non-GAAP)	\$1,863	\$2,094	\$2,696	\$830	\$909	\$1,035	\$1,151	\$3,925	\$1,080	\$1,100	\$1,125	\$1,180	\$4,485	\$4,920	
Y/Y Growth	19%	12%	29%	42%	47%	47%	46%	46%	30%	21%	9%	3%	14%	10%	
Operating Income (Non-GAAP)	\$633	\$840	\$1,657	\$762	\$924	\$1,055	\$1,105	\$3,846	\$1,040	\$1,092	\$1,251	\$1,356	\$4,739	\$5,694	
Operating Margin	9.8%	12.5%	17.0%	22.1%	24.0%	24.5%	24.2%	23.8%	24.3%	24.7%	26.3%	27.0%	25.6%	27.4%	
Non-GAAP EPS	\$0.44	\$0.63	\$1.28	\$0.52	\$0.63	\$0.73	\$0.77	\$2.65	\$0.73	\$0.76	\$0.87	\$0.94	\$3.30	\$3.94	
Free Cash Flow															
CFFO	\$34	\$493	\$1,071	\$898	\$952	\$849	\$659	\$3,358	\$942	\$986	\$1,052	\$1,173	\$4,153	\$5,033	
Capex	\$163	\$217	\$294	\$66	\$64	\$85	\$85	\$300	\$38	\$35	\$35	\$35	\$143	\$143	
FCF	(\$129)	\$276	\$777	\$832	\$888	\$764	\$574	\$3,058	\$904	\$951	\$1,017	\$1,138	\$4,010	\$4,890	
% revenue	(2%)	4%	8%	24%	23%	18%	13%	19%	21%	22%	21%	23%	22%	24%	
Segment Revenues															
DT Revenue	\$1,714	\$1,999	\$2,327	\$725	\$557	\$599	\$599	\$2,479	\$622	\$560	\$571	\$594	\$2,347	\$2,226	
AMD DT ASP (\$)	\$138	\$123	\$145	\$165	\$169	\$165	\$165	\$166	\$175	\$175	\$175	\$175	\$175	\$175	
AMD DT Units (K)	12,448	16,273	16,037	4,398	3,298	3,628	3,628	14,952	3,555	3,200	3,264	3,394	13,414	12,718	
DT TAM (K units)	92,984	92,186	83,739	20,191	17,620	21,074	22,566	81,452	18,889	19,211	20,132	21,625	79,857	75,225	
AMD Share	13%	18%	19%	22%	19%	17%	16%	18%	19%	17%	16%	16%	17%	17%	
Mobile Revenue	\$860	\$1,392	\$2,863	\$966	\$1,093	\$1,099	\$1,086	\$4,244	\$1,086	\$978	\$1,095	\$1,183	\$4,342	\$4,618	
AMD Mobile ASP (\$)	\$47	\$53	\$62	\$68	\$70	\$88	\$87	\$77	\$87	\$87	\$87	\$87	\$87	\$87	
AMD Mobile Units (K)	18,438	26,350	46,142	14,201	15,610	12,488	12,488	54,787	12,488	11,239	12,588	13,595	49,910	53,078	
Mobile TAM (K units)	183,520	182,052	244,208	79,090	78,304	74,484	74,165	306,043	71,299	70,190	72,469	74,295	288,253	273,264	
AMD Share	10%	14%	19%	18%	20%	17%	17%	18%	18%	16%	17%	18%	17%	19%	
GPU Revenue (UBSe)	\$1,864	\$1,318	\$1,243	\$410	\$600	\$700	\$780	\$2,490	\$443	\$648	\$756	\$842	\$2,689	\$2,958	
Gaming GPU Revenue(UBSe)	\$1,308	\$842	\$870	\$278	\$439	\$429	\$539	\$1,685	\$238	\$431	\$522	\$608	\$1,799	\$2,034	
DC GPU Revenue (UBSe)	\$140	\$210	\$142	\$50	\$75	\$155	\$125	\$405	\$100	\$100	\$110	\$110	\$420	\$450	
Computing and Graphics	\$4,306	\$4,709	\$6,433	\$2,100	\$2,250	\$2,398	\$2,465	\$9,213	\$2,151	\$2,186	\$2,422	\$2,619	\$9,379	\$9,802	
Q/Q Growth				7%	7%	7%	3%	(13%)	2%	11%	8%				
Y/Y Growth	45%	9%	37%	46%	65%	44%	26%	43%	2%	(3%)	1%	6%	2%	5%	
Server Revenue (UBSe)	\$319	\$900	\$1,621	\$587	\$750	\$1,020	\$1,194	\$3,551	\$1,254	\$1,331	\$1,411	\$1,504	\$5,500	\$7,376	
AMD Server ASP (\$)	\$558	\$736	\$783	\$860	\$899	\$925	\$950	\$916	\$960	\$980	\$1,000	\$1,025	\$992	\$1,033	
AMD Server Units (K)	572	1,223	2,072	683	834	1,103	1,257	3,876	1,306	1,359	1,411	1,467	5,543	7,141	
Server TAM (K units)	31,248	31,183	35,342	8,129	8,941	10,001	10,339	37,410	9,171	9,270	9,611	10,197	38,249	40,175	
AMD Share	2%	4%	6%	8%	9%	11%	12%	10%	14%	15%	14%	14%	14%	18%	
Semicustom Revenue	\$1,685	\$950	\$1,568	\$716	\$800	\$845	\$850	\$3,211	\$830	\$845	\$870	\$850	\$3,395	\$3,410	
Embedded	\$191	\$153	\$140	\$42	\$50	\$50	\$50	\$192	\$50	\$50	\$50	\$50	\$200	\$200	
Other (IP)	\$160	\$20	--	--	--	--	--	--	--	--	--	--	--	--	
Enterprise/Embedded	\$2,355	\$2,023	\$3,330	\$1,345	\$1,600	\$1,915	\$2,094	\$6,954	\$2,134	\$2,226	\$2,331	\$2,404	\$9,095	\$10,986	
Q/Q Growth	3%	(14%)	65%	287%	183%	69%	63%	109%	59%	39%	22%	15%	31%	21%	
Y/Y Growth															

Source: Company reports, UBS estimates



# AMAT: Applied Materials

## Investment Thesis/Risks

<b>Our thesis</b>	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 very well positioned and should remain a share gainer as the company leverages its broad portfolio for both processes and materials to enable technology scaling roadmaps; but we feel that estimates already reflect much of this given where we see WFE for '22 and '23. We do like AMAT's leverage to emerging verticals like advanced packaging and 3D structures in logic and DRAM.
<b>Risks to our thesis</b>	WFE should continue to grow through '22E, reaching ~\$100B/yr run-rate in 2H:22E. However, we expect spending to moderate from there as chipmakers digest all of the capacity addition and work down backlog. We also feel that long-term WFE intensity is more like 13.5-14% - far below the ~15.5-16% we are running at in 1H:22E. This suggests that the amount of equipment that will have been shipped through '22 is enough to accommodate ~35-40% more semiconductor revenue. This suggests a strong potential for digestion. AMAT is also relatively more exposed to how we see US/China trade restrictions transpiring through '22 and '23.

Source: UBS estimates

## UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	CY2024
<b>Revenues (\$MM)</b>																
UBS (New)	\$ 14,608	\$ 17,202	\$ 23,063	\$ 6,195	\$ 6,605	\$ 7,105	\$ 7,230	\$ 27,135	\$ 28,911	\$ 16,802	\$ 15,017	\$ 18,202	\$ 24,096	\$ 28,232	\$ 28,393	\$ 25,528
UBS (Old)				\$ 6,195	\$ 6,605	\$ 7,105	\$ 7,230	\$ 27,135	\$ 28,911				\$ 24,096	\$ 28,232	\$ 28,393	\$ 25,528
Consensus				\$ 6,203	\$ 6,375	\$ 6,766	\$ 7,116	\$ 26,460	\$ 27,981				\$ 24,104	\$ 27,268	\$ 27,999	\$ 25,528
Delta				(0.1%)	3.6%	5.0%	1.6%	2.6%	3.3%				(0.0%)	3.5%	1.4%	--
<b>EPS (Non-GAAP)</b>																
UBS (New)	\$ 3.04	\$ 4.16	\$ 6.84	\$ 1.91	\$ 2.04	\$ 2.27	\$ 2.28	\$ 8.51	\$ 8.87	\$ 4.20	\$ 3.21	\$ 4.58	\$ 7.37	\$ 8.84	\$ 8.64	\$ 7.63
UBS (Old)				\$ 1.91	\$ 2.04	\$ 2.27	\$ 2.28	\$ 8.51	\$ 8.87				\$ 7.37	\$ 8.84	\$ 8.64	\$ 7.63
Consensus				\$ 1.86	\$ 1.94	\$ 2.09	\$ 2.24	\$ 8.13	\$ 8.80				\$ 7.33	\$ 8.45	\$ 8.87	\$ 7.63
Delta				3.0%	5.0%	8.6%	2.1%	4.6%	0.7%				0.6%	4.7%	(2.5%)	--

Source: Company reports, UBS estimates

# AMAT: Model Summary

Applied Materials, Inc. (AMAT) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020E	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	Estimates FQ1E CQ4E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY							
																F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E
Revenue	\$15,463	\$16,802	\$15,017	\$18,202	\$5,582	\$6,196	\$6,123	\$6,195	\$24,096	\$6,605	\$7,105	\$7,230	\$7,292	\$28,232	\$28,393	\$14,537	\$17,253	\$14,608	\$17,202	\$23,063	\$27,135	\$28,911
YY Growth	31%	9%	(11%)	21%	41%	41%	31%	20%	32%	18%	15%	18%	18%	17%	1%	34%	19%	(15%)	18%	34%	18%	7%
Gross Margin	46.4%	45.9%	44.1%	45.3%	47.7%	48.0%	48.2%	47.4%	47.8%	48.0%	48.5%	48.5%	48.2%	48.3%	47.9%	46.1%	46.3%	44.0%	45.1%	47.5%	48.1%	48.1%
Opex	\$2,551	\$3,029	\$3,045	\$3,297	\$894	\$944	\$922	\$953	\$3,713	\$1,058	\$1,103	\$1,163	\$1,173	\$4,497	\$4,687	\$2,476	\$2,784	\$2,777	\$2,968	\$3,346	\$3,945	\$4,390
YY Growth	6%	19%	1%	8%	13%	15%	13%	9%	13%	18%	17%	26%	23%	21%	4%	6%	12%	(0%)	7%	13%	18%	11%
Operating Margin	28.7%	27.8%	23.8%	27.2%	31.7%	32.7%	33.1%	32.0%	32.4%	32.0%	33.0%	32.4%	32.1%	32.4%	31.4%	27.9%	29.0%	23.5%	26.3%	31.7%	32.4%	31.7%
Non-GAAP EPS	\$3.64	\$4.20	\$3.21	\$4.58	\$1.63	\$1.90	\$1.94	\$1.91	\$7.37	\$2.04	\$2.27	\$2.28	\$2.25	\$8.84	\$8.64	\$3.25	\$4.45	\$3.04	\$4.16	\$6.84	\$8.51	\$8.87
FCF																						
CFFO	\$4,429	\$3,155	\$3,400	\$4,238	\$1,187	\$1,686	\$1,149	\$1,851	\$5,873	\$1,442	\$2,178	\$1,845	\$2,034	\$7,499	\$8,360	\$3,609	\$3,787	\$3,247	\$3,804	\$5,443	\$7,316	\$8,242
Capex	\$484	\$552	\$410	\$441	\$204	\$137	\$206	\$186	\$733	\$198	\$213	\$217	\$219	\$847	\$852	\$345	\$622	\$441	\$422	\$668	\$814	\$867
FCF	\$3,945	\$2,603	\$2,990	\$3,797	\$983	\$1,549	\$943	\$1,665	\$5,140	\$1,244	\$1,965	\$1,628	\$1,815	\$6,652	\$7,508	\$3,264	\$3,165	\$2,806	\$3,382	\$4,775	\$6,502	\$7,375
% revenue	25.5%	15.5%	19.9%	20.9%	17.6%	25.0%	15.4%	26.9%	21.3%	18.8%	27.7%	22.5%	24.9%	23.6%	26.4%	22.5%	18.3%	19.2%	19.7%	20.7%	24.0%	25.5%
Segment Revenue																						
Semi Systems	\$10,214	\$10,226	\$9,573	\$12,106	\$3,972	\$4,454	\$4,307	\$4,450	\$17,183	\$4,750	\$5,150	\$5,200	\$5,200	\$20,300	\$19,600	\$9,517	\$10,805	\$9,027	\$11,367	\$16,286	\$19,550	\$20,200
YY Growth	34%	0%	(6%)	26%	55%	53%	40%	25%	42%	20%	16%	21%	17%	18%	(3%)	38%	14%	(16%)	26%	43%	20%	3%
Applied Global Service	\$3,221	\$3,838	\$3,889	\$4,313	\$1,203	\$1,286	\$1,369	\$1,365	\$5,223	\$1,425	\$1,500	\$1,550	\$1,612	\$6,087	\$6,748	\$3,017	\$3,756	\$3,854	\$4,155	\$5,013	\$5,840	\$6,716
YY Growth	20%	19%	1%	11%	18%	24%	24%	18%	21%	18%	17%	13%	18%	17%	11%	15%	24%	3%	8%	21%	16%	15%
Display & Adjacent Markets	\$1,933	\$2,669	\$1,476	\$1,686	\$375	\$431	\$417	\$350	\$1,573	\$400	\$425	\$450	\$450	\$1,725	\$1,925	\$1,900	\$2,617	\$1,651	\$1,607	\$1,634	\$1,625	\$1,875
YY Growth	43%	38%	(45%)	14%	3%	1%	(14%)	(15%)	(7%)	7%	(1%)	8%	29%	10%	12%	66%	38%	(37%)	(3%)	2%	(1%)	15%
Other	\$95	\$88	\$79	\$97	\$32	\$25	\$30	\$30	\$117	\$30	\$30	\$30	\$30	\$120	\$120	\$103	\$87	\$83	\$73	\$130	\$120	\$120
YY Growth	(43%)	(7%)	(10%)	23%	357%	25%	11%	(30%)	21%	(6%)	20%	--	--	3%	--	(44%)	(16%)	(5%)	(12%)	78%	(8%)	--
Segment Operating Income																						
Semi Systems	\$3,478	\$3,270	\$2,769	\$4,134	\$1,555	\$1,794	\$1,732	\$1,736	\$6,817	\$1,853	\$2,009	\$2,028	\$2,028	\$7,917	\$7,598	\$3,173	\$3,634	\$2,475	\$3,778	\$6,362	\$7,625	\$7,878
YY Growth	56%	(6%)	(15%)	49%	95%	83%	61%	35%	65%	19%	12%	17%	17%	16%	(4%)	76%	15%	(32%)	53%	68%	20%	3%
Applied Global Service	\$893	\$1,133	\$1,094	\$1,197	\$359	\$393	\$425	\$410	\$1,587	\$428	\$450	\$465	\$467	\$1,810	\$1,907	\$817	\$1,102	\$1,101	\$1,135	\$1,517	\$1,752	\$1,930
YY Growth	25%	27%	(3%)	9%	38%	42%	33%	20%	33%	19%	15%	9%	14%	14%	5%	18%	35%	(0%)	3%	34%	15%	10%
Display & Adjacent Markets	\$491	\$693	\$223	\$338	\$66	\$100	\$86	\$70	\$322	\$84	\$94	\$99	\$99	\$376	\$424	\$505	\$679	\$297	\$304	\$327	\$347	\$413
YY Growth	58%	41%	(68%)	52%	(15%)	15%	(12%)	(7%)	(5%)	27%	(6%)	15%	41%	17%	13%	117%	34%	(56%)	2%	8%	6%	19%
Other	(\$418)	(\$424)	(\$516)	(\$712)	(\$212)	(\$258)	(\$215)	(\$232)	(\$916)	(\$252)	(\$209)	(\$248)	(\$253)	(\$962)	(\$1,020)	(\$445)	(\$422)	(\$446)	(\$688)	(\$885)	(\$941)	(\$1,051)

Source: Company reports, UBS estimates

# AVGO: Broadcom Ltd

## Investment Thesis/Risks

<b>Our thesis</b>	We see AVGO as the most attractive compounder in semis for income investors and we model the dividend to grow again to ~\$17.50 for F2023E. The company is exposed to fast growing markets with very strong franchise in each of its end markets. It also benefits from scale and is becoming more selective in M&A – a trend which investors should view favorably. While AVGO is growing ~2x what it considers its long-term growth rate, it should be able to maintain lead times in the 2H of this cycle 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.
<b>Risks to our thesis</b>	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. AVGO announced dividend increase and the new \$10B share repo program, while it will continue to look for M&A targets – we note that its hurdle rate has gone up and it is harder to find needle moving assets with a customer set that dovetails well with AVGO's core ~600 accounts. The primary risk for the stock is that it gets caught in the downcycle just like peers and its lead times provide little protection.

Source: UBS estimates

## UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenue (\$MM)</b>														
UBS (new)	\$22,597	\$23,888	\$27,450	\$7,605	\$7,425	\$7,600	\$8,123	\$30,754	\$31,929	\$22,666	\$24,685	\$28,400	\$31,024	\$32,138
UBS (old)				\$7,605	\$7,425	\$7,600	\$8,123	\$30,754	\$31,929			\$28,400	\$31,024	\$32,138
Consensus				\$7,606	\$7,430	\$7,581	\$8,114	\$30,731	\$32,408			\$28,401	\$31,218	\$32,643
Delta				(0.0%)	(0.1%)	0.3%	0.1%	0.1%	(1.5%)			(0.0%)	(0.6%)	(1.5%)
<b>EPS (non-GAAP)</b>														
UBS (new)	\$21.30	\$22.15	\$28.00	\$8.16	\$7.90	\$8.28	\$8.98	\$33.31	\$34.68	\$21.01	\$23.50	\$29.55	\$33.72	\$34.87
UBS (old)				\$8.16	\$7.90	\$8.28	\$8.98	\$33.31	\$34.68			\$29.55	\$33.72	\$34.87
Consensus				\$8.12	\$7.92	\$8.17	\$8.94	\$33.15	\$36.03			\$29.51	\$33.99	\$36.64
Delta				0.4%	(0.3%)	1.4%	0.4%	0.5%	(3.7%)			0.1%	(0.8%)	(4.8%)

Source: Company reports, UBS estimates

# AVGO: Model Summary

Broadcom (AVGO) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	Estimates FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY						
																F2017A	F2018A	F2019A	F2020A	F2021A	F2022E	F2023E
Revenue	\$18,824	\$21,310	\$22,666	\$24,685	\$6,610	\$6,778	\$7,407	\$7,605	\$28,400	\$7,425	\$7,600	\$8,123	\$7,875	\$31,024	\$32,138	\$17,636	\$24,226	\$22,597	\$23,888	\$27,450	\$30,754	\$31,929
Y/Y Growth	21%	13%	6%	9%	15%	16%	15%	14%	15%	12%	12%	10%	4%	9%	4%	33%	37%	(7%)	6%	15%	12%	4%
Gross Profit (Non-GAAP)	\$12,001	\$14,610	\$16,199	\$18,151	\$4,952	\$5,088	\$5,527	\$5,689	\$21,256	\$5,584	\$5,738	\$6,092	\$5,922	\$23,337	\$24,129	\$11,137	\$16,657	\$16,055	\$17,552	\$20,443	\$23,103	\$23,955
Gross Margin	63.8%	68.6%	71.5%	73.5%	74.9%	75.1%	74.6%	74.8%	74.8%	75.2%	75.5%	75.0%	75.2%	75.2%	75.1%	63.1%	68.8%	71.0%	73.5%	74.5%	75.1%	75.0%
R&D	\$2,705	\$3,010	\$3,230	\$3,526	\$930	\$919	\$921	\$930	\$3,700	\$940	\$935	\$930	\$900	\$3,705	\$3,590	\$2,650	\$3,617	\$3,159	\$3,535	\$3,652	\$3,735	\$3,600
SG&A	\$520	\$695	\$1,008	\$990	\$220	\$223	\$222	\$225	\$890	\$230	\$220	\$215	\$220	\$885	\$890	\$464	\$1,866	\$967	\$1,078	\$879	\$890	\$880
Opex (Non-GAAP)	\$3,225	\$3,705	\$4,238	\$4,516	\$1,150	\$1,142	\$1,143	\$1,155	\$4,590	\$1,170	\$1,155	\$1,145	\$1,120	\$4,590	\$4,480	\$3,126	\$3,507	\$4,126	\$4,613	\$4,531	\$4,625	\$4,480
Y/Y Growth	1%	15%	14%	7%	(1%)	0%	3%	5%	2%	2%	1%	0%	(3%)	--	--	15%	12%	18%	12%	(2%)	2%	(3%)
Operating Income (Non-GAAP)	\$8,776	\$10,905	\$11,961	\$13,635	\$3,802	\$3,946	\$4,384	\$4,534	\$16,666	\$4,414	\$4,583	\$4,947	\$4,802	\$18,747	\$19,649	\$8,023	\$11,174	\$11,929	\$12,939	\$15,912	\$18,478	\$19,475
Operating Margin	46.6%	51.2%	52.8%	55.2%	57.5%	58.2%	59.2%	59.6%	58.7%	59.4%	60.3%	60.9%	61.0%	60.4%	61.1%	45.4%	46.1%	52.8%	54.2%	58.0%	60.1%	61.0%
Non-GAAP EPS	\$17.50	\$21.26	\$21.01	\$23.50	\$6.62	\$6.96	\$7.81	\$8.16	\$29.55	\$7.90	\$8.28	\$8.98	\$8.56	\$33.72	\$34.87	\$16.01	\$20.80	\$21.30	\$22.15	\$28.00	\$33.31	\$34.68
Free Cash Flow																						
CFFO	\$6,883	\$9,327	\$9,887	\$12,852	\$3,569	\$3,541	\$3,541	\$3,666	\$14,317	\$3,723	\$3,758	\$3,969	\$4,045	\$15,494	\$15,970	\$6,551	\$8,880	\$9,697	\$12,061	\$13,764	\$15,116	\$15,790
Capex	\$964	\$514	\$441	\$469	\$126	\$115	\$88	\$114	\$443	\$111	\$114	\$122	\$126	\$473	\$651	\$1,069	\$635	\$432	\$463	\$443	\$461	\$607
FCF	\$5,919	\$8,813	\$9,446	\$12,383	\$3,443	\$3,426	\$3,453	\$3,552	\$13,874	\$3,611	\$3,644	\$3,847	\$3,919	\$15,021	\$15,319	\$5,482	\$8,245	\$9,265	\$11,598	\$13,321	\$14,654	\$15,183
% revenue	31%	41%	42%	50%	52%	51%	47%	47%	49%	49%	48%	47%	50%	48%	48%	31%	34%	41%	49%	49%	48%	48%
Segment Revenue (New Segments from FQ1:19)																						
Wireless Comm	\$6,439	\$5,638	\$5,440	\$5,641	\$1,639	\$1,425	\$1,825	\$2,008	\$6,898	\$1,707	\$1,792	\$2,240	\$1,949	\$7,688	\$7,882	\$5,404	\$6,490	\$5,507	\$4,969	\$6,853	\$7,747	\$7,865
Q/Q Growth																						
Y/Y Growth	49%	(12%)	(4%)	4%	46%	35%	22%	2%	22%	4%	26%	23%	(3%)	11%	3%	45%	20%	(15%)	(10%)	38%	13%	2%
Networking					\$6,035	\$1,542	\$1,808	\$1,923	\$1,850	\$7,124												
Broadband					\$2,836	\$868	\$910	\$872	\$920	\$3,570												
Other Wired					\$295																	
Wired Infrastructure	\$8,340	\$8,942	\$9,059	\$9,166	\$2,410	\$2,717	\$2,796	\$2,771	\$10,694	\$2,826	\$2,911	\$2,969	\$2,969	\$11,675	\$12,025	\$8,549	\$8,675	\$8,895	\$9,312	\$10,083	\$11,476	\$11,965
Q/Q Growth																						
Y/Y Growth	1%	7%	1%	1%	16%	13%	11%	28%	17%	17%	7%	6%	7%	9%	3%	30%	1%	3%	5%	8%	14%	4%
Industrial & Automotive	\$962	\$1,018	\$944	\$606	\$193	\$205	\$197	\$207	\$803	\$213	\$213	\$213	\$215	\$855	\$921	\$884	\$1,011	\$986	\$626	\$792	\$847	\$901
Q/Q Growth																						
Y/Y Growth	40%	6%	(7%)	(36%)	45%	56%	36%	5%	32%	11%	4%	8%	4%	7%	8%	37%	14%	(2%)	(37%)	27%	7%	6%
Enterprise Storage	\$3,083	\$4,751	\$3,283	\$3,696	\$578	\$673	\$815	\$775	\$2,841	\$806	\$814	\$822	\$789	\$3,230	\$3,318	\$2,799	\$4,672	\$3,589	\$3,871	\$2,656	\$3,216	\$3,293
Q/Q Growth																						
Y/Y Growth	33%	54%	(31%)	13%	(48%)	(31%)	(20%)	32%	(23%)	39%	21%	1%	2%	14%	3%	22%	67%	(23%)	8%	(31%)	21%	2%
Total Semiconductor Solutions	\$18,824	\$20,349	\$17,190	\$17,984	\$4,820	\$5,021	\$5,634	\$5,760	\$21,235	\$5,552	\$5,730	\$6,244	\$5,922	\$23,448	\$24,146	\$17,636	\$24,226	\$17,373	\$17,267	\$20,383	\$23,286	\$24,025
Q/Q Growth																						
Y/Y Growth	8%	(16%)	5%	20%	19%	17%	17%	18%	15%	14%	11%	3%	10%	3%	33%	37%	NA	(1%)	18%	14%	3%	
Brocade					\$1,537	\$1,494	\$375	\$418	\$410	\$437	\$437	\$437	\$472	\$1,782	\$1,924							
Q/Q Growth					NA	(3%)	(12%)	35%	19%	5%	10%	16%	4%	6%	8%							
Y/Y Growth																						
SYMC					\$400	\$1,631	\$475	\$402	\$418	\$450	\$1,745	\$450	\$450	\$475	\$1,825	\$1,900						
Q/Q Growth																						
Y/Y Growth																						
CA					\$3,487	\$3,575	\$940	\$937	\$945	\$958	\$3,780	\$987	\$984	\$992	\$1,006	\$3,969	\$4,168					
Q/Q Growth																						
Y/Y Growth																						
Total Infrastructure Software					\$5,424	\$6,701	\$1,790	\$1,757	\$1,773	\$1,845	\$7,165	\$1,874	\$1,871	\$1,879	\$1,953	\$7,576	\$7,992					
Q/Q Growth																						
Y/Y Growth																						

Source: Company reports, UBS estimates



# CDNS: Cadence Design Systems

## Investment Thesis/Risks

<b>Our thesis</b>	Design activity remains solid and revenue growth is accelerating with both contract volumes and pricing driving ACV uplift. Verification product cycle is only just ramping and this is a + for the stock. We expect CDNS' new CEO to continue to push into System Analysis and we think this could create a headwind for Op. leverage and FCF is only being guided flat y/y and we remain on the sidelines.
<b>Risks to our thesis</b>	The overall backdrop for R&D and EDA spend remains very strong and this could create upside risk to our thesis. On the downside, we see System Analysis push as taking a bite out of Op. margins and limit FCF.

Source: UBS estimates

## UBS vs Street

	Actual	Actual	Actual	Actual	Actual	Estimate	Estimate	Estimate	Estimate	CY2019	CY2020	CY2021	CY2022	CY2023
	2019	2020	FQ1:2021	FQ2:2021	FQ3:2021	FQ4:2021	2021	2022	2023					
<b>Revenues (\$MM)</b>														
UBS	\$2,336	\$2,683	\$736	\$728	\$751	\$765	\$2,980	\$3,266	\$3,531	\$2,336	\$2,683	\$2,980	\$3,266	\$3,531
UBS (old)						\$765	\$2,980	\$3,266	\$3,531			\$2,980	\$3,266	\$3,531
Consensus						\$757	\$2,973	\$3,229	\$3,495			\$2,973	\$3,229	\$3,495
Delta						1.0%	0.2%	1.1%	1.0%			0.2%	1.1%	1.0%
<b>EPS</b>														
UBS	\$2.20	\$2.80	\$0.83	\$0.86	\$0.80	\$0.80	\$3.28	\$3.61	\$3.99	\$2.20	\$2.80	\$3.28	\$3.61	\$3.99
UBS (old)						\$0.80	\$3.28	\$3.61	\$3.99			\$3.28	\$3.61	\$3.99
Consensus						\$0.76	\$3.26	\$3.58	\$3.99			\$3.26	\$3.58	\$3.99
Delta						5.3%	0.6%	0.9%	0.2%			0.6%	0.9%	0.2%

Source: Company reports, UBS estimates

# CDNS: Model Summary

Cadence (CDNS) - Key Metrics (in \$MM except EPS and DSO)	F2017A C2017A	F2018A C2018A	F2019A C2019A	F2020A C2020A	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	FQ4E CQ4E	F2021E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E	F2024E C2024E
<b>Revenue</b>	\$1,943	\$2,138	\$2,336	\$2,683	\$736	\$728	\$751	\$765	\$2,980	\$787	\$805	\$826	\$848	\$3,266	\$3,531	\$3,863
Y/Y Growth	7%	10%	9%	15%	19%	14%	13%	1%	11%	7%	10%	10%	11%	10%	8%	9%
DSO	36	51	48	46	48	48	39	40	42	40	40	40	40	42	42	43
<b>Gross Margin</b>	90.2%	90.0%	90.6%	90.6%	90.4%	91.8%	91.6%	90.5%	91.1%	91.3%	91.3%	91.3%	91.3%	91.3%	91.4%	91.5%
<b>OpEx</b>	\$1,219	\$1,278	\$1,368	\$1,486	\$386	\$381	\$420	\$420	\$1,606	\$425	\$435	\$445	\$455	\$1,760	\$1,880	\$2,030
Y/Y Growth	7%	5%	7%	9%	8%	8%	17%	0%	8%	10%	14%	6%	8%	10%	7%	8%
<b>Operating Margin</b>	27.5%	30.2%	32.1%	35.2%	38.1%	39.5%	35.7%	35.6%	37.2%	37.2%	37.2%	37.4%	37.6%	37.4%	38.2%	39.0%
<b>Non-GAAP EPS</b>	\$1.40	\$1.87	\$2.20	\$2.80	\$0.83	\$0.86	\$0.80	\$0.80	\$3.28	\$0.87	\$0.89	\$0.91	\$0.95	\$3.61	\$3.99	\$4.46
<b>Free Cash Flow</b>																
CFO	\$471	\$605	\$730	\$905	\$208	\$380	\$296	\$142	\$1,027	\$250	\$320	\$222	\$306	\$1,099	\$1,163	\$1,290
Capex	\$58	\$62	\$75	\$95	\$17	\$14	\$19	\$30	\$80	\$20	\$20	\$20	\$20	\$80	\$80	\$80
<b>FCF</b>	\$413	\$543	\$655	\$810	\$191	\$366	\$278	\$112	\$947	\$230	\$300	\$202	\$286	\$1,019	\$1,083	\$1,210
% of total rev	21%	25%	28%	30%	26%	50%	37%	15%	32%	29%	37%	24%	34%	31%	31%	31%
Y/Y Growth	6%	32%	21%	24%	(2%)	13%	49%	7%	17%	20%	(18%)	(27%)	156%	8%	6%	12%
<b>Segment Revenues</b>																
<b>Product and Maintenance</b>	\$1,814	\$1,998	\$2,205	\$2,537	\$699	\$688	\$706	\$726	\$2,820	\$748	\$764	\$785	\$806	\$3,103	\$3,354	\$3,670
Y/Y Growth	8%	10%	10%	15%	20%	14%	12%	0%	11%	7%	11%	11%	11%	10%	8%	9%
<b>Service</b>	\$129	\$140	\$132	\$146	\$37	\$40	\$45	\$38	\$160	\$39	\$40	\$41	\$42	\$163	\$177	\$193
Y/Y Growth	(2%)	9%	(6%)	11%	2%	9%	23%	4%	10%	6%	(0%)	(8%)	11%	2%	8%	9%
<b>Product Category</b>																
<b>Functional Verification</b>	\$427	\$513	\$526	\$593	\$191	\$182	\$173	\$181	\$727	\$190	\$200	\$206	\$212	\$808	\$883	\$950
Y/Y Growth	(6%)	20%	2%	13%	35%	19%	13%	26%	23%	(1%)	10%	19%	17%	11%	9%	8%
<b>Digital IC Design and Sgnoff</b>	\$563	\$620	\$701	\$774	\$199	\$204	\$218	\$220	\$840	\$224	\$224	\$227	\$229	\$904	\$952	\$1,038
Y/Y Growth	7%	10%	13%	10%	11%	14%	21%	(7%)	9%	13%	10%	4%	4%	8%	5%	9%
<b>Custom IC Design and Simulation</b>	\$525	\$556	\$596	\$665	\$169	\$168	\$173	\$173	\$682	\$178	\$181	\$185	\$191	\$735	\$782	\$848
Y/Y Growth	16%	6%	7%	12%	10%	9%	8%	(13%)	3%	5%	8%	7%	10%	8%	6%	9%
<b>System Interconnect and Analysis</b>	\$194	\$192	\$216	\$276	\$74	\$80	\$83	\$79	\$316	\$82	\$84	\$90	\$96	\$352	\$395	\$450
Y/Y Growth	7%	(1%)	12%	28%	32%	25%	13%	(5%)	14%	11%	5%	9%	21%	12%	12%	14%
<b>IP</b>	\$233	\$257	\$298	\$375	\$103	\$95	\$105	\$111	\$414	\$113	\$115	\$118	\$121	\$466	\$519	\$576
Y/Y Growth	17%	10%	16%	26%	19%	6%	5%	13%	11%	9%	21%	12%	8%	13%	11%	11%

Source: Company reports, UBS estimates

# ENTG: Entegris

## Investment Thesis/Risks

<b>Our thesis</b>	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.
<b>Risks to our thesis</b>	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 its 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 2021/1F	Actual 2021/2F	Actual 2021/3F	Estimate 2021/4F	Estimate 2021	Estimate 2022/1F	Estimate 2022/2F	Estimate 2022/3F	Estimate 2022/4F	Estimate 2022	Estimate 2023	CALENDAR YEARS					
														CY2019	CY2020	CY2021	CY2022	CY2023	CY2024
<b>Revenues (\$MM)</b>																			
UBS	\$ 1,591	\$ 1,859	\$513	\$571	\$579	\$592	\$ 2,256	\$612	\$645	\$672	\$693	\$ 2,622	\$ 2,893	\$ 1,591	\$ 1,859	\$ 2,256	\$ 2,622	\$ 2,893	\$ 3,087
UBS (old)						\$592	\$ 2,256	\$612	\$645	\$672	\$693	\$ 2,622	\$ 2,893			\$ 2,256	\$ 2,622	\$ 2,893	\$ 3,087
Consensus						\$592	\$ 2,256	\$593	\$635	\$660	\$680	\$ 2,568	\$ 2,948			\$ 2,256	\$ 2,568	\$ 2,948	\$ 3,087
Delta			(0.0%)	(0.0%)		3.2%	1.6%	1.9%	2.0%			2.1%	(1.9%)			(0.0%)	2.1%	(1.9%)	0.0%
<b>EPS</b>																			
UBS (non-GAAP)	\$ 1.93	\$ 2.54	\$ 0.70	\$ 0.85	\$ 0.92	\$ 0.88	\$ 3.35	\$ 0.92	\$ 0.95	\$ 1.00	\$ 1.04	\$ 3.91	\$ 4.45	\$ 1.93	\$ 2.54	\$ 3.35	\$ 3.91	\$ 4.45	\$ 4.80
UBS (non-GAAP) (old)						\$ 0.88	\$ 3.35	\$ 0.92	\$ 0.95	\$ 1.00	\$ 1.04	\$ 3.91	\$ 4.45			\$ 3.35	\$ 3.91	\$ 4.45	\$ 4.80
Consensus (non-GAAP)						\$ 0.89	\$ 3.36	\$ 0.89	\$ 0.97	\$ 1.01	\$ 1.05	\$ 3.92	\$ 4.60			\$ 3.36	\$ 3.92	\$ 4.60	\$ 4.80
Delta			(1.0%)	(0.2%)		2.8%	(1.3%)	(1.5%)	(0.4%)			(0.2%)	(3.3%)			(0.2%)	(0.2%)	(3.3%)	0.0%

Source: Company reports, UBS estimates

# ENTG: Model Summary

Entegris (ENTG) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020E	FQ1A	FQ2A	FQ3A	FQ4E	Estimates	FQ1E	FQ2E	FQ3E	FQ4E	C2021E	C2022E	C2023E	FISCAL YEAR SUMMARY					
	C2018A	C2019A	C2020E	CQ1A	CQ2A	CQ3A	CQ4E	C2021E	CQ1E	CQ2E	CQ3E	CQ4E	F2018A				F2019A	F2020A	F2021E	F2022E	F2023E	
Revenue (\$MM)	\$1,343	\$1,550	\$1,591	\$1,859	\$513	\$571	\$579	\$592	\$2,256	\$612	\$645	\$672	\$693	\$2,622	\$2,893	\$1,550	\$1,591	\$1,859	\$2,256	\$2,622	\$2,893	
Y/Y Growth	14%	15%	3%	17%	24%	27%	20%	14%	21%	19%	13%	16%	17%	16%	10%		15%	3%	17%	21%	16%	10%
Gross Margin	45.8%	46.9%	45.3%	45.7%	45.8%	46.4%	45.6%	46.2%	46.0%	46.2%	46.2%	46.5%	46.8%	46.4%	47.0%		46.9%	45.3%	45.7%	46.0%	46.4%	47.0%
Opex	\$316	\$356	\$359	\$390	\$107	\$114	\$112	\$117	\$449	\$120	\$129	\$136	\$141	\$526	\$579		\$356	\$359	\$390	\$449	\$526	\$579
Y/Y Growth	3%	13%	1%	9%	24%	19%	7%	13%	15%	12%	13%	22%	21%	17%	10%		13%	1%	9%	15%	17%	10%
Operating Margin	22.3%	23.9%	22.7%	24.7%	25.0%	26.5%	26.3%	26.4%	26.1%	26.6%	26.2%	26.3%	26.5%	26.4%	27.0%		23.9%	22.7%	24.7%	26.1%	26.4%	27.0%
Non-GAAP EPS	\$1.44	\$1.89	\$1.93	\$2.54	\$0.70	\$0.85	\$0.92	\$0.88	\$3.35	\$0.92	\$0.95	\$1.00	\$1.04	\$3.91	\$4.45		\$1.89	\$1.93	\$2.54	\$3.35	\$3.91	\$4.45
Consensus																				\$3.36	\$3.87	\$4.30
Cash Flow																						
CFFO	\$293	\$313	\$382	\$447	\$53	\$82	\$150	\$155	\$442	\$140	\$132	\$151	\$156	\$579	\$716		\$313	\$382	\$447	\$442	\$579	\$716
Capex	\$94	\$110	\$112	\$132	\$43	\$42	\$49	\$91	\$225	\$92	\$97	\$101	\$104	\$393	\$434		\$110	\$112	\$132	\$225	\$393	\$434
FCF	\$200	\$202	\$270	\$315	\$10	\$40	\$101	\$64	\$217	\$48	\$35	\$50	\$52	\$185	\$282		\$202	\$270	\$315	\$217	\$185	\$282
% revenue	14.9%	13.1%	17.0%	16.9%	1.9%	7.0%	17.4%	10.8%	9.6%	7.9%	5.5%	7.4%	7.5%	7.1%	9.8%		13.1%	17.0%	16.9%	9.6%	7.1%	9.8%
Y/Y Growth	40%	1%	33%	17%	-188%	-62%	47%	-58%	-31%	393%	-12%	-50%	-19%	-15%	52%		1%	33%	17%	-31%	-15%	52%
Segment Revenue (\$MM)																						
Specialty Chemicals and Engineered Mater	\$485	\$530	\$527	\$610	\$167	\$180	\$176	\$183	\$707	\$190	\$199	\$204	\$216	\$809	\$884		\$530	\$527	\$610	\$707	\$809	\$884
Y/Y Growth	13%	9%	-1%	16%	15%	23%	17%	9%	16%	14%	11%	16%	18%	14%	9%		9%	-1%	16%	14%	9%	9%
Microcontamination Control	\$437	\$554	\$634	\$742	\$207	\$228	\$226	\$235	\$895	\$243	\$261	\$273	\$285	\$1,063	\$1,217		\$554	\$634	\$742	\$895	\$1,063	\$1,217
Y/Y Growth	20%	27%	14%	17%	30%	24%	17%	14%	21%	17%	15%	21%	22%	19%	15%		27%	14%	17%	21%	19%	15%
Advanced Materials Handling	\$445	\$493	\$458	\$539	\$149	\$173	\$186	\$182	\$690	\$188	\$194	\$203	\$201	\$786	\$827		\$493	\$458	\$539	\$690	\$786	\$827
Y/Y Growth	16%	11%	-7%	18%	28%	36%	29%	20%	28%	27%	12%	9%	10%	14%	5%		11%	-7%	18%	28%	14%	5%

Source: Company reports, UBS estimates

# INTC: Intel Corp.

## Investment Thesis/Risks

<b>Our thesis</b>	We remain strong believers that INTC will ultimately catch up in terms of the manufacturing and the relationship with TSMC is a big positive for the product roadmap. We also like INTC's diversified approach as it now architecturally covers the entire 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 a 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. We are also skeptical of the 10-12% LT CAGR and even so, much of this revenue seems parked in out in 2025/2026 and this seems too far out. Ergo, we are Neutral on INTC.
<b>Risks to our thesis</b>	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. On the other hand, building a foundry business is very challenging and the company 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 incremental workload. AMD remains a threat as well, though INTC's partnership with TSMC should start to nullify this threat.

Source: UBS estimates

## UBS vs Street

	Actual 2019	Actual 2020	Actual 2021/1F	Actual 2021/2F	Actual 2021/3F	Estimate 2021/4F	Estimate 2021	Estimate 2022/1F	Estimate 2022/2F	Estimate 2022/3F	Estimate 2022/4F	Estimate 2022	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																	
UBS	\$71,965	\$77,867	\$18,566	\$18,533	\$18,087	\$18,546	\$73,732	\$18,312	\$18,229	\$18,931	\$19,476	\$74,949	\$71,965	\$77,867	\$73,732	\$74,949	\$83,849
UBS Old						\$18,546	\$73,732	\$18,312	\$18,229	\$18,931	\$19,476	\$74,949			\$73,732	\$74,949	\$83,849
Consensus						\$18,327	\$73,513	\$17,583	\$18,004	\$18,670	\$19,035	\$73,292			\$73,513	\$73,292	\$77,712
Delta						1.2%	0.3%	4.1%	1.3%	1.4%	2.3%	2.3%			0.3%	2.3%	7.9%
<b>EPS</b>																	
UBS (Non-GAAP)	\$4.87	\$5.30	\$1.39	\$1.28	\$1.71	\$0.90	\$5.28	\$0.82	\$0.79	\$0.84	\$0.85	\$3.30	\$4.87	\$5.30	\$5.28	\$3.30	\$3.92
UBS (Non-GAAP) Old						\$0.90	\$5.28	\$0.82	\$0.79	\$0.84	\$0.85	\$3.30			\$5.28	\$3.30	\$3.92
Consensus (Non-GAAP)						\$0.90	\$5.28	\$0.86	\$0.87	\$0.94	\$0.96	\$3.64			\$5.28	\$3.64	\$3.74
Delta						(0.4%)	(0.2%)	(4.5%)	(10.0%)	(11.3%)	(11.8%)	(9.5%)			(0.2%)	(9.5%)	4.9%

Source: Company reports, UBS estimates

# INTC: Model Summary

Intel (INTC) - Key Metrics (in \$MM except EPS and units)	Estimates														
	F2017A C2017A	F2018A C2018A	F2019A C2019A	F2020A C2020A	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	FQ4E CQ4E	F2021E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
Revenue (GAAP)	62,761	70,848	71,965	77,867	19,673	19,631	19,192	19,546	78,042	18,312	18,229	18,931	19,476	74,949	83,849
(-) NSG	--	--	--	4,960	1,002	994	1,000	1,000	3,996	--	--	--	--	--	--
<b>Revenue (Non GAAP)</b>	<b>\$62,761</b>	<b>\$70,848</b>	<b>\$71,965</b>	<b>\$77,867</b>	<b>\$18,566</b>	<b>\$18,533</b>	<b>\$18,087</b>	<b>\$18,546</b>	<b>\$73,732</b>	<b>\$18,312</b>	<b>\$18,229</b>	<b>\$18,931</b>	<b>\$19,476</b>	<b>\$74,949</b>	<b>\$83,849</b>
Y/Y Growth	6%	13%	2%	8%	(6%)	(6%)	(1%)	(7%)	(5%)	(1%)	(2%)	5%	5%	2%	12%
Gross Profit (Non-GAAP)	40,036	44,842	43,264	44,823	10,849	10,976	10,452	9,922	42,199	9,706	9,570	9,844	9,933	39,053	43,453
<b>Gross Margin</b>	<b>63.8%</b>	<b>63.3%</b>	<b>60.1%</b>	<b>57.6%</b>	<b>58.4%</b>	<b>59.2%</b>	<b>57.8%</b>	<b>53.5%</b>	<b>57.2%</b>	<b>53.0%</b>	<b>52.5%</b>	<b>52.0%</b>	<b>51.0%</b>	<b>52.1%</b>	<b>51.8%</b>
R&D (Non-GAAP)	13,098	13,543	13,362	13,556	3,623	3,715	3,803	3,900	15,041	3,900	4,000	4,050	4,100	16,050	17,400
MG&A (Non-GAAP)	7,474	6,750	6,150	6,180	1,328	1,599	1,674	1,675	6,276	1,700	1,650	1,625	1,600	6,575	6,525
Other	(113)	259	--	(155)	(198)	(194)	(227)	--	(619)	--	--	--	--	--	--
<b>Total Opex (Non-GAAP)</b>	<b>\$20,459</b>	<b>\$20,552</b>	<b>\$19,512</b>	<b>\$19,581</b>	<b>\$4,753</b>	<b>\$5,120</b>	<b>\$5,250</b>	<b>\$5,575</b>	<b>\$20,698</b>	<b>\$5,600</b>	<b>\$5,650</b>	<b>\$5,675</b>	<b>\$5,700</b>	<b>\$22,625</b>	<b>\$23,925</b>
Y/Y Growth	(3%)	0%	(5%)	0%	(1%)	8%	13%	4%	6%	18%	10%	8%	2%	9%	6%
Operating Income (Non-GAAP)	19,577	24,290	23,752	25,292	6,096	5,856	5,202	4,347	21,501	4,106	3,920	4,169	4,233	16,428	19,528
<b>Operating Margin</b>	<b>31.2%</b>	<b>34.3%</b>	<b>33.0%</b>	<b>32.5%</b>	<b>32.8%</b>	<b>31.6%</b>	<b>28.8%</b>	<b>23.4%</b>	<b>29.2%</b>	<b>22.4%</b>	<b>21.5%</b>	<b>22.0%</b>	<b>21.7%</b>	<b>21.9%</b>	<b>23.3%</b>
<b>Non-GAAP EPS</b>	<b>\$3.47</b>	<b>\$4.58</b>	<b>\$4.87</b>	<b>\$5.30</b>	<b>\$1.39</b>	<b>\$1.28</b>	<b>\$1.71</b>	<b>\$0.90</b>	<b>\$5.28</b>	<b>\$0.82</b>	<b>\$0.79</b>	<b>\$0.84</b>	<b>\$0.85</b>	<b>\$3.30</b>	<b>\$3.92</b>
Free Cash Flow															
CFFO	22,110	29,432	33,145	35,384	5,548	8,746	9,900	7,387	31,581	9,042	7,420	7,171	7,480	31,114	33,570
Capex	11,778	15,181	16,213	14,259	3,972	3,602	4,005	6,921	18,500	7,000	7,000	7,000	7,000	28,000	30,000
<b>FCF</b>	<b>\$10,332</b>	<b>\$14,251</b>	<b>\$16,932</b>	<b>\$21,125</b>	<b>\$1,576</b>	<b>\$5,144</b>	<b>\$5,895</b>	<b>\$466</b>	<b>\$13,081</b>	<b>\$2,792</b>	<b>\$1,170</b>	<b>\$921</b>	<b>\$1,230</b>	<b>\$6,114</b>	<b>\$3,570</b>
% of revenue	16%	20%	24%	27%	8%	28%	33%	3%	18%	15%	6%	5%	6%	8%	4%
Y/Y Growth	(15%)	38%	19%	25%	(45%)	(34%)	32%	(92%)	(38%)	77%	(77%)	(84%)	164%	(53%)	(42%)

Source: Company reports, UBS estimates

# INTC: Model Summary

Intel (INTC) - Key Metrics (in \$MM except EPS and units)	F2017A C2017A	F2018A C2018A	F2019A C2019A	F2020A C2020A	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	FQ4E CQ4E	F2021E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
	Estimates														
<b>Product Revenue</b>															
Client Computing Group (CCG)	\$34,003	\$36,976	\$37,146	\$40,057	\$10,605	\$10,109	\$9,664	\$9,685	\$40,063	\$9,627	\$9,491	\$9,713	\$9,973	\$38,804	\$38,714
PC Client	31,707	33,219	32,681	35,642	9,617	9,397	8,954	9,685	37,653	9,627	9,491	9,713	9,973	38,804	38,714
Microprocessor Revenue	24,968	26,976	26,123	27,824	7,340	7,220	7,052	7,563	25,168	7,508	7,411	7,658	7,879	--	--
<b>Desktop Revenue</b>	<b>11,503</b>	<b>11,890</b>	<b>12,153</b>	<b>11,012</b>	<b>2,625</b>	<b>2,623</b>	<b>2,969</b>	<b>3,274</b>	<b>11,490</b>	<b>3,175</b>	<b>3,080</b>	<b>3,019</b>	<b>2,958</b>	<b>12,232</b>	<b>11,830</b>
Units	100,125	91,728	86,766	77,315	18,567	19,124	21,228	22,289	81,207	21,620	20,972	20,552	20,141	83,285	80,137
Q/Q Growth					(19%)	3%	11%	5%		(3%)	(3%)	(2%)	(2%)		
YY Growth	(0%)	(8%)	(5%)	(11%)	(4%)	15%	16%	(3%)		16%	10%	(3%)	3%	3%	(4%)
ASP (\$)	\$115	\$130	\$140	\$142	\$141	\$137	\$140	\$147	\$141	\$147	\$147	\$147	\$147	\$147	\$148
Q/Q Growth					4%	(3%)	2%	5%		--	--	--	--		
YY Growth	1%	13%	8%	2%	(6%)	(6%)	1%	8%	(1%)	4%	7%	5%	--	4%	1%
Mobile Revenue	<b>13,465</b>	<b>15,086</b>	<b>13,970</b>	<b>16,812</b>	<b>4,715</b>	<b>4,598</b>	<b>4,083</b>	<b>4,290</b>	<b>17,685</b>	<b>4,332</b>	<b>4,331</b>	<b>4,639</b>	<b>4,921</b>	<b>18,223</b>	<b>18,554</b>
Units	161,479	167,875	157,213	201,305	66,390	61,079	45,198	46,102	218,769	46,102	45,180	46,987	48,867	187,137	185,775
Q/Q Growth					5%	(8%)	(26%)	2%		--	(2%)	4%	4%		
YY Growth	3%	4%	(6%)	28%	55%	40%	(13%)	(27%)		9%	(31%)	(26%)	4%	6%	(14%)
ASP (\$)	\$83	\$90	\$89	\$84	\$71	\$75	\$90	\$93	\$81	\$94	\$96	\$99	\$101	\$97	\$100
Q/Q Growth					(4%)	6%	20%	3%		1%	2%	3%	2%		
YY Growth	1%	8%	(1%)	(6%)	(23%)	(17%)	11%	25%	(3%)	32%	27%	9%	8%	20%	3%
Other/Chipset	6,739	5,811	6,558	7,818	2,277	2,177	1,902	2,122	8,477	2,119	2,080	2,056	2,094	8,349	8,330
MCG (Mobile and Communications Group)	2,296	3,757	4,465	4,415	988	712	710	--	2,410	--	--	--	--	--	--
Data Center Group (DCG)	\$19,064	\$22,942	\$23,481	\$26,103	\$5,564	\$6,455	\$6,496	\$6,669	\$25,184	\$6,666	\$6,548	\$6,896	\$7,134	\$27,244	\$30,152
Server Revenue	17,594	21,209	21,438	23,075	4,812	5,703	5,747	5,920	22,182	5,917	5,799	6,147	6,385	24,248	27,156
Units	25,953	29,348	28,123	31,374	7,035	7,910	8,385	8,636	31,966	8,809	8,633	9,151	9,700	36,292	40,183
Q/Q Growth					(9%)	12%	6%	3%		2%	(2%)	6%	6%		
YY Growth	5%	13%	(4%)	12%	(12%)	(0%)	9%	11%	2%	25%	9%	9%	12%	14%	11%
ASP	\$678	\$723	\$762	\$735	\$684	\$721	\$685	\$685	\$694	\$672	\$672	\$672	\$658	\$668	\$676
Q/Q Growth					--	5%	(5%)	--		(2%)	--	--	(2%)		
YY Growth	4%	7%	5%	(4%)	(15%)	(8%)	2%	0%	(6%)	(2%)	(7%)	(2%)	(4%)	(4%)	1%
Chipset/Other	1,628	1,746	2,040	3,047	753	752	749	749	3,003	749	749	749	749	2,996	2,996
Q/Q					(5%)	(0%)	(0%)	--		--	--	--	--		
<b>Breakout by Vertical</b>															
Cloud	\$7,063	\$9,835	\$11,229	\$13,391	\$2,416	\$2,835	\$2,635	\$2,635	\$12,353					\$13,960	\$16,540
Y/Y Growth	24%	39%	14%	19%	(29%)	(20%)	(20%)	(20%)		(8%)				13%	18%
Comms SP	\$3,689	\$4,644	\$4,902	\$5,924	\$1,552	\$1,927	\$1,814	\$1,814	\$6,042					\$6,223	\$6,410
Y/Y Growth	19%	26%	6%	21%	5%	(6%)	18%	18%		2%				3%	3%
Enterprise/Gov't	\$8,312	\$8,409	\$7,305	\$6,656	\$1,695	\$1,671	\$2,047	\$2,047	\$6,789					\$7,060	\$7,201
YY Growth	(2%)	1%	(13%)	(9%)	(20%)	6%	89%	89%		2%				4%	2%
Internet of Things Group (IOTG)	\$3,169	\$3,455	\$3,821	\$3,007	\$914	\$984	\$1,042	\$1,094	\$4,034	\$1,094	\$1,105	\$1,116	\$1,116	\$4,442	\$5,091
Platform	2,645	3,100	3,736	3,007	914	984	1,042	1,094	4,034	1,094	1,105	1,116	1,127	4,442	5,091
Q/Q	--	--	21%	(20%)	18%	8%	6%	5%	34%	--	1%	1%	1%	10%	15%
Other	524	355	85	--	--	--	--	--	--	--	--	--	--	--	--
Non-Volatile Memory Solutions Group (NSG)	\$3,520	\$4,307	\$4,362	\$5,358	\$1,107	\$1,098	\$1,105	\$1,105	\$4,415	--	--	--	--	--	--
NAND (Non-GAAP excludes this)	--	--	--	4,960	1,002	994	1,000	1,000	3,996	--	--	--	--	--	--
Optane	--	--	--	\$398	\$105	\$104	\$105	\$105	\$419	--	--	--	--	--	--
Intel Security Group (ISecG)	\$534	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Programmable Solutions Group (PSG)	\$1,902	\$2,123	\$1,987	\$1,853	\$486	\$486	\$478	\$560	\$2,075	\$457	\$571	\$639	\$616	\$2,283	\$2,511
Y/Y	8%	12%	(6%)	(7%)	(6%)	(3%)	16%	33%	12%	(6%)	17%	34%	10%	10%	10%
Mobileye	\$109	\$688	\$879	\$967	\$377	\$327	\$326	\$352	\$1,382	\$387	\$434	\$486	\$544	\$1,851	\$2,648
IFS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	\$4,409
All Other	\$569	\$357	\$289	\$522	\$620	\$172	\$81	\$81	\$954	\$81	\$81	\$81	\$81	\$324	\$324

Source: Company reports, UBS estimates



# INTC: Model Summary

Intel (INTC) - Key Metrics (in \$MM except EPS and units)	F2017A C2017A	F2018A C2018A	F2019A C2019A	F2020A C2020A	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	FQ4E CQ4E	F2021E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
	Estimates														
<b>Operating Margins</b>															
Client Computing Group (CCG)	38%	38%	41%	38%	39%	37%	34%	34%	36%	34%	34%	34%	34%	34%	34%
Data Center Group (DCG)	44%	50%	44%	40%	23%	30%	32%	34%	30%	34%	36%	39%	39%	37%	42%
Internet of Things Group (IOTG)	21%	28%	29%	19%	28%	30%	28%	22%	27%	25%	27%	28%	28%	27%	27%
Non-Volatile Memory Solutions Group (NSG)	(7%)	(0%)	(27%)	7%	15%	37%	40%	12%	26%	5%	5%	5%	5%	--	--
Intel Security Group (ISEC)	18%	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Programmable Solutions Group (PSG)	24%	22%	16%	14%	18%	17%	16%	17%	16%	17%	18%	18%	19%	18%	20%
All Other	(637%)	(359%)	(1,342%)	(648%)	(374%)	(602%)	(1,291%)	(1,994%)	(630%)	(2,324%)	(2,694%)	(2,946%)	(3,118%)	(2,770%)	(2,777%)
<b>Q/Q Growth (Top Segment Level)</b>															
Client Computing Group (CCG)					(3%)	(5%)	(4%)	0%		(1%)	(1%)	2%	3%		
Data Center Group (DCG)					(9%)	16%	1%	3%		(0%)	(2%)	5%	3%		
Internet of Things Group (IOTG)					18%	8%	6%	5%		--	1%	1%	1%		
Optane (within NSG)					5%	(1%)	1%	--		(100%)	NA	NA	NA		
Programmable Solutions Group (PSG)					15%	--	(2%)	17%		(19%)	25%	12%	(4%)		
Mobiley					13%	(13%)	(0%)	8%		10%	12%	12%	12%		
All Other					194%	(72%)	(53%)	--		--	--	--	--		
<b>Y/Y Growth (Top Segment Level)</b>															
Client Computing Group (CCG)	3%	9%	0%	8%	8%	6%	(2%)	(11%)	0%	(9%)	(6%)	1%	3%	(3%)	(0%)
Data Center Group (DCG)	11%	20%	2%	11%	(20%)	(9%)	10%	10%	(4%)	20%	1%	6%	7%	8%	11%
Internet of Things Group (IOTG)	20%	9%	11%	(21%)	4%	47%	54%	41%	34%	20%	12%	7%	3%	10%	15%
Optane (within NSG)	NA	NA	NA	NA	(24%)	74%	5%	5%	5%	--	--	--	--	--	--
Programmable Solutions Group (PSG)	8%	12%	(6%)	(7%)	(6%)	(3%)	16%	33%	12%	(6%)	17%	34%	10%	10%	10%
Mobiley	NA	531%	28%	10%	48%	124%	39%	6%	43%	3%	33%	49%	55%	34%	43%
All Other	186%	(37%)	(19%)	81%	839%	24%	(24%)	(62%)	83%	(87%)	(53%)	--	--	(66%)	--

Source: Company reports, UBS estimates

# KLAC: KLA Corp

## Investment Thesis/Risks

<b>Our thesis</b>	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 expect memory revenue dollars to out-grow non-memory revenue dollars at the chip level which should start to move the mix back in the other direction – a headwind for KLAC's growth. We also believe that WFE will start to flatten off and peak as we move into 2H:22E and 2023E which will provide an additional headwind. We like the 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 but we simply view it as more of defensive investment when the cycle starts to roll over and the WFE dollars mix away from capacity and toward technology – which we think is more of a 2H:22 or C2023 event.
<b>Risks to our thesis</b>	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. Its valuation versus peers and the broader market has also compressed recently, suggesting that the market may be starting to discount some of our concerns. 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	2024	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																
UBS (New)	\$ 4,569	\$ 5,806	\$ 6,919	\$ 2,084	\$ 2,332	\$ 2,389	\$ 2,432	\$ 9,237	\$ 9,788	\$ 9,703	\$ 4,304	\$ 5,279	\$ 6,073	\$ 8,145	\$ 9,675	\$ 9,860
UBS (Old)					\$ 2,332	\$ 2,389	\$ 2,432	\$ 9,237	\$ 9,788	\$ 9,703				\$ 8,145	\$ 9,675	\$ 9,860
Consensus					\$ 2,334	\$ 2,370	\$ 2,411	\$ 9,199	\$ 9,483	\$ 10,058				\$ 8,147	\$ 9,480	\$ 9,802
Delta					(0.1%)	0.8%	0.8%	0.4%	3.2%	(3.5%)				(0.0%)	2.1%	0.6%
<b>EPS (Non-GAAP)</b>																
UBS (New)	\$ 8.46	\$ 10.35	\$ 14.55	\$ 4.64	\$ 5.43	\$ 5.52	\$ 5.61	\$ 21.19	\$ 22.25	\$ 21.92	\$ 9.14	\$ 8.73	\$ 11.48	\$ 18.36	\$ 22.20	\$ 22.33
UBS (Old)					\$ 5.43	\$ 5.52	\$ 5.61	\$ 21.19	\$ 22.25	\$ 21.92				\$ 18.36	\$ 22.20	\$ 22.33
Consensus					\$ 5.45	\$ 5.50	\$ 5.59	\$ 21.18	\$ 21.59	\$ 23.67				\$ 18.37	\$ 21.76	\$ 22.85
Delta					(0.2%)	0.2%	0.3%	0.1%	3.0%	(7.4%)				(0.0%)	2.0%	(2.3%)

Source: Company reports, UBS estimates

# KLAC: Model Summary

KLA Corporation (KLAC) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020E	Estimates				C2021E	FQ3E	FQ4:20E	FQ1E	FQ2E	C2022E	C2023E	FISCAL YEAR SUMMARY				
					FQ3A CQ1A	FQ4:20A CQ2A	FQ1A CQ3A	FQ2E CQ4E								F2019A	F2020A	F2021E	F2022E	F2023E
Systems	\$2,981	\$3,320	\$3,913	\$4,510	\$1,375	\$1,481	\$1,630	\$1,865	\$6,352	\$1,905	\$1,930	\$1,925	\$1,915	\$7,675	\$7,660	\$3,392	\$4,329	\$5,240	\$7,330	\$7,690
Y/Y Growth	19%	11%	18%	15%	31%	38%	42%	51%	41%	39%	30%	18%	3%	21%	(0%)	7%	28%	21%	40%	5%
Services	\$817	\$985	\$1,365	\$1,563	\$428	\$444	\$454	\$467	\$1,794	\$484	\$502	\$500	\$514	\$2,000	\$2,200	\$1,177	\$1,478	\$1,678	\$1,907	\$2,098
Y/Y Growth	9%	21%	39%	15%	15%	15%	16%	13%	15%	13%	13%	10%	10%	11%	10%	34%	26%	14%	14%	10%
Revenue	\$3,798	\$4,304	\$5,279	\$6,073	\$1,804	\$1,925	\$2,084	\$2,332	\$8,145	\$2,389	\$2,432	\$2,425	\$2,429	\$9,675	\$9,860	\$4,569	\$5,806	\$6,919	\$9,237	\$9,788
Y/Y Growth	17%	13%	23%	15%	27%	32%	35%	41%	34%	32%	26%	16%	4%	19%	2%	13%	27%	19%	34%	6%
Gross Margin	63.5%	64.4%	60.2%	61.4%	62.9%	62.0%	62.9%	63.2%	62.8%	63.0%	63.0%	63.0%	63.0%	63.0%	63.0%	61.8%	60.8%	62.2%	63.0%	63.0%
Opex	\$976	\$1,064	\$1,449	\$1,515	\$407	\$419	\$432	\$469	\$1,727	\$484	\$499	\$509	\$519	\$2,011	\$2,154	\$1,219	\$1,598	\$1,597	\$1,884	\$2,102
Y/Y Growth	13%	9%	36%	5%	8%	14%	15%	19%	14%	19%	19%	18%	11%	16%	7%	17%	31%	(0%)	18%	12%
Operating Margin	37.8%	39.7%	32.7%	36.4%	40.4%	40.2%	42.2%	43.1%	41.6%	42.7%	42.5%	42.0%	41.6%	42.2%	41.2%	35.1%	33.2%	39.1%	42.6%	41.5%
Non-GAAP EPS	\$7.03	\$9.14	\$8.73	\$11.48	\$3.85	\$4.43	\$4.64	\$5.43	\$18.36	\$5.52	\$5.61	\$5.55	\$5.53	\$22.20	\$22.33	\$8.46	\$10.35	\$14.55	\$21.19	\$22.25
Free Cash Flow																				
CFFO	\$1,190	\$1,390	\$1,373	\$1,968	\$646	\$466	\$864	\$624	\$2,600	\$799	\$837	\$739	\$869	\$3,244	\$3,420	\$1,153	\$1,779	\$2,185	\$3,124	\$3,293
Capex	\$49	\$87	\$149	\$200	\$61	\$55	\$69	\$47	\$232	\$48	\$49	\$49	\$49	\$193	\$197	\$130	\$153	\$232	\$212	\$196
FCF	\$1,141	\$1,303	\$1,224	\$1,768	\$585	\$410	\$795	\$578	\$2,368	\$751	\$788	\$690	\$821	\$3,050	\$3,223	\$1,022	\$1,626	\$1,953	\$2,912	\$3,097
% revenue	30.1%	30.3%	23.2%	29.1%	32.4%	21.3%	38.1%	24.8%	29.1%	31.4%	32.4%	28.5%	33.8%	31.5%	32.7%	22.4%	28.0%	28.2%	31.5%	31.6%
Segment Revenue																				
Total Systems Revenue	\$2,981	\$3,320	\$3,913	\$4,510	\$1,375	\$1,481	\$1,630	\$1,865	\$6,352	\$1,905	\$1,930	\$1,925	\$1,915	\$7,675	\$7,660	\$3,392	\$4,329	\$5,240	\$7,330	\$7,690
Process control	\$2,981	\$3,320	\$3,144	\$3,518	\$1,115	\$1,168	\$1,328	\$1,550	\$5,161	\$1,575	\$1,600	\$1,600	\$1,600	\$6,375	\$6,350	\$3,099	\$3,359	\$4,168	\$6,053	\$6,400
Spec semis			\$171	\$298	\$77	\$81	\$93	\$95	\$346	\$95	\$95	\$101	\$98	\$389	\$409	\$53	\$270	\$304	\$378	\$402
FPD+PCB			\$375	\$485	\$142	\$184	\$138	\$150	\$613	\$170	\$170	\$169	\$162	\$671	\$681	\$126	\$497	\$563	\$628	\$668
Other			\$159	\$210	\$42	\$48	\$72	\$70	\$232	\$65	\$65	\$55	\$55	\$240	\$220	\$50	\$203	\$206	\$272	\$220
Total Service Revenue	\$817	\$985	\$1,365	\$1,563	\$428	\$444	\$454	\$467	\$1,794	\$484	\$502	\$500	\$514	\$2,000	\$2,200	\$1,177	\$1,478	\$1,678	\$1,907	\$2,098

Source: Company reports, UBS estimates

# LRCX: Lam Research

## Investment Thesis/Risks

<b>Our thesis</b>	We are structural bulls on memory as we believe memory revenue dollars will continue to outgrow non-memory over time. Within memory, LRCX is more levered to NAND where meaningful consolidation has yet to really happen, we continue to expect capex to remain very high relative to industry EBITDA, and we see the quarterly trajectory of WFE inflecting higher through '22. The nature of the NAND business also makes LRCX's installed base one of the "stickiest" in the sector as LRCX should continue to monetize the dominant share that it secured many years back during the initiation planar-3D transition. LRCX should similarly benefit as other device types start to build more vertically. Lastly, LRCX has the fastest growing service business in the sector and if we valued this more in-line w/traditional "toll-taking" business models, this would imply a very low multiple for its equipment business.
<b>Risks to our thesis</b>	We see overall WFE starting to flatten off and potentially decline in '23 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	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>	\$ 9,654	\$ 10,045	\$ 14,626	\$ 4,304	\$ 4,500	\$ 4,675	\$ 4,850	\$ 18,329	\$ 5,000	\$ 5,000	\$ 5,100	\$ 5,200	\$ 20,300	\$ 10,560	\$ 9,549	\$ 11,929	\$ 16,797	\$ 19,525	\$ 20,500
UBS (New)					\$ 4,500	\$ 4,675	\$ 4,850	\$ 18,329									\$ 16,797	\$ 19,525	\$ 20,500
UBS (Old)																			
Consensus					\$ 4,413	\$ 4,489	\$ 4,585	\$ 17,791											
Delta					2.0%	4.2%	5.8%	3.0%	7.1%	6.3%	9.4%	10.1%	8.2%				0.5%	5.9%	7.9%
<b>EPS (Non-GAAP)</b>	\$ 14.55	\$ 15.94	\$ 27.25	\$ 8.36	\$ 8.82	\$ 9.28	\$ 9.81	\$ 36.24	\$ 10.37	\$ 10.54	\$ 10.80	\$ 11.19	\$ 42.88	\$ 17.34	\$ 14.51	\$ 20.47	\$ 32.75	\$ 40.00	\$ 43.49
UBS (New)					\$ 8.82	\$ 9.28	\$ 9.81	\$ 36.24									\$ 32.75	\$ 40.00	\$ 43.49
UBS (Old)																			
Consensus						\$ 8.51	\$ 8.70	\$ 8.98	\$ 34.54										
Delta						3.6%	6.7%	9.2%	4.9%	12.2%	11.6%	16.8%	18.4%	14.7%			1.0%	10.0%	14.1%

Source: Company reports, UBS estimates

# LRCX: Model Summary

Lam Research Corporation (LRCX) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020	Estimates				C2021E	FQ3E	FQ4:21E	FQ1E	FQ2E	C2022E	C2023E	FISCAL YEAR SUMMARY					
					FQ3 CQ1	FQ4:21A CQ2A	FQ1A CQ3A	FQ2E CQ4E								F2018A	F2019A	F2020A	F2021A	F2022E	F2023E
Systems	\$6,949	\$7,842	\$6,295	\$7,968	\$2,545	\$2,764	\$2,925	\$3,060	\$11,294	\$3,100	\$3,175	\$3,250	\$3,150	\$12,675	\$12,575	\$8,268	\$6,452	\$6,626	\$9,765	\$12,260	\$12,825
Y/Y Growth	70%	13%	(20%)	27%	54%	48%	36%	33%	42%	22%	15%	11%	3%	12%	(1%)	48%	(22%)	3%	47%	26%	5%
Services	\$2,609	\$3,029	\$3,254	\$3,960	\$1,302	\$1,381	\$1,380	\$1,440	\$5,503	\$1,575	\$1,675	\$1,750	\$1,850	\$6,850	\$7,925	\$2,809	\$3,202	\$3,419	\$4,861	\$6,070	\$7,475
Y/Y Growth	14%	16%	7%	22%	52%	49%	34%	25%	39%	21%	21%	27%	28%	24%	16%	15%	14%	7%	42%	25%	23%
Total Revenue	\$9,558	\$10,871	\$9,549	\$11,929	\$3,848	\$4,145	\$4,304	\$4,500	\$16,797	\$4,675	\$4,850	\$5,000	\$5,000	\$19,525	\$20,500	\$11,077	\$9,654	\$10,045	\$14,626	\$18,329	\$20,300
Y/Y Growth	50%	14%	(12%)	25%	54%	48%	35%	30%	41%	22%	17%	16%	11%	16%	5%	38%	(13%)	4%	46%	25%	11%
Gross Margin	46.9%	46.9%	45.5%	46.7%	46.3%	46.5%	46.0%	46.3%	46.3%	46.5%	46.5%	47.5%	48.0%	47.1%	47.5%	47.4%	45.9%	45.9%	46.7%	46.3%	47.9%
Opex	\$1,749	\$1,872	\$1,850	\$2,066	\$567	\$574	\$586	\$610	\$2,336	\$642	\$647	\$672	\$682	\$2,642	\$2,707	\$1,868	\$1,829	\$1,891	\$2,227	\$2,485	\$2,717
Y/Y Growth	19%	7%	(1%)	12%	16%	16%	12%	8%	13%	13%	13%	15%	12%	13%	2%	15%	(2%)	3%	18%	12%	9%
Operating Margin	28.7%	29.6%	26.2%	29.4%	31.6%	32.6%	32.4%	32.7%	32.4%	32.8%	33.2%	34.1%	34.4%	33.6%	34.3%	30.5%	27.0%	27.1%	31.3%	32.7%	34.5%
Non-GAAP EPS	\$13.70	\$17.34	\$14.51	\$20.47	\$7.49	\$8.09	\$8.36	\$8.82	\$32.75	\$9.28	\$9.81	\$10.37	\$10.54	\$40.00	\$43.49	\$17.87	\$14.55	\$15.94	\$27.25	\$36.24	\$42.88
Free Cash Flow																					
CFFO	\$2,039	\$3,131	\$2,585	\$2,342	\$1,165	\$1,436	\$458	\$1,175	\$4,233	\$1,240	\$1,309	\$1,380	\$1,499	\$5,429	\$6,033	\$2,656	\$3,176	\$2,126	\$3,588	\$4,181	\$5,844
Capex	\$224	\$291	\$243	\$257	\$90	\$105	\$136	\$135	\$466	\$140	\$146	\$125	\$125	\$536	\$513	\$273	\$303	\$203	\$349	\$557	\$508
FCF	\$1,815	\$2,841	\$2,343	\$2,085	\$1,075	\$1,331	\$321	\$1,040	\$3,768	\$1,100	\$1,163	\$1,255	\$1,374	\$4,893	\$5,520	\$2,382	\$2,873	\$1,923	\$3,239	\$3,624	\$5,337
% revenue	19.0%	26.1%	24.5%	17.5%	28.0%	32.1%	7.5%	23.1%	22.4%	23.5%	24.0%	25.1%	27.5%	25.1%	26.9%	21.5%	29.8%	19.1%	22.1%	19.8%	26.3%
System Revenue Segments (shipments before Jun 2018)																					
DRAM	\$1,947	NA	\$1,273	\$1,362	\$356	\$276	\$556														
Y/Y Growth	72%	NA	NA	7%	35%	(7%)	36%														
NAND	\$5,267	NA	\$2,498	\$3,513	\$1,222	\$1,354	\$1,316														
Y/Y Growth	72%	NA	NA	41%	85%	61%	57%														
Memory	\$7,214	NA	\$3,771	\$4,875	\$1,578	\$1,631	\$1,872														
Y/Y Growth	72%	NA	NA	29%	71%	43%	50%														
Foundry	\$2,033	NA	\$1,767	\$2,425	\$789	\$967	\$731														
Y/Y Growth	3%	NA	NA	37%	54%	79%	(5%)														
IDM / Logic	\$720	NA	\$758	\$668	\$178	\$166	\$322														
Y/Y Growth	43%	NA	NA	(12%)	(17%)	(11%)	150%														

Source: Company reports, UBS estimates

# MCHP: Microchip Technology Incorporated

## Investment Thesis/Risks

<b>Our thesis</b>	We see limited upside to street amid supply constraints. MCHP outsources manufacturing of 32 Bit MCU (by far the growth driver) and is heavily constrained, making it hard for MCHP to demonstrate a whole lot of MCU revenue upside (vs. already high expectations). We are still solidly mid-cycle (ISM>50). We see the cycle as still being strong enough for longer and although a stretched-out cycle improves near term set-up for the stock, we view MCHP as a defensive name that has consistently outperformed S&P/Analog much later in the cycle (ISM <50).
<b>Risks to our thesis</b>	Lead times could compress faster than we expect. Analog remains linked to macro.

Source: UBS estimates

## UBS vs Street

	F2019	F2020	F2021	2022/1F	2022/2F	2022/3F	2022/4F	F2022	F2023	F2024		CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																
UBS (new)	\$5,350	\$5,274	\$5,438	\$1,569	\$1,650	\$1,749	\$1,781	\$6,749	\$7,246	\$7,334		\$5,278	\$5,298	\$6,435	\$7,203	\$7,308
UBS (old)						\$1,749	\$1,781	\$6,749	\$7,246	\$7,334				\$6,435	\$7,203	\$7,308
Consensus						\$1,750	\$1,776	\$6,744	\$7,303	\$7,658				\$6,422	\$7,165	\$7,521
Delta						(0.1%)	0.3%	0.1%	(0.8%)	(4.2%)				0.2%	0.5%	(2.8%)
<b>EPS (non-GAAP)</b>																
UBS (new)	\$3.11	\$2.81	\$3.30	\$0.99	\$1.07	\$1.17	\$1.18	\$4.41	\$4.83	\$4.95		\$2.82	\$3.09	\$4.15	\$4.79	\$4.91
UBS (old)						\$1.17	\$1.18	\$4.41	\$4.83	\$4.95				\$4.15	\$4.79	\$4.91
Consensus						\$1.17	\$1.20	\$4.43	\$4.94	\$5.20				\$4.16	\$4.82	\$5.11
Delta						(0.2%)	(1.4%)	(0.4%)	(2.3%)	(4.9%)				(0.2%)	(0.6%)	(4.0%)

Source: Company reports, UBS estimates

# MCHP: Model Summary

Microchip (MCHP) - Key Metrics (in \$MM except EPS)	C2018A	C2019A	C2020A	Estimates								C2021E	C2022E	C2023E	FISCAL YEAR SUMMARY							
				FQ4:21A CQ1A	FQ1A CQ2A	FQ2A CQ3A	FQ3E CQ4E	FQ4:22E CQ1E	FQ1E CQ2E	FQ2E CQ3E	F2018A				F2019A	F2020A	F2021A	F2022E	F2023E	F2024E		
Revenue	\$5,022	\$5,278	\$5,298	\$1,467	\$1,569	\$1,650	\$1,749	\$6,435	\$1,781	\$1,794	\$1,825	\$1,803	\$7,203	\$7,308	\$3,981	\$5,350	\$5,274	\$5,438	\$6,749	\$7,246	\$7,334	
Y/Y Growth	29%	5%	0%	11%	20%	26%	29%	21%	21%	14%	11%	3%	12%	1%	17%	34%	(1%)	3%	24%	7%	1%	
Gross Profit	\$3,110	\$3,271	\$3,296	\$940	\$1,016	\$1,077	\$1,154	\$4,188	\$1,175	\$1,184	\$1,208	\$1,192	\$4,759	\$4,840	\$2,434	\$3,315	\$3,266	\$3,414	\$4,423	\$4,791	\$4,859	
Gross Margin	61.9%	62.0%	62.2%	64.1%	64.8%	65.3%	66.0%	65.1%	66.0%	66.0%	66.2%	66.1%	66.1%	66.2%	61.1%	62.0%	61.9%	62.8%	65.5%	66.1%	66.3%	
R&D (Non-GAAP)	\$680	\$789	\$740	\$202	\$212	\$220	\$224	\$857	\$228	\$230	\$234	\$231	\$922	\$935	\$487	\$753	\$795	\$739	\$883	\$927	\$939	
SG&A (Non-GAAP)	\$532	\$577	\$514	\$142	\$150	\$157	\$170	\$618	\$173	\$174	\$177	\$175	\$699	\$709	\$405	\$579	\$564	\$521	\$649	\$703	\$711	
Opex (Non-GAAP)	\$1,211	\$1,365	\$1,253	\$344	\$361	\$377	\$393	\$1,475	\$401	\$404	\$411	\$406	\$1,621	\$1,644	\$892	\$1,332	\$1,359	\$1,260	\$1,532	\$1,630	\$1,650	
Y/Y Growth	37%	13%	(8%)	2%	20%	26%	25%	18%	17%	12%	9%	3%	10%	1%	(2%)	49%	2%	(7%)	22%	6%	1%	
Operating Income	\$1,899	\$1,906	\$2,043	\$597	\$655	\$701	\$761	\$2,713	\$775	\$780	\$797	\$786	\$3,139	\$3,196	\$1,542	\$1,983	\$1,907	\$2,154	\$2,891	\$3,161	\$3,209	
Operating Margin	37.8%	36.1%	38.6%	40.7%	41.7%	42.5%	43.5%	42.2%	43.5%	43.5%	43.7%	43.6%	43.6%	43.7%	38.7%	37.1%	36.2%	39.6%	42.8%	43.6%	43.8%	
Non-GAAP EPS	\$3.07	\$2.82	\$3.09	\$0.93	\$0.99	\$1.07	\$1.17	\$4.15	\$1.18	\$1.19	\$1.22	\$1.20	\$4.79	\$4.91	\$2.72	\$3.11	\$2.81	\$3.30	\$4.41	\$4.83	\$4.95	
Free Cash Flow																						
CFFO	\$1,631	\$1,576	\$1,839	\$449	\$630	\$612	\$667	\$2,358	\$711	\$712	\$573	\$752	\$2,748	\$2,893	\$1,420	\$1,675	\$1,544	\$1,917	\$2,620	\$2,705	\$2,963	
Capex	\$247	\$96	\$49	\$55	\$86	\$79	\$80	\$300	\$130	\$54	\$54	\$54	\$293	\$219	\$207	\$229	\$68	\$93	\$375	\$217	\$220	
FCF	\$1,384	\$1,480	\$1,790	\$394	\$544	\$533	\$587	\$2,058	\$581	\$658	\$518	\$698	\$2,455	\$2,673	\$1,213	\$1,446	\$1,476	\$1,824	\$2,245	\$2,488	\$2,743	
% revenue	28%	28%	34%	27%	35%	32%	34%	32%	33%	37%	28%	39%	34%	37%	30%	27%	28%	34%	33%	34%	37%	
Y/Y Growth	14%	7%	21%	9%	10%	19%	20%	15%	48%	21%	(3%)	19%	19%	9%	23%	19%	2%	24%	23%	11%	10%	
Segment Revenue																						
Microcontrollers (MCU)	\$2,875	\$2,796	\$2,872	\$815	\$903	\$894	\$966	\$3,577	\$985	\$1,005	\$1,025	\$1,025	\$4,039	\$4,178	\$2,619	\$2,922	\$2,818	\$2,961	\$3,747	\$4,099	\$4,192	
Q/Q Growth				12%	11%	(1%)	8%		2%	2%	2%	--										
Y/Y Growth	13%	(3%)	3%	12%	26%	27%	33%	25%	21%	11%	15%	6%	13%	3%	22%	12%	(4%)	5%	27%	9%	2%	
Analog	\$1,390	\$1,527	\$1,472	\$415	\$432	\$491	\$515	\$1,854	\$526	\$526	\$536	\$515	\$2,103	\$2,085	\$952	\$1,531	\$1,511	\$1,520	\$1,964	\$2,092	\$2,100	
Q/Q Growth				11%	4%	14%	5%		2%	--	2%	(4%)				7%	61%	(1%)	1%	29%	6%	0%
Y/Y Growth	48%	10%	(4%)	13%	17%	36%	38%	26%	27%	22%	9%	(0%)	13%	(1%)								
LMO+PFGA	\$757	\$955	\$954	\$237	\$235	\$265	\$268	\$1,004	\$270	\$264	\$264	\$264	\$1,061	\$1,045	\$897	\$945	\$945	\$958	\$1,037	\$1,055	\$1,042	
Q/Q Growth	90%	26%	(0%)	(6%)	(1%)	13%	1%		1%	(2%)	--	--			119%	5%	--	1%	8%	2%	(1%)	
Y/Y Growth				2%	5%	8%	6%	5%	14%	12%	(0%)	(1%)	6%	(2%)								

Source: Company reports, UBS estimates

# MU: Micron Technology, Inc.

## Investment Thesis/Risks

<b>Our thesis</b>	We have a multi-year secular bull view on memory industry fundamentals and stock re-rating potential as Feb:22 Q is effectively the bottom in MU's financials and they should hockey stick higher from Feb to May and August Qs in 2022. Furthermore, as MU suggested, we believe the current "kitting" issues in PCs are transitory while cloud demand should also remain strong in 2022 – all of which argues for another strong year in 2022E and provides a favorable "up and to the right" trajectory for annual revenue/EPS. Lastly, we see significant potential for the stock to re-rate higher as DRAM cycles become shallower and shorter – an outcome that could transpire in '22 as investors see that this recent correction was much shorter and less severe than in the past.
<b>Risks to our thesis</b>	DRAM pricing decline may last longer than we are estimating based on supply and demand balance. Supply constraints may also cap Q/Q bit growth in November:22 Q and bits down in Feb:22 Q. In addition, FY2022 full year bit shipment for both DRAM/NAND may lag long-term CAGR. Lastly, from an M&A perspective, MU might be negatively impacted if WDC indeed merges with Kioxia in NAND where we already know MU missed out acquiring INTC's NAND business.

Source: UBS estimates

## UBS vs Street

	2019	2020	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	2023	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>															
UBS (New)	\$23,406	\$21,435	\$27,705	\$7,805	\$7,255	\$8,149	\$9,399	\$32,609	\$41,558	\$31,501	\$20,637	\$22,064	\$29,737	\$35,416	\$40,162
UBS (Old)				\$7,805	\$7,255	\$8,149	\$9,399	\$32,609	\$41,558				\$29,737	\$35,416	\$40,162
Consensus				\$7,677	\$7,300	\$7,986	\$8,954	\$31,917	\$37,634				\$29,609	\$33,767	\$37,853
Delta				1.7%	(0.6%)	2.0%	5.0%	2.2%	10.4%				0.4%	4.9%	6.1%
<b>EPS</b>															
UBS (New)	\$6.36	\$2.83	\$6.07	\$2.15	\$1.76	\$2.29	\$3.02	\$9.21	\$15.00	\$12.47	\$3.81	\$3.14	\$7.43	\$10.95	\$13.88
UBS (Old)				\$2.15	\$1.76	\$2.29	\$3.02	\$9.21	\$15.00				\$7.43	\$10.95	\$13.88
Consensus				\$2.10	\$1.84	\$2.11	\$2.63	\$8.68	\$11.36				\$7.38	\$9.47	\$11.51
Delta				2.3%	(4.8%)	8.6%	14.7%	6.0%	32.0%				0.7%	15.7%	20.6%

Source: Company reports, UBS estimates

# MU: Model Summary

Micron (MU): Key Metrics	Fiscal Year Summary																						
	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	Estimates FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	F2018	F2019	F2020	F2021	F2022E	F2023E		
Revenue	\$23,155	\$31,501	\$20,637	\$22,064	\$6,236	\$7,422	\$8,274	\$7,805	\$29,737	\$7,255	\$8,149	\$9,399	\$10,612	\$35,416	\$40,162	\$30,391	\$23,406	\$21,435	\$27,705	\$32,609	\$41,558		
Y/Y Growth	78%	36%	(34%)	7%	30%	36%	37%	35%	35%	16%	10%	14%	36%	19%	13%	50%	(23%)	(8%)	29%	18%	27%		
Gross Profit (Non-GAAP)	\$11,376	\$18,895	\$7,708	\$7,097	\$2,054	\$3,185	\$3,964	\$3,677	\$12,880	\$3,204	\$3,879	\$4,787	\$5,815	\$17,685	\$20,812	\$17,994	\$10,973	\$6,718	\$10,987	\$15,547	\$22,274		
Gross Margin	49.1%	60.0%	37.4%	32.2%	32.9%	42.9%	47.9%	47.1%	43.3%	44.2%	47.6%	50.9%	54.8%	49.9%	51.8%	59.2%	46.9%	31.3%	39.7%	47.7%	53.6%		
R&D Expenses (Non-GAAP) ex SBC	1,746	2,241	2,376	2,515	611	640	677	700	2,628	735	745	750	750	2,980	3,015	2,086	2,344	2,513	2,551	2,930	3,010		
SG&A Expenses (Non-GAAP) ex SBC	697	767	752	776	188	207	214	215	824	215	215	215	220	865	915	752	751	778	796	860	900		
Other & Restructuring (Non-GAAP)	53	(84)	72	15	133	453	22	--	608	--	--	--	--	(85)	77	8	616	--	--	--			
Total Opex (Non GAAP)	\$2,496	\$2,924	\$3,200	\$3,299	\$797	\$821	\$891	\$915	\$3,424	\$950	\$960	\$965	\$970	\$3,845	\$3,930	\$2,753	\$3,172	\$3,299	\$3,320	\$3,790	\$3,910		
Y/Y Growth	15%	17%	9%	3%	(7%)	(0%)	10%	13%	4%	19%	17%	8%	6%	12%	2%	11%	15%	4%	1%	14%	3%		
Operating Income (Non-GAAP)	\$8,880	\$15,971	\$4,508	\$3,798	\$1,257	\$2,364	\$3,073	\$2,762	\$9,456	\$2,254	\$2,919	\$3,822	\$4,845	\$13,840	\$16,882	\$15,241	\$7,801	\$3,419	\$7,667	\$11,757	\$18,364		
Operating Margin	38.4%	50.7%	21.8%	17.2%	20.2%	31.9%	37.1%	35.4%	31.8%	31.1%	35.8%	40.7%	45.7%	39.1%	42.0%	50.1%	33.3%	16.0%	27.7%	36.1%	44.2%		
Non-GAAP EPS	\$7.00	\$12.48	\$3.81	\$3.14	\$0.98	\$1.88	\$2.42	\$2.15	\$7.43	\$1.76	\$2.29	\$3.02	\$3.89	\$10.95	\$13.88	\$11.96	\$6.36	\$2.83	\$6.07	\$9.21	\$15.00		
Free Cash Flow																							
CCFO	10,651	18,574	10,390	8,262	3,057	3,560	3,854	4,281	14,752	4,149	3,893	4,529	5,832	18,403	24,724	17,400	13,189	8,306	12,438	16,852	24,691		
Capex	5,426	9,623	9,023	9,018	3,018	2,259	2,015	3,600	10,892	3,600	2,400	2,400	3,000	11,400	13,750	8,879	9,780	8,223	10,030	12,000	12,750		
FCF	\$5,225	\$8,951	\$1,367	(\$756)	\$39	\$1,518	\$1,847	\$681	\$4,085	\$549	\$1,493	\$2,129	\$2,832	\$7,003	\$10,974	\$8,521	\$3,409	\$83	\$2,588	\$4,852	\$11,941		
% revenue	23%	28%	7%	(3%)	1%	20%	22%	9%	14%	8%	18%	23%	27%	20%	27%	28%	15%	0%	9%	15%	29%		
Product Revenue																							
Total DRAM Revenue	\$16,072	\$23,635	\$14,420	\$15,097	\$4,444	\$5,448	\$6,091	\$5,790	\$21,773	\$5,334	\$5,959	\$6,997	\$8,237	\$26,527	\$31,913	\$22,610	\$16,807	\$14,509	\$20,039	\$24,080	\$32,920		
Unit Shipment (1MM GBe)	2,604	2,923	3,456	4,384	1,307	1,344	1,390	1,348	5,389	1,321	1,506	1,717	1,871	6,415	7,694	2,893	3,173	4,173	5,263	5,892	7,580		
Q/Q					7%	3%	3%	(3.0%)		(2%)	14%	14%	9%										
Y/Y		12%	18%	27%	44%	34%	11%	10%		23%	1%	12%	24%	39%		19%	20%	15%	10%	32%	26%	12%	29%
ASP/GB	\$6.17	\$8.09	\$4.17	\$3.44	\$3.40	\$4.05	\$4.38	\$4.30	\$4.04	\$4.04	\$3.96	\$4.08	\$4.40	\$4.13	\$4.15	\$7.82	\$5.30	\$3.23	\$3.81	\$4.09	\$4.34		
Q/Q					2%	19%	8%	(2.0%)		(6%)	(2%)	3%	8%			2%	0%	41%	(32%)	(39%)	18%	7%	6%
Y/Y		31%	(48%)	(17%)						17%						2%	0%	41%	(32%)	(39%)	18%	7%	6%
Cost/GB	\$2.71	\$2.55	\$2.25	\$2.14	\$1.93	\$2.01	\$1.97	\$1.97	\$1.97	\$1.95	\$1.79	\$1.67	\$1.60	\$1.74	\$1.59	\$2.55	\$2.29	\$2.20	\$1.99	\$1.83	\$1.60		
Q/Q					(5%)	4%	(2%)	--		(1%)	(8%)	(7%)	(4%)			(12%)	(8%)	(12%)	(10%)	(4%)	(8%)	(13%)	
Y/Y		(6%)	(12%)	(5%)						(8%)													
Total NAND Revenue	\$6,206	\$6,537	\$5,141	\$6,284	\$1,650	\$1,812	\$1,971	\$1,874	\$7,308	\$1,781	\$2,031	\$2,193	\$2,237	\$8,243	\$7,615	\$6,508	\$5,381	\$6,131	\$7,008	\$7,879	\$8,002		
Bit shipments ( MM GBe)	18,493	25,079	35,132	42,466	13,027	13,288	13,686	13,276	53,277	12,877	15,453	18,543	22,252	69,126	91,256	22,370	32,668	40,516	52,063	60,149	90,353		
Q/Q					8%	2%	3%	(3.0%)		(3%)	20%	20%	20%			33%	46%	24%	29%	16%	50%		
Y/Y		36%	40%	21%	30%	30%	34%	10%		25%	(1%)	16%	35%	68%	30%	32%	33%	46%	24%	29%	16%	50%	
ASP/GB	\$0.34	\$0.26	\$0.15	\$0.15	\$0.13	\$0.14	\$0.14	\$0.14	\$0.14	\$0.14	\$0.13	\$0.12	\$0.10	\$0.12	\$0.08	\$0.29	\$0.16	\$0.15	\$0.13	\$0.13	\$0.09		
Q/Q					(3%)	8%	6%	(2%)		(7%)	(5%)	(10%)	(15%)			(13%)	(30%)	(15%)	(43%)	(8%)	(11%)	(3%)	(32%)
Y/Y		(22%)	(44%)	1%						(2%)	(5%)	(10%)	(15%)			(13%)	(30%)	(15%)	(43%)	(8%)	(11%)	(3%)	(32%)
Cost/GB	\$0.22	\$0.16	\$0.12	\$0.12	\$0.12	\$0.11	\$0.10	\$0.10	\$0.11	\$0.10	\$0.09	\$0.08	\$0.08	\$0.09	\$0.07	\$0.17	\$0.12	\$0.12	\$0.11	\$0.09	\$0.07		
Q/Q		(26%)	(27%)	(1%)						2%	(10%)	(10%)	(10%)			(18%)	(17%)	(25%)	(29%)	(3%)	(8%)	(14%)	(22%)
Y/Y										(10%)													
Total NOR Revenue	\$959	\$1,033	\$1,089	\$584	\$117	\$137	\$187	\$116	\$557	\$115	\$135	\$184	\$113	\$546	\$533	\$1,068	\$1,144	\$694	\$559	\$549	\$536		
All Other	\$100	\$100	\$100	\$100	\$25	\$25	\$25	\$25	\$100	\$25	\$25	\$25	\$25	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100		

Source: Company reports, UBS estimates



# MRVL: Marvell Technology Group Ltd.

## Investment Thesis/Risks

<b>Our thesis</b>	Post IPHI and Innovium acquisition, MRVL becomes 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. Better supply is finally unlocking a new degree of freedom on the upside for the model and we expect the stock will act better when these delinquencies inflect lower and the story pivots to faster growth cloud.
<b>Risks to our thesis</b>	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.

Source: UBS estimates

## UBS vs Street

	F2019	F2020	F2021	2022/1F	2022/2F	2022/3F	2022/4F	F2022	2023/1F	2023/2F	2023/3F	2023/4F	F2023	F2024	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	
<b>Revenues (\$MM)</b>																					
UBS (new)	\$2,866	\$2,699	\$2,969	\$832	\$1,076	\$1,211	\$1,323	\$4,442	\$1,373	\$1,457	\$1,534	\$1,610	\$5,973	\$6,998	\$2,866	\$2,699	\$2,969	\$4,442	\$5,973	\$6,998	
UBS (old)							\$1,323	\$4,442	\$1,373	\$1,457	\$1,534	\$1,610	\$5,973	\$6,998				\$4,442	\$5,973	\$6,998	
Consensus							\$1,322	\$4,442	\$1,381	\$1,445	\$1,513	\$1,568	\$5,907	\$6,818				\$4,442	\$5,907	\$6,818	
Delta							0.0%	0.0%	(0.6%)	0.8%	1.3%	2.7%	1.1%	2.6%				0.0%	1.1%	2.6%	
<b>EPS (non-GAAP)</b>																					
UBS (new)	\$1.19	\$0.66	\$0.92	\$0.29	\$0.34	\$0.43	\$0.49	\$1.57	\$0.49	\$0.55	\$0.60	\$0.65	\$2.29	\$2.85	\$1.19	\$0.66	\$0.92	\$1.57	\$2.29	\$2.85	
UBS (old)								\$0.49	\$1.57	\$0.49	\$0.55	\$0.60	\$0.65	\$2.29	\$2.85				\$1.57	\$2.29	\$2.85
Consensus								\$0.48	\$1.54	\$0.49	\$0.53	\$0.58	\$0.62	\$2.22	\$2.86				\$1.54	\$2.22	\$2.86
Delta							1.3%	1.8%	0.1%	3.6%	3.4%	5.0%	3.2%	(0.4%)				1.8%	3.2%	(0.4%)	

Source: Company reports, UBS estimates

# MRVL: Model Summary

Marvell (MRVL) - Key Metrics (in \$MM except EPS)	F2019A C2018A	F2020A C2019A	F2021A C2020A	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	Estimates FQ4:22E CQ4E	F2022E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4:23E CQ4E	F2023E C2022E	F2024E C2023E
<b>Revenue</b>	\$2,866	\$2,699	\$2,969	\$832	\$1,076	\$1,211	\$1,323	\$4,442	\$1,373	\$1,457	\$1,534	\$1,610	\$5,973	\$6,998
Y/Y Growth	19%	-6%	10%	20%	48%	61%	66%	50%	65%	35%	27%	22%	34%	17%
<b>Gross Margin</b>	63.9%	63.3%	63.3%	64.3%	64.8%	65.1%	65.0%	64.9%	64.7%	64.8%	65.0%	65.0%	64.9%	65.4%
Opex	\$1,041	\$1,164	\$1,160	\$306	\$366	\$371	\$392	\$1,435	\$412	\$412	\$420	\$423	\$1,667	\$1,852
Y/Y Growth	22%	12%	0%	2%	23%	32%	38%	24%	35%	12%	13%	8%	16%	11%
<b>Operating Margin</b>	27.6%	20.2%	24.2%	27.5%	30.8%	34.5%	35.4%	32.6%	34.7%	36.5%	37.6%	38.7%	37.0%	38.9%
<b>Non-GAAP EPS</b>	\$1.19	\$0.66	\$0.92	\$0.29	\$0.34	\$0.43	\$0.49	\$1.57	\$0.49	\$0.55	\$0.60	\$0.65	\$2.29	\$2.85
Consensus							\$0.38	\$0.42	\$0.42	\$0.46	\$0.51	\$0.55	\$1.94	\$2.43
<b>Free Cash Flow</b>														
<b>CFFO</b>	\$597	\$360	\$817	(\$14)	\$222	\$265	\$383	\$856	\$432	\$483	\$486	\$574	\$1,975	\$2,549
<b>Capex</b>	\$76	\$85	\$107	\$21	\$32	\$77	\$40	\$170	\$41	\$44	\$46	\$48	\$179	\$210
<b>FCF</b>	\$521	\$276	\$710	(\$35)	\$190	\$188	\$344	\$686	\$391	\$439	\$440	\$525	\$1,796	\$2,339
Y/Y Growth	-4%	-47%	158%	-125%	-9%	-15%	146%	-3%	-1212%	131%	134%	53%	162%	30%
<b>Segment Revenue</b>														
<b>Data Center</b>			\$1,041	\$277	\$434	\$500	\$562	\$1,773	\$599	\$638	\$670	\$703	\$2,609	\$3,315
Y/Y Growth				4%	62%	109%	109%	70%	116%	47%	34%	25%	47%	27%
<b>Carrier Infrastructure</b>			\$600	\$168	\$197	\$215	\$239	\$818	\$258	\$276	\$284	\$293	\$1,111	\$1,293
Y/Y Growth				37%	38%	28%	44%	36%	54%	40%	32%	23%	36%	16%
<b>Enterprise Networking</b>			\$636	\$175	\$223	\$247	\$257	\$902	\$278	\$294	\$312	\$331	\$1,215	\$1,323
Y/Y Growth				10%	41%	56%	60%	42%	59%	32%	26%	29%	35%	9%
<b>Automotive/Industrial</b>			\$118	\$46	\$57	\$67	\$75	\$245	\$77	\$79	\$82	\$84	\$322	\$353
Y/Y Growth				69%	125%	114%	120%	107%	67%	38%	22%	13%	31%	10%
<b>Consumer</b>			\$575	\$167	\$165	\$183	\$190	\$704	\$161	\$169	\$186	\$199	\$717	\$715
Y/Y Growth				39%	23%	20%	13%	23%	-3%	2%	2%	5%	2%	0%

Source: Company reports, UBS estimates

# NVDA: NVIDIA Corporation

## Investment Thesis/Risks

<b>Our thesis</b>	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 in a hundreds of billions range given its very broad application spectrum.
<b>Risks to our thesis</b>	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. 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 2018	FY 2019	FY 2020	FY 2021	2022/1F	2022/2F	2022/3F	2022/4F	FY 2022	2023/1F	2023/2F	2023/3F	2023/4F	FY 2023	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	
<b>Revenues (\$MM)</b>																					
UBS (New)	\$ 9,714	\$ 11,716	\$ 10,918	\$ 16,675	\$ 5,661	\$ 6,507	\$ 7,103	\$ 7,423	\$ 26,694	\$ 7,485	\$ 8,129	\$ 8,935	\$ 8,661	\$ 33,210	\$ 11,716	\$ 10,918	\$ 16,675	\$ 26,694	\$ 33,210	\$ 37,978	
UBS (Old)									\$ 26,694	\$ 7,485	\$ 8,129	\$ 8,935	\$ 8,661	\$ 33,210				\$ 26,694	\$ 33,210	\$ 37,978	
Consensus									\$ 7,381	\$ 26,601	\$ 7,246	\$ 7,688	\$ 8,312	\$ 8,453	\$ 31,600				\$ 26,601	\$ 31,600	\$ 36,824
Delta									0.6%	0.4%	3.3%	5.7%	7.5%	2.5%	5.1%				0.4%	5.1%	3.1%
<b>EPS</b>																					
UBS (non-GAAP) (New)	\$ 1.23	\$ 1.66	\$ 1.45	\$ 2.50	\$ 0.91	\$ 1.04	\$ 1.17	\$ 1.25	\$ 4.37	\$ 1.24	\$ 1.36	\$ 1.52	\$ 1.46	\$ 5.59	\$ 1.66	\$ 1.45	\$ 2.50	\$ 4.37	\$ 5.59	\$ 6.48	
UBS (non-GAAP) (Old)									\$ 4.37	\$ 1.24	\$ 1.36	\$ 1.52	\$ 1.46	\$ 5.59				\$ 4.37	\$ 5.59	\$ 6.48	
Consensus (non-GAAP)									\$ 4.34	\$ 1.18	\$ 1.29	\$ 1.41	\$ 1.44	\$ 5.17				\$ 4.34	\$ 5.17	\$ 6.25	
Delta									2.9%	0.8%	5.7%	6.1%	7.5%	1.4%	7.9%				0.8%	7.9%	3.8%
UBS (GAAP, including SBC) (New)	\$ 1.20	\$ 1.66	\$ 1.13	\$ 1.73	\$ 0.76	\$ 0.94	\$ 0.97	\$ 1.02	\$ 3.69	\$ 1.01	\$ 1.12	\$ 1.28	\$ 1.21	\$ 4.61	\$ 1.66	\$ 1.13	\$ 1.73	\$ 3.69	\$ 4.61	\$ 5.43	
UBS (GAAP, including SBC) (Old)									\$ 3.69	\$ 1.01	\$ 1.12	\$ 1.28	\$ 1.21	\$ 4.61				\$ 3.69	\$ 4.61	\$ 5.43	

Source: Company reports, UBS estimates

# NVDA: Model Summary

NVIDIA (NVDA) - Key Metrics (in \$MM except EPS)	CY2017 F2018	CY2018 F2019	CY2019 F2020	CY2020 F2021	CQ1:21 FQ1:22	CQ2:21A FQ2:22A	CQ3:21A FQ3:22A	Estimates	CY2021E F2022E	CQ1:22E FQ1:23E	CQ2:22E FQ2:23E	CQ3:22E FQ3:23E	CQ4:22E FQ4:23E	CY2022E F2023E	CY2023E F2024E
<b>Revenue</b>	<b>\$9,714</b>	<b>\$11,716</b>	<b>\$10,918</b>	<b>\$16,675</b>	<b>\$5,661</b>	<b>\$6,507</b>	<b>\$7,103</b>	<b>\$7,423</b>	<b>\$26,694</b>	<b>\$7,485</b>	<b>\$8,129</b>	<b>\$8,935</b>	<b>\$8,661</b>	<b>\$33,210</b>	<b>\$37,978</b>
Y/Y Growth	41%	21%	(7%)	53%	84%	68%	50%	48%	60%	32%	25%	26%	17%	24%	14%
Gross Profit (Non GAAP)	\$5,844	\$7,233	\$6,822	\$10,948	\$3,746	\$4,337	\$4,761	\$5,011	\$17,855	\$5,112	\$5,511	\$6,022	\$5,881	\$22,527	\$26,008
<b>Gross Margin</b>	<b>60.2%</b>	<b>61.7%</b>	<b>62.5%</b>	<b>65.7%</b>	<b>66.2%</b>	<b>66.7%</b>	<b>67.0%</b>	<b>67.5%</b>	<b>66.9%</b>	<b>68.3%</b>	<b>67.8%</b>	<b>67.4%</b>	<b>67.9%</b>	<b>67.8%</b>	<b>68.5%</b>
R&D (Non-GAAP)	1,578	2,038	2,288	3,066	877	948	1,040	1,010	3,875	1,045	1,080	1,115	1,150	4,390	5,000
SG&A (Non-GAAP)	665	799	828	1,489	392	390	405	415	1,602	435	455	475	495	1,860	2,230
Non GAAP Adjustments	(15)	(12)	(29)	(411)	(80)	(72)	(70)	(70)	(292)	(70)	(70)	(70)	(70)	(280)	(268)
<b>Operating Expenses (Non-GAAP)</b>	<b>\$2,228</b>	<b>\$2,825</b>	<b>\$3,087</b>	<b>\$4,144</b>	<b>\$1,189</b>	<b>\$1,266</b>	<b>\$1,375</b>	<b>\$1,425</b>	<b>\$5,255</b>	<b>\$1,480</b>	<b>\$1,535</b>	<b>\$1,590</b>	<b>\$1,645</b>	<b>\$6,250</b>	<b>\$7,230</b>
Y/Y Growth	19%	27%	9%	34%	45%	22%	25%	20%	27%	24%	21%	16%	15%	19%	16%
Operating Income (Non GAAP)	\$3,616	\$4,408	\$3,735	\$6,804	\$2,557	\$3,071	\$3,386	\$3,586	\$12,600	\$3,632	\$3,976	\$4,432	\$4,236	\$16,277	\$18,778
<b>Operating Margin</b>	<b>37.2%</b>	<b>37.6%</b>	<b>34.2%</b>	<b>40.8%</b>	<b>45.2%</b>	<b>47.2%</b>	<b>47.7%</b>	<b>48.3%</b>	<b>47.2%</b>	<b>48.5%</b>	<b>48.9%</b>	<b>49.6%</b>	<b>48.9%</b>	<b>49.0%</b>	<b>49.4%</b>
GAAP EPS (incl. SBC)	\$1.20	\$1.66	\$1.13	\$1.73	\$0.76	\$0.94	\$0.97	\$1.02	\$3.69	\$1.01	\$1.12	\$1.28	\$1.21	\$4.61	\$5.43
Non-GAAP EPS (incl. SBC)	\$1.08	\$1.39	\$1.12	\$1.95	\$0.76	\$0.85	\$0.97	\$1.05	\$3.62	\$1.04	\$1.15	\$1.31	\$1.24	\$4.74	\$5.56
Non-GAAP EPS (excl. SBC)	<b>\$1.23</b>	<b>\$1.66</b>	<b>\$1.45</b>	<b>\$2.50</b>	<b>\$0.91</b>	<b>\$1.04</b>	<b>\$1.17</b>	<b>\$1.25</b>	<b>\$4.37</b>	<b>\$1.24</b>	<b>\$1.36</b>	<b>\$1.52</b>	<b>\$1.46</b>	<b>\$5.59</b>	<b>\$6.48</b>
Reported SBC (\$M)	\$390	\$557	\$845	\$1,398	\$429	\$465	\$559	\$590	\$2,043	\$602	\$614	\$626	\$639	\$2,480	\$2,685
<b>Free Cash Flow</b>															
CFFO	3,500	3,744	4,761	5,822	1,874	2,682	1,519	3,682	9,757	2,950	3,290	3,587	4,111	13,937	17,071
Capex	(593)	(600)	(488)	(1,128)	(298)	(183)	(221)	(275)	(977)	(250)	(250)	(250)	(250)	(1,000)	(1,200)
<b>FCF</b>	<b>\$2,907</b>	<b>\$3,144</b>	<b>\$4,273</b>	<b>\$4,694</b>	<b>\$1,576</b>	<b>\$2,499</b>	<b>\$1,298</b>	<b>\$3,407</b>	<b>\$8,780</b>	<b>\$2,700</b>	<b>\$3,040</b>	<b>\$3,337</b>	<b>\$3,861</b>	<b>\$12,937</b>	<b>\$15,871</b>
% of revenue	45%	45%	39%	28%	28%	38%	18%	46%	33%	36%	37%	37%	45%	39%	42%

Source: Company reports, UBS estimates

# NVDA: Model Summary

NVIDIA (NVDA) - Key Metrics (in \$MM except EPS)	CY2017 F2018	CY2018 F2019	CY2019 F2020	CY2020 F2021	CQ1:21 FQ1:22	CQ2:21A FQ2:22A	CQ3:21A FQ3:22A	Estimates CQ4:21E FQ4:22E	CY2021E F2022E	CQ1:22E FQ1:23E	CQ2:22E FQ2:23E	CQ3:22E FQ3:23E	CQ4:22E FQ4:23E	CY2022E F2023E	CY2023E F2024E
<b>Product Revenue</b>															
<b>Nintendo Switch Revenue</b>	\$866	\$785	\$752	\$918	\$135	\$118	\$367	\$164	\$783	\$109	\$136	\$303	\$143	\$692	\$573
Units (in MM)	14.82	17.42	19.92	27.38	4.73	4.45	3.83	13.72	26.73	4.00	3.59	4.71	11.07	23.37	19.62
ASP (in \$)	\$59	\$48	\$38	\$33	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30	\$30
<b>Gaming ex-Switch</b>	\$4,647	\$5,461	\$4,766	\$6,841	\$2,625	\$2,943	\$2,854	\$3,218	\$11,641	\$3,137	\$3,468	\$3,841	\$3,588	\$14,034	\$14,630
Q/Q Growth					13%	12%	(3%)	13%		(3%)	11%	11%	(7%)		
Y/Y Growth	19%	18%	(13%)	44%	128%	107%	47%	39%	70%	20%	18%	35%	11%	21%	4%
<b>Total Gaming</b>	\$5,513	\$6,246	\$5,518	\$7,759	\$2,760	\$3,061	\$3,221	\$3,382	\$12,424	\$3,247	\$3,604	\$4,144	\$3,730	\$14,725	\$15,203
Q/Q Growth					11%	11%	5%	5%		(4%)	11%	15%	(10%)		
Y/Y Growth	36%	13%	(12%)	41%	106%	85%	42%	36%	60%	18%	18%	29%	10%	19%	3%
Gross Margins (UBS Est.)	55%	56%	57%	59%	60%	60%	59%	59%	60%	59%	59%	59%	59%	59%	59%
<b>Professional Visualization</b>	\$933	\$1,130	\$1,212	\$1,053	\$372	\$519	\$577	\$589	\$2,057	\$559	\$626	\$664	\$677	\$2,526	\$2,819
Q/Q Growth					21%	40%	11%	2%		(5%)	12%	6%	2%		
Y/Y Growth	12%	21%	7%	(13%)	21%	156%	144%	92%	95%	50%	21%	15%	15%	23%	12%
Gross Margins (UBS Est.)	77%	72%	74%	69%	68%	68%	68%	68%	68%	70%	70%	70%	70%	70%	70%
<b>DC compute (excl. MLNX)</b>	\$1,932	\$2,932	\$2,983	\$5,029	\$1,504	\$1,715	\$2,386	\$2,625	\$8,230	\$2,782	\$2,949	\$3,126	\$3,220	\$12,077	\$14,966
Q/Q Growth	--	--	--	--	8%	14%	39%	10%	--	6%	6%	6%	3%	--	--
Y/Y Growth	133%	52%	2%	69%	32%	42%	86%	88%	64%	85%	72%	31%	23%	47%	24%
Gross Margins (UBS Est.)	82%	79%	76%	77%	80%	80%	79%	79%	79%	79%	79%	79%	79%	79%	79%
<b>Networking (MLNX)</b>	--	\$1,089	\$1,330	\$1,668	\$525	\$600	\$550	\$550	\$2,225	\$594	\$624	\$655	\$668	\$2,541	\$3,251
Q/Q Growth	--	--	--	--	3%	14%	(8%)	--	--	8%	5%	5%	2%	--	--
Y/Y Growth	NA	NA	22%	25%	22%	10%	(10%)	8%	33%	13%	4%	19%	21%	14%	28%
<b>Total Data Center (Incl MLNX)</b>	\$1,932	\$2,932	\$2,983	\$6,696	\$2,048	\$2,366	\$2,936	\$3,175	\$10,525	\$3,376	\$3,573	\$3,781	\$3,888	\$14,617	\$18,217
Q/Q Growth					8%	16%	24%	8%		6%	6%	6%	3%		
Y/Y Growth	133%	52%	2%	124%	79%	35%	55%	67%	57%	65%	51%	29%	22%	39%	25%
<b>Automotive</b>	\$558	\$641	\$700	\$536	\$154	\$152	\$135	\$138	\$579	\$154	\$173	\$188	\$203	\$719	\$1,038
Q/Q Growth					6%	(1%)	(11%)	2%		12%	12%	9%	8%		
Y/Y Growth	15%	15%	9%	(23%)	(1%)	37%	8%	(5%)	8%	0%	14%	39%	48%	24%	44%
Gross Margins (UBS Est.)	40%	45%	45%	41%	40%	41%	40%	43%	41%	42%	42%	42%	42%	42%	45%
<b>OEM &amp; IP</b>	\$778	\$767	\$505	\$631	\$327	\$409	\$234	\$140	\$1,110	\$149	\$153	\$158	\$163	\$623	\$701
Q/Q Growth					114%	25%	(43%)	(40%)		6%	3%	3%	3%		
Y/Y Growth	11%	(1%)	(34%)	25%	137%	180%	21%	(8%)	76%	-54%	-63%	-33%	16%	-44%	13%
Gross Margins (UBS Est.)	43%	43%	43%	41%	45%	45%	35%	35%	42%	40%	40%	40%	40%	40%	40%
<b>Segment Revenues (New segment from FY2021)</b>															
<b>Graphic</b>	NA	\$8,159	\$7,639	\$9,834	\$3,451	\$3,907	\$4,092	--	--	--	--	--	--	--	--
Q/Q Growth					13%	13%	5%								
Y/Y Growth		NA	(6%)	29%	81%	87%	47%								
Operating Profits		\$3,417	\$3,267	\$4,612	\$1,786	\$2,127	--	--	--	--	--	--	--	--	--
Operating Margins		42%	43%	47%	52%	54%	--	--	--	--	--	--	--	--	--
<b>Compute &amp; Network</b>	NA	\$3,417	\$3,279	\$6,841	\$2,210	\$2,600	\$3,011	--	--	--	--	--	--	--	--
Q/Q Growth					14%	18%	16%								
Y/Y Growth		NA	(4%)	109%	88%	46%	55%								
Operating Profits		\$1,251	\$751	\$2,548	\$861	\$1,034	--	--	--	--	--	--	--	--	--
Operating Margins		37%	23%	37%	39%	40%	--	--	--	--	--	--	--	--	--

Source: Company reports, UBS estimates

# ON: Onsemi

## Investment Thesis/Risks

<b>Our thesis</b>	ON delivered a strong set of results - a beat/raise (~\$30MM/\$70MM vs. street), Dec Q GM guide 42%-44% well above Buyside expectations - that were somewhat eclipsed by the compelling evidence of EV traction. However, the call was largely consistent w/ Analyst day targets (not a whole lot incremental in terms of revenue) that are now increasingly baked in and we would wait for a better entry point. In an endorsement of ON's technology, multiple EV customers are signing take or pay long term supply agreements (LTSA) and co-investing in late stage R&D. EV revenue should cross over ADAS in late C2023E as it ramps to >20% of Autos. Relative to GMs, we think Dec Q is benefiting from pricing and we are only modeling ~42% GMs for C2022E but we see a path to a more gradual shift to structurally higher margins (>45%).
<b>Risks to our thesis</b>	Onsemi is raising prices aggressively despite a heavy exposure to commodity Analog. The sustainability of this is an open question, although EV ramp could cushion impact. Near term impact of Auto production although EV remains strong.

Source: UBS estimates

## UBS vs Street

	F2019	F2020	2021/1F	2021/2F	2021/3F	2021/4F	F2021	2022/1F	2022/2F	2022/3F	2022/4F	F2022	F2023	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	
<b>Revenues (\$MM)</b>																				
UBS (new)	\$5,518	\$5,255	\$1,482	\$1,670	\$1,742	\$1,790	\$6,684	\$1,770	\$1,735	\$1,736	\$1,751	\$6,992	\$7,261		\$5,878	\$5,518	\$5,255	\$6,684	\$6,992	\$7,261
UBS (old)						\$1,790	\$6,684	\$1,770	\$1,735	\$1,736	\$1,751	\$6,992	\$7,261					\$6,684	\$6,992	\$7,261
Consensus						\$1,791	\$6,685	\$1,781	\$1,784	\$1,788	\$1,772	\$7,127	\$7,417					\$6,685	\$7,127	\$7,417
Delta						(0.1%)	(0.0%)	(0.6%)	(2.7%)	(2.9%)	(1.2%)	(1.9%)	(2.1%)					(0.0%)	(1.9%)	(2.1%)
<b>EPS (non-GAAP)</b>																				
UBS (new)	\$1.49	\$0.85	\$0.35	\$0.63	\$0.87	\$0.95	\$2.81	\$0.75	\$0.72	\$0.72	\$0.73	\$2.93	\$3.22		\$1.96	\$1.49	\$0.85	\$2.81	\$2.93	\$3.22
UBS (old)						\$0.95	\$2.81	\$0.75	\$0.72	\$0.72	\$0.73	\$2.93	\$3.22					\$2.81	\$2.93	\$3.22
Consensus						\$0.94	\$2.80	\$0.81	\$0.82	\$0.82	\$0.81	\$3.26	\$3.50					\$2.80	\$3.26	\$3.50
Delta						1.9%	0.5%	(7.2%)	(12.0%)	(12.7%)	(9.8%)	(10.4%)	(7.9%)					0.5%	(10.4%)	(7.9%)

Source: Company reports, UBS estimates

# ON: Model Summary

ONsemi (ON) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020E	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	Estimates FQ4E CQ4E	C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	C2022E	C2023E
	C2017A	C2018A	C2019A	C2020E	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	Estimates FQ4E CQ4E		FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E		
Revenue	\$5,543	\$5,878	\$5,518	\$5,255	\$1,482	\$1,670	\$1,742	\$1,790	\$6,684	\$1,770	\$1,735	\$1,736	\$1,751	\$6,992	\$7,261
Y/Y Growth	42%	6%	(6%)	(5%)	16%	38%	32%	24%	27%	19%	4%	(0%)	(2%)	5%	4%
Gross Profit	\$1,990	\$2,240	\$1,993	\$1,716	\$521	\$641	\$723	\$770	\$2,655	\$743	\$720	\$721	\$732	\$2,916	\$3,111
Gross Margin	35.9%	38.1%	36.1%	32.7%	35.2%	38.4%	41.5%	43.0%	39.7%	42.0%	41.5%	41.5%	41.8%	41.7%	42.8%
R&D (Non-GAAP)	\$595	\$651	\$641	\$643	\$174	\$166	\$155	\$193	\$688	\$195	\$191	\$191	\$193	\$769	\$770
SG&A (Non-GAAP)	\$602	\$618	\$585	\$537	\$151	\$149	\$144	\$129	\$574	\$127	\$125	\$125	\$126	\$503	\$523
Opex (Non-GAAP)	\$1,183	\$1,257	\$1,215	\$1,179	\$325	\$314	\$296	\$307	\$1,242	\$317	\$311	\$311	\$314	\$1,253	\$1,272
Y/Y Growth	33%	6%	(3%)	(3%)	2%	10%	4%	5%	5%	(2%)	(1%)	5%	2%	1%	2%
Operating Income	\$807	\$982	\$779	\$537	\$197	\$327	\$427	\$462	\$1,413	\$426	\$409	\$410	\$418	\$1,663	\$1,838
Operating Margin	14.6%	16.7%	14.1%	10.2%	13.3%	19.6%	24.5%	25.8%	21.1%	24.1%	23.6%	23.6%	23.9%	23.8%	25.3%
Non-GAAP EPS	\$1.46	\$1.96	\$1.49	\$0.85	\$0.35	\$0.63	\$0.87	\$0.95	\$2.81	\$0.75	\$0.72	\$0.72	\$0.73	\$2.93	\$3.22
Free Cash Flow															
CFFO	\$1,094	\$1,274	\$695	\$884	\$219	\$488	\$449	\$483	\$1,638	\$540	\$415	\$424	\$438	\$1,818	\$1,886
Capex	\$388	\$515	\$535	\$384	\$77	\$105	\$93	\$215	\$490	\$212	\$208	\$208	\$210	\$839	\$871
FCF	\$707	\$759	\$160	\$501	\$142	\$383	\$356	\$268	\$1,148	\$328	\$207	\$216	\$228	\$979	\$1,015
% revenue	13%	13%	3%	10%	10%	23%	20%	15%	17%	19%	12%	12%	13%	14%	14%
Y/Y Growth	91%	7%	(79%)	213%	320%	372%	249%	(6%)	129%	132%	(46%)	(39%)	(15%)	(15%)	4%
Segment Revenue															
PSG	\$2,819	\$3,038	\$2,788	\$2,606	\$747	\$847	\$892	\$917	\$3,402	\$901	\$883	\$884	\$891	\$3,559	\$3,696
Q/Q Growth					4%	13%	5%	3%		(2%)	(2%)	0%	1%		
Y/Y Growth	65%	8%	(8%)	(7%)	20%	37%	38%	28%	31%	21%	4%	(1%)	(3%)	5%	4%
ASG	\$1,951	\$2,071	\$1,972	\$1,910	\$532	\$608	\$614	\$630	\$2,383	\$631	\$618	\$619	\$624	\$2,493	\$2,589
Q/Q Growth					2%	14%	1%	3%		0%	(2%)	0%	1%		
Y/Y Growth	32%	6%	(5%)	(3%)	14%	42%	24%	21%	25%	19%	2%	1%	(1%)	5%	4%
ISG	\$773	\$769	\$757	\$739	\$203	\$216	\$237	\$243	\$898	\$238	\$233	\$233	\$235	\$940	\$976
Q/Q Growth					(2%)	6%	10%	3%		(2%)	(2%)	0%	1%		
Y/Y Growth	8%	(1%)	(2%)	(2%)	9%	28%	35%	17%	22%	17%	8%	(1%)	(3%)	5%	4%
End Market Revenue															
Auto	\$1,656	\$1,844	\$1,818	\$1,681	\$515	\$556	\$576	\$616	\$2,262	\$628	\$609	\$646	\$685	\$2,568	\$2,942
Q/Q Growth					5%	8%	4%	7%		2%	(3%)	6%	6%		
Y/Y Growth	26%	11%	(1%)	(8%)	16%	70%	37%	25%	35%	22%	10%	12%	11%	14%	15%
Industrial	\$1,431	\$1,559	\$1,402	\$1,337	\$371	\$434	\$479	\$493	\$1,776	\$488	\$498	\$488	\$488	\$1,961	\$2,061
Q/Q Growth					6%	17%	10%	3%		(1%)	2%	(2%)	--		
Y/Y Growth	47%	9%	(10%)	(5%)	18%	25%	47%	41%	33%	32%	15%	2%	(1%)	10%	5%
Others (Computing, Consumer, Comms, etc)	--	--	\$2,271	\$2,215	\$599	\$682	\$688	\$681	\$2,649	\$654	\$628	\$603	\$579	\$2,463	\$2,257
Q/Q Growth					2%	14%	1%	(1%)		(4%)	(4%)	(4%)	(4%)		
Y/Y Growth					15%	27%	20%	16%	20%	9%	(8%)	(12%)	(15%)	(7%)	(8%)

Source: Company reports, UBS estimates



# QRVO: Qorvo

## Investment Thesis/Risks

<b>Our thesis</b>	The main near-term question for us is now whether Mobile business could come back in March Q after QRVO's recent disappointing guidance, which we believe is likely and has to do with QRVO's supply constraints and a tepid China market QRVO is more exposed to vs. SWKS. Meanwhile, operational execution remains strong so far (GM) and AAPL's modem internalization could pose a content gain opportunity as QRVO could regain the envelope tracker. In addition, QRVO is also expanding its TAM with new diversity path, ultra wide-band, touch and medical solutions. Lastly, China 5G infrastructure where QRVO has high exposure in IDP business has finally washed out and should start to improve.
<b>Risks to our thesis</b>	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	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	CALENDAR YEARS				
														CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																		
UBS	\$ 3,090	\$ 3,239	\$ 4,015	\$ 1,110	\$ 1,255	\$ 1,113	\$ 1,168	\$ 4,646	\$ 1,140	\$ 1,320	\$ 1,379	\$ 1,216	\$ 5,055	\$ 3,132	\$ 3,730	\$ 4,551	\$ 5,007	\$ 5,325
UBS (old)						\$ 1,113	\$ 1,168	\$ 4,646	\$ 1,140	\$ 1,320	\$ 1,379	\$ 1,216	\$ 5,055			\$ 4,551	\$ 5,007	\$ 5,325
Consensus						\$ 1,106	\$ 1,146	\$ 4,617	\$ 1,164	\$ 1,325	\$ 1,366	\$ 1,228	\$ 5,082			\$ 4,544	\$ 5,001	\$ 5,451
Delta						0.6%	1.9%	0.6%	(2.1%)	(0.4%)	1.0%	(1.0%)	(0.5%)			0.2%	0.1%	(2.3%)
<b>EPS</b>																		
UBS (non-GAAP)	\$ 5.77	\$ 6.31	\$ 9.74	\$ 2.83	\$ 3.42	\$ 2.79	\$ 2.88	\$ 11.93	\$ 2.71	\$ 3.42	\$ 3.68	\$ 2.97	\$ 12.78	\$ 5.96	\$ 8.59	\$ 11.79	\$ 12.69	\$ 13.57
UBS (non-GAAP) (old)						\$ 2.79	\$ 2.88	\$ 11.93	\$ 2.71	\$ 3.42	\$ 3.68	\$ 2.97	\$ 12.78			\$ 11.79	\$ 12.69	\$ 13.57
Consensus (non-GAAP)						\$ 2.76	\$ 2.87	\$ 11.88	\$ 2.89	\$ 3.56	\$ 3.72	\$ 3.09	\$ 13.26			\$ 11.75	\$ 13.04	\$ 14.27
Delta						1.1%	0.5%	0.4%	(6.0%)	(4.0%)	(1.1%)	(3.7%)	(3.6%)			0.3%	(2.6%)	(4.9%)

Source: Company reports, UBS estimates

# QRVO: Model Summary

Qorvo, Inc. (QRVO) - Key Metrics (in \$MM except EPS and units)	C2018A	C2019A	C2020A	FQ4:21A	FQ1A	FQ2A	FQ3E	C2021E	FQ4:22E	FQ1E	FQ2E	FQ3E	C2022E	C2023E	FISCAL YEAR SUMMARY					
	CQ1A	CQ2A	CQ3A	CQ4E	CQ1E	CQ2E	CQ3E		CQ4E	C2018A	F2019A	F2020A	F2021A	F2022E	F2023E					
Revenue	\$3,075	\$3,132	\$3,730	\$1,073	\$1,110	\$1,255	\$1,113	\$4,551	\$1,168	\$1,140	\$1,320	\$1,379	\$5,007	\$5,325	\$2,974	\$3,090	\$3,239	\$4,015	\$4,646	\$5,055
Y/Y Growth	4%	2%	19%	36%	41%	18%	2%	22%	9%	3%	5%	24%	10%	6%	(2%)	4%	5%	24%	16%	9%
Gross Profit	\$1,457	\$1,489	\$1,917	\$565	\$583	\$658	\$583	\$2,388	\$607	\$598	\$693	\$724	\$2,623	\$2,775	\$1,415	\$1,466	\$1,552	\$2,091	\$2,430	\$2,654
Gross Margin	47.4%	47.5%	51.4%	52.6%	52.5%	52.4%	52.4%	52.5%	52.0%	52.5%	52.5%	52.5%	52.4%	52.1%	47.6%	47.5%	47.9%	52.1%	52.3%	52.5%
R&D (Non-GAAP)	\$422	\$444	\$519	\$139	\$144	\$150	\$152	\$584	\$160	\$165	\$170	\$170	\$665	\$699	\$422	\$423	\$458	\$537	\$605	\$675
SG&A (Non-GAAP)	\$213	\$227	\$254	\$68	\$72	\$73	\$74	\$287	\$81	\$85	\$89	\$90	\$345	\$371	\$208	\$217	\$233	\$262	\$299	\$356
Opex (Non-GAAP)	\$635	\$671	\$773	\$207	\$216	\$222	\$226	\$871	\$241	\$250	\$259	\$260	\$1,010	\$1,070	\$630	\$640	\$691	\$799	\$904	\$1,031
Y/Y Growth	(0%)	6%	15%	15%	21%	2%	16%	13%	16%	16%	17%	15%	16%	6%	(5%)	2%	8%	16%	13%	14%
Operating Income	\$822	\$818	\$1,144	\$357	\$367	\$435	\$357	\$1,517	\$367	\$348	\$434	\$464	\$1,613	\$1,705	\$785	\$826	\$861	\$1,292	\$1,526	\$1,623
Operating Margin	26.7%	26.1%	30.7%	33.3%	33.1%	34.7%	32.1%	33.3%	31.4%	30.6%	32.9%	33.6%	32.2%	32.0%	26.4%	26.7%	26.6%	32.2%	32.8%	32.1%
Non-GAAP EPS	\$5.62	\$5.96	\$8.59	\$2.74	\$2.83	\$3.42	\$2.79	\$11.79	\$2.88	\$2.71	\$3.42	\$3.68	\$12.69	\$13.57	\$5.14	\$5.77	\$6.31	\$9.74	\$11.93	\$12.78
Consensus	\$5.62	\$5.96	\$8.58	\$2.74	\$2.83	\$3.25	\$3.26	\$12.08	\$2.74	\$2.83	\$3.55	\$3.74	\$12.85	\$2.79	\$5.13	\$5.77	\$6.31	\$9.75	\$12.08	\$13.20
<b>Free Cash Flow</b>																				
CFFO	\$882	\$919	\$1,113	\$403	\$342	\$457	\$520	\$1,722	\$313	\$397	\$415	\$455	\$1,579	\$1,738	\$853	\$810	\$946	\$1,302	\$1,632	\$1,710
Capex	\$218	\$164	\$145	\$77	\$65	\$77	\$71	\$291	\$70	\$68	\$79	\$83	\$300	\$402	\$270	\$221	\$164	\$187	\$284	\$303
FCF	\$664	\$754	\$969	\$325	\$276	\$380	\$448	\$1,431	\$243	\$328	\$336	\$372	\$1,279	\$1,336	\$583	\$589	\$782	\$1,115	\$1,348	\$1,407
% revenue	22%	24%	26%	30%	25%	30%	40%	31%	21%	29%	25%	27%	26%	25%	20%	19%	24%	28%	29%	28%
Y/Y Growth	52%	14%	28%	82%	50%	60%	22%	48%	(25%)	19%	(12%)	(17%)	(11%)	4%	160%	1%	33%	43%	21%	4%

Source: Company reports, UBS estimates

# QRVO: Model Summary

Qorvo, Inc. (QRVO) - Key Metrics (in \$MM except EPS and units)	C2018A	C2019A	C2020A	FQ4:21A CQ1A	FQ1A CQ2A	FQ2A CQ3A	Estimates CQ4E	C2021E	FQ4:22E CQ1E	FQ1E CQ2E	FQ2E CQ3E	FQ3E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY					
																F2018A	F2019A	F2020A	F2021A	F2022E
<b>Segment Revenue</b>																				
<b>AAPL Revenue</b>	\$928	\$1,102	\$1,100	\$318	\$318	\$448	\$463	\$1,546	\$344	\$342	\$463	\$465	\$1,614	\$1,649	\$1,068	\$980	\$1,060	\$1,224	\$1,572	\$1,614
Units (in MM)	204	193	196	56	46	48	80	230	52	46	52	81	231	230	217	196	187	215	226	231
Blended Content (in \$)	\$4.5	\$5.7	\$5.6	\$6.0	\$6.5	\$7.0	\$7.0	\$6.7	\$7.0	\$7.0	\$7.0	\$7.0	\$7.0	\$7.2	\$4.9	\$5.0	\$5.7	\$5.7	\$6.9	\$7.0
Y/Y Growth	(16%)	19%	(0%)	64%	61%	49%	13%	41%	8%	8%	3%	0%	4%	2%	4%	(8%)	8%	15%	28%	3%
% total QRVO revenue	30%	35%	29%	30%	29%	36%	42%	34%	29%	30%	35%	34%	32%	31%	36%	32%	33%	30%	34%	32%
<b>Samsung Revenue</b>	\$168	\$252	\$291	\$84	\$57	\$69	\$68	\$278	\$84	\$86	\$90	\$86	\$345	\$373	\$196	\$163	\$280	\$296	\$278	\$351
Units (in MM)	290	295	251	76	57	69	68	270	70	72	74	69	284	290	314	284	281	269	264	286
Blended Content (in \$)	\$0.6	\$0.9	\$1.2	\$1.1	\$1.0	\$1.0	\$1.0	\$1.0	\$1.2	\$1.2	\$1.2	\$1.3	\$1.2	\$1.3	\$0.6	\$0.6	\$1.0	\$1.1	\$1.1	\$1.2
Y/Y Growth	(10%)	50%	15%	7%	(4%)	(20%)	1%	(5%)	0%	51%	30%	26%	24%	8%	(7%)	(17%)	72%	6%	(6%)	26%
% total QRVO revenue	5%	8%	8%	8%	5%	5%	6%	6%	7%	8%	7%	6%	7%	7%	7%	5%	9%	7%	6%	7%
<b>Huawei Revenue</b>	\$380	\$263	\$69	\$2	\$1	\$1	\$2	\$6	\$1	\$1	\$0	--	\$2	--	\$284	\$416	\$181	\$46	\$6	\$1
Units (in MM)	206	241	189	15	11	8	6	40	4	2	1	--	7	--	158	226	231	155	29	3
Blended Content (in \$)	\$1.8	\$1.1	\$0.4	\$0.1	\$0.1	\$0.2	\$0.3	\$0.2	\$0.3	\$0.3	\$0.2	\$0.2	\$0.3	#DIV/0!	\$1.8	\$1.8	\$0.8	\$0.3	\$0.2	\$0.3
Y/Y Growth	44%	(31%)	(74%)	(94%)	(94%)	(93%)	11%	(91%)	(15%)	(57%)	(83%)	(100%)	(65%)	(100%)	(12%)	46%	(57%)	(74%)	(87%)	(86%)
% total QRVO revenue	12%	8%	2%	0%	0%	0%	0%	0%	0%	0%	0%	--	0%	--	10%	13%	6%	1%	0%	0%
<b>China ex-Huawei</b>	\$731	\$668	\$1,144	\$405	\$461	\$469	\$306	\$1,641	\$435	\$392	\$432	\$494	\$1,753	\$1,936	\$632	\$639	\$876	\$1,290	\$1,670	\$1,772
Y/Y Growth	13%	(9%)	71%	56%	143%	36%	(12%)	43%	7%	(15%)	(8%)	61%	7%	10%	(24%)	1%	37%	47%	30%	6%
% total QRVO revenue	24%	21%	31%	38%	41%	37%	28%	36%	37%	34%	33%	36%	35%	36%	21%	21%	27%	32%	36%	35%
<b>Other ex-Apple, Samsung and Huawei</b>	\$731	\$668	\$1,144	\$405	\$461	\$469	\$306	\$1,641	\$435	\$392	\$432	\$494	\$1,753	\$1,936	\$632	\$639	\$876	\$1,290	\$1,670	\$1,772
Y/Y Growth	13%	(9%)	71%	56%	143%	36%	(12%)	43%	7%	(15%)	(8%)	61%	7%	10%	(24%)	1%	37%	47%	30%	6%
% total QRVO revenue	24%	21%	31%	38%	41%	37%	28%	36%	37%	34%	33%	36%	35%	36%	21%	21%	27%	32%	36%	35%
<b>Mobile Products</b>	\$2,207	\$2,284	\$2,605	\$808	\$836	\$987	\$839	\$3,470	\$864	\$821	\$985	\$1,044	\$3,714	\$3,958	\$2,180	\$2,198	\$2,397	\$2,857	\$3,526	\$3,738
Q/Q Growth				(2%)	4%	18%	(15%)		3%	(5%)	20%	6%								
Y/Y Growth	0%	4%	14%	45%	79%	31%	2%	33%	7%	(2%)	(0%)	24%	7%	7%	(9%)	1%	9%	19%	23%	6%
<b>Industrial and Defense Products</b>	\$867	\$848	\$1,126	\$265	\$274	\$268	\$274	\$1,081	\$304	\$319	\$335	\$335	\$1,293	\$1,366	\$789	\$893	\$842	\$1,159	\$1,120	\$1,317
Q/Q Growth				(2%)	3%	(2%)	2%		11%	5%	5%	--								
Y/Y Growth	16%	(2%)	33%	14%	(14%)	(12%)	2%	(4%)	15%	16%	25%	22%	20%	6%	22%	13%	(6%)	38%	(3%)	18%

Source: Company reports, UBS estimates

# QCOM: Qualcomm

## Investment Thesis/Risks

<b>Our thesis</b>	QCOM has a myriad of new growth vectors, most of which leverage the R&D that it has already sunk into its mobile business which supports very strong and sustainable margins. QCOM's position in most of these markets though is nowhere near as dominant as it has been in mobile for the better part of 20 years making us question whether the market will reward the stock with a higher multiple. To us, the next driver for a big upside to its new financial model is now around the pace of mmWave proliferation – very rich content for QCOM and an area where it has a major technology advantage. It's hard though to pinpoint timing given its significant added expense and investment requirements for carriers plus the lack of a killer application. In the meantime, we do not see the stock re-rating and we remain Neutral.
<b>Risks to our thesis</b>	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 recently updated LT financial model.

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	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																			
UBSe	\$ 19,532	\$ 23,532	\$ 33,566	\$ 10,300	\$ 9,661	\$ 9,748	\$ 10,974	\$ 40,684	\$ 10,913	\$ 10,553	\$ 10,811	\$ 11,061	\$ 43,338	\$ 21,506	\$ 19,767	\$ 26,690	\$ 35,631	\$ 41,296	\$ 43,995
UBS (Old)				\$ 10,300	\$ 9,661	\$ 9,748	\$ 10,974	\$ 40,684	\$ 10,913	\$ 10,553	\$ 10,811	\$ 11,061	\$ 43,338				\$ 35,631	\$ 41,296	\$ 43,995
Consensus				\$ 10,429	\$ 9,605	\$ 9,396	\$ 10,526	\$ 39,603	\$ 11,677	\$ 10,235	\$ 10,198	\$ 11,424	\$ 42,691				\$ 35,670	\$ 41,204	\$ 43,647
Delta				-1.2%	0.6%	3.7%	4.3%	2.7%	-6.5%	3.1%	6.0%	-3.2%	1.5%				-0.1%	0.2%	0.8%
<b>EPS (Non GAAP)</b>																			
UBSe	\$ 3.54	\$ 4.19	\$ 8.54	\$ 2.96	\$ 2.32	\$ 2.37	\$ 2.86	\$ 10.51	\$ 2.72	\$ 2.56	\$ 2.62	\$ 2.76	\$ 10.66	\$ 3.91	\$ 3.34	\$ 5.37	\$ 9.33	\$ 10.27	\$ 10.87
UBS (Old)				\$ 2.96	\$ 2.32	\$ 2.37	\$ 2.86	\$ 10.51	\$ 2.72	\$ 2.56	\$ 2.62	\$ 2.76	\$ 10.66				\$ 9.33	\$ 10.27	\$ 10.87
Consensus				\$ 3.00	\$ 2.49	\$ 2.41	\$ 2.88	\$ 10.80	\$ 3.35	\$ 2.68	\$ 2.66	\$ 3.14	\$ 11.55				\$ 9.37	\$ 11.13	\$ 11.76
Delta				-1.5%	-6.7%	-1.6%	-0.8%	-2.7%	-18.9%	-4.2%	-1.5%	-12.0%	-7.7%				-0.5%	-7.8%	-7.6%

Source: Company reports, UBS estimates

# QCOM: Model Summary

Qualcomm (QCOM) - Key Metrics (in \$MM except EPS and units)	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	Estimates FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY						
	F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E	F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E	F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E	
Revenue	\$22,360	\$21,506	\$19,767	\$26,690	\$7,935	\$8,060	\$9,336	\$10,300	\$35,631	\$9,661	\$9,748	\$10,974	\$10,913	\$41,296	\$43,995	\$22,291	\$22,732	\$24,273	\$23,532	\$33,566	\$40,684	\$43,338
Y/Y Growth	(6%)	(4%)	(8%)	35%	52%	65%	12%	25%	34%	22%	21%	18%	6%	16%	7%	(5%)	2%	7%	(3%)	43%	21%	7%
Gross Profit (Non-GAAP)	\$13,882	\$12,279	\$11,535	\$14,521	\$4,566	\$4,665	\$5,443	\$6,054	\$20,728	\$5,288	\$5,336	\$5,981	\$5,922	\$22,527	\$24,065	\$14,021	\$13,039	\$11,246	\$12,749	\$19,484	\$22,659	\$23,591
Gross Margin	62.1%	57.1%	58.4%	54.4%	57.5%	57.9%	58.3%	58.8%	58.2%	54.7%	54.7%	54.5%	54.3%	54.5%	54.7%	62.9%	57.4%	57.6%	54.2%	58.0%	55.7%	54.4%
R&D	\$4,982	\$4,874	\$4,756	\$5,252	\$1,448	\$1,522	\$1,548	\$1,500	\$6,018	\$1,575	\$1,575	\$1,575	\$1,680	\$6,405	\$7,174	\$4,845	\$5,025	\$4,670	\$5,097	\$5,870	\$6,225	\$6,972
SG&A	\$2,242	\$2,232	\$1,871	\$1,701	\$446	\$478	\$493	\$475	\$1,892	\$485	\$490	\$495	\$520	\$1,990	\$2,181	\$2,080	\$2,393	\$1,876	\$1,720	\$1,844	\$1,945	\$2,129
Opex (Non-GAAP)	\$7,224	\$7,106	\$6,627	\$6,953	\$1,894	\$2,000	\$2,041	\$1,975	\$7,910	\$2,060	\$2,065	\$2,070	\$2,200	\$8,395	\$9,354	\$6,925	\$7,418	\$6,546	\$6,817	\$7,714	\$8,170	\$9,101
Y/Y Growth	13%	(2%)	(7%)	5%	11%	19%	14%	11%	14%	9%	3%	1%	11%	6%	11%	7%	7%	(12%)	4%	13%	6%	11%
Operating Income	\$6,658	\$5,173	\$4,908	\$7,568	\$2,672	\$2,665	\$3,402	\$4,079	\$12,818	\$3,228	\$3,271	\$3,911	\$3,722	\$14,132	\$14,711	\$7,096	\$5,621	\$4,700	\$5,932	\$11,770	\$14,489	\$14,491
Operating Margin	29.8%	24.1%	24.8%	28.4%	33.7%	33.1%	36.4%	39.6%	36.0%	33.4%	33.6%	35.6%	34.1%	34.2%	33.4%	31.8%	24.7%	24.1%	25.2%	35.1%	35.6%	33.4%
Non-GAAP EPS	\$4.07	\$3.91	\$3.34	\$5.37	\$1.90	\$1.92	\$2.55	\$2.96	\$9.33	\$2.32	\$2.37	\$2.86	\$2.72	\$10.27	\$10.87	\$4.28	\$3.70	\$3.54	\$4.19	\$8.54	\$10.51	\$10.66
<b>Free Cash Flow</b>																						
CFFO	\$5,076	\$2,489	\$8,048	\$7,871	\$2,911	\$3,373	\$1,077	\$4,181	\$11,542	\$3,215	\$3,099	\$3,300	\$3,530	\$13,145	\$13,844	\$4,692	\$3,895	\$7,286	\$5,814	\$10,536	\$13,795	\$13,783
Capex	\$787	\$710	\$1,031	\$1,580	\$483	\$506	\$430	\$412	\$1,831	\$386	\$390	\$439	\$437	\$1,652	\$1,760	\$690	\$784	\$887	\$1,407	\$1,888	\$1,627	\$1,734
FCF	\$4,289	\$1,779	\$7,017	\$6,291	\$2,428	\$2,867	\$647	\$3,769	\$9,711	\$2,828	\$2,709	\$2,861	\$3,094	\$11,493	\$12,084	\$4,002	\$3,111	\$6,399	\$4,407	\$8,648	\$12,168	\$12,050
% revenue	19%	8%	35%	24%	31%	36%	7%	37%	27%	29%	28%	26%	28%	28%	27%	18%	14%	26%	19%	26%	30%	28%
Y/Y Growth	(22%)	(59%)	294%	(10%)	229%	97%	(54%)	39%	54%	16%	(5%)	342%	(18%)	18%	5%	(42%)	(22%)	106%	(31%)	96%	41%	(1%)

Source: Company reports, UBS estimates

# QCOM: Model Summary

Qualcomm (QCOM) - Key Metrics (in \$MM except EPS and units)	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	Estimates FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY								
	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	Estimates FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	F2017A	F2018A	F2019A	F2020A	F2021E	F2022E	F2023E		
<b>Segment Revenue</b>																								
MSM Chipset Revenue	\$12,689	\$11,975	\$9,149	\$12,327	\$4,065	\$3,863	\$4,686	\$5,605	\$18,219	\$5,138	\$5,035	\$5,690	\$5,795	\$21,659	\$22,403	\$12,279	\$12,607	\$9,641	\$10,462	\$16,830	\$21,468	\$22,311		
Unit (in MM)	838	804	618	651	207	199	240	250	896	222	220	249	261	953	1,018	843	855	649	576	876	942	1,006		
ASP (in \$)	\$15	\$15	\$15	\$19	\$20	\$19	\$20	\$22	\$20	\$23	\$23	\$23	\$22	\$23	\$22	\$15	\$15	\$15	\$18	\$19	\$23	\$22		
RFFE	\$1,240	\$1,200	\$1,641	\$3,010	\$903	\$957	\$1,237	\$1,167	\$4,264	\$1,174	\$1,244	\$1,546	\$1,260	\$5,225	\$5,559	\$1,200	\$1,275	\$1,478	\$2,362	\$4,158	\$5,131	\$5,458		
Q/Q Growth					(15%)	6%	29%	(6%)		1%	6%	24%	(18%)											
Y/Y Growth	15%	(3%)	37%	83%	39%	114%	45%	10%	42%	30%	30%	25%	8%	23%	6%	15%	6%	16%	60%	76%	23%	6%		
Other (auto, IoT, compute, networking)	\$3,100	\$3,195	\$3,747	\$4,071	\$1,313	\$1,652	\$1,819	\$1,820	\$6,604	\$1,927	\$2,007	\$2,099	\$2,183	\$8,215	\$9,852	\$3,000	\$3,400	\$3,545	\$3,662	\$6,040	\$7,853	\$9,428		
Auto					\$709	\$240	\$253	\$279	\$280	\$1,052	\$310	\$325	\$350	\$381	\$1,366	\$1,838		\$640	\$638	\$984	\$1,265	\$1,720		
IoT					\$3,362	\$1,073	\$1,399	\$1,540	\$1,540	\$5,552	\$1,617	\$1,682	\$1,749	\$1,802	\$6,849	\$8,014		\$2,728	\$3,024	\$5,056	\$6,588	\$7,708		
CDMA Technologies (QCT)	\$17,029	\$16,370	\$14,544	\$19,408	\$6,281	\$6,472	\$7,733	\$8,592	\$29,078	\$8,239	\$8,286	\$9,335	\$9,238	\$35,099	\$37,814	\$16,479	\$17,282	\$14,665	\$16,493	\$27,019	\$34,452	\$37,197		
Q/Q Growth					(4%)	3%	19%	11%		(4%)	1%	13%	(1%)											
Y/Y Growth	10%	(4%)	(11%)	33%	53%	70%	56%	32%	50%	31%	28%	21%	8%	21%	8%	7%	5%	(15%)	12%	64%	28%	8%		
QTL Revs Ex AAPL, Huawei TRDS Revenue ex AAPL, Huawei Nominal Royalty Rate		\$2,876	\$3,502	\$3,392	\$1,008	\$1,050	\$1,115	\$1,032	\$4,206	\$982	\$1,083	\$1,219	\$1,030	\$4,314	\$4,341		\$2,007	\$3,513	\$3,439	\$3,986	\$4,316	\$4,301		
					\$168,909	\$114,317	\$32,817	\$37,446	\$41,268	\$42,988	\$154,519	\$38,491	\$42,488	\$41,547	\$48,005	\$170,530	\$173,856	\$160,975	\$164,371	\$164,161	\$132,607	\$135,091	\$165,514	\$172,177
Huawei		\$750	\$300	\$459	\$105	\$71	\$58	\$37	\$272	\$23	\$11	\$6	--	\$39	--	--	--	--	\$450	\$239	\$455	\$76	--	
Huawei Revenue Nominal Royalty Rate					\$17,145	\$3,510	\$2,534	\$2,163	\$1,608	\$9,814	\$984	\$462	\$262	--	\$1,708	--				\$38,284	\$14,971	\$3,316	--	
AAPL	--	\$1,164	\$1,541	\$448	\$368	\$384	\$640	\$1,840	\$418	\$368	\$414	\$644	\$1,844	\$1,840		--	--	\$628	\$1,437	\$1,840	\$1,840	\$3,680		
Unit (in MM)		146	193	56	46	48	80	230	52	46	52	81	231	230				79	180	230	230	230		
ASP (in \$)		\$8	\$8	\$8	\$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	\$1,614	\$1,489	\$1,558	\$1,709	\$6,370	\$1,423	\$1,462	\$1,639	\$1,674	\$6,198	\$6,181	\$6,445	\$5,162	\$4,589	\$5,028	\$6,321	\$6,232	\$6,141		
Q/Q Growth					(3%)	(8%)	5%	10%		(17%)	3%	12%	2%			(0%)								
Y/Y Growth	(25%)	(18%)	2%	6%	51%	43%	3%	3%	21%	(12%)	(2%)	5%	(2%)	(3%)	(0%)	(16%)	(20%)	(11%)	10%	26%	(1%)	(1%)		
<b>Segment EBT</b>																								
QCT Expenses	\$14,051	\$13,761	\$12,520	\$15,204	\$4,697	\$4,677	\$5,269	\$5,756	\$20,399	\$5,685	\$5,718	\$6,255	\$6,375	\$24,031	\$26,092	\$13,732	\$14,316	\$12,522	\$13,729	\$19,257	\$23,413	\$25,666		
Y/Y Growth	4%	(2%)	(9%)	21%	37%	46%	33%	25%	34%	21%	22%	19%	11%	18%	9%	1%	4%	(13%)	10%	40%	22%	10%		
QCT EBT	\$2,978	\$2,609	\$2,024	\$4,204	\$1,584	\$1,795	\$2,464	\$2,835	\$8,678	\$2,554	\$2,569	\$3,081	\$2,864	\$11,067	\$11,722	\$2,747	\$2,966	\$2,143	\$2,764	\$7,762	\$11,039	\$11,531		
% segment revenue	17%	16%	14%	22%	25%	28%	32%	33%	30%	31%	31%	33%	31%	32%	31%	17%	17%	15%	17%	29%	32%	31%		
QTL Expenses	\$1,404	\$1,653	\$1,594	\$1,590	\$423	\$436	\$444	\$410	\$1,713	\$398	\$409	\$410	\$469	\$1,686	\$1,787	\$1,271	\$1,637	\$1,635	\$1,587	\$1,693	\$1,627	\$1,776		
Y/Y Growth	22%	18%	(4%)	(0%)	5%	10%	11%	5%	8%	(6%)	(6%)	(8%)	14%	(2%)	6%	12%	29%	(0%)	(3%)	7%	(4%)	9%		
QTL EBT	\$4,529	\$3,228	\$3,381	\$3,694	\$1,191	\$1,053	\$1,114	\$1,299	\$4,657	\$1,024	\$1,052	\$1,229	\$1,206	\$4,511	\$4,394	\$5,174	\$3,525	\$2,954	\$3,441	\$4,628	\$4,605	\$4,365		
% segment revenue	76%	66%	68%	70%	74%	71%	72%	76%	73%	72%	72%	75%	72%	73%	71%	80%	68%	64%	68%	73%	74%	71%		

Source: Company reports, UBS estimates

# STX: Seagate

## Investment Thesis/Risks

<b>Our thesis</b>	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.
<b>Risks to our thesis</b>	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	2023/1F	2023/2F	2023/3F	2023/4F	2023	CY2019	CY2020	CY2021	CY2022	CY2023	
<b>Revenues (\$MM)</b>																			
UBS	\$ 10,391	\$ 10,509	\$ 10,681	\$ 3,115	\$ 3,100	\$ 2,948	\$ 2,925	\$ 12,088	\$ 3,045	\$ 3,118	\$ 2,963	\$ 3,150	\$ 12,276	\$ 9,958	\$ 10,172	\$ 11,959	\$ 12,036	\$ 12,555	
UBS (old)																			
Consensus																			
Delta					(0.4%)	1.5%	(0.0%)		0.2%	(0.5%)	(0.2%)	(0.8%)	3.1%	0.4%			(0.1%)	0.2%	2.6%
<b>EPS</b>																			
UBS (non-GAAP)	\$ 4.80	\$ 4.96	\$ 5.70	\$ 2.35	\$ 2.22	\$ 2.04	\$ 2.02	\$ 8.63	\$ 2.20	\$ 2.30	\$ 2.06	\$ 2.30	\$ 8.86	\$ 4.07	\$ 4.80	\$ 8.05	\$ 8.55	\$ 9.14	
UBS (non-GAAP) (old)																			
Consensus (non-GAAP)																			
Delta					\$ 2.36	\$ 2.06	\$ 2.08	\$ 8.84	\$ 2.23	\$ 2.33	\$ 2.18	\$ 2.27	\$ 9.02			(1.7%)	(1.6%)	0.5%	

Source: Company reports, UBS estimates

# STX: Model Summary

Seagate (STX) - Key Metrics (in \$MM except EPS)	C2019A	C2020	Estimates				C2021E	FQ3E	FQ4:22E	FQ1E	FQ2E	C2022E	C2023E	FISCAL YEAR SUMMARY			
			FQ3A	FQ4:21A	FQ1A	FQ2E								F2020A	F2021A	F2022E	F2023E
Revenue (\$MM)	\$9,958	\$10,172	\$2,731	\$3,013	\$3,115	\$3,100	\$11,959	\$2,948	\$2,925	\$3,045	\$3,118	\$12,036	\$12,555	\$10,509	\$10,681	\$12,088	\$12,276
Y/Y Growth	-12%	2%	0%	20%	35%	18%	18%	8%	-3%	-2%	1%	1%	4%	1%	2%	13%	2%
Gross Margin	27.2%	27.2%	27.4%	29.6%	31.0%	30.5%	29.7%	30.5%	30.5%	30.5%	30.5%	30.5%	30.3%	27.7%	27.7%	30.6%	30.4%
Opex	\$1,408	\$1,292	\$329	\$346	\$339	\$357	\$1,371	\$359	\$359	\$357	\$359	\$1,434	\$1,486	\$1,362	\$1,314	\$1,414	\$1,448
Y/Y Growth	-8%	-8%	-3%	11%	6%	12%	6%	9%	4%	5%	1%	5%	4%	-6%	-4%	8%	2%
Operating Margin	13.1%	14.5%	15.4%	18.1%	20.1%	19.0%	18.2%	18.3%	18.2%	18.8%	19.0%	18.6%	18.4%	14.7%	15.4%	18.9%	18.6%
Non-GAAP EPS	\$4.07	\$4.80	\$1.48	\$2.00	\$2.35	\$2.22	\$8.05	\$2.04	\$2.02	\$2.20	\$2.30	\$8.55	\$9.14	\$4.96	\$5.64	\$8.63	\$8.86
Cash Flow																	
CFFO	\$1,822	\$1,548	\$378	\$478	\$496	\$721	\$2,073	\$625	\$589	\$603	\$633	\$2,450	\$2,516	\$1,714	\$1,626	\$2,430	\$2,463
Capex	\$639	\$514	\$104	\$124	\$117	\$155	\$500	\$147	\$146	\$140	\$153	\$587	\$609	\$585	\$498	\$566	\$590
FCF	\$1,183	\$1,034	\$274	\$354	\$379	\$566	\$1,573	\$478	\$442	\$463	\$480	\$1,863	\$1,907	\$1,129	\$1,128	\$1,865	\$1,873
% revenue	11.9%	10.2%	10.0%	11.7%	12.2%	18.2%	13.2%	16.2%	15.1%	15.2%	15.4%	15.5%	15.2%	10.7%	10.6%	15.4%	15.3%
Product Revenue (\$MM)																	
HDD REVENUE	\$9,200	\$9,409	\$2,493	\$2,737	\$2,864	\$2,882	\$10,976	\$2,698	\$2,635	\$2,768	\$2,877	\$10,978	\$11,403	\$9,719	\$9,792	\$11,079	\$11,162
Y/Y Growth	-13%	2%	-1%	18%	34%	19%	17%	8%	-4%	-3%	0%	0%	4%	1%	1%	13%	1%
HDD Shipment in Exabytes	366	481	140	152	159	170	621	192	198	204	217	811	1,029	442	536	719	921
Y/Y Growth	0%	31%	16%	30%	39%	32%	29%	37%	30%	28%	27%	31%	27%	27%	21%	34%	28%
Price\$MM/EB	\$25	\$20	\$18	\$18	\$18	\$17	\$18	\$14	\$13	\$14	\$13	\$14	\$11	\$22	\$18	\$15	\$12
Y/Y Growth	-13%	-22%	-15%	-10%	-4%	-10%	-10%	-21%	-26%	-25%	-22%	-23%	-18%	-21%	-17%	-16%	-21%
Enterprise Data Solutions, SSD & Other	\$759	\$762	\$238	\$276	\$251	\$218	\$983	\$250	\$290	\$277	\$241	\$1,057	\$1,152	\$790	\$889	\$1,009	\$1,114
Y/Y Growth	-7%	0%	24%	42%	42%	10%	29%	5%	5%	10%	10%	8%	9%	2%	13%	13%	10%

Source: Company reports, UBS estimates

# SWKS: Skyworks Solutions

## Investment Thesis/Risks

<b>Our thesis</b>	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.
<b>Risks to our thesis</b>	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 2018	Actual 2019	Actual 2020	Actual 2021	Estimate 2022/1F	Estimate 2022/2F	Estimate 2022/3F	Estimate 2022/4F	Estimate 2022	Estimate 2023	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																
UBS (New)	\$ 3,868	\$ 3,377	\$ 3,356	\$ 5,109	\$ 1,501	\$ 1,339	\$ 1,304	\$ 1,521	\$ 5,665	\$ 6,142	\$ 3,788	\$ 3,301	\$ 3,970	\$ 5,100	\$ 5,873	\$ 6,247
UBS (Old)					\$ 1,501	\$ 1,339	\$ 1,304	\$ 1,521	\$ 5,665	\$ 6,142				\$ 5,100	\$ 5,873	\$ 6,247
Consensus					\$ 1,502	\$ 1,328	\$ 1,347	\$ 1,530	\$ 5,708	\$ 6,237				\$ 5,101	\$ 5,876	\$ 6,381
Delta					(0.1%)	0.8%	(3.2%)	(0.6%)	(0.7%)	(1.5%)				(0.0%)	(0.0%)	(2.1%)
<b>EPS</b>																
UBS (non-GAAP) (New)	\$ 7.22	\$ 6.17	\$ 6.13	\$ 10.50	\$ 3.13	\$ 2.59	\$ 2.49	\$ 3.14	\$ 11.36	\$ 12.65	\$ 7.05	\$ 6.02	\$ 7.80	\$ 10.27	\$ 11.87	\$ 12.99
UBS (non-GAAP) (Old)					\$ 3.13	\$ 2.59	\$ 2.49	\$ 3.14	\$ 11.36	\$ 12.65				\$ 10.27	\$ 11.87	\$ 12.99
Consensus (non-GAAP)					\$ 3.11	\$ 2.60	\$ 2.66	\$ 3.17	\$ 11.53	\$ 12.79				\$ 10.25	\$ 11.92	-
Delta					0.8%	(0.3%)	(6.1%)	(0.7%)	(1.5%)	(1.1%)				0.2%	(0.4%)	

Source: Company reports, UBS estimates

# SWKS: Model Summary

Skyworks Solutions, Inc. (SWKS) - Key Metrics (in \$MM except EPS and units)	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	Estimates	FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	FISCAL YEAR SUMMARY					
					\$1,172	\$1,116	\$1,311	\$1,501	\$5,100	\$1,339	\$1,304	\$1,521	\$1,709	\$5,873	\$6,247	\$3,651	\$3,868	\$3,377	\$3,356	\$5,109	\$5,665	
Revenue	\$3,789	\$3,788	\$3,301	\$3,970																		
Y/Y Growth	16%	(0%)	(13%)	20%	53%	52%	37%	(1%)	28%	14%	17%	16%	14%	15%	6%	11%	6%	(13%)	(1%)	52%	11%	
Gross profit (Non-GAAP)	\$1,929	\$1,929	\$1,663	\$2,006	\$595	\$565	\$668	\$769	\$2,597	\$687	\$669	\$787	\$884	\$3,026	\$3,226	\$1,855	\$1,975	\$1,709	\$1,684	\$2,599	\$2,912	
Gross Margin	50.9%	50.9%	50.4%	50.5%	50.8%	50.6%	51.0%	51.3%	50.9%	51.3%	51.3%	51.7%	51.7%	51.5%	51.6%	50.8%	51.1%	50.6%	50.2%	50.9%	51.4%	
R&D (Non-GAAP)	\$333	\$372	\$379	\$404	\$107	\$113	\$126	\$140	\$485	\$147	\$147	\$147	\$156	\$597	\$646	\$320	\$362	\$383	\$395	\$447	\$581	
SG&A (Non-GAAP)	\$164	\$165	\$159	\$167	\$48	\$49	\$55	\$45	\$196	\$58	\$60	\$60	\$62	\$240	\$253	\$165	\$163	\$161	\$160	\$199	\$223	
Total Opex (Non-GAAP)	\$490	\$537	\$538	\$570	\$155	\$161	\$180	\$185	\$682	\$205	\$207	\$207	\$218	\$837	\$899	\$476	\$525	\$543	\$555	\$646	\$804	
Y/Y Growth	12%	10%	0%	6%	14%	16%	23%	24%	19%	33%	28%	15%	18%	23%	7%	10%	10%	3%	2%	16%	25%	
Operating Income (Non-GAAP)	\$1,439	\$1,392	\$1,125	\$1,436	\$440	\$403	\$488	\$584	\$1,915	\$482	\$462	\$580	\$666	\$2,189	\$2,327	\$1,379	\$1,450	\$1,166	\$1,129	\$1,953	\$2,108	
Operating Margin	38.0%	36.7%	34.1%	36.2%	37.6%	36.1%	37.2%	38.9%	37.6%	36.0%	35.4%	38.1%	38.9%	37.3%	37.2%	37.8%	37.5%	34.5%	33.7%	38.2%	37.2%	
Non-GAAP EPS	\$6.83	\$7.05	\$6.02	\$7.80	\$2.37	\$2.15	\$2.62	\$3.13	\$10.27	\$2.59	\$2.49	\$3.14	\$3.64	\$11.87	\$12.99	\$6.44	\$7.22	\$6.17	\$6.13	\$10.50	\$11.36	
<b>Free Cash Flow</b>																						
CFFO	\$1,336	\$1,449	\$1,217	\$1,291	\$616	\$273	\$398	\$573	\$1,860	\$768	\$623	\$481	\$586	\$2,458	\$2,650	\$1,471	\$1,261	\$1,367	\$1,205	\$1,772	\$2,445	
Capex	\$281	\$524	\$380	\$397	\$141	\$117	\$263	\$180	\$700	\$161	\$156	\$183	\$205	\$705	\$750	\$303	\$422	\$398	\$389	\$639	\$680	
FCF	\$1,055	\$925	\$837	\$894	\$475	\$156	\$135	\$393	\$1,160	\$607	\$467	\$299	\$381	\$1,754	\$1,900	\$1,168	\$838	\$969	\$815	\$1,133	\$1,766	
% revenue	28%	24%	25%	23%	41%	14%	10%	26%	23%	45%	36%	20%	22%	30%	30%	32%	22%	29%	24%	22%	31%	
<b>Segment Revenue</b>																						
AAPL Revenue	\$1,541	\$1,781	\$1,805	\$2,373	\$586	\$541	\$776	\$910	\$2,812	\$700	\$579	\$933	\$969	\$3,181	\$3,457	\$1,425	\$1,782	\$1,752	\$1,879	\$2,965	\$3,123	
Units (in MM)	216	204	193	196	56	46	48	80	230	52	46	52	81	231	230	217	218	187	186	230	230	
Blended Content (in \$)	\$7.1	\$8.7	\$9.4	\$12.1	\$13.6	\$8.9	\$14.0	\$11.0	\$12.2	\$18.0	\$10.0	\$13.5	\$14.5	\$13.8	\$15.0	\$6.6	\$8.2	\$9.4	\$10.1	\$12.9	\$13.6	
Samsung Revenue	\$380	\$83	\$123	\$138	\$46	\$42	\$41	\$41	\$170	\$49	\$50	\$51	\$55	\$205	\$239	\$438	\$85	\$103	\$149	\$160	\$191	
Units (in MM)	316	290	295	253	76	57	69	68	270	70	72	74	69	284	290	317	295	295	261	263	283	
Blended Content (in \$)	\$1.2	\$0.3	\$0.4	\$0.5	\$0.6	\$0.7	\$0.6	\$0.6	\$0.6	\$0.7	\$0.7	\$0.7	\$0.8	\$0.7	\$0.8	\$1.4	\$0.3	\$0.3	\$0.6	\$0.6	\$0.7	
Huawei Revenue	\$306	\$248	\$191	\$142	--	--	\$0	\$9	\$9	\$6	\$3	\$1	--	\$10	--	\$365	\$249	\$242	\$170	\$0	\$19	
Units (in MM)	158	207	241	189	15	12	8	6	41	4	2	1	--	7	--	151	193	245	213	67	13	
Blended Content (in \$)	\$1.9	\$1.2	\$0.8	\$0.8	--	--	\$0.0	\$1.5	\$0.2	\$1.6	\$1.4	\$1.2	\$1.6	\$1.5	#DIV/0!	\$2.4	\$1.3	\$1.0	\$0.8	\$0.0	\$1.5	
Total non-AAP/Huawei/Samsung	\$588	\$609	\$116	\$236	\$156	\$191	\$113	\$115	\$575	\$137	\$215	\$57	\$206	\$616	\$509	\$540	\$690	\$194	\$161	\$550	\$524	
Mobile	\$2,815	\$2,721	\$2,235	\$2,889	\$787	\$774	\$931	\$1,075	\$3,566	\$892	\$848	\$1,043	\$1,230	\$4,013	\$4,205	\$2,706	\$2,806	\$2,290	\$2,359	\$3,675	\$3,857	
Q/Q Growth					(34%)	(2%)	20%	16%	(17%)	(5%)	23%	18%					29%	4%	(18%)	3%	56%	5%
Y/Y Growth	37%	(3%)	(18%)	29%	47%	52%	41%	(9%)	23%	13%	10%	12%	14%	13%	5%	29%	4%	(18%)	3%	56%	5%	
Broad Markets	\$948	\$1,067	\$1,066	\$1,081	\$385	\$343	\$380	\$426	\$1,534	\$447	\$456	\$479	\$479	\$1,861	\$2,042	\$945	\$1,036	\$1,087	\$997	\$1,434	\$1,808	
Q/Q Growth					18%	(11%)	11%	12%	5%	2%	5%	--										
Y/Y Growth	12%	13%	(0%)	1%	68%	50%	28%	31%	42%	16%	33%	26%	12%	21%	10%	17%	10%	5%	(8%)	44%	26%	

Source: Company reports, UBS estimates

# SNPS: Synopsys Inc.

## Investment Thesis/Risks

<b>Our thesis</b>	We see a long runway for margin accretive growth due to: 1) multiple revenue growth vectors in Digital; 2) halo effect from new products (DSO.ai) in the near term; 3) operating leverage that should drive (in our view at least) mid-teens EPS growth. SNPS is executing in a strong market environment as it sees tailwinds from multiple long term growth vectors (large semis customers renewals, new products, hyperscalers, China, IP, Security business) all of which play to its strengths in core Digital. SNPS does not see a ceiling to margins as operating leverage and execution ultimately drive mid-teens EPS growth in its model.
<b>Risks to our thesis</b>	We see EDA as a stable business model. However, hardware can be lumpy and EDA ultimately remains linked to Semi R&D that is far less cyclical than revenue, but timing and renewal rates could still be subject to cycles.

Source: UBS estimates

## UBS vs Street

	FY2019	FY2020	FY2021	FY2022	FY2023	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>										
UBS	\$3,361	\$3,685	\$4,204	\$1,284	\$1,166	\$1,164	\$1,162	\$4,776	\$5,321	\$4,518
UBS (old)				\$1,284	\$1,166	\$1,164	\$1,162	\$4,776	\$5,321	\$4,518
Consensus				\$1,267	\$1,166	\$1,187	\$1,217	\$4,831	\$5,274	\$4,500
Delta				1.4%	(0.1%)	(1.9%)	(4.5%)	(1.1%)	0.9%	0.4%
<b>EPS</b>										
UBS	\$4.56	\$5.56	\$6.85	\$2.40	\$1.83	\$1.81	\$1.80	\$7.84	\$9.33	\$7.73
UBS (old)				\$2.40	\$1.83	\$1.81	\$1.80	\$7.84	\$9.33	\$7.73
Consensus				\$2.38	\$1.86	\$1.92	\$1.96	\$8.17	\$9.06	\$7.71
Delta				0.7%	(1.7%)	(5.7%)	(8.3%)	(4.1%)	3.0%	0.2%

Source: Company reports, UBS estimates

# SNPS: Model Summary

Synopsis (SNPS) - Key Metrics (in \$MM except EPS and DSO)	Estimates										FISCAL YEARS													
	C2017A	C2018A	C2019A	C2020A	FQ2A CQ1A	FQ3A CQ2A	FQ4:21A CQ3A	FQ1E CQ4E	C2021E	FQ2E CQ1E	FQ3E CQ2E	FQ4:22E CQ3E	FQ1E CQ4E	C2022E	C2023E	C2024E	F2017A	F2018A	F2019A	F2020A	F2021A	F2022E	F2023E	F2024E
Revenue	\$2,842	\$3,172	\$3,375	\$3,821	\$1,024	\$1,057	\$1,152	\$1,284	\$4,518	\$1,166	\$1,164	\$1,162	\$1,270	\$4,761	\$5,428	\$6,163	\$2,725	\$3,121	\$3,361	\$3,685	\$4,204	\$4,776	\$5,321	\$5,944
Y/Y Growth	13%	12%	6%	13%	19%	10%	12%	32%	18%	14%	10%	1%	(1%)	5%	14%	14%	12%	15%	8%	10%	14%	14%	11%	12%
DSO					54	49	44	72		55	60	65	72				60	65	60	77	49	64	69	71
Gross Margin	79.4%	79.7%	80.2%	81.3%	81.7%	83.1%	82.1%	80.5%	81.8%	80.5%	80.7%	80.7%	80.4%	80.6%	80.4%	80.4%	79.5%	79.8%	80.2%	80.9%	82.1%	80.6%	80.4%	80.4%
OpEx	\$668	\$696	\$825	\$1,132	\$317	\$337	\$340	\$464	\$1,458	\$353	\$349	\$348	\$416	\$1,466	\$1,854	\$2,289	\$647	\$691	\$839	\$1,032	\$1,281	\$1,514	\$1,803	\$2,154
Y/Y Growth	8%	4%	19%	37%	43%	4%	13%	62%	29%	11%	4%	2%	(10%)	1%	26%	23%	14%	7%	21%	23%	24%	18%	19%	19%
Operating Margin	23.5%	21.9%	24.4%	29.6%	31.0%	31.9%	29.5%	36.1%	32.3%	30.3%	30.0%	29.9%	32.8%	30.8%	34.2%	37.1%	23.8%	22.1%	25.0%	28.0%	30.5%	31.7%	33.9%	36.2%
Non-GAAP EPS	\$3.58	\$3.89	\$4.50	\$6.07	\$1.70	\$1.81	\$1.82	\$2.40	\$7.73	\$1.83	\$1.81	\$1.80	\$2.15	\$7.59	\$9.60	\$11.91	\$3.42	\$3.91	\$4.56	\$5.56	\$6.85	\$7.84	\$9.33	\$11.19
Free Cash Flow																								
CFO	\$529	\$339	\$954	\$1,155	\$526	\$422	\$371	(\$150)	\$1,169	\$733	\$532	\$462	(\$38)	\$1,689	\$2,065	\$2,388	\$635	\$424	\$801	\$991	\$1,493	\$1,578	\$1,822	\$2,341
Capex	\$80	\$100	\$224	\$128	\$16	\$23	\$27	\$30	\$96	\$30	\$30	\$30	\$25	\$115	\$100	\$100	\$70	\$99	\$198	\$155	\$94	\$120	\$100	\$100
FCF	\$448	\$240	\$731	\$1,028	\$510	\$399	\$344	(\$180)	\$1,073	\$703	\$502	\$432	(\$63)	\$1,574	\$1,965	\$2,288	\$564	\$325	\$602	\$837	\$1,399	\$1,458	\$1,722	\$2,241
% of total rev	16%	8%	22%	27%	50%	38%	30%	(14%)	24%	60%	43%	37%	(5%)	33%	36%	37%	21%	10%	18%	23%	33%	31%	32%	38%
Segment Revenues																								
EDA	\$1,852	\$1,956	\$1,956	\$2,160	\$588	\$590	\$617	\$642	\$2,437	\$655	\$655	\$655	\$701	\$2,665	\$2,879	\$3,328	\$1,796	\$1,937	\$1,964	\$2,116	\$2,331	\$2,606	\$2,880	\$3,173
Y/Y Growth	9%	6%	0%	10%	15%	11%	6%	20%	13%	11%	11%	6%	9%	9%	8%	16%	8%	8%	1%	8%	10%	12%	11%	10%
IP & System Integration	\$783	\$913	\$1,076	\$1,287	\$339	\$364	\$421	\$526	\$1,649	\$394	\$390	\$383	\$440	\$1,607	\$1,986	\$2,192	\$753	\$897	\$1,057	\$1,203	\$1,463	\$1,693	\$1,897	\$2,149
Y/Y Growth		17%	18%	20%	31%	8%	20%	55%	28%	16%	7%	(9%)	(16%)	(3%)	24%	10%	13%	19%	18%	14%	22%	16%	12%	13%
Other	\$6	\$4	\$5	\$10	\$4	\$5	\$5	\$5	\$18	\$5	\$5	\$5	\$5	\$19	\$19	\$19	\$1	\$7	\$5	\$8	\$16	\$19	\$19	\$19
Y/Y Growth		(34%)	20%	100%	106%	56%	104%	81%	83%	34%	(6%)	--	--	5%	--	--	NA	423%	(25%)	63%	90%	19%	--	--
Software Integrity	\$201	\$299	\$338	\$365	\$94	\$98	\$110	\$112	\$414	\$112	\$114	\$120	\$125	\$471	\$544	\$624	\$174	\$281	\$335	\$358	\$394	\$458	\$526	\$603
Y/Y Growth	49%	13%	8%	6%	5%	21%	22%	13%	19%	17%	9%	11%	14%	16%	15%	15%	76%	61%	19%	7%	10%	16%	15%	15%

Source: Company reports, UBS estimates

# TER: Teradyne

## Investment Thesis/Risks

<b>Our thesis</b>	TER has cyclical tailwinds that should last well into 2023 as investors may be under-estimating the size of its core SoC tester TAM for 2022. As chipmakers turn on recently installed manufacturing capacity and work down backlogs, these devices must be tested. Structurally, 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.
<b>Risks to our thesis</b>	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 gradual recovery in EPS we are expecting in 2023E and a big recovery in 2024E could happen sooner if ARM compute designs become broader much earlier than expected and TER is feasting on this structural shift.

Source: UBS estimates

## UBS vs Street

	FY 2018	FY 2019	FY 2020	2021/1F	2021/2F	2021/3F	2021/4F	FY 2021	2022/1F	2022/2F	2022/3F	2022/4F	FY 2022	FY 2023	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																		
UBS (New)	\$2,101	\$2,295	\$3,121	\$782	\$1,086	\$951	\$871	\$3,689	\$1,050	\$1,280	\$1,095	\$1,110	\$4,535	\$4,589	\$3,121	\$3,689	\$4,535	\$4,589
UBS (Old)							\$871	\$3,689	\$1,050	\$1,280	\$1,095	\$1,110	\$4,535	\$4,589	\$3,689	\$4,535	\$4,589	
Consensus							\$865	\$3,682	\$885	\$1,120	\$1,068	\$969	\$4,041	\$4,465	\$3,682	\$4,041	\$4,465	
Delta							0.8%	0.2%	18.6%	14.3%	2.6%	14.6%	12.2%	2.8%		0.2%	12.2%	2.8%
<b>EPS (non-GAAP, adjusted)</b>																		
UBS (New)	\$2.37	\$2.75	\$4.59	\$1.11	\$1.91	\$1.59	\$1.26	\$5.84	\$1.72	\$2.38	\$1.78	\$1.83	\$7.72	\$7.91	\$4.59	\$5.84	\$7.72	\$7.91
UBS (Old)							\$1.26	\$5.84	\$1.72	\$2.38	\$1.78	\$1.83	\$7.72	\$7.91	\$5.84	\$7.72	\$7.91	
Consensus							\$1.29	\$5.90	\$1.32	\$1.92	\$1.80	\$1.54	\$6.59	\$7.62		\$5.90	\$6.59	\$7.62
Delta							(1.6%)	(1.0%)	30.4%	24.0%	(1.1%)	18.8%	17.2%	3.8%		(1.0%)	17.2%	3.8%

Source: Company reports, UBS estimates

# TER: Model Summary

Teradyne (TER): Key Metrics (in \$MM except EPS)	F2017A	F2018A	F2019A	F2020A	FQ1A	FQ2A	FQ3A	FQ4E	F2021E	FQ1E	FQ2E	FQ3E	FQ4E	F2022E	F2023E	
	C2017A	C2018A	C2019A	C2020A	CQ1A	CQ2A	CQ3A	CQ4E	C2021E	CQ1E	CQ2E	CQ3E	CQ4E	C2022E	C2023E	
<b>Revenue</b>	\$2,137	\$2,101	\$2,295	\$3,121	\$782	\$1,086	\$951	\$871	\$3,689	\$1,050	\$1,280	\$1,095	\$1,110	\$4,535	\$4,589	
Y/Y Growth	22%	(2%)	9%	36%	11%	29%	16%	15%	18%	34%	18%	15%	27%	23%	1%	
<b>Gross Profit</b>	\$1,229	\$1,225	\$1,352	\$1,788	\$462	\$647	\$571	\$523	\$2,202	\$630	\$774	\$657	\$666	\$2,727	\$2,778	
<b>Gross Margin</b>	57.5%	58.3%	58.9%	57.3%	59.1%	59.6%	60.1%	60.0%	59.7%	60.0%	60.5%	60.0%	60.0%	60.1%	60.5%	
R&D	\$306	\$302	\$323	\$375	\$100	\$110	\$107	\$116	\$433	\$117	\$119	\$125	\$125	\$487	\$520	
SG&A	\$348	\$391	\$437	\$465	\$130	\$140	\$135	\$142	\$547	\$146	\$151	\$156	\$156	\$608	\$615	
<b>Opex (Non-GAAP)</b>	\$654	\$692	\$760	\$840	\$230	\$250	\$242	\$258	\$980	\$263	\$270	\$281	\$281	\$1,094	\$1,135	
Y/Y Growth	8%	6%	10%	11%	17%	21%	15%	14%	17%	14%	8%	16%	9%	12%	4%	
Operating Income (Non-GAAP)	\$570	\$528	\$582	\$946	\$231	\$397	\$329	\$263	\$1,215	\$366	\$503	\$375	\$384	\$1,627	\$1,637	
Operating Margin	26.7%	25.1%	25.4%	30.3%	29.6%	36.5%	34.6%	30.2%	32.9%	34.8%	39.3%	34.2%	34.6%	35.9%	35.7%	
<b>Non-GAAP EPS (incl. SBC)</b>	\$2.34	\$2.37	\$2.75	\$4.59	\$1.11	\$1.91	\$1.59	\$1.26	\$5.84	\$1.72	\$2.38	\$1.78	\$1.83	\$7.72	\$7.91	
<b>Free Cash Flow</b>																
CFFO	\$626	\$477	\$564	\$869	\$38	\$206	\$523	\$280	\$1,042	\$199	\$344	\$461	\$393	\$1,396	\$1,442	
Capex	\$105	\$106	\$135	\$185	\$39	\$35	\$29	\$45	\$148	\$53	\$64	\$55	\$56	\$227	\$184	
<b>FCF</b>	<b>\$521</b>	<b>\$370</b>	<b>\$429</b>	<b>\$684</b>	<b>(\$1)</b>	<b>\$172</b>	<b>\$493</b>	<b>\$235</b>	<b>\$894</b>	<b>\$146</b>	<b>\$280</b>	<b>\$406</b>	<b>\$337</b>	<b>\$1,170</b>	<b>\$1,258</b>	
% revenue	24%	18%	19%	22%	(0%)	16%	52%	27%	24%	14%	22%	37%	30%	26%	27%	
<b>Segment Information</b>																
<b>SOC test</b>	\$1,475	\$1,219	\$1,286	\$1,877	\$420	\$742	\$575	\$500	\$2,237	\$675	\$865	\$675	\$700	\$2,915	\$2,795	
Y/Y Growth		(17%)	6%	46%		5%	29%	28%	11%	19%	61%	17%	17%	40%	30%	(4%)
Q/Q Growth						(7%)	76%	(22%)	(13%)		35%	28%	(22%)	4%		
TAM	\$2,650	\$2,900	\$3,300	\$3,450					\$4,650					\$6,250	\$6,000	
share	56%	42%	39%	54%						48%					47%	47%
<b>Memory test</b>	\$188	\$273	\$266	\$382	\$108	\$92	\$113	\$90	\$403	\$110	\$120	\$120	\$120	\$470	\$545	
Y/Y Growth		45%	(3%)	44%		28%	11%	(21%)	25%	6%	2%	30%	6%	33%	17%	16%
Q/Q Growth						50%	(14%)	23%	(21%)		22%	9%	--	--		
TAM	\$700	\$950	\$650	\$900					\$1,000					\$1,100	\$1,200	
share	27%	29%	41%	42%						40%					43%	45%
<b>Total Semi Test</b>	<b>\$1,663</b>	<b>\$1,492</b>	<b>\$1,552</b>	<b>\$2,260</b>	<b>\$528</b>	<b>\$834</b>	<b>\$688</b>	<b>\$590</b>	<b>\$2,640</b>	<b>\$785</b>	<b>\$985</b>	<b>\$795</b>	<b>\$820</b>	<b>\$3,385</b>	<b>\$3,340</b>	
Y/Y Growth	22%	(10%)	4%	46%		9%	27%	16%	13%	17%	49%	18%	16%	39%	28%	(1%)
Q/Q Growth						1%	58%	(17%)	(14%)		33%	25%	(19%)	3%		
<b>System Test</b>	<b>\$192</b>	<b>\$216</b>	<b>\$288</b>	<b>\$410</b>	<b>\$133</b>	<b>\$105</b>	<b>\$103</b>	<b>\$130</b>	<b>\$470</b>	<b>\$115</b>	<b>\$115</b>	<b>\$110</b>	<b>\$110</b>	<b>\$450</b>	<b>\$480</b>	
Y/Y Growth	1%	13%	33%	42%		14%	46%	(13%)	25%	15%	(13%)	10%	7%	(15%)	(4%)	7%
Q/Q Growth						28%	(21%)	(2%)	27%		(12%)	--	(4%)	--		
<b>Wireless Test</b>	<b>\$112</b>	<b>\$132</b>	<b>\$157</b>	<b>\$173</b>	<b>\$41</b>	<b>\$55</b>	<b>\$69</b>	<b>\$45</b>	<b>\$210</b>	<b>\$50</b>	<b>\$65</b>	<b>\$70</b>	<b>\$55</b>	<b>\$240</b>	<b>\$240</b>	
Y/Y Growth	16%	18%	19%	10%		(6%)	12%	68%	13%	21%	22%	18%	2%	22%	15%	--
Q/Q Growth						3%	34%	25%	(35%)		11%	30%	8%	(21%)		
<b>Universal Robots</b>	\$170	\$234	\$248	\$221	\$66	\$76	\$78	\$90	\$309							
<b>MiR</b>	\$12	\$27	\$50	\$45	\$14	\$16	\$13	\$16	\$59							
<b>AutoGuide</b>	--	\$4	\$2	\$13	\$0	\$0	\$0	\$0	\$1							
<b>Total Industrial Automation</b>	<b>\$169</b>	<b>\$261</b>	<b>\$298</b>	<b>\$280</b>	<b>\$80</b>	<b>\$92</b>	<b>\$91</b>	<b>\$106</b>	<b>\$369</b>	<b>\$100</b>	<b>\$115</b>	<b>\$120</b>	<b>\$125</b>	<b>\$460</b>	<b>\$529</b>	
Y/Y Growth	70%	55%	14%	(6%)		33%	57%	33%	15%	32%	25%	25%	32%	18%	25%	15%
Q/Q Growth						(13%)	15%	(1%)	17%		(6%)	15%	4%	4%		

Source: Company reports, UBS estimates



# TXN: Texas Instruments

## Investment Thesis/Risks

<b>Our thesis</b>	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.
<b>Risks to our thesis</b>	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	2021/1F	2021/2F	2021/3F	2021/4F	2021	2022/1F	2022/2F	2022/3F	2022/4F	2022	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>															
UBS (New)	\$14,383	\$14,461	\$ 4,289	\$ 4,580	\$ 4,643	\$ 4,421	\$17,933	\$ 4,525	\$ 4,814	\$ 5,082	\$ 4,786	\$19,207	\$17,933	\$19,207	\$19,909
UBS (Old)						\$ 4,421	\$17,933	\$ 4,525	\$ 4,814	\$ 5,082	\$ 4,786	\$19,207	\$17,933	\$19,207	\$19,909
Consensus						\$ 4,400	\$17,912	\$ 4,359	\$ 4,561	\$ 4,875	\$ 4,709	\$18,504	\$17,912	\$18,504	\$19,844
Delta						0.5%	0.1%	3.8%	5.5%	4.2%	1.6%	3.8%	0.1%	3.8%	0.3%
<b>Non GAAP EPS</b>															
UBS (New)	\$ 5.03	\$ 5.58	\$ 1.78	\$ 2.05	\$ 2.08	\$ 1.92	\$ 7.83	\$ 1.93	\$ 2.15	\$ 2.30	\$ 2.07	\$ 8.46	\$ 7.83	\$ 8.46	\$ 8.53
UBS (Old)						\$ 1.92	\$ 7.83	\$ 1.93	\$ 2.15	\$ 2.30	\$ 2.07	\$ 8.46	\$ 7.83	\$ 8.46	\$ 8.53
Consensus						\$ 1.92	\$ 7.93	\$ 1.86	\$ 1.98	\$ 2.17	\$ 2.05	\$ 8.12	\$ 7.93	\$ 8.12	\$ 8.81
Delta						(0.1%)	(1.3%)	3.5%	8.5%	6.3%	1.0%	4.2%	(1.3%)	4.2%	(3.2%)

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	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	FQ4E CQ4E	Estimates	F2021E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
<b>Revenue</b>	\$14,961	\$15,784	\$14,383	\$14,461	\$4,289	\$4,580	\$4,643	\$4,421	\$17,933	\$4,525	\$4,814	\$5,082	\$4,786	\$19,207	\$19,909	
Y/Y Growth	12%	6%	(9%)	1%	29%	41%	22%	8%	24%	5%	5%	9%	8%	7%	4%	
Q/Q Growth					5%	7%	1%	(5%)		2%	6%	6%	(6%)			
Gross Profit	\$9,614	\$10,277	\$9,164	\$9,269	\$2,797	\$3,077	\$3,152	\$2,940	\$11,966	\$2,973	\$3,249	\$3,456	\$3,207	\$12,885	\$13,337	
<b>Gross Margin</b>	64.3%	65.1%	63.7%	64.1%	65.2%	67.2%	67.9%	66.5%	66.7%	65.7%	67.5%	68.0%	67.0%	67.1%	67.0%	
R&D	\$1,508	\$1,559	\$1,544	\$1,530	\$386	\$391	\$388	\$388	\$1,553	\$398	\$412	\$428	\$432	\$1,670	\$1,852	
SG&A	\$1,694	\$1,684	\$1,645	\$1,623	\$425	\$425	\$412	\$412	\$1,674	\$422	\$437	\$455	\$459	\$1,773	\$1,967	
<b>Opex (Non-GAAP)</b>	\$3,202	\$3,243	\$3,189	\$3,153	\$811	\$816	\$800	\$800	\$3,227	\$820	\$849	\$883	\$891	\$3,443	\$3,819	
Y/Y Growth	2%	1%	(2%)	(1%)	2%	5%	1%	2%	2%	1%	4%	10%	11%	7%	11%	
Operating Income (Non-GAAP)	\$6,412	\$7,034	\$5,975	\$6,116	\$1,986	\$2,261	\$2,352	\$2,140	\$8,739	\$2,153	\$2,400	\$2,573	\$2,315	\$9,442	\$9,517	
<b>Operating Margin</b>	42.9%	44.6%	41.5%	42.3%	46.3%	49.4%	50.7%	48.4%	48.7%	47.6%	49.9%	50.6%	48.4%	49.2%	47.8%	
<b>Non-GAAP EPS</b>	\$3.64	\$5.63	\$5.03	\$5.58	\$1.78	\$2.05	\$2.08	\$1.92	\$7.83	\$1.93	\$2.15	\$2.30	\$2.07	\$8.46	\$8.53	
Consensus					\$5.24	\$5.97	\$1.87	\$2.05	\$2.07	\$1.92	\$7.93	\$1.86	\$1.98	\$2.17	\$2.05	\$8.12
<b>Free Cash Flow</b>																
CFFO	\$5,363	\$7,189	\$6,649	\$6,139	\$1,850	\$2,121	\$2,428	\$1,905	\$8,304	\$2,174	\$2,238	\$2,334	\$2,290	\$9,036	\$9,364	
Capex	\$695	\$1,131	\$847	\$649	\$308	\$386	\$486	\$442	\$1,622	\$498	\$554	\$584	\$550	\$2,186	\$2,290	
<b>FCF</b>	\$4,668	\$6,058	\$5,802	\$5,490	\$1,542	\$1,735	\$1,942	\$1,463	\$6,682	\$1,676	\$1,684	\$1,750	\$1,740	\$6,849	\$7,074	
% revenue	31%	38%	40%	38%	36%	38%	42%	33%	37%	37%	35%	34%	36%	36%	36%	
Y/Y Growth	14%	30%	(4%)	(5%)	123%	9%	50%	(24%)	22%	9%	(3%)	(10%)	19%	3%	3%	

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	FQ1A CQ1A	FQ2A CQ2A	FQ3A CQ3A	Estimates	F2021E C2021E	FQ1E CQ1E	FQ2E CQ2E	FQ3E CQ3E	FQ4E CQ4E	F2022E C2022E	F2023E C2023E
<b>Segment Revenue</b>															
Analog	\$9,900	\$10,801	\$10,223	\$10,886	\$3,280	\$3,464	\$3,548	\$3,477	\$13,769	\$3,547	\$3,724	\$3,873	\$3,679	\$14,823	\$15,382
Y/Y Growth	16%	9%	(5%)	6%	33%	42%	24%	11%	26%	8%	8%	9%	6%	8%	4%
Q/Q Growth					5%	6%	2%	(2%)		2%	5%	4%	(5%)		
TI Analog Market Share	18.7%	18.4%	19.0%	19.7%	19.5%	19.5%									
Embedded Processing	\$3,498	\$3,554	\$2,943	\$2,570	\$767	\$780	\$738	\$694	\$2,979	\$728	\$765	\$803	\$843	\$3,140	\$3,389
Y/Y Growth	16%	2%	(17%)	(13%)	17%	43%	13%	(4%)	16%	(5%)	(2%)	9%	22%	5%	8%
Q/Q Growth					7%	2%	(5%)	(6%)		5%	5%	5%	5%		
Other	\$1,563	\$1,429	\$1,217	\$1,005	\$242	\$336	\$357	\$250	\$1,185	\$250	\$325	\$406	\$264	\$1,245	\$1,138
Y/Y Growth	(14%)	(9%)	(15%)	(17%)	12%	30%	19%	9%	18%	3%	(3%)	14%	6%	5%	(9%)
Q/Q Growth					6%	39%	6%	(30%)		--	30%	25%	(35%)		
<b>Segment Revenue Operating Profit</b>															
Analog	\$4,468	\$5,109	\$4,477	\$4,912	\$1,646	\$1,778	\$1,871	\$1,791	\$7,086	\$1,844	\$1,936	\$2,014	\$1,913	\$7,708	\$8,171
Margin (%)	45%	47%	44%	45%	50%	51%	53%	52%	51%	52%	52%	52%	52%	52%	53%
Embedded Processing	\$1,143	\$1,205	\$907	\$743	\$287	\$312	\$282	\$257	\$1,138	\$273	\$306	\$321	\$304	\$1,204	\$1,272
Margin (%)	33%	34%	31%	29%	37%	40%	38%	37%	38%	38%	40%	40%	36%	38%	38%
Other	\$472	\$399	\$339	\$239	\$6	\$123	\$152	\$92	\$373	(\$40)	\$83	\$163	\$24	\$230	\$74
Margin (%)	30%	28%	28%	24%	2%	37%	43%	37%	32%	(16%)	26%	40%	9%	18%	6%
<b>End Market Exposure</b>															
Communications	\$1,795	\$1,736	\$1,590	\$1,213	\$285	\$293	\$276								
% of Sales	12%	11%	11%	8%	7%	6%	6%								
Y/Y Growth	3%	(3%)	(8%)	(24%)	(1%)	(16%)	(18%)								
Enterprise	\$898	\$1,105	\$780	\$876	\$202	\$239	\$243								
% of Sales	6%	7%	5%	6%	5%	5%	5%								
Y/Y Growth	12%	23%	(29%)	12%	(10%)	(12%)	27%								
Industrial	\$5,236	\$5,682	\$5,119	\$5,419	\$1,719	\$1,977	\$1,858								
% of Sales	35%	36%	36%	37%	40%	43%	40%								
Y/Y Growth	19%	9%	(10%)	6%	29%	45%	41%								
CE	\$3,740	\$3,630	\$3,275	\$3,833	\$1,065	\$1,065	\$1,193								
% of Sales	25%	23%	23%	27%	25%	23%	26%								
Y/Y Growth	8%	(3%)	(10%)	17%	48%	21%	13%								
Automotive	\$2,843	\$3,157	\$3,041	\$2,852	\$914	\$941	\$960								
% of Sales	19%	20%	21%	20%	21%	21%	21%								
Y/Y Growth	18%	11%	(4%)	(6%)	25%	114%	25%								
Other	\$449	\$474	\$579	\$268	\$104	\$65	\$113								
% of Sales	3%	3%	4%	2%	2%	1%	2%								
Y/Y Growth	(16%)	6%	22%	(54%)											

Source: Company reports, UBS estimates



# WDC: Western Digital

## Investment Thesis/Risks

<b>Our thesis</b>	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 C2022/2023 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.
<b>Risks to our thesis</b>	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 the Kioxia JV, this would be a big positive for valuation.

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 2023/1F	Estimate 2023/2F	Estimate 2023/3F	Estimate 2023/4F	Estimate 2023	CY2019	CY2020	CY2021	CY2022	CY2023
<b>Revenues (\$MM)</b>																		
UBS	\$ 16,569	\$ 16,736	\$ 16,922	\$ 5,051	\$ 4,777	\$ 4,870	\$ 4,946	\$ 19,644	\$ 4,973	\$ 4,659	\$ 4,598	\$ 4,731	\$ 18,961	\$ 15,582	\$ 16,327	\$ 18,885	\$ 19,449	\$ 18,946
UBS (old)					\$ 4,777	\$ 4,870	\$ 4,946	\$ 19,644	\$ 4,973	\$ 4,659	\$ 4,598	\$ 4,731	\$ 18,961	\$ 18,885	\$ 19,449	\$ 18,946		
Consensus					\$ 4,810	\$ 4,734	\$ 4,909	\$ 19,504	\$ 5,118	\$ 5,286	\$ 5,175	\$ 5,314	\$ 20,894	\$ 18,918	\$ 20,047	\$ 21,706		
Delta					(0.7%)	2.9%	0.8%	0.7%	(2.8%)	(11.9%)	(11.2%)	(11.0%)	(9.3%)	(0.2%)	(3.0%)	(12.7%)		
<b>EPS</b>																		
UBS (non-GAAP)	\$ 4.82	\$ 3.03	\$ 4.51	\$ 2.49	\$ 2.17	\$ 2.27	\$ 2.29	\$ 9.22	\$ 2.03	\$ 1.27	\$ 0.88	\$ 0.93	\$ 5.10	\$ 1.30	\$ 3.41	\$ 7.84	\$ 7.86	\$ 3.97
UBS (non-GAAP) (old)					\$ 2.17	\$ 2.27	\$ 2.29	\$ 9.22	\$ 2.03	\$ 1.27	\$ 0.88	\$ 0.93	\$ 5.10	\$ 7.84	\$ 7.86	\$ 3.97		
Consensus (non-GAAP)					\$ 2.12	\$ 1.92	\$ 2.05	\$ 8.59	\$ 2.21	\$ 2.38	\$ 2.28	\$ 2.40	\$ 9.27	\$ 7.79	\$ 8.57	\$ 9.54		
Delta					2.3%	18.1%	11.4%	7.3%	(7.9%)	(46.6%)	(61.3%)	(61.4%)	(45.0%)	0.6%	(8.2%)	(58.4%)		

Source: Company reports, UBS estimates

# WDC: Model Summary

Western Digital (WDC) - Key Metrics (in \$MM except EPS)	C2017A	C2018A	C2019A	C2020E	Estimates				C2021E	FQ3E	FQ4:21A	FQ1A	FQ2E	C2022E	C2023E	FISCAL YEAR SUMMARY					
					CQ1A	CQ2A	CQ3A	CQ4E								F2018A	F2019A	F2020A	F2021E	F2022E	F2023E
Revenue (\$MM)	\$20,008	\$19,391	\$15,582	\$16,327	\$4,137	\$4,920	\$5,051	\$4,777	\$18,885	\$4,870	\$4,946	\$4,973	\$4,659	\$19,449	\$18,946	\$20,647	\$16,569	\$16,736	\$16,922	\$19,644	\$18,961
Y/Y Growth	26%	-3%	-20%	5%	-1%	15%	29%	21%	16%	18%	1%	-2%	-2%	3%	-3%	8%	-20%	1%	1%	16%	-3%
Gross Margin	41.6%	38.7%	25.1%	27.4%	27.7%	32.9%	33.9%	33.7%	32.2%	34.1%	34.0%	32.3%	28.7%	32.3%	26.6%	42.5%	30.5%	26.9%	28.6%	33.9%	28.4%
Opex	\$3,307	\$3,228	\$2,996	\$2,855	\$732	\$790	\$761	\$771	\$3,054	\$781	\$791	\$801	\$811	\$3,184	\$3,344	\$3,354	\$3,022	\$2,983	\$2,926	\$3,104	\$3,264
Y/Y Growth	20%	-2%	-7%	-5%	-1%	11%	7%	11%	7%	0%	5%	5%	5%	4%	5%	2%	-10%	-1%	-2%	6%	5%
Operating Margin	25.1%	22.1%	5.9%	9.9%	10.0%	16.8%	18.8%	17.6%	16.1%	18.1%	18.0%	16.2%	11.3%	16.0%	9.0%	26.2%	12.2%	9.1%	11.3%	18.1%	11.2%
Non-GAAP EPS	\$12.83	\$11.73	\$1.30	\$3.41	\$1.02	\$2.16	\$2.49	\$2.17	\$7.84	\$2.27	\$2.29	\$2.03	\$1.27	\$7.86	\$3.97	\$14.74	\$4.84	\$3.04	\$4.54	\$9.22	\$5.10
Cash Flow																					
CFFO	\$4,252	\$3,064	\$883	\$1,102	\$116	\$994	\$521	\$1,122	\$2,753	\$804	\$808	\$657	\$698	\$2,967	\$1,536	\$4,205	\$1,547	\$824	\$1,898	\$3,255	\$2,065
Capex	\$634	\$900	\$565	\$918	\$244	\$304	\$245	\$575	\$1,368	\$575	\$575	\$501	\$531	\$2,182	\$2,103	\$809	\$757	\$647	\$1,124	\$1,970	\$2,072
FCF	\$3,618	\$2,164	\$318	\$184	(\$128)	\$690	\$276	\$547	\$1,385	\$229	\$233	\$156	\$167	\$785	(\$567)	\$3,396	\$790	\$177	\$774	\$1,285	(\$7)
% revenue	18%	11%	2%	1%	-3%	14%	5%	11%	7%	5%	5%	3%	4%	4%	-3%	16%	5%	1%	5%	7%	0%
Product Revenue (\$MM)																					
HDD Revenue	\$10,243	\$9,948	\$8,996	\$7,916	\$1,962	\$2,501	\$2,561	\$2,245	\$9,269	\$2,343	\$2,386	\$2,371	\$2,231	\$9,331	\$9,434	\$10,698	\$8,746	\$8,967	\$8,216	\$9,534	\$9,326
Y/Y Growth	-5%	-3%	-10%	-12%	-7%	22%	39%	18%	17%	19%	-5%	-7%	-1%	1%	1%	1%	-18%	3%	-8%	16%	-2%
NAND Revenue	\$9,765	\$9,443	\$6,586	\$8,411	\$2,175	\$2,419	\$2,490	\$2,533	\$9,617	\$2,527	\$2,560	\$2,602	\$2,428	\$10,117	\$9,512	\$9,949	\$7,823	\$7,769	\$8,706	\$10,110	\$9,635
Y/Y Growth	48%	-3%	-30%	28%	6%	8%	20%	25%	14%	16%	6%	5%	-4%	5%	-6%	17%	-21%	-1%	12%	16%	-5%

Source: Company reports, UBS estimates

# Valuation Method and Risk Statement

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Risk factors include but are not limited to macroeconomic factors such as a downturn in the economy, a disruption of international trade, technological disruption due to new inventions, or business model innovation whereby structural changes in the industry alter the future course of unit sales, ASPs, and revenues.

# Required Disclosures

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# Required Disclosures (continued)

## UBS Investment Research: Global Equity Rating Definitions

12-Month Rating	Definition	Coverage <sup>1</sup>	IB Services <sup>2</sup>
<b>Buy</b>	FSR is > 6% above the MRA.	54%	32%
<b>Neutral</b>	FSR is between -6% and 6% of the MRA.	36%	30%
<b>Sell</b>	FSR is > 6% below the MRA.	10%	23%
Short-Term Rating	Definition	Coverage <sup>3</sup>	IB Services <sup>4</sup>
<b>Buy</b>	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
<b>Sell</b>	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 30 September 2021.

1:Percentage of companies under coverage globally within the 12-month rating category.

2:Percentage of companies within the 12-month rating category for which investment banking (IB) services were provided within the past 12 months.

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<b>Company Name</b>	<b>Reuters</b>	<b>12-month rating</b>	<b>Price</b>	<b>Price date</b>
<b>Advanced Micro Devices Inc<sup>16,20</sup></b>	AMD.O	Neutral (CBE)	US\$135.80	20 Dec 2021
<b>Analog Devices Inc<sup>16</sup></b>	ADI.O	Buy	US\$168.32	20 Dec 2021
<b>Applied Materials Inc<sup>16,20</sup></b>	AMAT.O	Neutral (CBE)	US\$145.01	20 Dec 2021
<b>Broadcom Inc.<sup>16</sup></b>	AVGO.O	Buy	US\$645.03	20 Dec 2021
<b>Cadence Design Systems<sup>16</sup></b>	CDNS.O	Neutral	US\$177.32	20 Dec 2021
<b>Entegris Inc<sup>16</sup></b>	ENTG.O	Neutral	US\$129.84	20 Dec 2021
<b>Intel Corp.<sup>16,6,7</sup></b>	INTC.O	Neutral	US\$49.60	20 Dec 2021
<b>KLA Corporation<sup>16</sup></b>	KLAC.O	Neutral	US\$385.50	20 Dec 2021
<b>LAM Research Corp<sup>16</sup></b>	LRCX.O	Buy	US\$661.08	20 Dec 2021
<b>Marvell Technology Group<sup>16</sup></b>	MRVL.O	Buy	US\$84.17	20 Dec 2021
<b>Microchip Technology Inc<sup>16</sup></b>	MCHP.O	Neutral	US\$82.60	20 Dec 2021
<b>Micron Technology Inc<sup>16</sup></b>	MU.O	Buy	US\$82.03	20 Dec 2021
<b>NVIDIA Corp<sup>16</sup></b>	NVDA.O	Buy	US\$277.19	20 Dec 2021
<b>Onsemi<sup>16</sup></b>	ON.O	Neutral	US\$60.94	20 Dec 2021
<b>Qorvo Inc<sup>16</sup></b>	QRVO.O	Neutral	US\$146.16	20 Dec 2021
<b>Qualcomm Inc.<sup>16</sup></b>	QCOM.O	Neutral	US\$176.67	20 Dec 2021
<b>Seagate Technology PLC<sup>16,7</sup></b>	STX.O	Buy	US\$105.13	20 Dec 2021
<b>Skyworks Solutions Inc<sup>16</sup></b>	SWKS.O	Neutral	US\$149.91	20 Dec 2021
<b>Synopsys Inc<sup>16</sup></b>	SNPS.O	Buy	US\$346.11	20 Dec 2021
<b>Teradyne Inc<sup>16</sup></b>	TER.O	Buy	US\$155.71	20 Dec 2021
<b>Texas Instruments Inc<sup>16</sup></b>	TXN.O	Neutral	US\$184.24	20 Dec 2021
<b>Western Digital Corp<sup>13,16</sup></b>	WDC.O	Neutral	US\$55.90	20 Dec 2021

Source: UBS. All prices as of local market close.

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