

US Semiconductors

2021 Outlook; The "Momentum" Trade Is Waning, But Fundamentals Should Remain Strong

Overall sector thoughts

Following a very strong year in 2020 amid a challenging economic backdrop where UBS estimates Real GDP has contracted ~4% Y/Y, we fundamentally expect another strong year in C2021 with semis revenue growing another ~12% Y/Y to ~\$492B on the back of UBSe ~6% Y/Y growth in Real GDP. When considering outcomes for C2021, we are mindful that C2020 semi revenue has actually grown ~7% to ~\$439B - a result that is incredibly above our ~\$435B forecast for C2020 at this time last year despite a Global Pandemic in the meantime. The snap-back in revenue expectations from immediately post-COVID has also come in conjunction with forward multiples that have now come all the way back to slightly exceed levels very early this year immediately pre-COVID, all of which has led semis to outperform the S&P 500 by ~6%, ~11%, ~15%, and ~29% over the past 1wk, 1mo, 3mo, 6mo and YTD periods respectively. So where does that leave us? From a high level, semis are now >5% of the S&P500 - an all time high, save for ~6mos during the 2000 tech bubble - but there is still ample room for growth. This should come as semis continue to out-grow global GDP on the back of some technology inflections that were in place pre-COVID (5G, AI/ML proliferation) but also what could be a renewed global investment cycle for infrastructure that is the result of lessons learned from COVID. Yes, the sector is trading at 10+yr highs on forward PE, but relative to the S&P 500 and other S&P tech sectors, valuation does not seem as extended because it is still very early in a new economic cycle making valuation less of a direct concern. That said, fully 90% of all estimate revisions in semis are now upward - a record level since we have been able to track such data and now eclipsing the peak of the 2016/2017 cycle. At the same time, the magnitude of revisions is starting to become much less significant with the upward revisions this month finally dipping below the 10-yr average of all revision trends. In other words, the "momentum trade" seems to be losing steam and the market was much less rewarding of upward revisions and much more penal for cuts during this earnings season than anything we have seen in the past 10+ys of data. So, we still skew positive, but we are increasingly focused on the memory vertical (MU top pick for 2021 and part of UBS's [21 stocks for 2021](#) - a collection of best ideas) and the compute vertical (NVDA and INTC) but remain a bit more Neutral on SPE and remain relatively cautious on the smartphone vertical.

Semis key debates

While 2021 is apt to be a challenging year for PC and server share and ASP, we expect INTC to announce a long-term volume commitment for outsourcing that should start to shift the narrative. AI compute demand still far outstrips supply and the sever backdrop should be better in '21 so we continue to like NVDA. DRAM is on the cusp of what should be 6-8Q cycle with mobile pricing already having inflected and Inotera issues possibly tipping the scales for server pricing. We remain relatively cautious on smartphone as risk for a component inventory correction is growing.

Semicaps key debates

Q4 WFE is tracking to ~\$65B/yr annualized - a number that is possible for C2021 (this would be up ~12% Y/Y) as foundry remains strong and both NAND and DRAM are up (though NAND more) but NAND capex is tracking to exceed NAND EBITDA in C2021 - rarely sustainable - and domestic China appears to have pulled in enough spend that growth appears challenging for C2021. We remain Sell on TER as we see C2021 Street EPS biased to the downside.

Equities

Americas
Semiconductors

Timothy Arcuri

Analyst

timothy.arcuri@ubs.com
+1-415-352 5676

Pradeep Ramani

Analyst

pradeep.ramani@ubs.com
+1-415-352 5517

Diana Chang

Analyst

diana.chang@ubs.com
+1-212-713 1474

Seth Gilbert

Associate Analyst

seth.gilbert@ubs.com
+1-212-713 2660

How did we get here?

2020 has been a very strong year for semis under almost any lens with the sector having out-performed the S&P 500 by ~6%, ~11%, ~15%, and ~29% over the past 1wk, 1mo, 3mo, 6mo and YTD periods respectively. Performance has also been driven a relatively balanced combination of estimate revisions and multiple appreciation throughout much of this year. While the market is skewing toward being more penal for estimate cuts and less rewarding for upward revisions, this is to be expected with the sector trading at 10+yr high PE and fully 90% of all estimate revisions being upward - a record level since we have been able to track such data and now eclipsing the peak of the 2016/2017 cycle, much of which was driven by memory. While estimates continue to go higher, the magnitude is becoming less significant with the upward revisions this month finally dipping below the 10-yr average of all revision trends - e.g. the revision piece of the stock growth is losing steam. Relative to valuation and growth expectations, the S&P 500 semis and semi equipment industry sub-group is trading at ~21x C2021 EPS which is below the median of ~25x for the broad range of other tech sectors against growth expectations that are reasonable (~9% Y/Y revenue growth for C2021) but approaching that of software which trades at a much higher multiple.

Zooming out, semis are now >5% of the S&P 500 - an all time high, save for ~6mos during the dot-com bubble in 2000. To some degree, this is very reasonable as semiconductors are now basic tech/industrial building blocks and in a post COVID world, technology will become even more important for connectivity and basic commerce. Relative to global GDP, semis continue to gain share but at ~0.7% are still below prior peak levels which leaves significant headroom for growth.

Figure 1: Summary of C2021 Consensus Estimate Changes

Company Name	Ticker	Rating	Stock Price	PT	C2021 Consensus (1/1/2020)	C2021 Consensus (Current)	Delta (1/1/2020 vs Current)	UBSe	Delta (UBSe vs Consensus)	
Compute										
Advanced Micro Devices, Inc.	AMD	Neutral	\$97	\$75	Rev (\$MM) EPS (Non-GAAP)	\$10,196 \$1.51	\$12,000 \$1.82	17.70% 20.23%	\$11,922 \$1.78	(0.65%) (2.24%)
Intel Corporation	INTC	Buy	\$51	\$62		\$73,892 \$4.66	\$71,018 \$4.51	(3.89%) (3.27%)	\$71,485 \$4.55	0.66% 0.98%
NVIDIA Corporation	NVDA	Buy	\$534	\$650		\$15,035 \$8.87	\$19,668 \$11.57	30.81% 30.45%	\$20,941 \$12.62	6.47% 9.10%
Smartphone										
Qualcomm Inc	QCOM	Neutral	\$150	\$125		\$27,880 \$6.31	\$30,293 \$7.21	8.66% 14.23%	\$28,733 \$6.75	(5.15%) (6.33%)
Skyworks Solutions, Inc.	SWKS	Neutral	\$146	\$139		\$3,909 \$7.83	\$3,993 \$7.76	2.16% (0.87%)	\$4,032 \$7.87	0.96% 1.32%
Qorvo, Inc.	QRVO	Neutral	\$160	\$133		\$3,577 \$7.44	\$4,136 \$9.44	15.64% 26.95%	\$3,798 \$7.95	(8.18%) (15.85%)
Analog										
Texas Instruments Incorporated	TXN	Neutral	\$163	\$146		\$15,272 \$5.67	\$15,151 \$5.82	(0.79%) 2.68%	\$16,711 \$6.65	10.30% 14.22%
Semi Equipment										
KLA Corporation	KLAC	Neutral	\$260	\$205		\$6,132 \$11.71	\$6,429 \$12.50	4.85% 6.76%	\$6,015 \$11.40	(6.44%) (8.79%)
Applied Materials, Inc.	AMAT	Neutral	\$88	\$73		\$18,141 \$4.45	\$19,554 \$4.96	7.79% 11.57%	\$18,015 \$4.49	(7.87%) (9.42%)
Teradyne, Inc.	TER	Sell	\$119	\$88		\$2,781 \$3.68	\$3,243 \$4.81	16.61% 30.52%	\$3,015 \$4.02	(7.04%) (16.43%)
Networking										
Broadcom Inc.	AVGO	Buy	\$426	\$445		\$26,626 \$26.08	\$26,489 \$26.56	(0.51%) 1.84%	\$26,665 \$27.05	0.66% 1.84%
Marvell Technology Group Ltd.	MRVL	Buy	\$47	\$50		\$3,550 \$1.46	\$3,450 \$1.37	(2.82%) (6.38%)	\$3,577 \$1.52	3.70% 11.04%
Memory										
Micron Technology, Inc.	MU	Buy	\$72	\$82		\$26,319 \$5.86	\$26,212 \$4.92	(0.41%) (15.95%)	\$26,471 \$5.46	0.99% 10.96%
EDA										
Synopsys, Inc.	SNPS	Buy	\$250	\$260		\$3,901 \$5.98	\$4,117 \$6.48	5.52% 8.51%	\$4,166 \$6.54	1.19% 0.83%
Cadence Design Systems, Inc.	CDNS	Neutral	\$127	\$125		\$2,669 \$2.49	\$2,830 \$2.87	6.01% 15.45%	\$2,840 \$2.84	0.37% (1.02%)

Source : Company reports, Factset, UBSe

Figure 2: Semis weighting of GICS IT Index



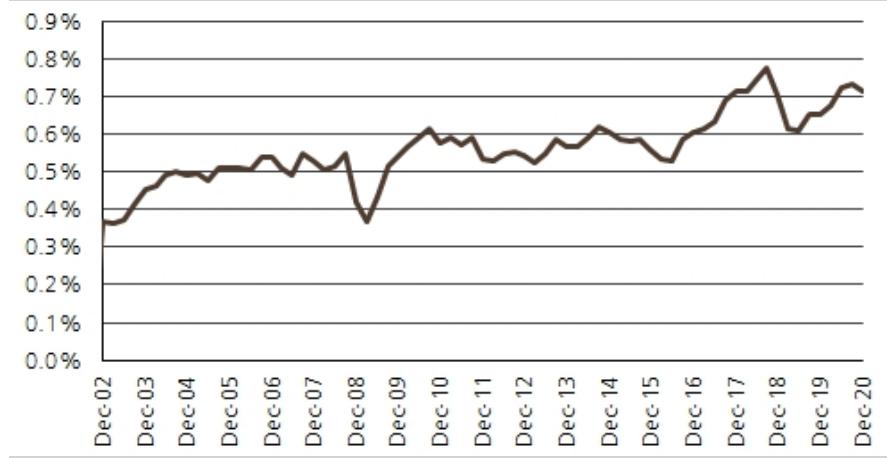
Source : Factset

Figure 3: Semis weighting of S&P500



Source : Factset

Figure 4: Semis as a % of Real Global GDP



Source : Factset, UBSe

Figure 5: S&P Sectors P/E and Price Performance



Source : Factset

Figure 6: S&P Tech Sub-Sectors P/E and Price Performance



Source : Factset

Figure 7: Semiconductor and Semi Equipment waterfall

Figures are \$B	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020E	2021E	
Global GDP (real)	48,701	50,714	53,155	54,334	55,630	57,199	59,628	61,060	62,912	64,585	65,694	63,395	67,262	
real GDP, Y/Y	-2.0%	4.1%	4.8%	2.2%	2.4%	2.8%	4.2%	2.4%	3.0%	3.7%	2.9%	-3.5%	6.1%	
US GDP (real)	13,296	13,637	13,848	14,160	14,420	14,785	15,239	15,500	15,862	16,337	16,690	16,106	16,718	
Y/Y	-2.5%	2.6%	1.6%	2.2%	1.8%	2.5%	3.1%	1.7%	2.3%	3.0%	2.2%	-3.5%	3.8%	
% of Glob GDP	27.3%	26.9%	26.1%	26.1%	25.9%	25.8%	25.6%	25.4%	25.3%	25.4%	25.4%	25.4%	24.9%	
Semiconductor Revenue	226	298	300	292	306	336	335	339	412	469	412	439	492	
Y/Y	-9.0%	31.8%	0.4%	-2.7%	4.8%	9.9%	-0.2%	1.1%	21.6%	13.8%	-12.1%	6.6%	12.1%	
% of Global GDP	0.5%	0.6%	0.6%	0.5%	0.5%	0.6%	0.6%	0.6%	0.7%	0.7%	0.6%	0.7%	0.7%	
% of US GDP	1.7%	2.2%	2.2%	2.1%	2.1%	2.3%	2.2%	2.2%	2.6%	2.9%	2.5%	2.7%	2.9%	
Memory Semis Revenue	45	70	61	57	66	79	77	77	124	158	106	118	134	
Y/Y	-3.3%	55.4%	-12.7%	-6.2%	16.0%	19.4%	-2.2%	-0.6%	61.1%	27.8%	-32.6%	11.2%	13.3%	
% 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%	26.9%	27.2%	
DRAM Revenue	22	39	29	26	34	47	45	124	73	99	62	65	83	
Y/Y	-6.7%	74.9%	-25.1%	-11.1%	31.2%	36.8%	-4.0%	175.5%	-41.4%	36.9%	-37.1%	3.6%	28.3%	
% 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%	54.7%	61.9%	
% 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%	14.7%	16.9%	
NAND Revenue	15	22	24	25	27	112	29	32	47	54	40	50	47	
Y/Y	20.8%	46.5%	12.3%	4.1%	7.7%	307.8%	-74.2%	11.0%	47.2%	15.1%	-26.1%	25.1%	-5.5%	
% of Memory Semis Revenue	33.1%	31.2%	40.2%	44.6%	41.4%	141.5%	37.4%	41.7%	38.1%	34.3%	37.7%	42.4%	35.4%	
% of Total Semis Revenue	6.6%	7.3%	8.2%	8.7%	9.0%	33.2%	8.6%	9.4%	11.4%	9.7%	11.4%	9.6%	9.6%	
Non-memory Semis Revenue	182	229	239	235	239	257	258	262	288	311	306	321	358	
Y/Y	-10.3%	26.0%	4.4%	-1.8%	2.1%	7.3%	0.4%	1.6%	10.0%	7.8%	-1.7%	4.9%	11.6%	
% of Total Semis Revenue	80.2%	76.7%	79.7%	80.5%	78.4%	76.5%	77.0%	77.3%	70.0%	66.3%	74.2%	73.1%	72.8%	
IC Revenue	190	250	246	238	252	277	274	277	343	393	333	361	407	
Y/Y	-8.8%	31.3%	-1.5%	-3.2%	5.7%	10.1%	-1.0%	0.8%	24.0%	14.7%	-15.3%	8.3%	12.7%	
% 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%	82.2%	82.7%	
Semiconductor Capital Spending	26	57	67	59	58	65	65	70	92	107	102	112	118	
Y/Y	-41.2%	118.5%	17.9%	-11.9%	-1.5%	11.6%	0.2%	8.8%	30.8%	16.0%	-4.5%	9.5%	5.3%	
Total Capex Intensity	11.4%	18.9%	22.3%	20.1%	18.9%	19.2%	20.8%	22.3%	22.8%	24.8%	25.4%	23.9%	23.9%	
WFE	13	32	36	30	27	32	33	35	47	54	49	59	64	
Y/Y	-47.8%	145.2%	15.2%	-18.5%	-7.3%	16.3%	4.1%	6.1%	33.6%	14.2%	-8.5%	18.8%	8.5%	
% of Total Semis Capex	49.8%	55.9%	54.6%	50.5%	47.5%	49.5%	51.4%	50.1%	51.2%	50.4%	48.3%	52.4%	54.0%	
Total WFE Intensity	5.7%	10.6%	12.1%	10.2%	9.0%	9.5%	9.9%	10.4%	11.4%	11.5%	12.0%	13.3%	12.9%	
Memory WFE	5	13	13	7	9	13	13	16	17	26	34	21	27	34
Y/Y	-57.0%	197.4%	-6.8%	-43.6%	31.7%	36.4%	25.9%	6.0%	55.5%	30.1%	-38.0%	27.2%	25.5%	
% of WFE	35.1%	42.6%	34.5%	23.9%	33.9%	39.8%	48.2%	48.1%	56.0%	63.8%	43.2%	46.3%	53.5%	
Memory WFE Intensity	10.1%	19.3%	20.7%	12.4%	14.1%	16.1%	20.7%	22.1%	21.4%	21.7%	20.0%	22.9%	23.4%	
NAND WFE	1	5	7	4	5	6	7	11	17	19	13	15	20	
Y/Y	-61.2%	211.2%	60.6%	-40.6%	19.8%	23.0%	12.9%	50.3%	59.0%	8.7%	-33.5%	20.0%	30.0%	
% of Memory WFE	32.4%	33.9%	58.3%	61.4%	55.9%	50.4%	45.2%	64.1%	65.5%	54.7%	58.7%	55.4%	57.4%	
% of Total WFE	11.4%	14.4%	20.1%	14.7%	19.0%	20.1%	21.8%	30.8%	36.7%	34.9%	25.4%	25.6%	30.7%	
NAND WFE Intensity	9.9%	21.0%	30.0%	17.1%	19.0%	5.7%	25.1%	34.0%	36.7%	34.7%	31.2%	29.9%	41.1%	
DRAM WFE	3	9	5	3	4	6	9	6	9	16	10	12	15	
Y/Y	-51.4%	202.2%	-41.3%	-47.7%	50.5%	53.5%	39.2%	-32.2%	52.9%	70.9%	-37.3%	24.1%	19.8%	
% of Memory WFE	22.9%	28.2%	14.4%	9.2%	15.0%	19.7%	26.4%	16.9%	19.3%	28.9%	19.8%	20.7%	22.8%	
% of Total WFE	11.4%	15.8%	7.8%	4.7%	7.1%	9.8%	13.6%	8.5%	9.9%	14.6%	9.6%	10.8%	12.3%	
DRAM WFE Intensity	13.1%	22.7%	17.8%	10.5%	12.0%	13.5%	19.5%	4.8%	12.5%	15.7%	15.6%	18.7%	17.5%	
Non-memory WFE	8	18	24	23	18	19	17	18	21	20	28	31	30	
Y/Y	-41.0%	117.0%	31.5%	-5.4%	-19.6%	6.0%	-10.4%	6.3%	13.2%	-6.0%	43.3%	12.3%	-6.1%	
% of WFE	64.9%	57.4%	65.5%	76.1%	66.1%	60.2%	51.8%	51.9%	44.0%	36.2%	56.8%	53.7%	46.5%	
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%	9.8%	8.2%	

Source : Factset, UBS

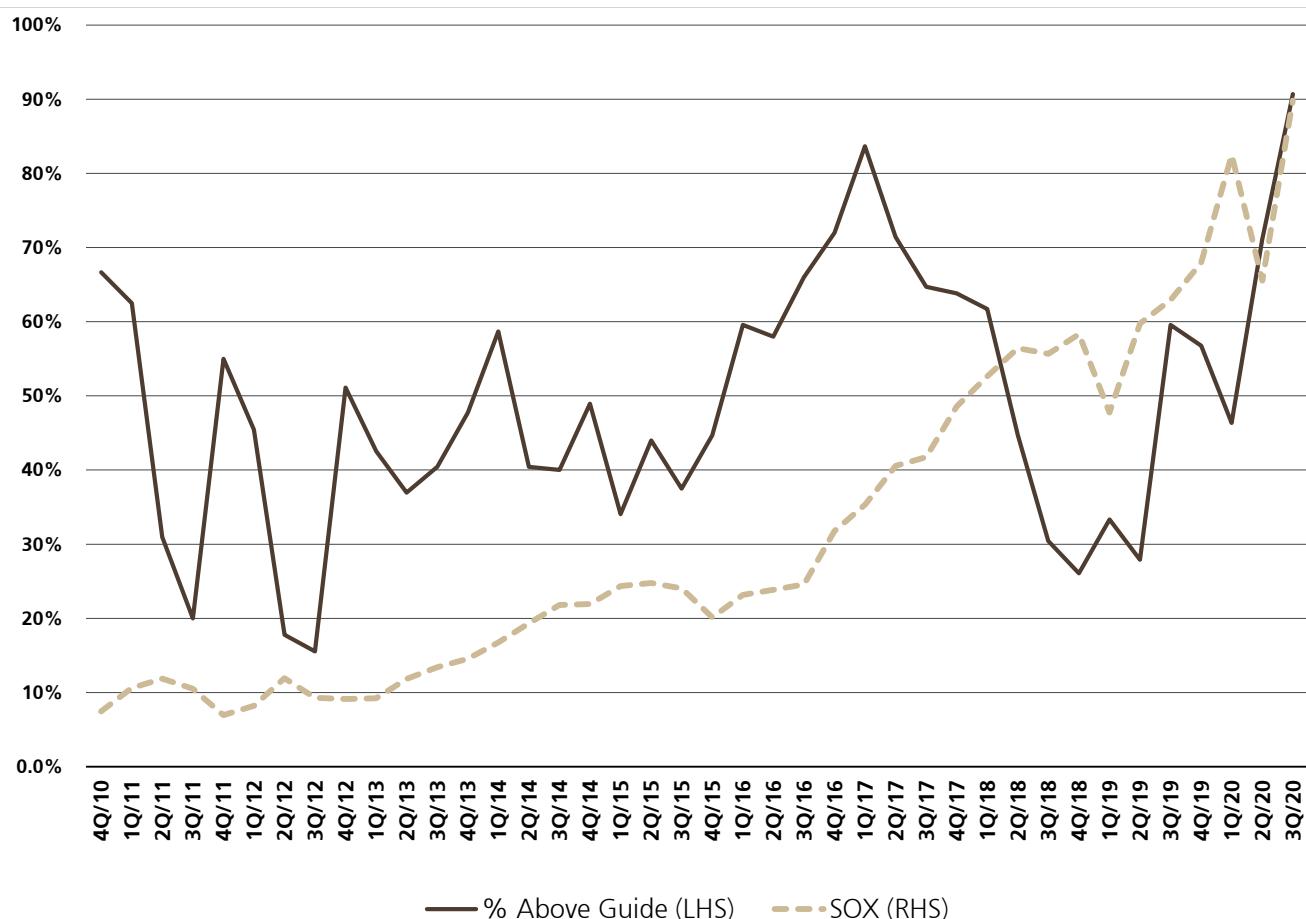
Company Guidance and Stock Reaction

Reading the data

We analyze 50+ stocks in our coverage universe to see trends related to how often companies beat/miss their next quarter guidance vs consensus and what the average stock price reaction is to a forward beat/miss vs consensus. The solid brown line in the below figure and the red line in the Price Impact Figure in the next page represent the % of companies who have issued next quarter guidance better than (beat) pre-call consensus estimates. The below figure compares the beat/miss results with SOX performance and the figure on the next page shows the average change in stock price t+1 after the company issues guidance. In both figures below 3Q20 represents the CQ3:20 earnings call where companies guide EPS for CQ4:20. While there are many variables when a company guides, we would expect the stock price to go up when companies guide above.

This quarter we saw ~91% of Semis and Semi Equipment co's guide EPS above for CQ4:20 (issued at CQ3:20 earnings call) which is significantly higher than average/ median of ~48% / ~46% when looking at the last 10 years of quarterly earnings.

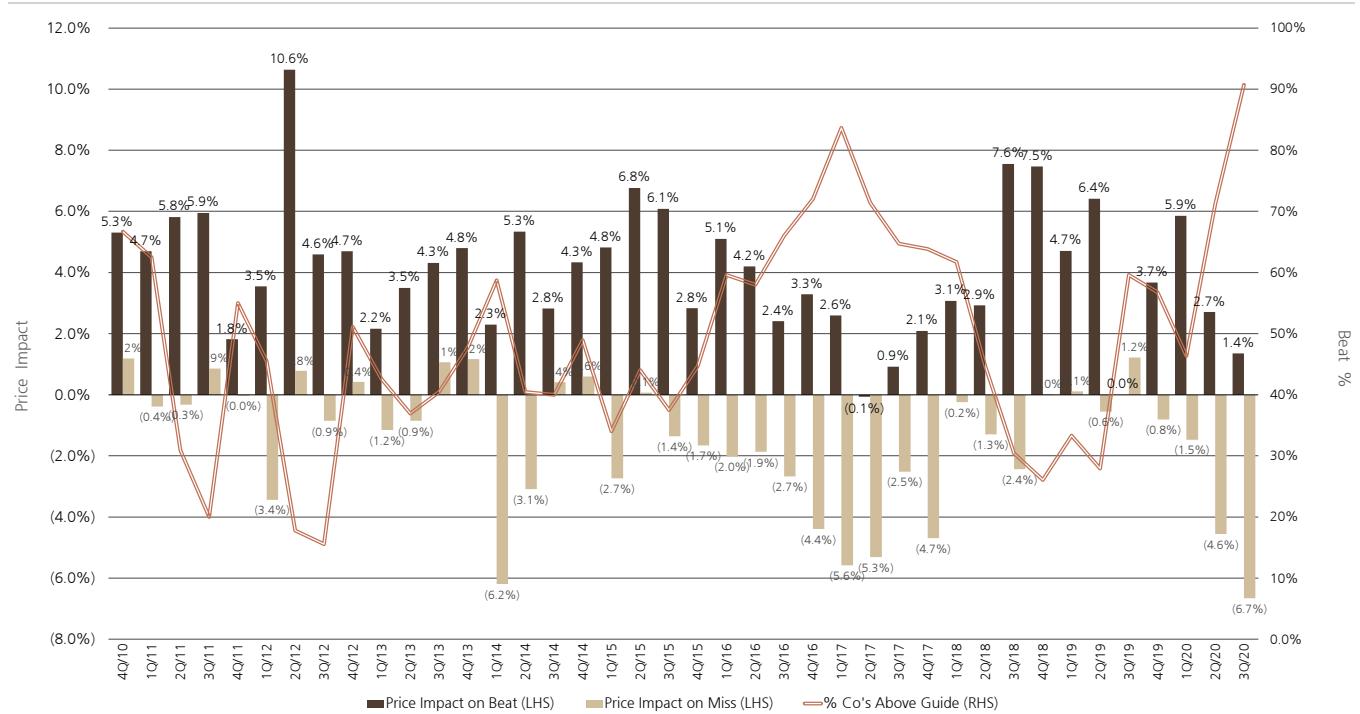
Figure 8: Semis & Semi Equipment Company Earnings Beat/Miss to Guidance – Last 10 Years



Source : Company reports, Factset, UBS estimates

However, for companies whose CQ4:20 EPS guidance beat the consensus estimate pre call, their stock prices went up by ~1.4% (from ~2.7% last Q) on average t+1 after the guidance was issued whereas the stock prices of companies that missed the consensus estimate went down by ~6.7% (from ~4.6% last Q). Overall, the charts shows us that the market was much less rewarding of upward revisions and more penal for cuts than any time during the period that we can track this data.

Figure 9: Price Impact of Company Guidance Issued For Next Q vs Pre-call Consensus

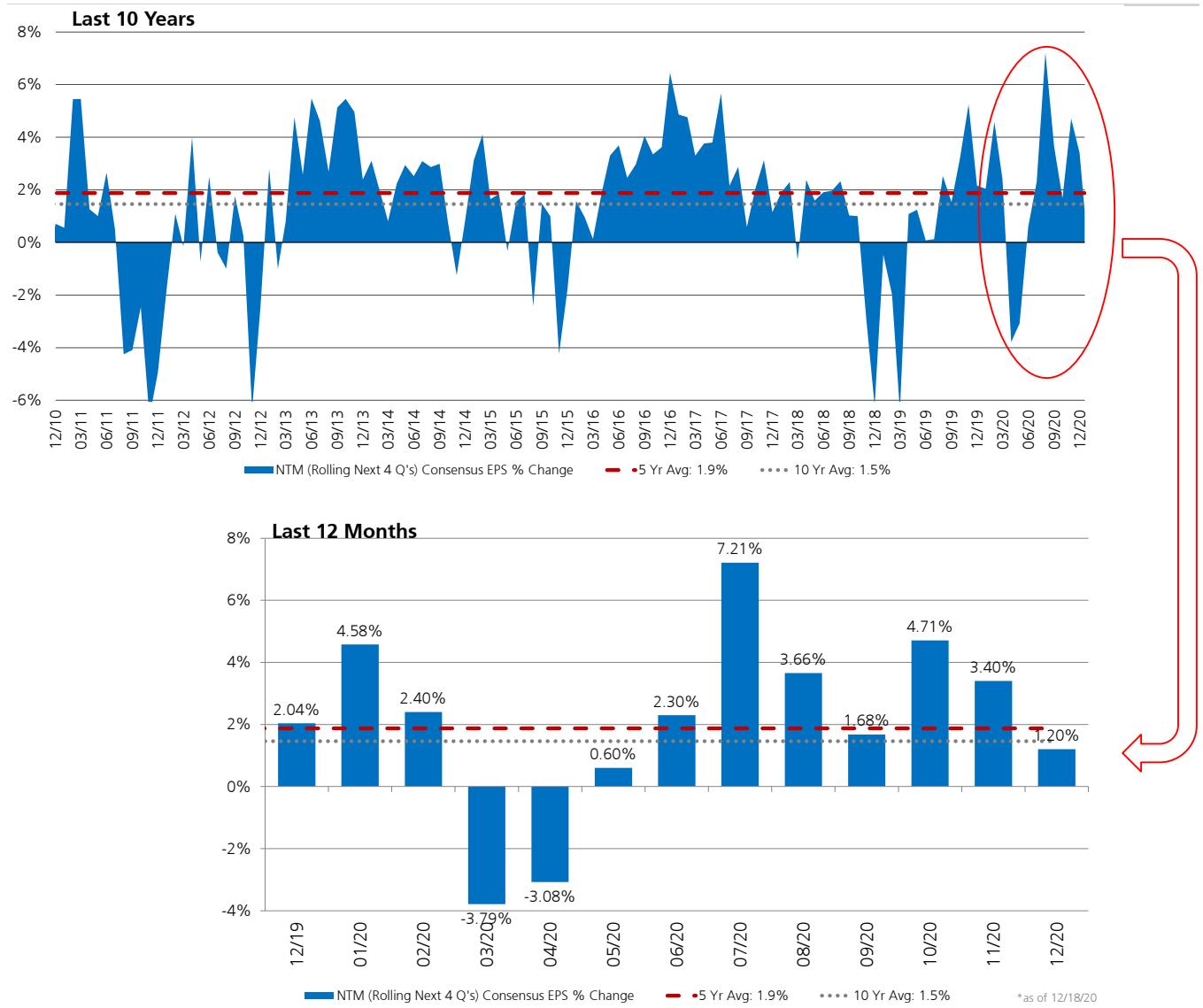


Source : Company reports, Factset, UBS estimates

Magnitude of Consensus EPS Changes

The bars in the below chart are the average NTM (defined as rolling next 4 Q's) % change in consensus EPS on a monthly basis with the last bar being a MTD view. Not surprisingly, on average NTM consensus EPS estimates bottomed in March at -3.8%. Consensus EPS estimates rose 3.4% in November and we see estimates rising by ~1% MTD in December. Overall, this tells us that while estimates are still moving higher, they are doing so at a slower rate and have now dipped below the 10yr average of revisions (which are typically up ~1.5%).

Figure 10: How much is NTM consensus EPS changing each month?



Source : company reports, Factset, UBS estimates

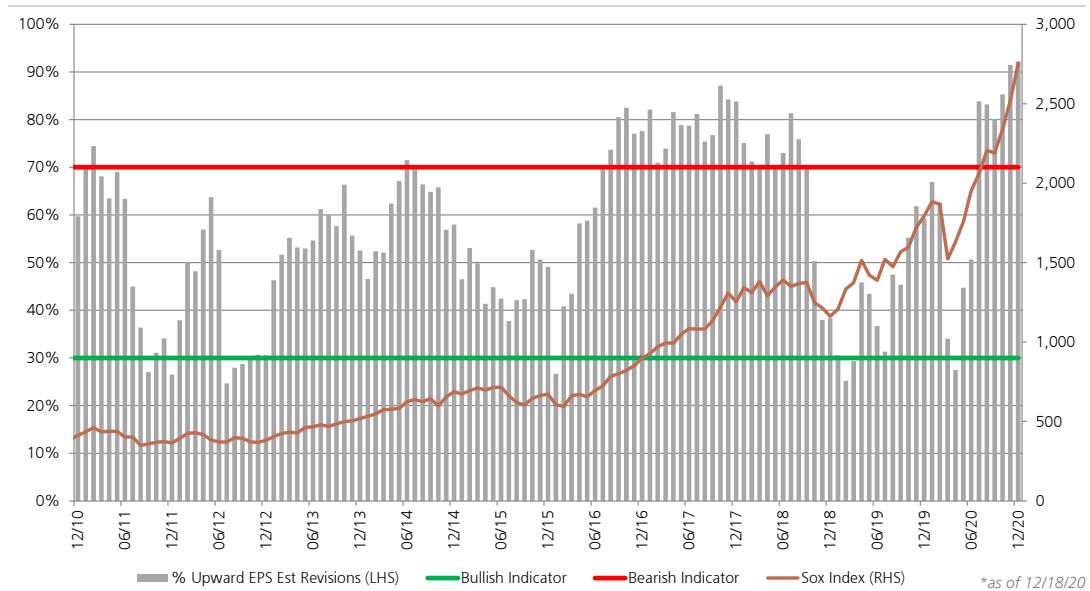
Estimate Revisions Analysis

Reading the data

We analyze 50+ stocks in our coverage universe for EPS and Revenue estimate revisions informing us with a high level view on where estimates have trended (up or down). The bars in the below chart are the overall monthly % upward estimate changes of the 50+ stocks in our coverage universe with the last bar displaying a MTD view. We highlight the bullish, < 30% marker in green, and bearish, >70% marker in red, as rough indications of how we view different levels of estimate changes.

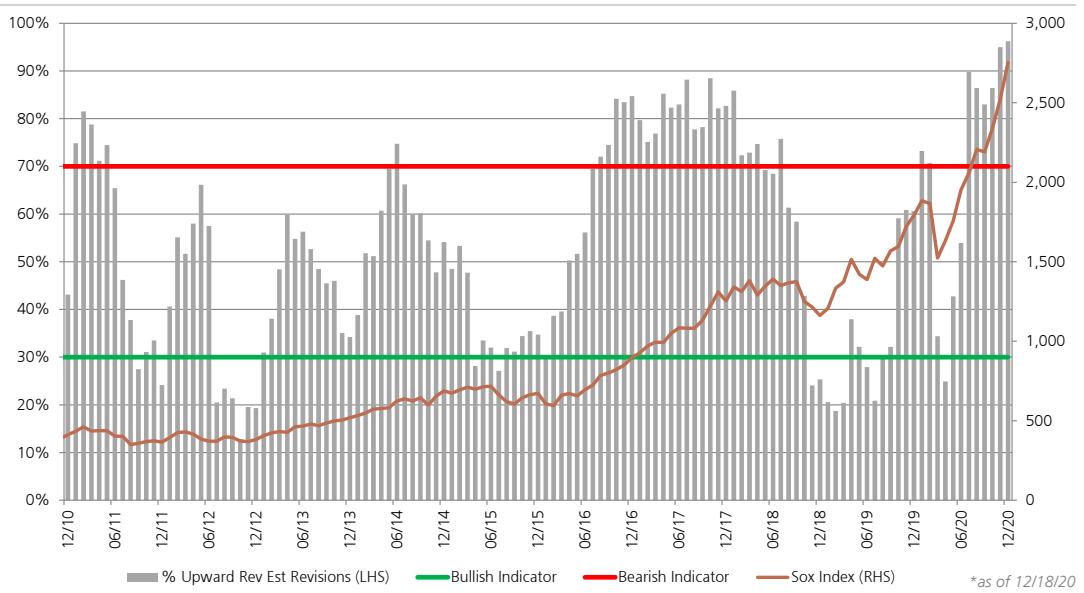
As shown in the below figures, the % of total upward EPS and Rev ests in May 2020 now surpasses the 30% marker. We saw a bottom of upward Rev/EPS revisions in April 2020 at 27% / 25% and from there we have seen fairly continuous % of upward revisions in the following months. The % of upward estimate revisions is increasing further in December MTD (from November). We can see from these charts that we have not seen revisions reach this proportion of upward skew for at least the past 10yrs (the time that we can track this data). Typically, 70% has been a red flag of sorts although revisions can stay above this level for an extended period because the industry has become less cyclical.

Figure 11: Upward EPS Revisions vs SOX



Source : Factset, UBS estimates

Figure 12: Upward Revenue Revisions vs SOX



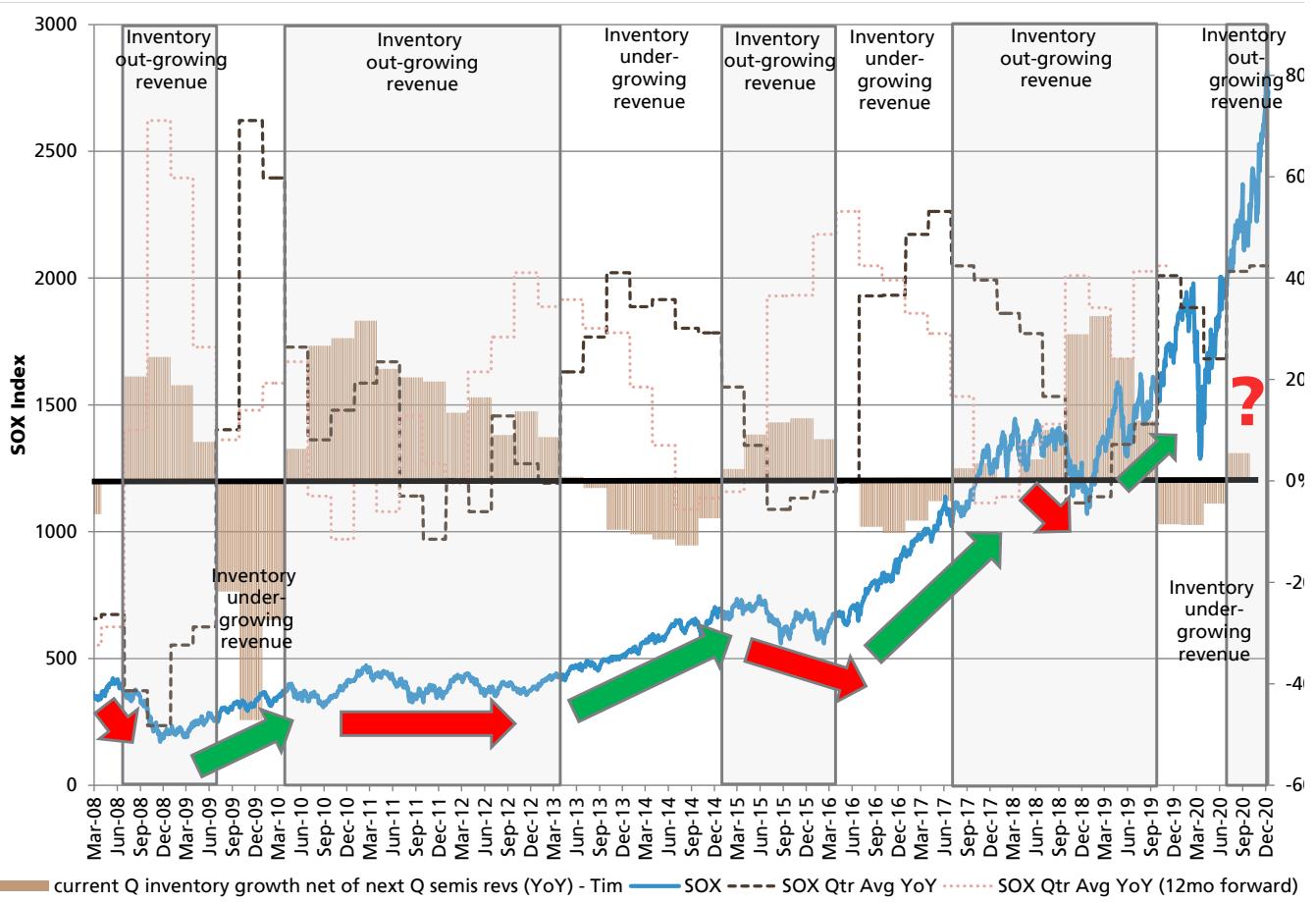
Source : Factset, UBS estimates

Inventory Analysis

The below figure compares Y/Y inventory growth to overall semiconductor revenue growth on a 1Q lag basis. In a perfect world, if the industry expected semiconductor revenue to grow, for example, 5% Y/Y into perpetuity, it would manage inventory growth to 5% Y/Y every Q. This, of course, is not the way the world works and instead these inventory cycles in turn create semiconductor cycles. Semiconductor stocks typically perform best when inventory is chasing demand – in other words when inventory is growing more slowly than Y/Y revenue growth in the following Q. This has very favorable implications up and down the P&L and cash flow in terms of improving leverage and factory capacity utilization.

In Spring 2018 we crossed over into a period where inventory growth started to exceed revenue growth – typically negative for semiconductor stocks. This gap peaked in CQ1:19 at levels consistent with prior cyclical peaks but has since begun to shrink as the industry has slowed inventory growth and revenue growth comps have become much easier. Based on the recently reported CQ3:20 numbers compared to our CQ4:20 semis revenue forecasts, inventory growth might be slightly over revenue growth again, showing some procurement was certainly pulled into C2H:20, auto/industrial sectors have bottomed out, and the supply chains are now building inventories. Typically, stocks do better when inventory growth is chasing revenue growth, but we are now in opposite territory and yet stocks are obviously performing well.

Figure 13: Inventory Analysis



Source : Company reports. UBS estimates

Our proprietary model comparing non-memory semis sell-through and OEM consumption **indicates a 12.4 pct pts over-shipment for semis (non-memory) vs OEM consumption in 2020** assuming our forecasts hold, with non-memory semis increasing 10.2% YoY vs OEM revenues down 2.2% YoY.

Though some of this delta can be attributed to semis consumption occurring beyond OEMs, the gap is too meaningful not to assume downside risks to semis revenue estimates. **This indicates a high probability of an inventory correction entering '21.** We forecast that for most segments, the inventory correction will accelerate in 4Q20-1Q21, with exceptions being Analog and DRAM, for which the worst of the channel inventory build is likely behind us. Overall though this data tells us that sell-through needs to significantly catch up with upstream sell-in, otherwise semis are in for a component inventory correction in 2021.

Figure 14: Semis Sell-Through vs. OEM revenue

	2018	2019	1Q20	2Q20	3Q20	4Q20E	2020E	1Q21E	2Q21E	3Q21E	4Q21E	2021E	2022E
Semis revenues (Sell Through)	411.9	352.6	93.0	95.2	102.7	101.3	392.3	99.7	103.3	113.0	117.4	433.4	487.3
% of total semis industry revs	87.9%	85.6%	88.9%	92.0%	90.4%	86.2%	89.3%	84.6%	86.9%	86.6%	93.9%	88.1%	89.7%
% QoQ			0.6%	2.4%	7.9%	-1.4%		-1.5%	3.6%	9.3%	3.9%		
% YoY	14.4%	-14.4%	11.2%	12.0%	12.3%	9.5%	11.3%	7.2%	8.5%	10.0%	15.8%	10.5%	12.4%
Semis revs ex memory (Sell Through)	246.4	241.2	62.9	62.2	69.6	71.2	265.9	70.5	70.8	76.7	77.8	295.8	315.5
% QoQ			-1.4%	-1.1%	11.9%	2.3%		-1.0%	0.4%	8.4%	1.4%		
% YoY	8.2%	-2.1%	12.7%	6.3%	10.3%	11.6%	10.2%	12.1%	13.8%	10.3%	9.3%	11.3%	6.6%
OEM revenues	1663.9	1663.3	379.7	376.1	410.9	460.4	1627.1	407.5	412.3	426.1	471.2	1717.0	1751.2
% QoQ			-16.7%	-0.9%	9.2%	12.1%		-11.5%	1.2%	3.3%	10.6%		
% YoY	4.4%	0.0%	-3.6%	-6.1%	-0.6%	1.0%	-2.2%	7.3%	9.6%	3.7%	2.3%	5.5%	2.0%

Source : Company data, UBS estimates – OEMs: 74 companies sample; Semis: 49 companies

Semiconductor Revenue Forecasts

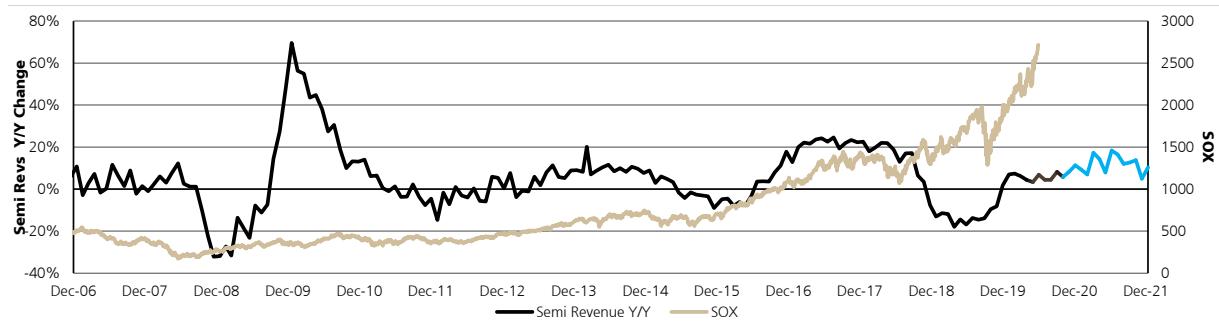
As shown in our global inventory note ([LINK](#)) we forecast semis industry revenues to increase 6.6% YoY in 2020 followed by an increase of 12.1% in 2021 as we note better than expected smartphone demand and have recently revised up Analog and Logic ICs (ex-CPU) revenues. We forecast 2022 semis industry revenues of \$543.2B (+10.4% YoY) with the growth acceleration mainly driven by Memory (+20.5% YoY). Excluding memory, we forecast semis industry revenues to increase 4.9%/11.6%/6.6% YoY in 2020/21/22, respectively. This compares to TSMC's recent guidance for semis (ex-memory) to be 'up mid-single digit' in 2020.

Figure 15: Global Semis revenues forecasts by product segments (Sell-In basis)

Revenues (US\$bn)	2015	2016	2017	2018	2019	2020E	2021E	2022E
MPU	43.3	43.1	44.4	46.9	48.0	51.8	53.9	55.5
	% YoY	-1.7%	-0.5%	3.1%	5.7%	2.3%	8.0%	4.0%
MCU	15.5	16.3	16.4	17.1	15.8	15.0	16.1	16.9
	% YoY	1.1%	5.0%	1.1%	3.8%	-7.4%	-5.0%	7.0%
DSP	2.6	2.9	3.3	3.3	2.7	2.2	2.4	2.4
	% YoY	-6.5%	12.5%	14.5%	-0.6%	-18.6%	-17.0%	7.0%
Analog	45.2	47.8	53.1	58.8	53.9	55.5	63.6	68.0
	% YoY	1.9%	5.8%	10.9%	10.8%	-8.3%	3.0%	14.5%
CMOS Logic	90.8	89.9	102.2	109.3	106.4	118.1	137.0	149.3
	% YoY	-1.0%	-0.9%	13.7%	6.9%	-2.7%	11.0%	16.0%
Memory	77.2	76.8	123.6	157.7	106.4	118.3	134.1	161.6
	% YoY	-2.6%	-0.6%	61.1%	27.6%	-32.5%	11.2%	13.3%
Total IC	274.5	276.6	343.0	393.1	333.2	361.0	407.0	453.7
	% YoY	-0.9%	0.8%	24.0%	14.6%	-15.2%	8.3%	12.7%
Discrete, Opto & Passives	60.7	62.2	69.1	75.7	78.9	78.2	85.2	89.4
	% YoY	3.7%	2.5%	11.1%	9.6%	4.2%	-1.0%	9.0%
Total Semiconductors	335.2	338.8	412.1	468.8	412.1	439.1	492.1	543.2
	% YoY	-0.1%	1.1%	21.6%	13.8%	-12.1%	6.6%	12.1%
Semis ex memory	258.0	262.1	288.4	311.0	305.7	320.8	358.1	381.6
	% YoY	0.6%	1.6%	10.1%	7.8%	-1.7%	4.9%	11.6%
Semis ex memory ex CPU	214.7	219.0	244.1	264.1	257.7	269.0	304.2	326.1
	% YoY	1.1%	2.0%	11.4%	8.2%	-2.4%	4.4%	13.1%
								7.2%

Source : SIA, Company reports, UBS estimates

Figure 16: Semi Revenue Y/Y Growth vs SOX



Source : SIA Data, Factset, UBS estimates

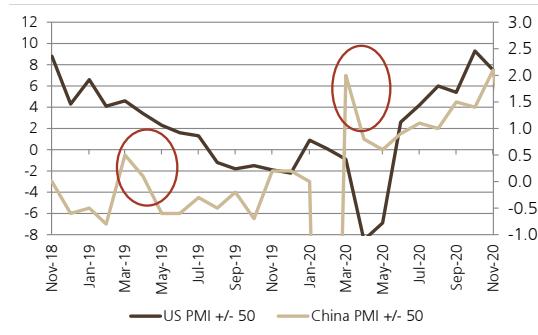
Macro Backdrop

Cyclicals have re-rated very quickly since the market bottomed in March 2020 and this bodes well for semiconductors. Overall, we now see full year semiconductor revenue in C2020 of +6.6% or ~\$439B and +12.1% or ~\$492B in C2021.

[See Figure 15: Global Semis revenues forecasts by product segments \(Sell-In basis\) ↗](#)

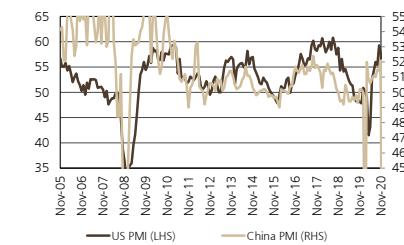
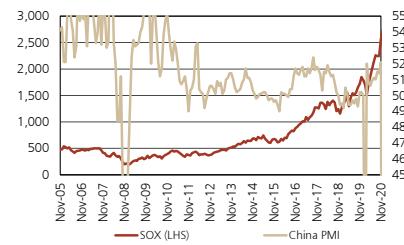
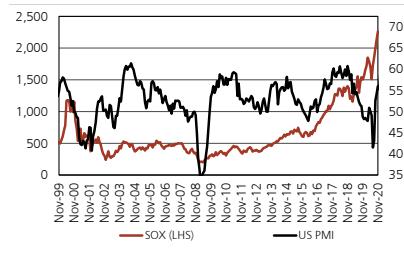
Macroeconomic indicators in China were de-coupled with indicators in the US and bottomed earlier as the Chinese economy, which was worsening through most of 2018, showed signs of stabilization in early 2019. This formed a more favorable backdrop for semis and the same may be true this time as the Chinese economy is now opening back up ahead of Western economies as can be seen in the below figures. The important point here though is that both China PMI and US PMI are in expansionary phases as the global economy is opening back up.

Figure 17: US PMI vs China PMI



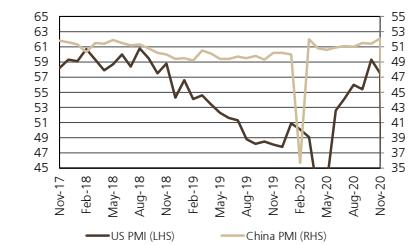
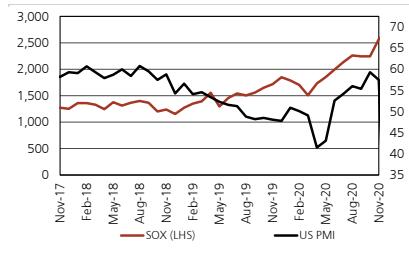
Source : Factset, UBS

Figure 18: SOX vs PMI Long Term Trend



Source : Factset, UBS

Figure 19: SOX vs PMI Last 3 Year Trend



Source : Factset, UBS

Sector Valuation and Stock Performance

P/E

We can see that stocks have rallied to multiples that are now back actually above pre-COVID levels and fully well north of 2 standard deviations versus any mean.

Figure 20: Combined Semiconductor/Semi Equipment Forward P/E – 1 yr

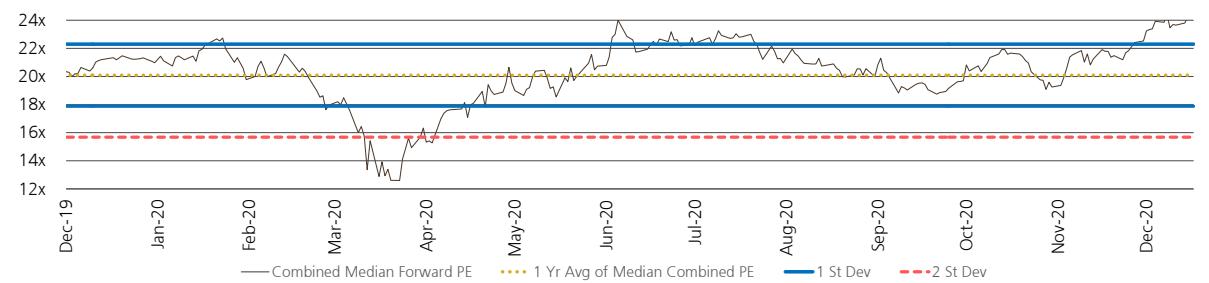


Figure 21: Combined Semiconductor/Semi Equipment Forward P/E – 5 yr

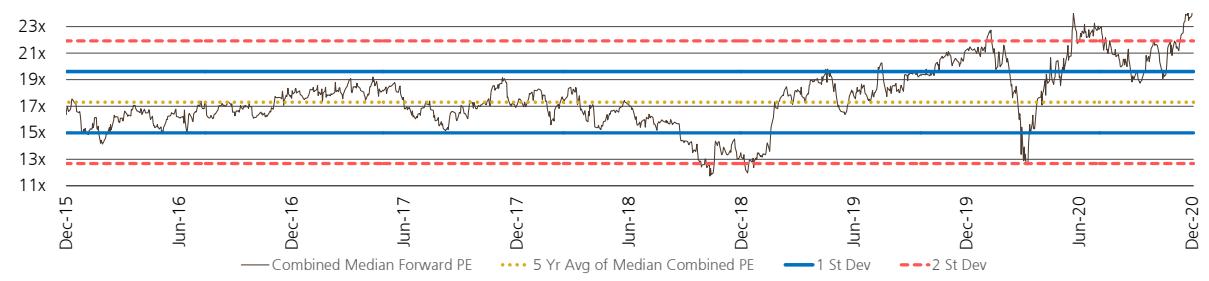


Figure 22: Combined Semiconductor/Semi Equipment Forward P/E – 10 yr

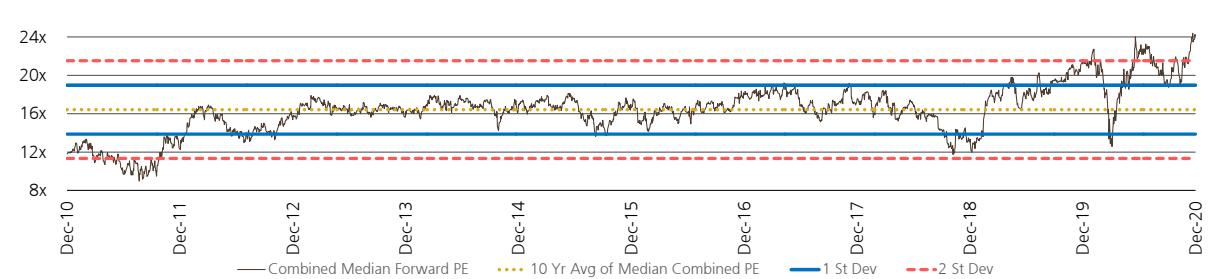
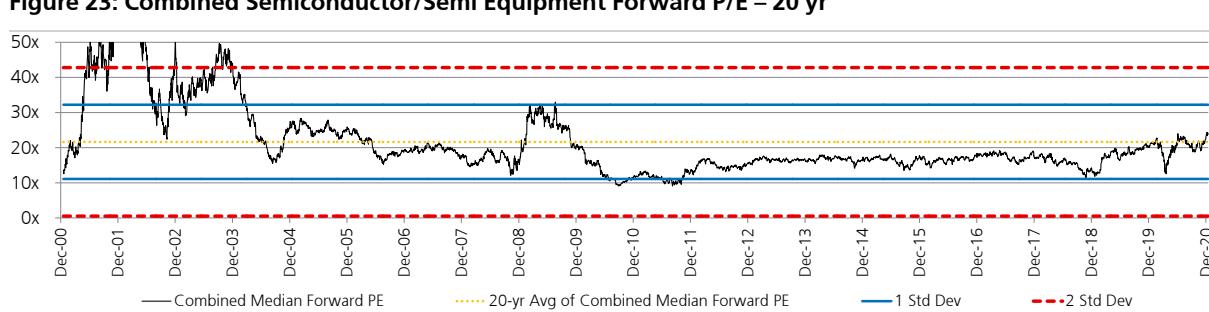


Figure 23: Combined Semiconductor/Semi Equipment Forward P/E – 20 yr



EV / Sales

Figure 24: 1 Year LTM EV / Sales

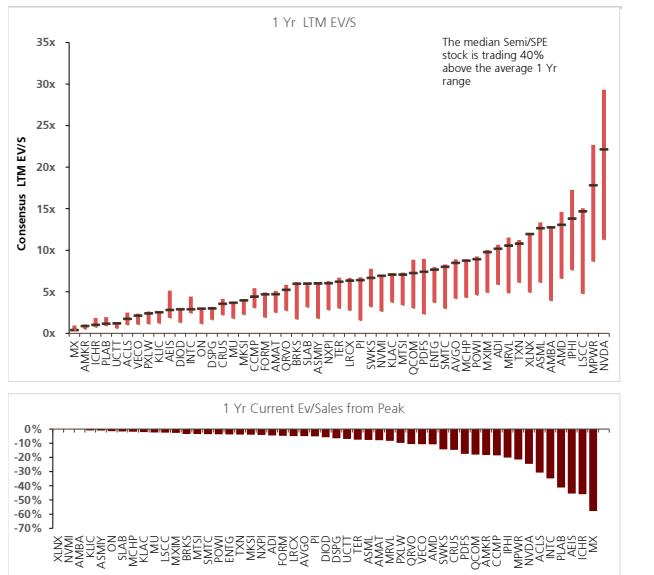


Figure 25: 5 Year LTM EV / Sales

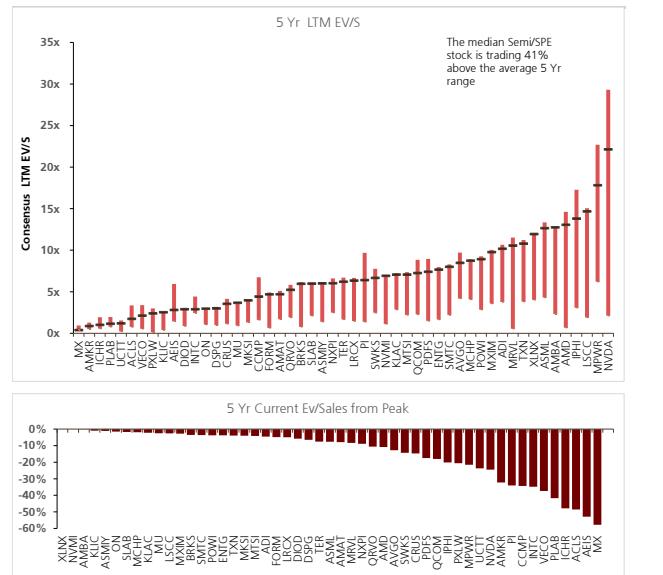


Figure 26: 10 Year LTM EV / Sales

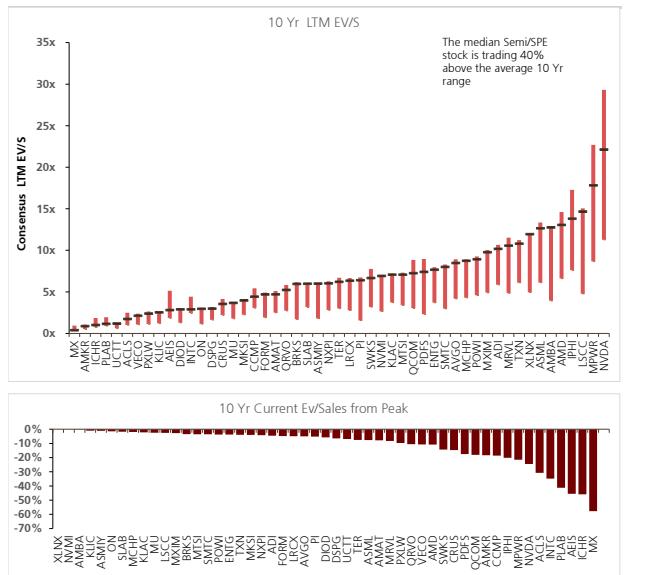
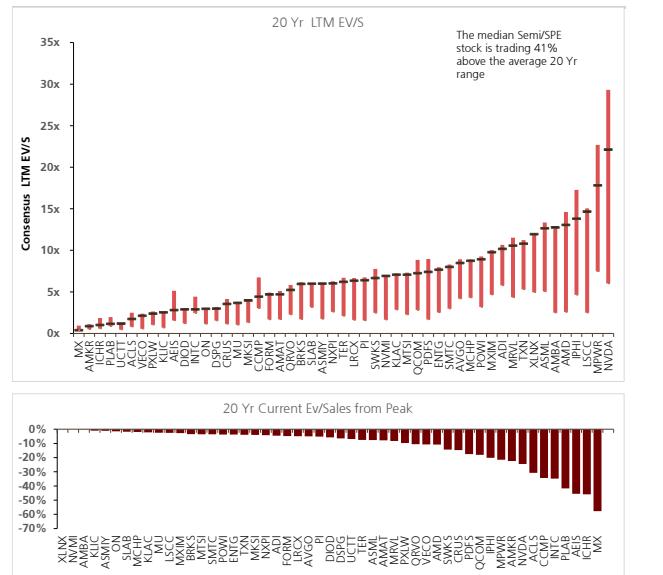


Figure 27: 20 Year LTM EV / Sales



Stock Performance

Semis have outperformed the S&P500 over any time frame we can measure.

Figure 28: Broad Markets/S&P Sector Performance

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
S&P 500	1.48%	3.13%	10.89%	19.56%	15.22%	16.60%	46.21%	0.14%	(4.28%)	(8.95%)	(12.22%)	(27.76%)	(29.11%)	(63.44%)	1.34%	3.34%	4.19%	8.18%	30.80%	32.10%	51.54%
NASDAQ-100 Index	2.82%	6.47%	15.08%	27.74%	46.02%	48.70%	97.76%	1.48%	(0.94%)	(4.75%)	(4.04%)	3.04%	2.99%	(11.90%)	(0.47%)	(1.38%)	(2.28%)	(3.54%)	(9.03%)	(9.40%)	(17.77%)
DJ Industrial Average	1.01%	1.75%	8.61%	16.02%	6.18%	7.20%	28.44%	(0.33%)	(5.66%)	(11.23%)	(15.76%)	(36.79%)	(38.51%)	(81.21%)	(0.14%)	4.28%	8.95%	12.22%	27.76%	29.11%	63.44%
S&P 500 / Semiconductors & Semiconductor Equipment	1.34%	7.41%	19.83%	31.78%	42.98%	45.71%	109.65%	0.28%	1.58%	6.78%	8.24%	7.22%	6.77%	29.33%	0.14%	5.86%	15.73%	20.46%	34.98%	35.88%	92.77%
Average	1.66%	5.55%	16.20%	27.02%	32.12%	34.14%	84.21%	0.39%	(2.32%)	(4.54%)	(5.94%)	(13.57%)	(14.47%)	(31.80%)	0.22%	3.02%	6.65%	9.33%	21.13%	21.93%	47.50%
Median	1.48%	6.47%	15.08%	27.74%	42.98%	45.71%	97.76%	0.21%	(2.61%)	(6.85%)	(8.13%)	(12.36%)	(13.06%)	(37.67%)	0.00%	3.81%	6.57%	10.20%	29.28%	30.61%	57.49%
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
S&P 500 / Energy -SEC	(3.75%)	9.51%	17.65%	0.15%	(34.64%)	(33.33%)	(33.33%)	(5.09%)	2.10%	(2.19%)	(31.63%)	(77.62%)	(79.04%)	(142.98%)	(5.23%)	6.38%	6.76%	(19.41%)	(49.86%)	(49.93%)	(79.54%)
S&P 500 / Financials -SEC	(0.07%)	3.98%	16.23%	19.04%	(6.95%)	(7.09%)	19.92%	(1.41%)	(3.42%)	(3.61%)	(12.74%)	(49.93%)	(52.80%)	(89.73%)	(1.55%)	0.85%	5.34%	(0.52%)	(22.17%)	(23.69%)	(26.29%)
S&P 500 / Information Technology -SEC	3.32%	5.69%	13.19%	25.63%	40.26%	43.23%	104.63%	1.98%	(1.72%)	(6.64%)	(6.15%)	(2.72%)	(2.49%)	(5.02%)	1.84%	2.56%	2.31%	6.07%	25.04%	26.63%	58.42%
S&P 500 / Communication Services -SEC	0.80%	3.22%	12.87%	19.71%	21.38%	22.39%	55.61%	(0.54%)	(4.19%)	(6.97%)	(12.07%)	(21.60%)	(23.33%)	(54.04%)	(0.68%)	0.09%	1.98%	0.15%	6.16%	5.79%	9.40%
S&P 500 / Industrials -SEC	0.27%	1.23%	11.52%	26.35%	8.83%	9.17%	35.70%	(1.07%)	(6.18%)	(8.32%)	(5.43%)	(34.15%)	(36.55%)	(73.95%)	(1.21%)	(1.90%)	0.63%	6.79%	(6.39%)	(7.43%)	(10.51%)
S&P 500	1.48%	3.13%	10.89%	19.56%	15.22%	16.60%	46.21%	0.14%	(4.28%)	(8.95%)	(12.22%)	(27.76%)	(29.11%)	(63.44%)	(0.45%)	0.45%	(1.40%)	4.51%	16.45%	16.89%	19.24%
S&P 500 / Consumer Discretionary -SEC	2.78%	3.58%	9.48%	24.07%	31.67%	33.49%	65.45%	1.44%	(3.83%)	(10.35%)	(7.71%)	(11.31%)	(12.23%)	(44.20%)	1.30%	0.45%	(1.40%)	4.51%	16.45%	16.89%	19.24%
S&P 500 / Materials -SEC	0.87%	2.33%	7.45%	27.63%	16.73%	18.52%	43.50%	(0.47%)	(5.08%)	(12.39%)	(4.15%)	(26.25%)	(27.19%)	(66.16%)	(0.61%)	(0.80%)	(3.44%)	8.07%	1.51%	1.92%	(2.72%)
S&P 500 / Health Care -SEC	0.64%	1.47%	6.87%	12.80%	10.44%	11.66%	30.57%	(0.70%)	(5.94%)	(12.96%)	(18.98%)	(32.54%)	(34.06%)	(79.08%)	(0.84%)	(1.66%)	(4.02%)	(6.76%)	(4.78%)	(4.94%)	(15.64%)
S&P 500 / Consumer Staples -SEC	0.84%	0.02%	5.75%	14.48%	7.35%	8.01%	27.93%	(0.50%)	(7.38%)	(14.08%)	(17.30%)	(35.63%)	(37.70%)	(81.72%)	(0.64%)	(3.11%)	(5.14%)	(5.08%)	(7.87%)	(8.59%)	(18.28%)
S&P 500 / Utilities -SEC	1.11%	(4.25%)	5.61%	6.33%	(3.40%)	(2.25%)	14.54%	(0.24%)	(11.66%)	(14.23%)	(25.45%)	(46.38%)	(47.96%)	(95.11%)	(0.38%)	(7.38%)	(5.28%)	(13.23%)	(18.62%)	(18.85%)	(31.67%)
S&P 500 / Real Estate - SEC	2.07%	(1.94%)	1.93%	2.43%	(4.80%)	(0.85%)	15.55%	0.73%	(9.35%)	(17.91%)	(29.35%)	(47.78%)	(46.57%)	(94.10%)	0.59%	(5.07%)	(8.96%)	(17.13%)	(20.02%)	(17.45%)	(30.66%)
Average	0.87%	2.33%	9.95%	16.52%	8.51%	9.96%	35.52%	(0.48%)	(5.08%)	(9.88%)	(15.26%)	(34.47%)	(35.75%)	(74.13%)	(0.67%)	(0.87%)	(1.02%)	(3.32%)	(7.32%)	(7.24%)	(11.66%)
Median	0.86%	2.73%	10.19%	19.30%	9.64%	10.41%	33.14%	(0.49%)	(4.68%)	(9.65%)	(12.48%)	(33.34%)	(35.30%)	(76.52%)	(0.64%)	(0.80%)	(1.40%)	(0.52%)	(6.39%)	(7.43%)	(15.64%)
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
S&P 500 / Electronic Equipment, Instruments & Components	0.26%	4.62%	21.21%	31.54%	20.33%	21.36%	54.08%	(1.08%)	(2.79%)	1.38%	(0.24%)	(22.65%)	(24.36%)	(55.57%)	(1.22%)	1.49%	10.33%	11.98%	5.11%	4.76%	7.87%
S&P 500 / Semiconductors & Semiconductor Equipment	1.34%	7.41%	19.83%	31.78%	42.98%	45.71%	109.65%	(0.34%)	(1.69%)	(7.29%)	(30.15%)	(45.33%)	(45.44%)	(103.96%)	(0.14%)	4.28%	8.95%	12.22%	27.76%	29.11%	63.44%
S&P 500 / Technology Hardware, Storage & Peripherals	4.38%	8.27%	17.27%	45.83%	69.17%	76.76%	191.91%	3.03%	0.86%	(2.57%)	14.05%	26.19%	31.04%	82.26%	2.89%	5.14%	6.38%	26.27%	53.95%	60.16%	145.70%
S&P 500 / Communications Equipment -II	1.00%	5.72%	12.55%	1.63%	(2.35%)	0.28%	5.69%	(0.34%)	(1.69%)	(7.29%)	(30.15%)	(45.33%)	(45.44%)	(103.96%)	(0.48%)	2.59%	1.66%	(17.93%)	(17.57%)	(16.32%)	(40.52%)
S&P 500	1.48%	3.13%	10.89%	19.56%	15.22%	16.60%	46.21%	0.14%	(4.28%)	(8.95%)	(12.22%)	(27.76%)	(29.11%)	(63.44%)	(0.14%)	4.28%	8.95%	12.22%	27.76%	29.11%	63.44%
S&P 500 / IT Services -IND	3.32%	5.28%	9.30%	16.39%	19.29%	20.34%	63.66%	1.98%	(2.12%)	(10.53%)	(15.39%)	(23.69%)	(25.38%)	(45.99%)	1.84%	2.16%	(1.58%)	(3.17%)	4.07%	3.74%	17.45%
S&P 500 / Software -IND	4.15%	3.03%	8.54%	17.26%	42.09%	44.36%	105.98%	2.80%	(4.38%)	(11.29%)	(14.52%)	(0.89%)	(1.35%)	(3.67%)	2.67%	(0.10%)	(2.34%)	(2.30%)	26.87%	27.76%	59.77%
Average	2.28%	5.35%	14.23	23.43%	29.53%	32.20%	82.46%	1.09%	(2.40%)	-6.54	(9.74%)	(15.69%)	(15.77%)	(31.73%)	0.93%	2.59%	3.90	4.51%	16.70%	18.20%	42.28%
Median	1.48%	5.28%	12.55	19.56%	20.33%	21.36%	63.66%	1.06%	(2.46%)	-8.12	(13.37%)	(23.17%)	(24.87%)	(50.78%)	0.85%	2.37%	4.02	4.84%	15.99%	16.26%	38.61%

Source : Factset

On a relative basis, SPE and other suppliers to the industry are the stocks that have done the best over the past 3mos - indicative of the pro-cyclical trade that investors have been making. We are not so sure this persists into 2021 as producers like MU might be better performers on a relative basis in our view.

Figure 29: Semiconductors/Semi Equipment Performance

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	
FORM	FormFactor, Inc.	1.12%	8.61%	79.06%	42.35%	66.65%	67.82%	206.52%	(0.22%)	1.20%	59.23%	10.57%	23.67%	22.10%	96.86%	(0.36%)	5.48%	68.18%	22.79%	51.43%	51.22%	160.30%	
AEIS	Advanced Energy Industries, Inc.	3.06%	13.04%	67.62%	51.65%	41.32%	45.78%	145.53%	1.72%	5.64%	47.78%	19.87%	(1.66%)	0.07%	35.88%	1.58%	9.91%	56.73%	32.09%	26.10%	29.18%	99.32%	
BRKS	Brooks Automation, Inc.	2.69%	5.68%	63.79%	75.43%	78.19%	71.96%	190.37%	1.35%	(1.73%)	43.96%	43.65%	35.21%	26.25%	80.72%	1.21%	2.55%	52.90%	55.87%	62.97%	55.36%	144.16%	
UCTT	Ultra Clean Holdings, Inc.	(4.26%)	18.78%	61.26%	46.32%	40.65%	43.27%	305.03%	(5.61%)	11.38%	41.43%	14.54%	(2.33%)	(2.44%)	195.38%	(5.75%)	15.65%	50.37%	26.76%	25.43%	26.67%	258.82%	
NANO	Onto Innovation, Inc.	1.33%	12.26%	60.31%	35.73%	29.34%	35.14%	67.95%	(0.01%)	4.85%	40.48%	3.95%	(13.64%)	(10.57%)	(41.71%)	(0.15%)	9.13%	49.43%	16.17%	14.12%	18.54%	21.73%	
LRCX	Lam Research Corporation	(0.80%)	12.57%	58.96%	54.96%	66.29%	67.34%	258.37%	(2.14%)	5.17%	39.12%	23.18%	23.31%	21.63%	148.72%	(2.28%)	9.44%	48.07%	35.40%	51.07%	50.74%	212.16%	
AMAT	Applied Materials, Inc.	(0.44%)	17.65%	55.31%	45.83%	43.35%	43.94%	167.83%	(1.79%)	10.25%	35.47%	14.05%	0.37%	(1.78%)	58.18%	(1.93%)	14.53%	44.42%	26.27%	28.13%	27.34%	121.62%	
LSCC	Lattice Semiconductor Corporation	4.50%	7.01%	55.17%	59.43%	130.56%	118.47%	539.57%	3.16%	(0.40%)	35.33%	27.65%	87.59%	72.75%	429.91%	3.02%	3.88%	44.28%	39.87%	115.35%	101.87%	493.35%	
TER	Teradyne, Inc.	3.17%	12.69%	53.72%	52.19%	75.03%	74.18%	275.31%	1.83%	5.28%	33.89%	20.41%	32.05%	28.47%	165.66%	1.69%	9.56%	42.84%	32.63%	59.81%	57.58%	229.10%	
PI	Impinj, Inc.	1.66%	22.68%	53.15%	52.71%	63.57%	53.54%	159.67%	0.32%	15.27%	33.32%	20.93%	20.59%	7.83%	50.02%	0.18%	19.55%	42.26%	33.15%	48.35%	36.94%	113.46%	
MTSI	MACOM Technology Solutions Holdings, Inc.	5.35%	18.82%	52.67%	49.66%	88.20%	83.50%	225.28%	4.00%	11.41%	32.83%	17.88%	45.22%	37.79%	115.62%	3.86%	15.69%	41.78%	30.10%	72.98%	66.90%	179.06%	
XLNX	Xilinx, Inc.	5.56%	16.45%	49.76%	62.42%	55.32%	58.19%	74.19%	4.22%	9.04%	29.93%	30.64%	12.34%	12.47%	(35.46%)	4.08%	13.32%	38.88%	42.86%	40.10%	41.59%	27.98%	
ASMLY	ASM International N.V. Sponsored ADR	2.68%	25.76%	47.68%	51.17%	84.19%	79.11%	404.56%	1.34%	18.35%	27.84%	19.39%	41.21%	33.40%	294.91%	1.20%	22.63%	36.79%	31.61%	68.97%	62.51%	358.35%	
VECO	Veco Instruments Inc.	6.69%	16.62%	47.56%	35.11%	25.40%	30.23%	149.53%	5.35%	9.22%	27.72%	3.33%	(17.58%)	(15.48%)	39.87%	5.21%	13.50%	36.67%	15.55%	10.18%	13.63%	103.31%	
IPHI	Inphi Corporation	6.05%	6.84%	47.30%	36.71%	113.69%	114.85%	386.83%	4.70%	(0.57%)	27.46%	4.93%	70.71%	69.13%	277.17%	4.57%	3.71%	36.41%	17.15%	98.47%	98.25%	340.61%	
POWI	Power Integrations, Inc.	7.91%	9.90%	44.82%	29.81%	57.52%	65.59%	158.50%	6.57%	2.50%	24.99%	(1.97%)	14.54%	19.87%	48.85%	6.43%	6.77%	33.94%	10.25%	42.30%	48.99%	112.29%	
ON	ON Semiconductor Corporation	3.47%	12.22%	44.29%	59.68%	29.61%	33.73%	82.45%	2.13%	4.81%	24.46%	27.90%	(13.36%)	(11.99%)	(27.20%)	1.99%	9.09%	33.41%	40.12%	14.40%	17.13%	36.24%	
KLAC	KLA Corporation	1.45%	7.38%	43.88%	33.93%	45.75%	47.58%	191.97%	0.10%	(0.03%)	24.04%	2.15%	2.77%	1.87%	88.32%	(0.04%)	4.25%	32.99%	14.37%	30.53%	30.98%	145.76%	
ICHR	Ichor Holdings, Ltd.	(3.88%)	12.00%	43.42%	30.73%	(6.28%)	(7.67%)	87.61%	(5.23%)	4.59%	23.59%	(1.05%)	(49.26%)	(53.38%)	(22.05%)	(5.37%)	8.87%	32.54%	11.17%	(21.50%)	(24.27%)	41.39%	
KLIC	Kulicke & Soffa Industries, Inc.	(1.94%)	13.82%	42.38%	43.30%	22.65%	25.74%	72.85%	(3.28%)	6.41%	22.55%	11.52%	(20.33%)	(19.97%)	(36.80%)	(3.42%)	10.69%	31.49%	23.74%	7.43%	9.14%	26.64%	
MU	Micron Technology, Inc.	1.37%	16.57%	41.74%	41.80%	34.36%	36.34%	113.28%	0.03%	9.16%	21.91%	10.02%	(8.62%)	(9.37%)	3.63%	(0.11%)	13.44%	30.86%	22.24%	19.14%	19.74%	67.07%	
ENTG	Entegris, Inc.	3.43%	9.16%	41.37%	53.55%	92.23%	88.69%	273.80%	2.08%	1.75%	21.54%	21.77%	49.25%	42.98%	164.14%	1.94%	6.03%	30.49%	33.99%	77.01%	72.09%	227.58%	
NVMI	Nova Measuring Instruments Ltd	2.80%	13.31%	40.17%	41.53%	85.67%	86.12%	204.99%	1.45%	5.90%	20.34%	9.75%	42.69%	40.40%	95.34%	1.31%	10.18%	29.28%	21.97%	70.45%	69.52%	158.78%	
MKSI	MKS Instruments, Inc.	0.60%	13.55%	39.07%	36.65%	36.32%	35.46%	130.09%	(0.74%)	6.15%	19.23%	4.87%	(6.66%)	(10.25%)	20.43%	(0.88%)	10.42%	28.18%	17.05%	21.10%	18.86%	83.87%	
DIOD	Diodes Incorporated	0.54%	7.57%	38.94%	37.43%	21.73%	33.27%	113.64%	(0.80%)	0.16%	19.10%	5.65%	(21.25%)	(12.44%)	3.98%	(0.94%)	4.44%	28.05%	17.87%	6.51%	16.67%	67.42%	
MPWR	Monolithic Power Systems, Inc.	11.13%	12.75%	35.44%	51.56%	91.82%	91.14%	200.19%	9.79%	5.34%	19.78%	48.84%	45.43%	90.54%	9.65%	9.62%	24.56%	32.00%	76.60%	74.54%	153.98%		
MCHP	Microchip Technology Incorporated	(0.14%)	9.70%	34.97%	33.59%	33.42%	36.35%	96.21%	(1.48%)	2.29%	15.13%	1.81%	(9.56%)	(9.36%)	(13.44%)	(1.62%)	6.57%	24.08%	14.03%	18.20%	19.75%	50.00%	
AMKR	Amkor Technology, Inc.	1.92%	14.01%	33.97%	25.81%	18.31%	18.86%	143.74%	0.58%	6.60%	14.14%	(5.97%)	(24.67%)	(26.86%)	34.09%	0.44%	10.88%	23.09%	6.25%	3.09%	2.26%	97.53%	
SMTC	Semtech Corporation	3.39%	6.29%	33.12%	37.68%	36.14%	44.04%	58.84%	2.04%	(1.12%)	13.29%	5.90%	(6.84%)	(1.67%)	(50.81%)	1.91%	3.16%	22.24%	18.12%	20.92%	27.44%	12.63%	
CRUS	Cirrus Logic, Inc.	(0.95%)	6.27%	32.32%	22.68%	(2.14%)	3.23%	124.71%	(2.29%)	(1.14%)	12.49%	(9.10%)	(45.11%)	(42.49%)	15.06%	(2.43%)	3.14%	21.43%	3.12%	(17.35%)	(13.37%)	78.50%	
ACLS	Axcelis Technologies, Inc.	5.00%	11.16%	30.85%	4.74%	21.10%	22.73%	65.70%	3.66%	3.75%	11.02%	(27.04%)	(21.88%)	(29.98%)	(43.95%)	3.52%	8.03%	19.97%	(14.82%)	5.88%	6.13%	19.49%	
PXLW	Pixelworks, Inc.	13.11%	26.20%	30.77%	(16.47%)	(26.28%)	(8.54%)	(8.83%)	11.77%	18.79%	10.93%	(48.25%)	(69.25%)	(54.26%)	(118.49%)	11.63%	23.07%	19.88%	(36.03%)	(41.49%)	(25.14%)	(55.05%)	
QCOM	Qualcomm Inc	(3.99%)	0.53%	30.16%	66.26%	69.48%	69.30%	162.33%	(5.34%)	(6.88%)	10.33%	34.48%	26.50%	23.59%	52.68%	(5.48%)	(2.60%)	19.28%	46.70%	54.26%	52.70%	116.12%	
ASML	ASML Holding NV ADR	4.25%	11.92%	30.15%	31.70%	61.28%	61.88%	197.20%	2.92%	4.51%	10.31%	(0.08%)	18.30%	16.17%	87.55%	2.78%	8.79%	19.26%	12.14%	46.06%	45.28%	150.99%	
SLAB	Silicon Laboratories Inc.	4.28%	13.29%	28.69%	28.04%	9.26%	10.90%	58.80%	2.94%	5.89%	8.85%	(3.74%)	(33.72%)	(34.82%)	(50.86%)	2.80%	10.17%	17.80%	8.48%	(5.96%)	(5.70%)	12.58%	
MXIM	Maxim Integrated Products, Inc.	1.56%	6.29%	28.23%	42.28%	39.55%	41.77%	64.44%	0.22%	(1.12%)	8.40%	10.50%	(3.42%)	(3.95%)	(45.21%)	0.08%	3.16%	17.35%	22.72%	24.34%	25.17%	18.23%	
AMD	Advanced Micro Devices, Inc.	5.65%	16.17%	26.51%	77.53%	111.16%	126.42%	414.29%	4.31%	8.76%	6.67%	45.75%	68.19%	80.71%	304.63%	4.17%	13.04%	15.62%	57.97%	95.95%	109.82%	368.07%	
CDNS	Cadence Design Systems, Inc.	8.39%	12.18%	25.85%	36.78%	83.54%	84.15%	200.87%	7.04%	4.77%	6.02%	5.00%	40.56%	38.43%	91.22%	6.90%	9.05%	14.97%	17.22%	68.32%	67.55%	154.66%	
DSPG	DSP Group, Inc.	1.33%	5.36%	24.89%	6.16%	7.18%	21.88%	53.73%	(0.01%)	(2.05%)	5.05%	(33.11%)	(36.82%)	(38.53%)	(55.93%)	(0.15%)	2.23%	14.00%	(20.89%)	(9.06%)	7.51%	18.47%	
ADI	Analog Devices, Inc.	1.77%	5.82%	24.50%	17.34%	20.99%	21.01%	64.68%	0.43%	(1.59%)	4.66%	(14.44%)	(21.99%)	(26.99%)	(36.11%)	0.29%	2.69%	13.61%	(2.22%)	5.77%	4.41%	14.75%	
SNPS	Synopsys, Inc.	6.88%	13.15%	23.99%	32.45%	79.81%	82.77%	192.29%	5.54%	5.74%	4.16%	0.67%	36.83%	37.06%	82.64%	5.40%	10.02%	10.27%	13.11%	12.89%	64.59%	66.17%	146.08%
NXPI	NXP Semiconductors NV	(0.13%)	5.80%	23.72%	35.38%	24.20%	25.51%	109.99%	(1.48%)	(1.60%)	3.88%	3.60%	(18.78%)	(20.20%)	0.34%	(1.62%)	2.67%	12.83%	15.82%	8.98%	8.91%	63.78%	
QRVO	Qorvo, Inc.	0.80%	7.52%	22.49%	41.69%	37.31%	39.57%	164.50%	(0.54%)	0.11%	2.65%	9.91%	(5.67%)	(6.14%)	54.85%	(0.68%)	4.39%	11.60%	22.13%	22.09%	22.97%	118.29%	
MRVL	Marvell Technology Group Ltd.	9.76%	9.62%	21.69%	34.65%	77.33%	82.77%	208.85%	8.42%	2.22%	1.86%	2.87%	34.36%	37.06%	99.20%	8.28%	6.49%	10.80%	15.09%	62.12%	66.17%	162.64%	
SIMO	Silicon Motion Technology Corporation SP	3.31%	21.89%	20.64%	0.70%	(9.51%)	(5.46%)	38.10%	1.97%	14.48%	0.80%	(31.08%)	(52.48%)	(51									

Comp Tables

Figure 30: Semiconductors I

Company	Rating	Price	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash as % of MCap Current		Gross Margin		ROE		Revenue Growth																				
		(lc)	Target (lc)	Cap (\$m)	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E																			
Analog Devices	Not Rated	143.78	-	\$53,235	8.7x	9.2x	20.1x	20.7x	25.2x	26.9x	24.1x	24.9x	2.1%	1.8%	4.4%	4.0%	43.2%	44.4%	-8%	69.2%	70.1%	15.8%	17.5%	-7%	13%																				
Infineon	Buy	30.95	30	\$49,439	4.8x	3.9x	18.7x	13.6x	nm	48.7x	40.6x	26.6x	0.8%	1.1%	-12.0%	2.3%	25.8%	28.9%	-13%	34.6%	37.0%	10.4%	15.0%	22%	3%																				
Maxim Integrated	Not Rated	85.84	-	\$23,012	7.4x	9.0x	21.1x	22.3x	22.8x	25.4x	27.7x	29.8x	2.9%	1.3%	4.3%	3.9%	35.0%	40.2%	2%	66.1%	68.2%	41.7%	35.4%	-8%	18%																				
Microchip Technology	Not Rated	139.72	-	\$36,349	8.5x	7.9x	20.9x	18.7x	25.5x	23.6x	22.7x	20.1x	1.1%	1.0%	4.9%	5.3%	40.4%	42.1%	-24%	62.1%	63.1%	27.8%	28.7%	2%	8%																				
Melexis	Sell	81.85	55.00	\$4,033	6.5x	5.8x	25.7x	21.5x	41.9x	37.4x	51.9x	39.0x	0.0%	1.2%	2.4%	2.6%	25.3%	27.0%	0%	38.8%	40.9%	17.6%	22.1%	13%	12%																				
NXP	Not Rated	158	-	\$44,329	5.9x	5.2x	18.9x	14.5x	28.2x	21.2x	26.3x	19.4x	0.7%	0.8%	4.1%	5.4%	31.4%	36.0%	-14%	50.9%	53.8%	18.3%	23.1%	-3%	13%																				
ON Semi	Not Rated	31.60	-	\$13,013	3.1x	2.8x	15.5x	12.3x	45.0x	28.0x	41.1x	23.4x	0.0%	0.0%	2.7%	4.4%	19.9%	22.7%	-21%	32.5%	35.9%	9.2%	15.4%	-6%	10%																				
Renesas Electronics	Buy	1,100	1,300	\$17,866	3.3x	3.1x	9.0x	10.9x	18.2x	16.0x	35.6x	25.6x	0.9%	0.9%	7.1%	8.1%	37.2%	28.3%	-27%	46.2%	46.1%	8.1%	10.4%	7%	8%																				
Rohm	Buy	10010.00	10300.00	\$9,758	2.2x	2.0x	11.1x	9.0x	25.6x	33.3x	42.0x	28.6x	1.5%	1.7%	3.0%	2.3%	19.6%	22.5%	33%	30.7%	32.6%	3.3%	4.7%	-3%	9%																				
STMicroelectronics	Buy	30	32	\$33,306	3.3x	2.9x	15.2x	11.3x	59.9x	37.3x	34.3x	22.7x	0.5%	0.7%	1.6%	2.6%	21.6%	25.9%	2%	37.0%	39.0%	11.9%	15.6%	5%	12%																				
TE Connectivity	Not Rated	116.16	-	\$38,293	3.0x	3.1x	15.0x	14.2x	28.2x	23.9x	23.3x	21.2x	1.9%	1.7%	4.0%	4.6%	20.1%	22.1%	-10%	31.0%	32.5%	14.2%	17.8%	-11%	12%																				
Texas Instruments	Neutral	162.69	146.00	\$149,211	10.9x	9.2x	22.7x	18.5x	30.7x	28.1x	29.3x	24.2x	2.3%	2.6%	3.4%	3.7%	48.0%	49.5%	-1%	63.9%	64.9%	59.8%	73.2%	-1%	19%																				
Analog Semis		Mean		5.6x		5.3x		17.8x		15.6x		31.9x		29.1x		33.2x		25.5k		1.2%		1.2%		2.5%		4.1%		30.6k		32.5%		-7%		46.9%		48.7%		19.8%		23.2%		1%		11%	
		Median		5.4		4.6		18.8		28.2		27.4		31.8		31.8		24.5		1.0%		1.1%		3.7%		4.0%		28.6%		-9%		42.5%		43.5%		15.0%		17.6%		-2%		12%			

Source : Factset, UBSe

Figure 31: Semiconductors II

Company	Rating	Price	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash as % of MCap Current		Gross Margin		ROE		Revenue Growth																		
		(lc)	Target (lc)	Cap (\$m)	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E																	
SK Hynix	Buy	11950.00	12500.00	\$78,454	2.9x	2.5x	6.2x	5.0x	36.1x	22.5x	24.4x	15.0x	1.0%	1.1%	2.9%	4.6%	46.1%	51.1%	-4%	34.1%	41.4%	7.0%	10.3%	23%	12%																		
Nanya Tech	Not Rated	85.70	-	\$9,327	3.5x	3.0x	9.1x	6.9x	15.0x	20.3x	30.5x	19.8x	1.8%	2.3%	5.5%	4.0%	38.5%	43.9%	17%	34.7%	34.7%	5.5%	8.0%	24%	16%																		
Microchip Technology	Buy	72.26	82.00	\$80,508	3.6x	3.0x	8.4x	6.0x	151.7x	30.8x	22.3x	13.3x	0.0%	0.0%	0.7%	3.3%	43.0%	50.6%	3%	31.4%	36.5%	9.0%	13.4%	-1%	21%																		
Samsung Electronics	Buy	73,300	82,000	\$396,321	1.7x	1.6x	6.4x	5.5x	19.5x	17.3x	19.2x	15.4x	1.9%	2.1%	4.2%	4.8%	26.7%	29.0%	24%	39.0%	40.8%	8.1%	9.3%	9%	7%																		
Memory Semis		Mean		2.9x		2.6x		7.5x		5.8x		55.6x		22.7x		24.1x		15.9x		1.2%		1.4%		3.3%		4.2%		38.6%		43.7%		10%		32.7%		38.3%		7.4%		10.3%		14%	
		Median		3.2x		2.8x		7.4x		5.7x		27.8x		21.4x		23.4x		15.2x		1.4%		1.6%		3.5%		40.7%		47.2%		10%		32.8%		38.6%		7.5%		9.8%		16%			

Source : Factset, UBSe

Company	Rating	Price	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash as % of MCap Current		Gross Margin		ROE		Revenue Growth	
		(lc)	Target (lc)	Cap (\$m)	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E
Analog Devices	Not Rated	143.78	-	\$53,235	8.7x	9.2x	20.1x	20.7x	25.2x	26.9x	24.1x	24.9x	2.1%	1.8%	4.4%	4.0%	43.2%	44.4%	-8%	69.2%	70.1%	15.8%	17.5%	-7%	13%	
Broadcom	Buy	426.10	445.00	\$172,318	8.8x	7.6x	9.0x	9.4x	18.3x	14.3x	31.9x	23.2x	0.1%	0.1%	3.7%	8.9%	20.2%	22.4%	-41%	28.6%	31.5%	5.8%	11.0%	97%	57%	
Maxim Integrated	Not Rated	85.84	-	\$23,012	7.4x	9.0x	21.1x	22.3x	22.8x	25.4x	27.7x	29.8x	2.9%	1.3%	4.3%	3.4%	6.8%	7.4%	-19%	73.5%	73.6%	38.6%	51.0%	5%	9%	
Microchip Technology	Not Rated	139.72	-	\$36,349	8.5x	7.9x	20.9x	18.7x	25.5x	23.6x	22.															

Figure 32: Semiconductor Equipment

Company	Rating	Price	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash as % of MCap Current		Gross Margin		ROE		Revenue Growth	
		(lc)	Target (lc)	Cap (\$m)	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E
Advantest	Neutral	7360.00	5800.00	\$13,800	4.7x	4.3x	19.4x	16.0x	27.1x	24.5x	29.7x	25.6x	1.0%	1.2%	3.4%	3.8%	24.4%	26.9%	-7%	56.1%	56.4%	19.2%	19.5%	7%	11%	
Applied Materials	Neutral (C/B)	87.50	73	\$79,795	4.6x	4.3x	16.5x	14.7x	30.1x	15.0x	20.5x	18.0x	1.0%	1.3%	3.4%	4.0%	27.8%	28.9%	2%	45.2%	46.3%	36.0%	38.7%	18%	10%	
ASM International	Not Rated	169.10	-	\$10,239	6.0x	5.4x	19.5x	18.2x	47.1x	26.4x	29.0x	24.3x	1.1%	1.1%	2.0%	3.6%	30.8%	29.9%	5%	46.8%	46.0%	15.1%	16.4%	20%	11%	
ASM Pacific Tech	Neutral	100.00	90	\$5,264	2.6x	2.4x	nm	10.4x	46.9x	41.0x	nm	17.1x	2.2%	3.2%	2.2%	2.5%	nm	23.2%	-6%	34.1%	37.6%	nm	17.4%	6%	10%	
ASML	Neutral	390.50	350.00	\$203,377	12.2x	10.6x	39.0x	30.9x	127.6x	52.6x	51.0x	38.6x	0.8%	1.0%	0.8%	1.9%	31.3%	34.2%	0%	48.2%	50.1%	23.3%	29.3%	24%	15%	
Disco	Neutral	34,200	30,000	\$11,568	6.9x	6.3x	21.3x	17.9x	61.3x	36.0x	37.2x	31.1x	1.2%	1.2%	1.5%	2.6%	32.3%	35.0%	7%	59.5%	60.8%	13.6%	14.8%	22%	11%	
Eugene Tech	Buy	33000.00	39000.00	\$671	3.2x	1.6x	20.1x	6.3x	127.1x	13.8x	91.7x	11.2x	0.7%	1.0%	0.7%	6.2%	16.1%	25.5%	13%	50.0%	48.8%	3.4%	21.5%	7%	102%	
Jusung Engineering	Not Rated	8,620	-	\$373	4.5x	2.5x	nm	16.6x	23.8x	nm	18.4x	0.7%	0.7%	19.3%	5.4%	-8.1%	14.8%	7%	28.5%	42.3%	-10.4%	9.5%	-51%	81%		
KLA Corp	Neutral	259.68	205.00	\$40,023	6.9x	6.6x	19.3x	16.7x	23.5x	25.8x	22.7x	20.4x	1.4%	1.5%	4.5%	4.1%	35.9%	39.2%	-4%	61.4%	62.4%	60.6%	57.1%	14%	11%	
Nikon	Not Rated	688	-	\$2,503	0.2x	nm	3.9x	nm	nm	nm	nm	nm	3.7%	2.7%	-6.0%	-3.9%	4.1%	113%	33.7%	38.6%	-6.1%	-0.4%	-21%	1%	-	-
Screen	Neutral	7150.00	5900.00	\$3,478	1.2x	1.1x	12.9x	10.8x	31.7x	25.2x	27.1x	19.5x	0.9%	1.3%	3.2%	4.0%	9.0%	10.5%	7%	26.4%	28.1%	6.7%	8.8%	-2%	3%	
Teradyne	Sell	119.35	88	\$19,818	6.7x	6.9x	20.1x	22.6x	26.3x	23.7x	26.1x	29.7x	0.3%	0.4%	4.0%	4.5%	33.3%	30.7%	4%	57.3%	35.9%	32.8%	39%	-3%	-	
Tokyo Electron	Buy	37250.00	47000.00	\$55,038	4.0x	3.6x	15.9x	13.5x	33.7x	29.3x	24.9x	21.0x	2.1%	2.4%	2.8%	3.2%	25.1%	26.8%	6%	40.9%	42.0%	25.2%	26.0%	24%	11%	
VAT Group	Buy	214.60	207	\$7,329	9.8x	8.6x	31.7x	25.2x	56.6x	41.4x	45.2x	35.1x	1.9%	2.4%	1.8%	2.5%	30.9%	34.1%	-2%	62.2%	62.1%	26.7%	31.3%	32%	14%	
Wonik IPS	Buy	45250.00	47000.00	\$1,953	1.8x	1.4x	10.1x	7.4x	9.7x	16.2x	18.2x	11.6x	0.8%	0.9%	9.3%	5.6%	17.8%	19.3%	8%	41.7%	40.7%	18.1%	22.5%	72%	25%	
Semi Equipment		Mean	5.0x	4.4x	20.5x	15.4x	49.9x	28.2x	35.3x	23.0x	1.3%	1.5%	1.0%	3.3%	21.6%	25.5%	10%	46.1%	48.0%	19.1%	23.0%	14%	21%			
		Median	4.6x	4.3x	19.4x	16.0x	33.7x	25.5x	28.1x	20.7x	1.0%	1.2%	2.2%	3.8%	26.5%	26.9%	5%	46.8%	46.3%	18.6%	21.5%	18%	11%			

Source : Factset, UBS

Figure 33: Apple Suppliers

Company	Rating	Price	Price	Market	EV/Sales		EV/EBITDA		EV/FCF		Price/Earnings		Dividend Yield		FCF Yield		EBITDA Margin		Net Cash as % of MCap Current		Gross Margin		ROE		Revenue Growth		
		(lc)	Target (lc)	Cap (\$m)	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E	
ams AG	Suspended	18.98	\$5,835	1.9x	1.2x	9.6x	5.5x	36.4x	15.1x	23.2x	12.5x	0.1%	0.1%	3.7%	8.9%	20.2%	22.4%	-41%	28.6%	31.5%	5.8%	11.0%	97%	57%	-	-	
Broadcom	Buy	426.10	445	\$172,043	8.8x	7.6x	nm	9.4x	18.3x	9.4x	18.6x	14.3x	3.1%	3.4%	6.8%	7.4%	nm	nm	-19%	73.5%	73.6%	38.6%	51.0%	5%	9%		
Cirrus Logic	Not Rated	80.65	-	\$4,663	3.5x	3.4x	14.5x	13.8x	nm	21.8x	19.0x	18.2x	nm	0.0%	nm	4.6%	24.5%	24.3%	10%	51.8%	51.8%	nm	16.4%	8%	5%		
Dialog Semiconductor	Not Rated	41.31	-	\$3,856	2.4x	2.3x	11.5x	10.2x	27.0x	15.0x	17.1x	15.7x	0.0%	0.0%	3.1%	5.5%	20.5%	22.6%	10%	49.7%	50.6%	13.8%	13.8%	-10%	3%		
Qualcomm	Neutral	149.53	125.00	\$168,711	nm	5.8x	20.5x	15.6x	30.9x	19.1x	22.3x	18.3x	1.3%	1.4%	3.4%	5.5%	33.7%	37.4%	-3%	58.6%	58.1%	85.5%	110.7%	-6%	29%		
Skyworks Solutions	Neutral	146	139	\$24,190	10.9x	9.0x	22.7x	18.3x	30.7x	20.4x	29.3x	24.1x	2.3%	2.6%	3.4%	3.7%	48.0%	49.6%	-1%	63.9%	64.9%	59.8%	72.9%	-1%	19%		
Qorvo	Neutral	149.53	125.00	\$168,632	nm	6.1x	20.4x	15.6x	31.5x	14.2x	30.9x	21.8x	1.9%	2.2%	3.3%	5.4%	29.8%	28.8%	-3%	58.6%	58.1%	85.5%	98.5%	13%	29%		
Catchr	Neutral	202	205	\$5,510	0.9x	0.9x	3.2x	2.8x	3.1x	3.9x	9.8x	8.6x	4.9%	4.9%	17.2%	13.7%	27.4%	31.3%	49%	25.7%	29.2%	10.1%	10.8%	9%	0%		
Foxconn Technology	Sell	52.60	45.00	\$2,610	0.2x	0.2x	2.1x	1.9x	5.6x	1.6x	10.2x	9.8x	5.0%	5.0%	4.0%	14.2%	7.2%	8.5%	119%	nm	6.0%	4.9%	6%	-5%	-	-	
Zhen Ding Technology	Buy	120	150	\$4,091	0.9x	0.8x	5.1x	4.2x	nm	152.7x	12.6x	10.1x	3.7%	4.4%	-2.2%	0.7%	18.5%	20.3%	16%	21.6%	23.2%	11.5%	14.5%	9%	14%		
Largan	Buy	3315.00	4050.00	\$15,762	6.4x	5.2x	9.5x	7.7x	17.1x	14.9x	17.9x	13.6x	2.4%	2.1%	4.7%	5.4%	66.7%	67.8%	23%	67.7%	66.6%	17.7%	20.0%	-1%	22%		
Goertek	Neutral	36.60	42.50	\$18,463	2.3x	1.7x	22.5x	17.4x	nm	42.8x	42.6x	29.7x	0.3%	0.5%	-1.9%	2.5%	10.1%	9.8%	-5%	17.2%	16.9%	15.0%	18.0%	69%	33%	-	-
Luxshare	Buy	52.39	65.00	\$55,060	3.9x	2.8x	33.9x	22.9x	302.9x	63.0x	50.0x	32.2x	0.3%	0.5%	0.0%	1.6%	11.5%	12.4%	0%	20.0%	20.1%	27.1%	30.6%	85%	38%	-	-
AAC	Sell	43	32	\$6,671	2.6x	2.5x	10.9x	9.5x	39.9x	34.6x	22.8x	18.4x	1.6%	2.0%	2.7%	3.1%	23.9%	26.2%	-7%	25.0%	28.2%	6.8%	8.0%	10%	4%		
Apple suppliers		Mean	3.7x	3.5x	14.3x	11.1x	297.3x	30.6x	23.3x	17.7x	2.1%	2.1%	3.7%	5.9%	26.3%	27.8%	11%	43.2%	44.1%	29.5%	34.4%	21%	18%				
		Median	2.5x	2.7x	11.5x	9.9x	30.7x	17.1x	20.7x	16.9x	1.9%	2.0%	3.4%	5.4%	23.9%	24.3%	0%	49.7%	50.6%	15.0%	17.2%	8%	16%				

We can see from the table below that the S&P semis sub-sector is trading at ~21.5x C2021 PE which is below the median of other tech sectors, led by software at ~32x. This is against growth expectations that are fairly reasonable for C2021, at +9% for C2021.

Figure 34: Industry sector valuation

Company	Price	Market Cap (\$m)	EV/Sales		EV/EBITDA		Price/Earnings		Revenue Growth	
			2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E
S&P 500 / Communication Services -SEC	\$220.47	\$3,393,482	4.2x	3.8x	12.8x	11.6x	26.8x	23.6x	2%	10%
S&P 500 / Consumer Discretionary -SEC	\$1,298.63	\$3,478,955	2.7x	2.4x	22.6x	17.2x	53.4x	33.6x	1%	13%
S&P 500 / Consumer Staples -SEC	\$694.52	\$2,057,604	1.7x	1.7x	14.9x	14.2x	22.5x	21.2x	4%	3%
S&P 500 / Energy -SEC	\$298.33	\$751,675	1.7x	1.5x	11.1x	8.2x	-205.2x	32.8x	-33%	16%
S&P 500 / Financials -SEC	\$475.85	\$3,217,378	2.9x	2.7x	15.3x	13.7x	17.3x	14.3x	-2%	2%
S&P 500 / Health Care -SEC	\$1,312.28	\$4,226,399	2.6x	2.4x	14.2x	12.8x	18.1x	16.4x	9%	7%
S&P 500 / Industrials -SEC	\$748.34	\$2,652,956	2.8x	2.5x	20.7x	14.6x	42.6x	23.8x	-12%	10%
S&P 500 / Information Technology -SEC	\$2,259.85	\$8,633,183	6.8x	6.3x	21.0x	18.8x	31.1x	27.2x	5%	8%
S&P 500 / Materials -SEC	\$450.40	\$822,469	2.9x	2.7x	13.9x	11.7x	27.1x	21.1x	-7%	8%
S&P 500 / Real Estate - SEC	\$228.80	\$770,466	9.9x	9.5x	22.3x	21.1x	21.6x	20.6x	-1%	5%
S&P 500 / Utilities -SEC	\$317.19	\$869,610	4.8x	4.6x	12.5x	11.7x	19.6x	18.7x	-5%	4%
Industry Sectors			Mean	3.9x	3.6x	16.5x	14.1x	6.8x	23.0x	-4%
			Median	2.9x	2.7x	14.9x	13.7x	22.5x	21.2x	-1%
										8%

Source : Factset, UBSe

Figure 35: IT sector valuation

Company	Price	Market Cap (\$m)	EV/Sales		EV/EBITDA		Price/Earnings		Revenue Growth	
			2020E	2021E	2020E	2021E	2020E	2021E	2020E	2021E
S&P 500 / Communications Equipment -IND	\$441.50	\$252,217	3.7x	3.6x	10.6x	10.6x	15.6x	15.1x	-4%	3%
S&P 500 / Electronic Equipment, Instruments & Components -IND	\$275.98	\$186,412	3.2x	3.0x	16.6x	14.5x	27.5x	23.4x	3%	7%
S&P 500 / IT Services -IND	\$620.26	\$1,710,144	6.5x	6.1x	23.1x	20.0x	34.2x	28.8x	0%	6%
S&P 500 / Semiconductors & Semiconductor Equipment -IND	\$1,775.46	\$1,629,623	6.8x	6.3x	16.3x	14.8x	24.4x	21.4x	11%	9%
S&P 500 / Software -IND	\$3,951.19	\$2,687,498	10.5x	9.5x	23.7x	21.3x	35.8x	32.3x	12%	11%
S&P 500 / Technology Hardware, Storage & Peripherals -IND	\$5,705.06	\$2,167,289	5.7x	5.2x	24.1x	21.3x	34.2x	29.0x	4%	9%
IT Sectors			Mean	6.1x	5.6x	19.1x	17.1x	28.6x	25.0x	4%
			Median	6.1x	5.7x	19.9x	17.4x	30.8x	26.1x	3%
										8%

Source : Factset, UBSe

Compute Outlook

AMD, INTC, NDVA

We expect Data center related spend to be driven by Hyperscalers in 2021. We expect Hyperscalers server shipments to grow ~11% Y/Y in 2020 and we expect strength to persist in 2021. While Enterprise continues to be weak, we see some green shoots from company commentary to suggest modest recovery lies ahead in 2021. AMD Milan should ramp around the same time as Ice Lake in CQ1:21 and although AMD faces stiffer competition, we still see a path for AMD share to approach ~19% (20MM units) year end. ARM is indicating that it should approach ~5% share in servers by 2020 largely driven by AWS, but its share gain trajectory in 2021 will depend upon the traction ARM sees with other hyperscalers. Ultimately while we see Data center share loss as more or less inevitable for INTC in C2021, in our view the situation is likely forcing Intel's hand to aggressively pivot to outsourcing starting w/GPU (PonteVecchio) in 2021 and CPU (Granite Rapids) on TSMC 5nm in 2022 (to accelerate vs. INTC internal plans of 2023), otherwise still face ~18-24mo competitive lag even into 2024 – simply untenable, in our view ([LINK](#) to deep dive analysis).

Accelerated compute should continue to benefit from longer term trends (AI/ML/Data Analytics) that shift compute cycles away from the core CPU towards accelerators. NVDA remains well positioned to benefit from this shift towards Data center scale compute given its MLNX acquisition and we model NVDA Data Center business showing solid >30% Y/Y growth even as ASIC competition inevitably makes some head way for more predictable workloads.

The PC vertical benefited this year from a post-COVID work-from-home upgrades, but we believe this trend has legs as enterprises move to establish a more secure and standard remote hardware infrastructure to enable more frequent and permanent work from home arrangements. This has been supported by commentary from major PC OEMs as well as both AMD and INTC (see [HERE](#)) as well as a panel of UBS IT executives at our recent Global TMT Conference. As a result, UBS sees PC growth of ~4% in C2020 but sees the market sustaining in the flattish range for C2021 and C2022. While most of the relative strength will remain on the notebook side, we do expect some improvement in desktop following a very poor year this year.

Figure 36: Cloud Capex rebounded solidly in C2020. We expect strength to continue into C2021

UBS cloud capex forecast				
US\$ mn	C2017	C2018	C2019	C2020E
Capital expenditure				
Apple	11,927	13,858	9,247	9,830
Alphabet	13,139	25,060	23,514	22,782
Microsoft	8,696	14,223	13,546	17,811
Amazon.com	10,057	11,322	13,259	20,851
Facebook	6,732	13,980	15,102	16,055
Baidu	1,820	2,336	2,769	2,409
Alibaba	3,437	6,628	7,358	8,892
Tencent	2,227	3,460	3,090	5,111
Total ex Apple	46,108	77,009	78,637	93,911
% YoY ex Apple	30.3%	67.0%	2.1%	19.4%
Apple	-4.2%	16.2%	-33.3%	6.3%
Alphabet	31.8%	90.7%	-6.2%	-3.1%
Microsoft	-4.6%	63.6%	-4.8%	31.5%
Amazon.com	49.3%	12.6%	17.1%	57.3%
Facebook	49.9%	107.7%	8.0%	6.3%
Baidu	15.6%	28.4%	18.5%	-13.0%
Alibaba	127.7%	92.8%	11.0%	20.9%
Tencent	12.3%	55.3%	-10.7%	65.4%

Source : UBS estimates, Gartner

Figure 37: UBS Server Model

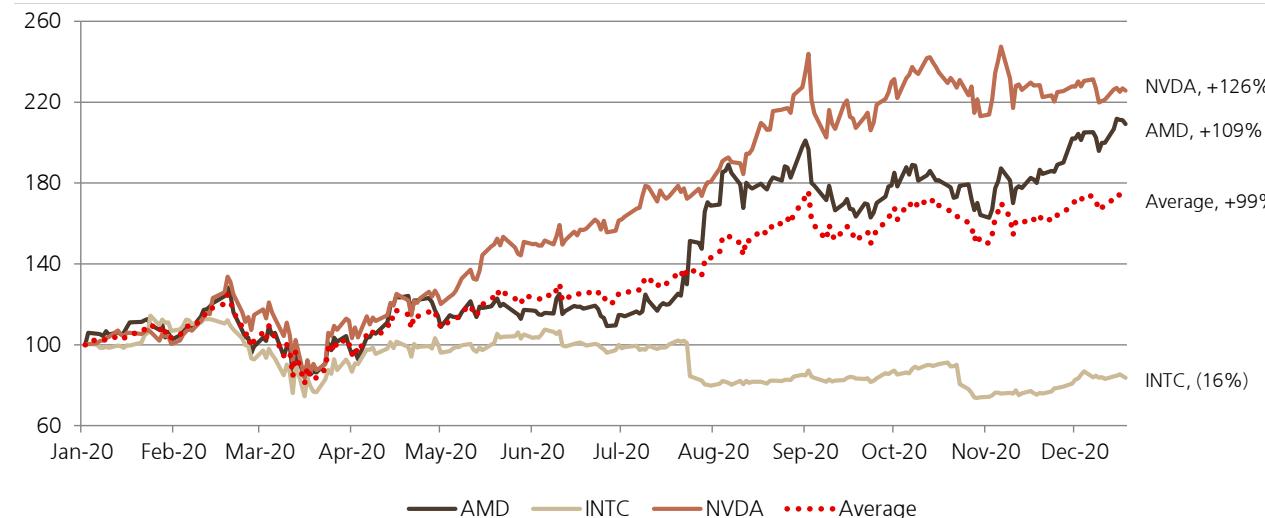
	2017	2018	2019	2020E	2021E	2022E	2023E	2024E	2025E
Total Server shipments (K unit)	11,451	12,951	12,585	13,069	14,086	15,593	16,378	17,918	18,801
<i>YoY growth (%)</i>	2.5%	13.1%	-2.8%	3.9%	7.8%	10.7%	5.0%	9.4%	4.9%
Traditional Enterprise	5,929	6,154	6,076	5,833	5,775	5,832	5,832	5,891	5,891
<i>YoY growth (%)</i>	-9.8%	3.8%	-1.3%	-4.0%	-1.0%	1.0%	0.0%	1.0%	0.0%
<i>% of total</i>	52%	48%	48%	45%	41%	37%	36%	33%	31%
Hyperscalers	5,523	6,797	6,509	7,236	8,311	9,760	10,545	12,027	12,910
<i>YoY growth (%)</i>	20.0%	23.1%	-4.2%	11.2%	14.9%	17.4%	8.0%	14.1%	7.3%
<i>% of total</i>	48%	52%	52%	55%	59%	63%	64%	67%	69%
Light-load servers	5,302	6,321	5,923	6,440	7,314	8,492	9,069	10,223	10,974
<i>YoY growth (%)</i>	18.8%	19.2%	-6.3%	8.7%	13.6%	16.1%	6.8%	12.7%	7.3%
<i>% of total</i>	96%	93%	91%	89%	88%	87%	86%	85%	85%
AI/ML/database servers	221	476	586	796	997	1,269	1,476	1,804	1,937
<i>YoY growth (%)</i>	60.0%	115.4%	23.1%	35.9%	25.3%	27.2%	16.4%	22.2%	7.3%
<i>% of total</i>	4%	7%	9%	11%	12%	13%	14%	15%	15%

Source : UBS estimates , Gartner

Figure 38: UBS Global PC Model**Global PC Unit forecast**

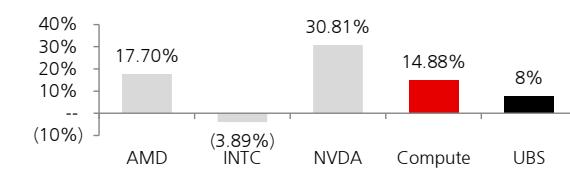
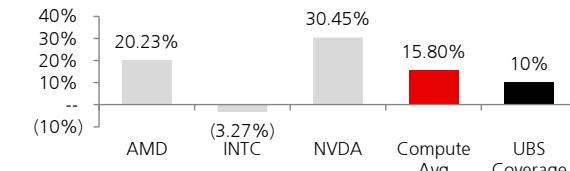
	2012	2013	2014	2015	2016	2017	2018	2019	2020E	2021E	2022E
PC units by form factor (m)											
Desktops	147.1	135.8	133.6	118.2	108.0	102.3	99.8	100.3	78.6	74.5	70.7
YoY growth	-5.5%	-7.7%	-1.7%	-11.5%	-8.7%	-5.3%	-2.4%	0.5%	-21.7%	-5.2%	-5.1%
Notebooks	205.0	180.5	180.1	169.5	162.2	160.4	160.0	162.3	182.1	180.8	179.1
YoY growth	-2.2%	-12.0%	-0.2%	-5.9%	-4.3%	-1.1%	-0.2%	1.4%	12.2%	-0.7%	-0.9%
Total PCs (exc. Chrome)	352.1	316.3	313.7	287.7	270.1	262.7	259.8	262.6	260.6	255.3	249.9
YoY growth	-3.6%	-10.2%	-0.8%	-8.3%	-6.1%	-2.8%	-1.1%	1.1%	-0.7%	-2.1%	-2.1%
Chromebooks	NA	2.7	5.7	6.8	9.4	12.8	14.9	16.4	30.0	36.0	39.6
YoY growth	0.0%	0.0%	111.9%	18.8%	38.2%	35.7%	16.7%	9.8%	83.5%	20.0%	10.0%
Total PCs	352.1	319.0	319.4	294.5	279.5	275.4	274.7	279.0	290.7	291.3	289.5
YoY growth	-3.6%	-9.4%	0.1%	-7.8%	-5.1%	-1.5%	-0.3%	1.6%	4.2%	0.2%	-0.6%

Source : UBS estimates

Figure 39: YTD Stock Performance (Base 100) and P/E Multiples

	P/E Multiples												Δ in Multiple YTD
	Jan-20	Jan-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Jul-20	Sep-20	Oct-20	Nov-20	Dec-20	
AMD	44.0x	39.4x	38.8x	36.3x	42.3x	43.9x	41.5x	54.9x	61.7x	54.0x	43.6x	52.8x	8.7x
INTC	13.1x	12.8x	11.7x	11.2x	12.0x	12.9x	12.3x	10.0x	11.0x	10.8x	9.6x	11.0x	-2.1x
NVDA	33.5x	32.3x	34.5x	32.5x	36.4x	40.4x	43.3x	47.0x	56.0x	50.2x	47.5x	47.9x	14.5x
Average	30.2x	28.2x	28.3x	26.7x	30.2x	32.4x	32.4x	37.3x	42.9x	38.3x	33.6x	37.2x	7.0x

Source : Factset, UBSe

Avg Change in Consensus Revenue
1/1/2020 <--> CurrentAvg Change in Consensus Non-GAAP EPS
1/1/2020 <--> Current

AMD

Figure 40: Key Debate + UBS View

Key Debate

While execution on the Milan ramp remains the key for AMD, the debates on the stock in 2021 should broaden to include: 1) Impact to AMD's server share gain trajectory from any upcoming changes to INTC manufacturing strategy and competition from Ice Lake/Sapphire Rapids; 2) AMD's execution on closing the XLNX acquisition; 3) traction beyond the data center CPU into GPUs & share gain in PC; and 4) its success in further fortifying its software ecosystem as it moves to also compete more directly with NVDA in the data center.

UBS View

The die is largely cast for AMD to post another strong share gain year in C2021 for both server and PC. Our base forecast assumes that the company grows server units from ~575k in Q4:20 to ~900k in Q4:21 which on AMD's TAM basis, implies share can grow to the high teen exiting C2021. For PC, we assume total share of ~20% in C2020 rising ~200bps in C2021. Fundamentally, it is hard to argue with the strong new product line-up and runway for share gain in both PC and server – which carries much higher gross margins. We find it hard to rationalize the urgency to consummate a XLNX deal at this time and this price; we think it brings relatively little beyond end-market diversification (PC is still ~2/3 of core AMD OP even in 2021) – especially into the communications vertical. As we have said previously, we can see the 5yr rationale, but it does little in the way of building data center scale, we remain lukewarm at best as to FPGA's competitive position in the data center, and we think the deal risks de-focusing the company from what should remain an easy to tell share-gain narrative. At the same time, we believe INTC is moving much more aggressively than most investors believe toward outsourcing (we should hear more in January) and this is going to blunt the portion of AMD's competitive edge that relates to process (we think well over half). Ultimately, AMD is still far behind in building a software ecosystem for the data center a forthcoming aggressive pivot from INTC makes it harder for us to capitalize EPS 3-4yrs from now at a multiple near NVDA that would be required for us to justify a Buy rating.

Source : Company reports, UBSe

Links to Key UBS Research Notes:

- [FQ3:20 - XLNX Deal Finally Announced Amid Strong Results and Guidance; We Remain On the Sidelines](#)
- Prior Reports: [AMD-XLNX](#) | [AMD-XLNX First Read](#) | [Ryzen CPU Launch](#) | [FQ2:20](#) | [FQ1:20](#) | [Analyst Day](#) | [FQ4:19](#) | [Highlights From CES](#)

INTC

Figure 41: Key Debate + UBS View

Key Debate

Key debates on INTC revolve around; 1) manufacturing strategy (degree and time lines around outsourcing at INTC's 7nm node (TSMC 5nm) and more significantly, INTC's 5nm node (TSMC 3nm - a process where INTC could still wield some influence); 2) the extent and trajectory of looming share losses in Data Center CPU (Milan vs. Ice Lake and Sapphire Rapids) and the associated impact on server ASPs which have begun to decline precipitously and are now below AMD's on a blended basis ; 3) traction on non CPU architectures (discrete GPU, AI related ASICs such as Habana) as INTC prepares to take on NVDA in the data center; and 4) re-investment of proceeds from NAND sale to Hynix and success in peripheral verticals like autos and IoT.

UBS View

With more share losses in the Data center looming in 2021 , our analysis of INTC's competitive position and manufacturing roadmaps suggests that the scales are tilting towards increased degrees of outsourcing - starting with its 7nm GPU (Ponte-Veccchio) in 2021 with the center die on Granite Rapids potentially outsourced to TSMC starting in 2022 . Outsourcing , while no doubt inherently complex and likely phased, could ultimately nullify a significant portion of AMD's process related competitive advantage much sooner than INTC would be able to do so on its own. We see such a move as largely Neutral to gross margin (though benefiting the P&L from increased product velocity) but potentially ~20%-25% accretive to FCF. INTC's aggressive adoption of tiled design flow also allows it to continue pursuing captive 7/5/3nm manufacturing technology even as it is likely forced to make a big long-term volume commitment to a foundry partner to entice engagement. While we think crystallization of the CHIPS Act in early C2021 will catalyze more movement along this front, in the mean time the stock remains under-owned , with valuation well below 10 year lows , meaning investors are getting paid while the wait for the catalysts to play out in C2021.

Source : Company reports, UBSe

Links to Key UBS Research Notes:

- [Deep Dive: Manufacturing And Product Strategy](#)
- Prior Reports: [FQ3:20](#) | [FQ2:20](#) | [10nm Tiger Lake Launch](#) | [Resuming ASR Plan](#) | [Intel Architecture Day Highlights](#) | [Investor Call W/ Head of Cloud/Enterprise](#)

NVDA

Figure 42: Key Debate + UBS View

Key Debate

Key debates for NVDA center around: 1) sustainability of RTX Series 30 ramp in FQ1 and FQ2:22 as INTC refills the channel amid significant supply constraints; 2) growth prospects in data center as growth has oscillated from 50-60% Y/Y to flat over the past few years driven by market dynamics and product cycles; 3) increased success in the inference vertical with Ampere and T4 (plug and play for existing sever infrastructure); 4) ability to migrate existing x86 workload over to its compute offload solutions (SmartNIC); 5) emergence of AI from scientific computing to more mainstream verticals that are traditionally more enterprise in nature; 6) closure of ARM transaction and roadmap development around ARM as NVDA has taken a license and is pushing aggressive development of the ecosystem - thus increasing the value of the ARM asset; 7) ability to stave off gaming competition from an invigorated AMD 7nm lineup.

UBS View

NVDA is a computing platform company with big moats on both hardware and software. As NVDA navigates supply constraints for key new products, gaming demand is significantly out-stripping new product supply - a situation that we think likely persists through early CH1:21 with gaming remaining strong as Ampere pushes into the <\$400 ASP mainstream segments. Although the server environment remains lukewarm ahead of upcoming Ice Lake/Milan ramps in CQ1:21, a better server environment seems likely which, together with the Ampere product cycle should drive some Q/Q growth re-acceleration in data center as Ampere is still in the very early stages of a multi-year product cycle. NVDA remains the best positioned to capture a huge wedge of opportunity as compute demand is growing 10x Y/Y while current AI architectures are only able to deliver ~40% Y/Y increase in compute capacity. Lastly, the ARM deal would be transformational and make NVDA able to much more rapidly monetize its IP, particularly for rapidly growing edge computing applications. Longer-term, the company is also starting to move more revenue to recurring sources with the Mercedes partnership opening up a wallet that is likely much larger than the up-front hardware opportunity and recurring in nature.

Source : Company reports, UBS

Links to Key UBS Research Notes:

- [FQ3:21 - Solid Results/Guidance As New Product Cycles Remain Early Days](#)
- *Prior Reports:* [GTC Highlights](#) | [ARM Deal Finally Announced](#) | [Ampere – A "Game Changer"](#) | [FQ2:21](#) | [Mercedes-Benz Partnership](#) | [FQ1:21](#) | [GTC 2020](#)

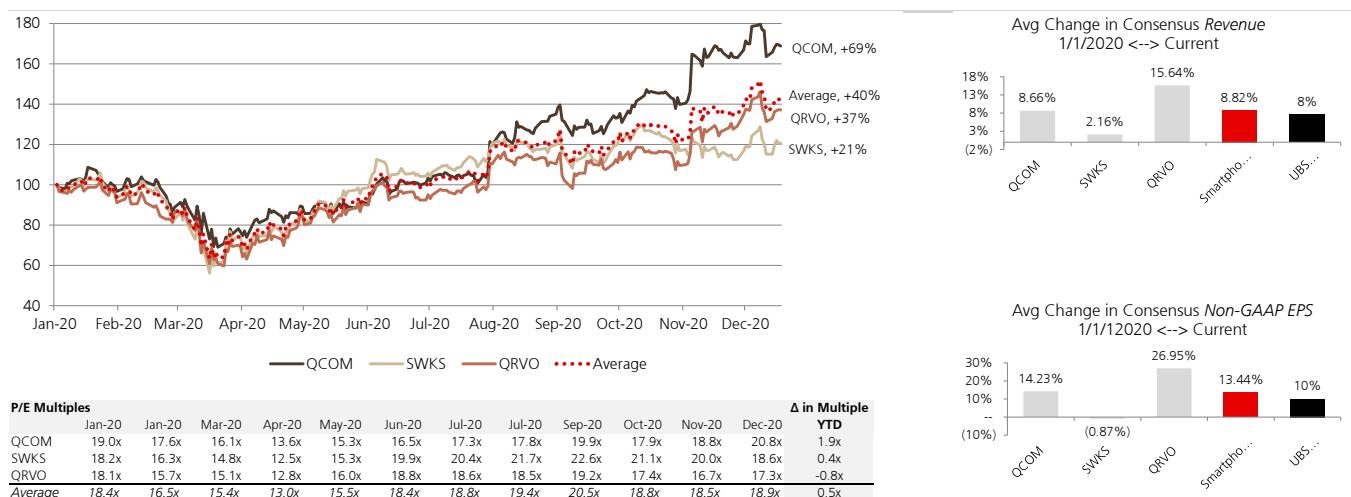
Smartphone Outlook

QCOM, SWKS, QRVO

Near-term demand remains very strong and is likely to remain so through CQ1:21 as non-Huawei smartphone OEMs fill the channel in anticipation of gaining a significant portion of Huawei's share through 2021. 5G remains early stages and we estimate ~246MM 5G unit sell-in for C2020 (~20% of smartphone shipments), growing to 442MM shipments for C2021 (~33% of total shipments). Our initial forecast for C2022 is 670MM shipments leveling up to ~1.1B., or ~80% penetration by 2025. This is all consistent with our Telecom Research team's view that 5G network coverage could address 60-80% of the connected global population by 2024. Overall, smartphone units are set to decline ~8% this year with growth of mid to high single digits likely for 2021 as the mix aggressively shifts to 5G.

For the RFEE suppliers, we continue to model the RFEE TAM growing from ~\$15.5B in C2019 to ~\$17B in C2020 and up to ~\$23B in C2023 on the back of the expanded content around 5G. Much of the debate for semiconductor OEMs revolves around mmWave and the pace of network buildout/customer adoption after AAPL adopted it across the entire new SKU range this Fall for US models. Olympics in Japan and China could be catalysts for broader mmWave adoption, though network densification, line of sight requirements, and battery life remains impediments to adoption. Even so, QCOM has forged a very strong competitive position that feels a bit like its CDMA position during the 3G migration. QRVO has some mmWave IP, but more levered on the infrastructure side while SWKS has not invested significantly in the technology. Overall, while 5G is still year 1-1.5 of what should be a 4-5yr ramp, we remain concerned that near-term component sell-in is running well ahead of smartphone sell-through - which remains soft at the overall level (China still down >15% Y/Y) with much of this procurement predicated upon Huawei share losses in C2021. We believe the stage may be set for some component digestion as we move into and through Chinese New Year, though we certainly acknowledge that 5G content growth still has more legs as it moves to mainstream price points. Lastly, a potentially big inflection looms as AAPL rolls out its own modem for iPhone (currently targeted for Fall 2022 models, though possibly earlier for iPad) thus throwing some uncertainty into the market as to the competitive position of each supplier. We see AVGO as well positioned to enable AAPL to get its own modem to market and while we remain very bullish about QCOM's adjacency story, this will be gated over the next few years by loss of Apple's modem business which is benefiting the company in the near-term. UBS global team has recently increased smartphone forecast by 3.4%/1.5% in C20E/21E. UBS now forecasts a 8% y/y decline in C20E, followed by a recovery of +6% y/y in C21E ([HERE](#)).

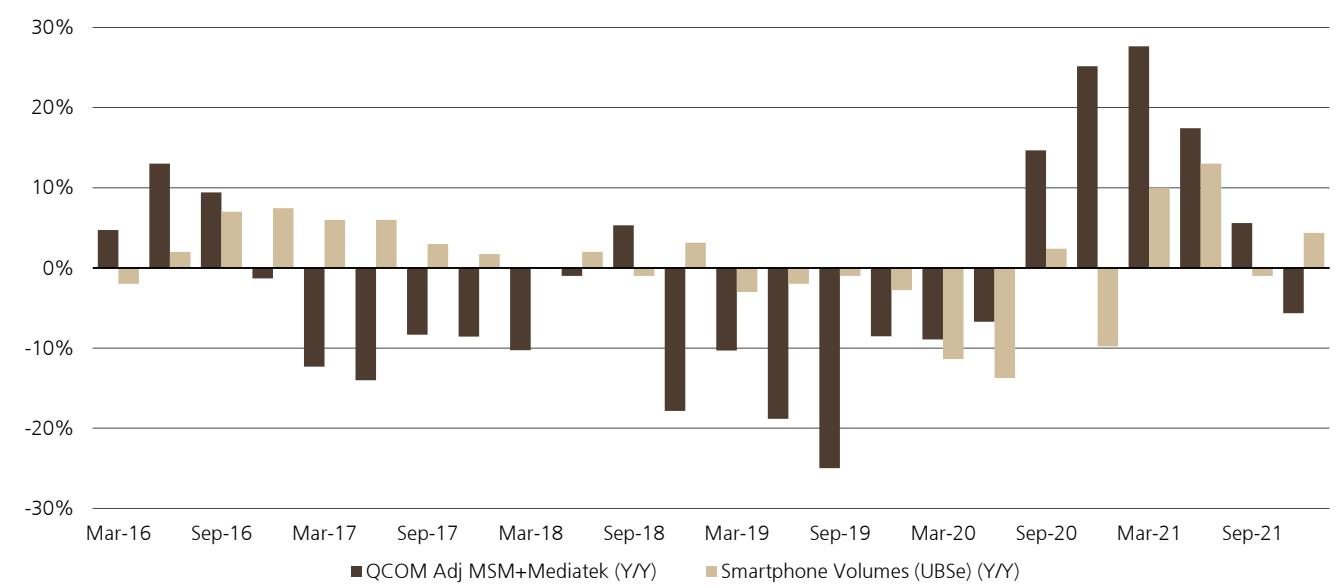
Figure 1: YTD Stock Performance (Base 100) and P/E Multiples



Source : Factset, UBS

Smartphone Analysis

Figure 2: Modem vs Smartphone Sell-In Y/Y



Source : UBS estimates, Company Data

Figure 3: UBS Device Market Model - Mobile Phone Units (MM)

Total volume (m)	FY '17	FY '18	FY '19	Q1 '20	Q2 '20	Q3 '20E	Q4 '20E	FY '20E	FY '21E
Samsung	369	323	321	64	57	88	68	277	326
% of total	21.9%	20.3%	20.7%	21.4%	18.9%	24.0%	17.0%	20.3%	22.8%
Apple	216	204	193	40	35	38	74	186	208
% of total	12.8%	12.8%	12.4%	13.4%	11.6%	10.2%	18.4%	13.6%	14.6%
Huawei*	170	200	241	49	56	52	41	198	50
% of total	10.1%	12.5%	15.5%	16.4%	18.5%	14.2%	10.2%	14.5%	3.5%
OPPO*	112	113	113	22	24	31	34	111	170
% of total	8.0%	8.1%	8.2%	8.1%	8.6%	8.8%	9.6%	8.8%	12.7%
Vivo*	100	105	101	25	24	32	30	110	140
% of total	7.2%	7.5%	7.3%	9.0%	8.5%	8.9%	8.5%	8.7%	10.5%
Xiaomi	92	122	125	29	28	43	39	139	165
% of total	6.6%	8.7%	9.1%	10.6%	10.1%	12.1%	11.0%	11.0%	12.3%
Other	628	526	461	70	77	83	115	344	369
% of total	37.3%	33.0%	29.7%	23.4%	25.7%	22.8%	28.7%	25.2%	25.9%
Total volumes (m)	1,685	1,594	1,554	299	301	366	400	1,365	1,428
% change y-o-y	1.5%	-5.4%	-2.5%	-21.3%	-22.9%	-5.1%	0.5%	-12.2%	4.6%

Source : UBS estimates, Company Data

Figure 4: UBS Device Market Model - Smartphone Units (MM)

Smartphone volume (m)	FY '17	FY '18	FY '19	Q1 '20	Q2 '20	Q3 '20E	Q4 '20E	FY '20E	FY '21E
Samsung	316	290	295	58	54	80	63	255	313
% of total	22.8%	20.7%	21.5%	21.0%	19.4%	22.6%	17.8%	20.2%	23.4%
% change	2.3%	-8.2%	1.7%	-19.4%	-28.9%	2.5%	-8.6%	-13.6%	22.5%
Apple	216	204	193	40	35	38	74	186	208
% of total	15.6%	14.6%	14.1%	14.5%	12.6%	10.6%	20.8%	14.7%	15.6%
% change	0.2%	-5.3%	-5.6%	-8.0%	-4.1%	-12.8%	5.0%	-3.6%	12.0%
Huawei*	153	206	241	49	56	52	41	198	50
% of total	11.0%	14.7%	17.6%	17.8%	20.0%	14.7%	11.6%	15.7%	3.7%
% change	10.1%	34.6%	16.9%	-17.1%	-4.9%	-22.3%	-27.0%	-17.9%	-74.7%
OPPO*	112	113	113	22	24	31	34	111	170
% of total	8.0%	8.1%	8.2%	8.1%	8.6%	8.8%	9.6%	8.8%	12.7%
% change	13.8%	1.6%	-0.4%	-3.0%	-18.6%	-0.6%	17.2%	-1.2%	52.6%
Vivo*	100	105	101	25	24	32	30	110	140
% of total	7.2%	7.5%	7.3%	9.0%	8.5%	8.9%	8.5%	8.7%	10.5%
% change	25.6%	5.4%	-4.3%	6.9%	-16.5%	14.5%	40.2%	9.5%	27.3%
Xiaomi	92	122	125	29	28	43	39	139	165
% of total	6.6%	8.7%	9.1%	10.6%	10.1%	12.1%	11.0%	11.0%	12.3%
% change	49.6%	33.6%	1.9%	4.7%	-12.1%	33.3%	19.4%	11.5%	18.7%
LG Electronics	56	40	29	6	6	8	8	28	29
% of total	4.0%	2.8%	2.1%	2.1%	2.2%	2.2%	2.3%	2.2%	2.2%
% change	1.4%	-29.1%	-26.6%	-22.7%	-14.6%	4.0%	20.6%	-3.6%	3.8%
Other	343	321	275	47	52	71	65	234	262
% of total	24.8%	22.9%	20.1%	16.9%	18.5%	20.1%	18.4%	18.6%	19.6%
Total smartphone volumes (m)	1,387	1,402	1,371	276	278	354	354	1,261	1,337
% change y-o-y	4%	1%	-2%	-11%	-14%	2%	-10%	-8%	6%
% of total volumes	82%	88%	88%	92%	92%	97%	88%	92%	94%

Source : UBS estimates, Company Data *Procurement estimates shown

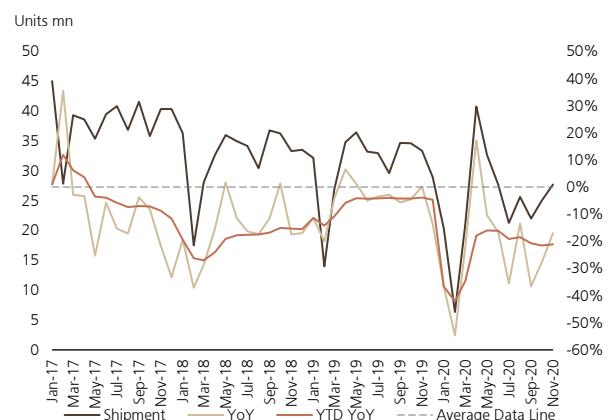
Figure 5: UBS Device Market Model - Mobile Revenue (\$MM)

Total revenues (US\$m)	FY '17	FY '18	FY '19	Q1 '20	Q2 '20	Q3 '20E	Q4 '20E	FY '20E	FY '21E
Apple	148,045	155,766	146,356	28,962	26,418	26,444	57,516	139,340	164,585
% change	6.2%	5.2%	-6.0%	-6.7%	1.7%	-20.7%	2.8%	-4.8%	18.1%
% of total	41.5%	43.0%	41.4%	42.7%	40.8%	35.5%	56.8%	44.7%	48.9%
LG Electronics	9,966	7,226	5,087	828	1,064	1,275	1,340	4,507	4,456
% change	-1.4%	-27.5%	-29.6%	-37.9%	-22.6%	0.7%	20.2%	-11.4%	-1.1%
% of total	2.8%	2.0%	1.4%	1.2%	1.6%	1.7%	1.3%	1.4%	1.3%
Samsung	77,765	74,793	74,017	17,292	13,055	20,346	15,047	65,739	80,663
% change	5.7%	-3.8%	-1.0%	-12.8%	-26.5%	1.7%	-8.3%	-11.2%	22.7%
% of total	21.8%	20.6%	20.9%	25.5%	20.2%	27.3%	14.9%	21.1%	24.0%
Other	120,911	124,660	128,009	20,675	24,162	26,359	27,326	102,020	86,570
% change	16%	3%	3%	-35%	-27%	-19%	-12%	-20%	-15%
% of total	34%	34%	36%	31%	37%	35%	27%	33%	26%
Total revenues (US\$m)	356,687	362,445	353,470	67,757	64,698	74,424	101,229	311,607	336,274
% change y-o-y	8.9%	1.6%	-2.5%	-19.2%	-17.1%	-14.6%	-3.1%	-11.8%	7.9%

Source : UBS estimates, Company Data

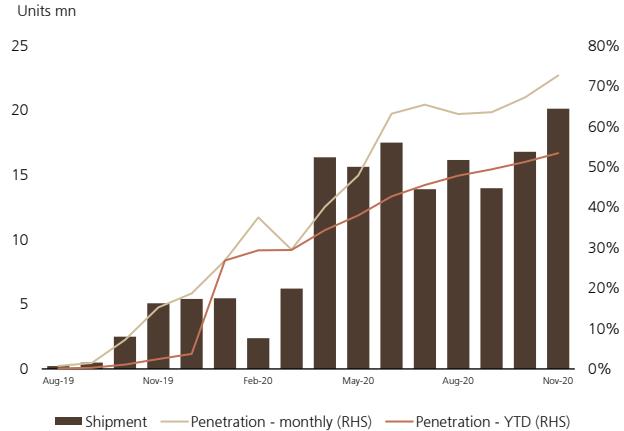
China Smartphone Analysis

Figure 6: China Smartphone Shipment



Source : CAICT Data, UBS

Figure 7: China 5G Smartphone Shipment



Source : CAICT Data, UBS

QCOM

Figure 8: Key Debate + UBS View

Key Debate

Most 5G roads lead through QCOM - especially if mmWave starts to gain momentum - and it maintains a global technology lead. Key debates for the company from here include: 1) sustainability and growth prospects for non-smartphone adjacencies as QCOM is now providing better disclosure around these segments; 2) prospects for broader mmWave proliferation as QCOM has made a big investment in the technology and maintains a big leadership position; 3) broader adoption of ARM in both PC and server as NVDA helps to catalyze development of the ecosystem and AAPL's M1 chip for Mac establishes a strong beachhead; 4) future growth prospects for the licensing business as its has now harvested the vast majority of global OEMs for 5G agreements; 5) sources of upside to estimates as the stock has already re-rated.

UBS View

The company-specific debates continue to play out in QCOM's favor, specifically the adjacencies which are, almost across the board, ahead of the plan the company has laid out. The issue we have with the stock at these levels is that an enormous gap has opened up between smartphone component sell-in and smartphone sell-through – a gap that suggests an inventory correction may be forthcoming even in a strong 5G year in C2021 and it is still early innings for the 5G migration. QCOM remains highly levered to mmWave, but we question the pace of broader adoption due to several important issues (including the potential for VZ to slow its investment as it builds out c-band spectrum) and the global pandemic has pushed out the use case for dense urban environments. So while we like the 5G opportunities for QCOM – especially non-handset adjacencies – we remain concerned about a component inventory correction and find it hard to get excited at these levels with the stock having re-rated to historic high multiples and Street estimates that to us fully bake in an optimistic case on a number of fronts (including the timing for AAPL's modem launch).

Source : Company reports, UBSe

Links to Key UBS Research Notes:

- [First Read: Qualcomm Inc. "Apple Modem Headlines Are Finally Here" \(Neutral\)](#)
- [Prior Reports: FQ4:20 | FTC Announcement | Wins FTC Appeal; Raise PT | FQ3:20 | FQ2:20 | Oral Arguments Made In FTC Appeal](#)

SWKS

Figure 9: Key Debate + UBS View

Key Debate

To us, there are two key debates. First, Huawei. As the OEMs' lack of component availability pushes high-end share to the likes of Apple, this is very good for SWKS. On the other hand, Chinese OEMs are pushing very aggressively to fill the channel in an attempt to capture this same share – all of which heightens the risk of an inventory correction in 2021. Second, 5G. The ramp remains early stages, but this is likely the best we will see in terms of content gains as this becomes less of a tailwind as 5G proliferates to lower price tiers.

UBS View

SWKS results and guidance have re-affirmed one of the better content gains that SWKS has seen for an iPhone launch – a gain that we estimate to be ~ \$2/unit for iPhone. Gross margin remains a drag, but much of this seems COVID-related so this should come back over time. China's progress on RF is a concern, but SWKS' execution is always strong and it finally has TC-SAW and some BAW capabilities to push into higher frequencies for 5G. The company is poised for a strong 2021, while the IoT business provides unique ballast and scale upon which it could choose to build via M&A. Some investors seem to expect that the AVGO RF asset is still a possible acquisition for SWKS, we think not. We may be overestimating the competitive threat and under-estimating SWKS's capture of incremental dollars for 5G in 2020/2021. Further, we may be overly concerned about the lagging BAW capabilities and may be underestimating AVGO's willingness to sell the RF asset Net/net, SWKS is now trading at ~20x NTM P/E (10yr high) so the stock has already enjoyed the 5G re-rating that the market has assigned to the entire smartphone complex and we are just not willing to underwrite this sort of a multiple on our estimates as the iPhone trade loses luster moving through 2021 as the Fall 2021 iPhone does not support as much incremental RF content as this recent version and the next big content gain window is more 2022.

Source : Company reports, UBS

Links to Key UBS Research Notes:

- [FQ4:20 - Solid Results/Guidance Affirm Solid iPhone Content Gains; 5G + Huawei Remain Key Debates](#)
- Prior Reports: [FQ3:20](#) | [FQ2:20](#) | [FQ1:20](#) | [FQ4:19](#) | [FQ3:19](#)

QRVO

Figure 10: Key Debate + UBS View

Key Debate

5G should drive ~30-40% growth in overall RF content, but we see key debates as follows: 1) QRVO's share of the incremental RF dollars as QCOM pushes more into low and (less likely) mid-bands; 2) valuation and competitive prospects for the GaN business as this is a very unique asset that remains highly levered to 5G and mmWave on the infrastructure side; 3) execution and ability to maintain its strong competitive position as AAPL moves from a QCOM thin modem to a captive modem.

UBS View

QRVO delivered a solid Q on better GM with broad-based strength across both mobile/IDP segments (up 20% / 71% y/y). More importantly, the implied guidance for the mobile segment reaffirms solid content gains, especially in China. With investors having re-rated the entire smartphone complex higher amid frenzied activity in China (due to the desire among non-Huawei OEMs to gain share in '21) and the biggest iPhone launch in several years, we simply cannot chase smartphone stocks like QRVO at these levels. QCOM's results highlight a rapidly expanding gap between component sell-in and smartphone sell-through - one that, to us, suggests some inventory digestion moving through 2021 - even amid strong 5G handset demand. We very much like QRVO's IDP business as it is a very unique asset and QRVO is building a solid execution track record, but this is not enough to drive us to get behind the stock at these levels given these sector concerns.

Source : Company reports, UBSe

Links to Key UBS Research Notes:

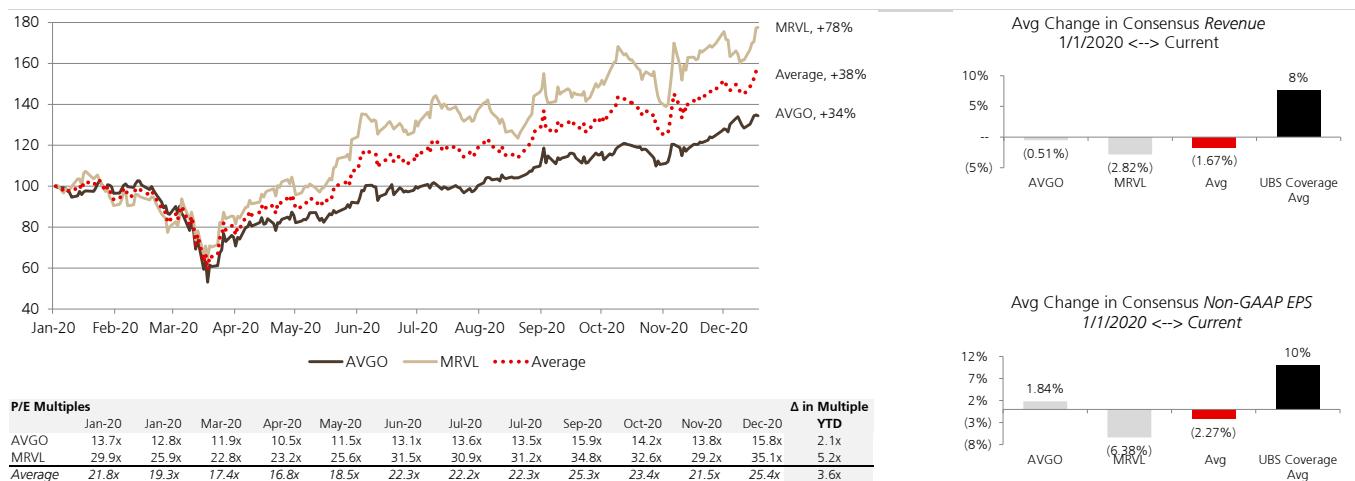
- [FQ2:21 - Solid Margins And China Exposure Drive Strong Results, But We See Heightened Risk of Component Inventory Correction in '21](#)
- *Prior Reports:* [Positive Pre-announce \(FQ2:21\) On Mobile Strength](#) | FQ1:21 | FQ4:20 | FQ3:20 | FQ2:20

Networking/Infrastructure Outlook

AVGO, MRVL

Overall networking read-through from earnings commentaries remain solid with continued strength in cloud/telco spending despite ongoing enterprise weakness. MRVL has pointed out that supply chain is likely to remain a constraint for networking revenue growth at least through FQ1 and into FQ2 (substrate, wafer/test capacity), but the vast majority of the demand is not perishable and thus going into backlog that sets the stage for several Qs of solid growth as supply catches up with demand. Meanwhile, AVGO also suggests strong bookings activity should continue through FQ1, thus providing good visibility through mid-year.

Figure 53: YTD Stock Performance (Base 100) and P/E Multiples



Source : Factset, UBS

AVGO

Figure 54: Key Debate + UBS View

Key Debate

Key Debates for AVGO revolve around: 1) While Networking demand remains solid, supply still remains constrained in CH1:21, but will it moderate the Wired Infrastructure trajectory; 2) Do recent changes in Management structure & new segment level disclosures lead investors to value AVGO on an SOTP basis leading to some re-rating of its Conglomerate discount; 3) Balancing dividends with M&A - AVGO remains a cash flow story and while dividend outlook remains solid, we see a path to \$3.90-\$3.95/sh in quarterly dividends in F2022 the company continues to balance capital returns with pursuing inorganic growth opportunities.

UBS View

Results and guidance were solid, if unspectacular - though still gated by supply chain constraints that AVGO has been highlighting for 2Qs and is only now being discussed as a broader issue across semis. As expected, the company raised the dividend to \$3.60/Q, or ~3.5% yield at current prices - just slightly below our \$3.65/Q model - but we still see enough organic growth potential this year to create a path to ~\$3.90-3.95/share in F2022 (suggesting yield would push 4% with no stock appreciation). Maybe most importantly, backlog grew ~\$2B Q/Q (some clearly related to wireless and ongoing supply constraints) and commentary suggests strong bookings activity should continue through FQ1, thus providing good visibility through mid-year. The wireless commentary/ guidance was about as expected and the networking read-through is also solid especially considering ongoing enterprise weakness. The more curious developments, however, have nothing to do with the numbers. First, the company is moving CFO Tom Krause to run the software business and creating a new COO role. Recognizing the assumptions that some investors may make surrounding CEO succession, CEO Hock Tan made it clear that he plans to get more involved with investor outreach. Second, AVGO is finally providing full segment P&L for semis and software - a development that may cause investors to start valuing the stock on a SOTP basis. We have long argued that the stock is undervalued, and this should certainly help. We are taking the proverbial bait and moving to SOTP-based EV/FCF valuation, however, to reflect the reality that it would be unlikely to run a large semiconductor company and maintain leadership positions across multiple key verticals with opex that is only 16% of revenue, we are making an adjustment using other large peers as comps.

Source : Company reports, UBS

Links to Key UBS Research Notes:

- [FQ4:20: Results/Guidance Solid, If Unspectacular; New Segment Disclosures Should Drive Higher Valuation](#)
- *Prior Reports:* [FQ3:20 | Takeaways From CFO Meeting](#) | [FQ2:20 | Flexing The Financial Model](#) | [FQ1:20](#)

MRVL

Figure 55: Key Debate + UBS View

Key Debate

Infrastructure pure-plays are hard to find and MRVL is a 5G leader while continuing to invest in ARM server for which the Street is giving little to no credit. Key debates revolve around: 1) the ability of the storage business to grow and the timing of new cloud ASIC opportunities; 2) the rollout of new revenue from 5G basestation suppliers as new content gains continue to drive growth; 3) ability and timing in closing IPHI which opens up significant new revenue channels and 4) ASIC opportunities in both cloud and networking as large OEMs and hyperscalers increasingly want to design their own cloud infrastructure.

UBS View

Near-term guidance remains hampered by supply constraints, but these are temporary and should be resolved by mid 2021 which networking backlog and new opportunities continue to grow. Enterprise headwinds (formerly ~ \$30MM/Q) are abating somewhat but remain intact, and the new product story remains, if anything, ahead of plan with Samsung (and now NOK) ramping in networking, recent wins on the cloud side (DIY SSD controller) starting to convert to revenue, and the still nascent automotive Ethernet story gaining momentum. The custom ASIC business can be lumpy - especially with big cloud customers - but MRVL is one of very few suppliers able to execute high volume and the opportunity set is very wide across a number of potentially large verticals (ARM server, cloud SSD, top of rack networking, etc..). On top of it all are some potential 2nd derivative benefits as Huawei likely loses 5G basestation share to other OEMs where MRVL has much larger exposure. The bottom line is that this story is all about F2022 and 2023. The company is delivering on the key debates, it's still very early innings for both the 5G and cloud stories, and autos provides some longer-term optionality.

Source : Company reports, UBSe

Links to Key UBS Research Notes:

- [FQ3:20: Supply Constraints Mute Guidance, But New Product/Design Win Story Remains; PT to \\$50](#)
- Prior Reports: [MRVL/IPHI: Revenue Synergies Remain Key](#) | [MRVL-IPHI In-depth Pro-Forma Analysis](#) | [MRVL Acquiring IPHI](#) | [Analyst Day](#) | [Analyst Day Preview](#) | [FQ2:21](#) | [Sizing Up Potential Impact If Samsung Gains 5G](#) | [Highlights From CEO Call](#) | [Updating MRVL's 5G Basestation Oppty](#) | [FQ1:21](#)

Sizing Marvell's 5G Opportunity

Figure 56: Back of envelope estimate of MRVL base-station (macro) revenue

Market Assumptions	C2019	C2020	C2021	C2022	C2023
5G NR Macro base station units (MM)	0.3	0.7	1.1	1.4	1.5
MRVL Assumptions	C2019	C2020	C2021	C2022	C2023
Samsung					
Units (K)		35	74	121	165
Content/Units (K)					
Samsung - baseband units only		2,800	2,660	2,554	2,451
Samsung - DFE for radio head			1,400	1,373	1,373
Samsung - total content			4,060	3,927	3,825
Massive MIMO attached rate (%)		1%	3%	10%	23%
MRVL's Revenue Opportunity (\$MM)	\$ 98	\$ 200	\$ 326	\$ 457	
Nokia					
Units (K)		15	43	98	171
Content/Units (K)		1,000	960	922	885
MRVL's Revenue Opportunity (\$MM)	\$ 15	\$ 41	\$ 90	\$ 151	
Ericsson/ZTE					
Units (K)		185	199	214	230
Content/Units (K)		800	768	737	708
MRVL's Revenue Opportunity (\$MM)	\$ 148	\$ 153	\$ 158	\$ 163	
Total Marvell base station (macro) SAM (\$MM)	\$ 261	\$ 394	\$ 574	\$ 771	

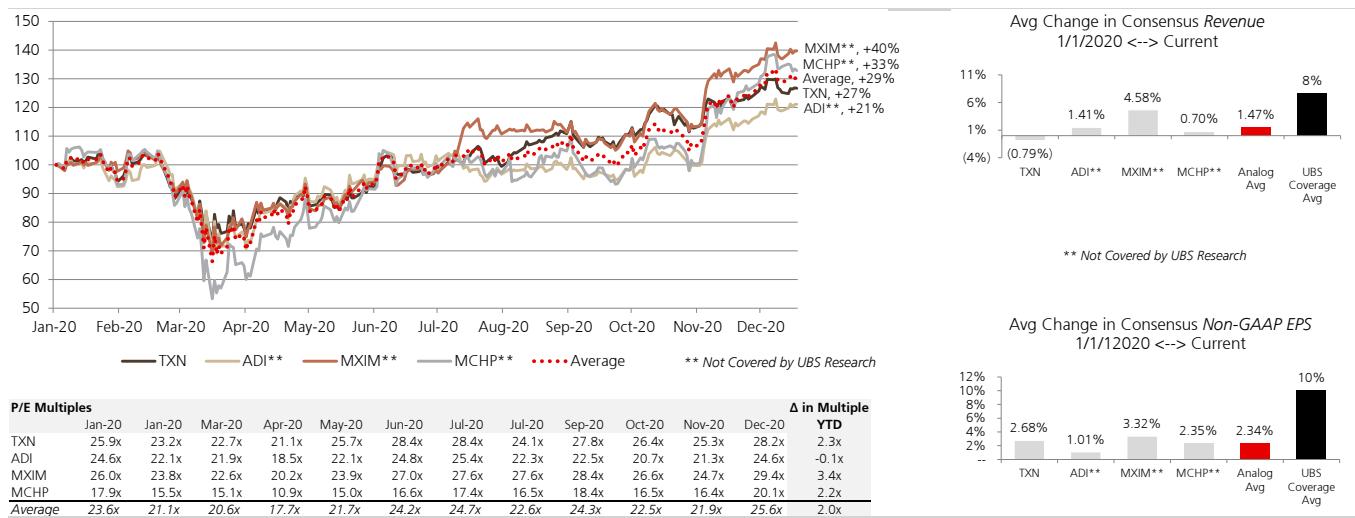
Source : UBS estimates

Analog Outlook

While Autos have seen a V shaped recovery in 2020, we think Industrial End markets could be a growth driver in 2021.

While Analog semis revenue generally tracks GDP, looking into 2021 we think there could be some divergence in Analog end markets. The highly cyclical autos complex has seen already seen v shaped recovery from Q2 trough levels and we expect the recovery to continue into 2021. Industrials on the other hand have seen a more flattish trajectory (for TXN) and remain soft. Nevertheless, we think that momentum is building in the Industrial end market in C2021 and expect Industrials to be a far more significant driver of revenue growth from TXN into 2021. Supply on the other hand could be a gating factor in Autos as our work suggests that substrate related shortages will persist in CH1:21. All told, longer term demand trends remain intact - content gain narrative in automotive (EV, ADAS, Safety, Infotainment) and Industrial Automation/IoT/Infrastructure will continue to remain TXN's most attractive markets in C2021 and beyond.

Figure 57: YTD Stock Performance (Base 100) and P/E Multiples



Source : Factset, UBS

TXN

Figure 58: Key Debate + UBS View

Key Debate

Key debates on TXN revolve around :1) Sustainability of Analog rebound into C2021 driven by Autos and Industrials. While we think demand for automotive chips likely remains strong in C2021 , like many other semis TXN will be navigating supply constraints; 2) Will Embedded bounce back in C2021: Although Embedded revenue has rebounded nicely from Q2, the longer term trajectory seems to be suggestive of on-going share loss.

UBS View

While there were items to pick at from the latest earnings report (GM, share repo), the company delivered strong results and guidance while maintaining a cautiously optimistic overall tone. TXN was still able to guide a little better than normal seasonal despite Huawei headwinds and a much higher CQ3 revenue base than expected. GM was not great in terms of drop-through, but factory utilization is steady, mix was a bit of a headwind, and the CQ4 guidance is more consistent with the drop-through that we would expect. Probably the most notable item to us was a de-minimis share repo (a record low). Yes, it is running well ahead of its TTM capital return model, but nonetheless notable for a company that tends to time its share repo very well given a strong intrinsic value model (it bought back near record amount 6mos ago when stock went 100). Moving into 2021, industrial (TXN's biggest end market) remains soft, but we think auto recovery seems to have legs, and comps are much easier as TXN no longer faces revenue headwinds from working down inventory at distributors and the inventory sitting on the BS should allow it to participate real-time in demand upside. Even on higher estimates that remain well above Street, we believe this seems largely factored in at current prices and historical valuation ranges.

Source : Company reports, UBSe

Links to Key UBS Research Notes:

- [FQ3:20 - Strong Q and Guide; Debates Remain Unchanged](#)
- *Prior Reports:* [FQ2:20](#) | [FQ1:20](#) | [Highlights From Capital Mgmt Strategy Call](#) | [FQ4:19](#) | [Highlights From UBS Global TMT Conference](#)

Semi Equipment Outlook

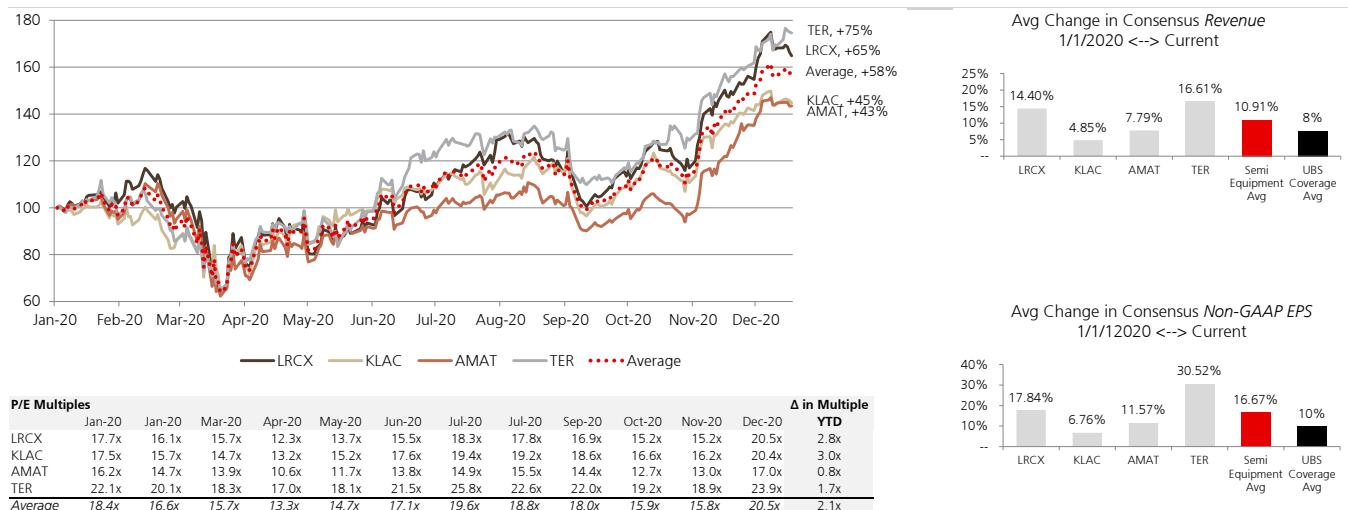
KLAC, AMAT, TER

C2020 WFE has been characterized by a sharp snap-back after the CQ1 Covid-19 related reset as WFE grew from ~\$12.25B in CQ1 to ~\$16.25B in CQ4. The issue that we see from here is that WFE is now annualizing to \$65B/yr - a number from which it is hard for us to build an upside case as we look to WFE for 2021. We continue to forecast WFE of \$63.5B, up from \$58B in C2020, or growth of ~10% Y/Y. The problem is that Street estimates are already there and even if foundry strength persists, it is hard to see quarterly revenue growing much from CQ4 levels and likely more of a sideways trajectory. We note this has been historically very well correlated to stock prices ([LINK](#) to WFE deep dive analysis) so it becomes challenging to build a strong upside case from these stocks levels, although there is still room for the group to continue to re-rate. On this point, semis in aggregate are still trading at >20% premium to SPE which suggests that SPE multiples have gone higher not because of "re-rating" versus semis as much as "re-rating" for the entire semiconductor vertical.

Relative to WFE intensity, we estimate this year will be ~13.3% - or essentially a 15+ year high - some of which is being clearly fueled by spending from China in advance of future revenue (e.g. YMTC). China has been a significant source of WFE growth in the past 3yrs with domestic China representing ~\$8B of the ~\$11B in growth in WFE from 2017-2020. While this is likely to continue, we see domestic China more likely down for 2021 as SMIC digests some capacity and YMTC also took delivery of a significant portion of its planned buildout for the first Fab until it starts to equip the 2nd fab in late 2021. We are already baking in a significant increase in WFE from Samsung for both foundry and NAND as it takes a more market share focused approach in that market. We forecast NAND WFE +30% Y/Y and DRAM up ~20% but off a much lower base. We note this NAND view differs from that put forth by many of the SPE companies who are recently claiming that NAND will be more like flattish and growth coming from DRAM. With respect to WFE intensity, we would not assume much growth from the 13.3% levels in 2020 simply because some of the domestic China WFE will ultimately replace spending that is currently happening in other regions, though there is some upward creep in WFE intensity over time. Relative to the prospect for a significant correction in WFE, we view this as unlikely in part because the OpM of the entire semiconductor industry has increased such that WFE is not overly extended relative to the profit pool of the industry.

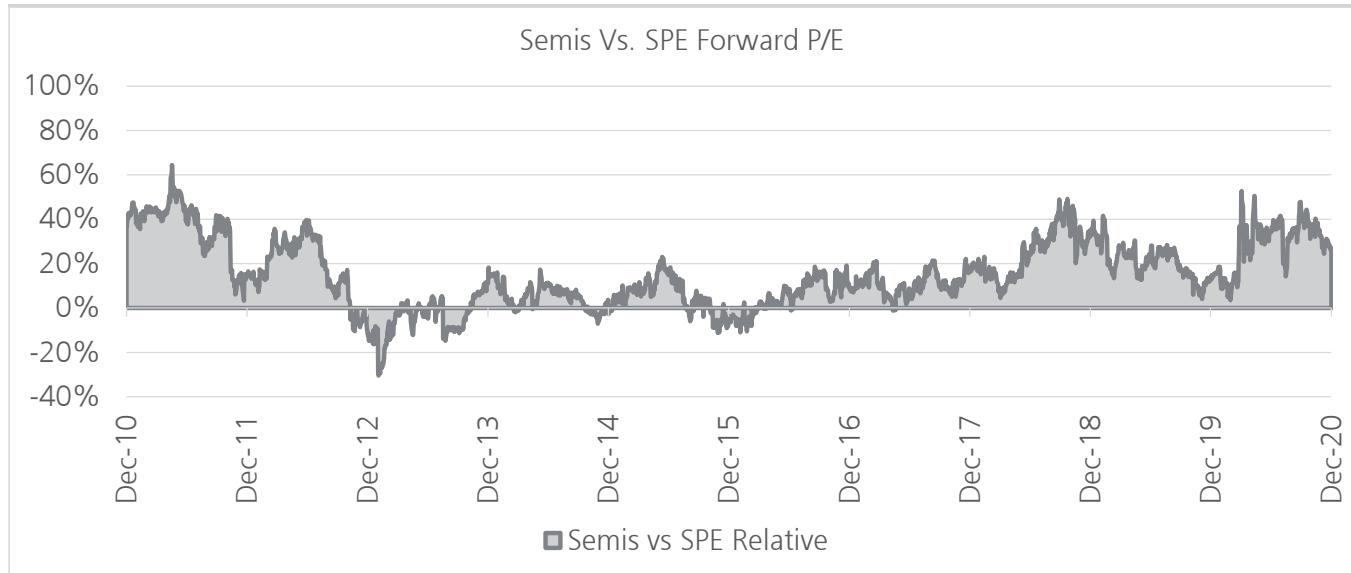
One issue that we are watching is the sustainability of NAND WFE as we estimate NAND WFE is >\$5B in CQ4, or a run-rate of >\$20B. This is historically a level that ends up driving bit growth of as much as ~50% - clearly too much relative to end demand growth. Our spending by Q by segment is shown in one of the Figures below. Further arguing this point is our estimate that NAND industry capex will run ABOVE NAND industry EBITDA in C2021 - typically not sustainable.

Figure 59: YTD Stock Performance (Base 100) and P/E Multiples



Source : Factset, UBS

Figure 60: Semis Vs. SPE Forward P/E



Source : Factset, UBS

WFE Forecasts

We updated our WFE outlook recently ([LINK](#)) and make no updates to our WFE forecasts in this note. We continue to estimate C2020 WFE of ~\$58.5B or +17% y/y consisting of \$27.1B memory (\$12.1B DRAM (+24% Y/Y), \$15.0B NAND (+20% Y/Y) and \$31.4B foundry/logic (+13% Y/Y). For C2021E, we estimate WFE of \$63.5B (+8.5% Y/Y) consisting of memory +26% (driven mostly by NAND +30% Y/Y) and foundry/logic - 6%.

Figure 61: WFE Forecast Summary

	2015	2016	2017	2018	2019	2020E	2021E	2022E
Capex (\$MM)								
Memory Total	25,723	28,639	43,406	55,225	41,189	44,098	50,061	52,648
DRAM	12,419	9,398	16,712	25,053	17,816	22,032	23,914	25,351
NAND/non-volatile other	13,304	19,241	26,693	30,172	23,373	22,067	26,148	27,297
Large non Memory IDMs	11,573	10,761	13,178	14,692	18,960	16,568	17,409	18,143
Tier-one/two foundries	19,088	20,475	23,626	20,137	25,340	33,121	31,085	30,315
Other & SATS	8,287	10,517	11,872	16,746	16,122	17,952	19,060	19,433
Total	64,671	70,392	92,082	106,800	101,611	111,739	117,616	120,538
WFE (\$MM)								
Memory Total	16,017	16,977	25,900	34,350	22,250	27,100	34,000	35,200
DRAM	8,780	6,100	9,100	15,550	9,750	12,100	14,500	15,500
NAND	7,237	10,877	16,800	18,800	12,500	15,000	19,500	19,700
Non-memory Total	17,241	18,323	21,250	19,500	27,850	31,400	29,500	28,800
Logic	5,640	5,800	5,750	6,750	9,350	8,200	8,500	8,800
Foundry	11,600	12,523	15,500	12,750	18,500	23,200	21,000	20,000
Total	33,258	35,300	47,150	53,850	50,100	58,500	63,500	64,000
WFE, Y/Y Change								
Memory Total	25.9%	6.0%	52.6%	32.6%	(35.2%)	21.8%	25.5%	3.5%
DRAM	39.2%	(30.5%)	49.2%	70.9%	(37.3%)	24.1%	19.8%	6.9%
NAND	12.9%	50.3%	54.4%	11.9%	(33.5%)	20.0%	30.0%	1.0%
Non-memory Total	(10.4%)	6.3%	16.0%	(8.2%)	42.8%	12.7%	(6.1%)	(2.4%)
Logic	2.6%	2.8%	(0.9%)	17.4%	38.5%	(12.3%)	3.7%	3.5%
Foundry	(15.6%)	8.0%	23.8%	(17.7%)	45.1%	25.4%	(9.5%)	(4.8%)
Total	4.1%	6.1%	33.6%	14.2%	(7.0%)	16.8%	8.5%	0.8%
Sement % of total								
Memory Total	48.2%	48.1%	54.9%	63.8%	44.4%	46.3%	53.5%	55.0%
DRAM	26.4%	17.3%	19.3%	28.9%	19.5%	20.7%	22.8%	24.2%
NAND	21.8%	30.8%	35.6%	34.9%	25.0%	25.6%	30.7%	30.8%
Non-memory Total	51.8%	51.9%	45.1%	36.2%	55.6%	53.7%	46.5%	45.0%
Logic	17.0%	16.4%	12.2%	12.5%	18.7%	14.0%	13.4%	13.8%
Foundry	34.9%	35.5%	32.9%	23.7%	36.9%	39.7%	33.1%	31.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
WFE Intensity %								
Memory Total	20.7%	22.1%	20.9%	21.7%	20.9%	22.9%	25.4%	21.8%
DRAM	19.5%	14.8%	12.5%	15.7%	15.6%	18.7%	17.5%	14.7%
NAND	25.1%	34.0%	35.6%	34.7%	29.9%	29.1%	39.9%	36.5%
Non-memory	6.7%	7.0%	7.4%	6.3%	9.1%	9.8%	8.2%	7.5%
Total	9.9%	10.4%	11.4%	11.5%	12.2%	13.3%	12.9%	11.8%
Total (excluding discretes)	12.1%	12.8%	13.7%	13.7%	15.0%	16.2%	15.6%	14.1%

Source : Company reports, UBSe

Figure 62: Summary of WFE by top spenders**WFE by Top Spenders**

	2012	% YoY	2013	% YoY	2014	% YoY	2015	% YoY	2016	% YoY	2017	% YoY	2018	% YoY	2019	% YoY	2020E	% YoY	2021E	% YoY	2022E	% YoY
Intel	7,500		6,130		5,150		5,000		5,975		6,014		8,350		8,828		7,641		6,825		6,825	
Logic Memory	7,500		6,130		5,150		5,000		975		1,375		2,475		888		550		--		--	
Micron	750		825		1,625		2,750		3,533		2,918		5,675		4,694		3,838		4,980		6,760	
DRAM	250		381		650		1,200		1,424		1,610		2,837		3,297		3,048		3,057		4,056	
NAND	500		444		975		1,550		2,110		1,309		2,837		1,397		790		1,924		2,704	
Global Foundries	2,850		2,400		2,625		1,650		1,350		1,100		1,500		413		250		250		250	
Western Digital	539		601		706		947		1,099		433		749		648		527		850		850	
Samsung	6,955		6,904		7,478		8,191		7,097		16,654		14,718		10,671		16,225		21,699		18,172	
Memory	2,337		3,738		5,725		5,828		5,505		12,430		12,366		6,262		10,961		15,372		12,995	
DRAM	1,636		1,869		2,705		2,675		2,118		4,330		7,256		1,822		5,481		6,643		5,832	
NAND	701		1,869		3,019		3,153		3,387		8,100		5,110		4,440		5,480		8,729		7,162	
Logic/Foundry	4,618		3,166		1,754		2,363		1,593		4,224		2,352		4,409		5,264		6,327		5,177	
SK Hynix	1,696		1,831		2,567		4,206		3,898		5,284		8,064		5,510		4,406		5,721		7,639	
DRAM	548		1,083		1,797		3,464		2,483		2,501		4,264		3,610		2,506		3,211		4,150	
NAND	1,148		747		770		742		1,415		2,783		3,800		1,900		1,900		2,510		3,489	
Japan Memory	552		852		1,190		1,161		1,967		2,974		2,462		2,226		2,727		2,164		2,386	
NAND	434		619		721		557		1,533		2,841		3,265		2,205		2,727		2,164		2,386	
Sony	631		481		463		1,365		250		670		650		1,018		818		1,200		1,500	
TSMC	6,241		6,058		8,094		5,233		6,137		7,065		6,226		11,242		12,325		10,400		9,750	
UMC	1,317		710		1,072		1,219		1,700		1,188		715		360		350		330		330	
Nanya	DRAM								200		478		331		122		125		250		250	
SMIC	Foundry								980		1,706		1,555		1,750		1,700		3,800		2,700	
Hua Hong	Foundry																		810		600	
Shanghai Huali	Foundry																		800		800	
YMTC																			1,000		3,000	
Memory	--	--	--	--	--	--	--	--	--	--	250		250		1,000		1,000		2,250		3,000	
DRAM	--	--	--	--	--	--	--	--	--	--	250		1,000		1,000		2,250		3,000		3,000	
NAND	--	--	--	--	--	--	--	--	--	--	250		1,000		1,000		2,250		3,000		3,000	
Fujian Jinhua IC	Logic																		--		--	
Changxin Memory (Innotron)	DRAM																		500		--	
OTHERS			263		208		313		555		387		392		661		668		658		731	
Total			29,644		(18.5%)		27,473		(7.3%)		31,953		16.3%		33,258		4.1%		35,300		6.1%	
Wafer Fab Equipment (\$MM)			29,644		(18.5%)		27,473		(7.3%)		31,953		16.3%		33,258		4.1%		35,300		6.1%	
Memory, SMM			7,082		9,325		12,720		16,017		16,977		26,400		34,350		22,250		27,100		34,000	
YoY			(44%)		32%		36%		26%		6%		56%		30%		(35%)		22%		25%	
DRAM			2,732		4,111		6,309		8,780		6,100		9,100		15,550		9,750		12,100		14,500	
YoY			(48%)		50%		53%		39%		(31%)		49%		71%		(37%)		24%		20%	
NAND/other			4,351		5,214		6,411		7,237		10,877		17,300		18,800		12,500		15,000		19,500	
YoY			(41%)		20%		23%		13%		50%		59%		9%		(34%)		20%		30%	
Foundry, SMM			14,367		11,430		13,738		11,600		12,523		15,250		12,750		18,500		23,200		21,000	
YoY			9%		(20%)		20%		(16%)		8%		22%		(16%)		45%		25%		(9%)	
Logic, SMM			8,195		6,718		5,495		5,640		5,800		5,500		6,750		9,350		8,200		8,500	
YoY			(23%)		(18%)		(18%)		3%		3%		5%		23%		39%		(12%)		4%	
Foundry + logic, SMM																						
YoY																						
% total																						
Memory			24%		34%		40%		48%		48%		56%		64%		44%		46%		54%	
DRAM			9%		15%		20%		25%		17%		19%		29%		19%		21%		23%	
NAND/other			15%		19%		20%		22%		31%		37%		35%		25%		26%		31%	
Foundry			48%		42%		43%		35%		35%		32%		24%		37%		40%		33%	
Logic			28%		24%		17%		17%		16%		12%		13%		19%		14%		13%	
Total WFE			100%																			

Source : Company reports, UBSe

We spend a lot of time to disaggregate WFE on a quarterly basis between DRAM, NAND and foundry/logic. We show all of this work and these estimates in the tables below. We can see from this that we believe NAND is running ~\$5.5B in WFE for CQ4:20, or annualizing to ~\$22B - a level which the charts that come later shows that could ultimately produce ~50% bit supply growth. In part, this is why we are so negative on NAND pricing for C2021.

Figure 63: WFE data by company (2005-2013)

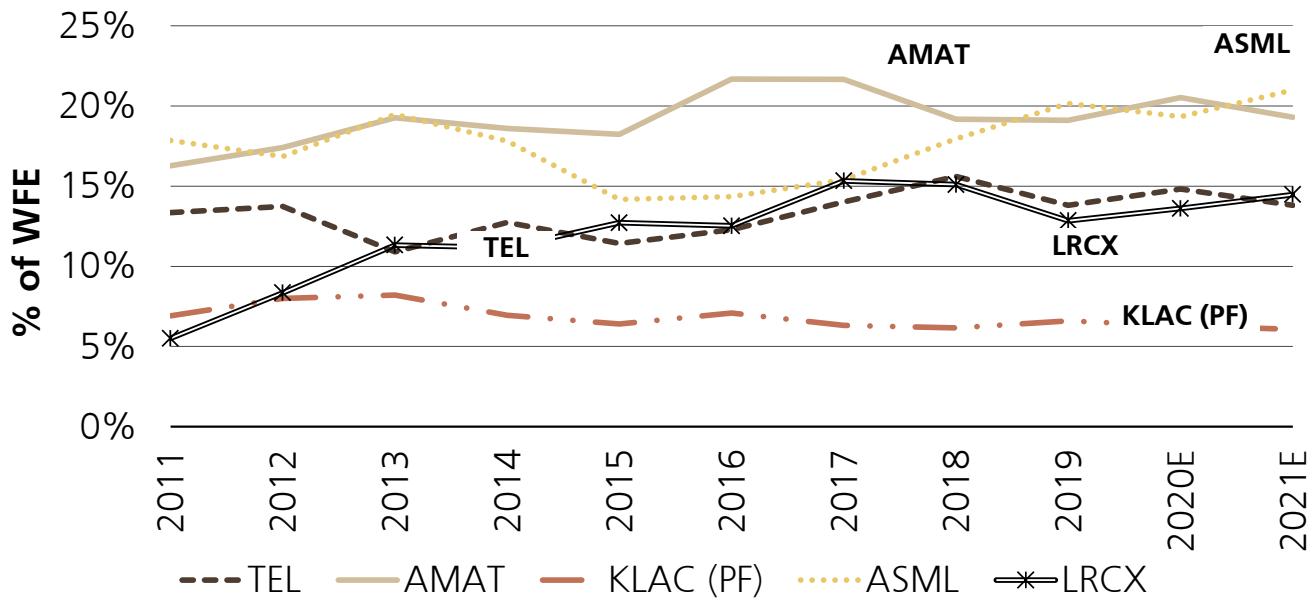
Source : Company Reports, UBSe

Figure 64: WFE data by company (2014-2021E)

Product	2014				2015				2016				2017				2018				2019				2020				2021						
	1Q'14	2Q'14	3Q'14	4Q'14	1Q'15	2Q'15	3Q'15	4Q'15	1Q'16	2Q'16	3Q'16	4Q'16	1Q'17	2Q'17	3Q'17	4Q'17	1Q'18	2Q'18	3Q'18	4Q'18	1Q'19	2Q'19	3Q'19	4Q'19	1Q'20	2Q'20	3Q'20	4Q'20E	1Q'21E	2Q'21E	3Q'21E	4Q'21E			
ASML	\$1,409	\$1,733	\$1,172	\$1,378	\$1,405	\$1,256	\$1,085	\$965	\$944	\$1,417	\$1,382	\$1,319	\$1,294	\$1,525	\$2,137	\$2,302	\$2,048	\$2,421	\$2,420	\$2,777	\$1,935	\$2,104	\$2,582	\$3,475	\$1,739	\$2,781	\$3,635	\$3,150	\$3,205	\$3,211	\$3,452	\$3,462			
Euro																						\$1,689	\$1,851	\$2,326	\$3,131	\$1,584	\$2,439	\$3,096	\$2,674	\$2,730	\$2,735	\$2,940	\$2,948		
FX																						0.87	0.88	0.90	0.90	0.91	0.88	0.85	0.85	0.85	0.85	0.85	0.85		
AMAT	\$1,584	\$1,476	\$1,434	\$1,446	\$1,560	\$1,635	\$1,494	\$1,373	\$1,587	\$1,786	\$2,127	\$2,150	\$2,404	\$2,532	\$2,431	\$2,847	\$2,999	\$2,748	\$2,309	\$2,268	\$2,184	\$2,273	\$2,302	\$2,814	\$2,567	\$2,916	\$3,070	\$3,450	\$3,300	\$3,050	\$2,900	\$3,000			
LRCX	\$957	\$848	\$722	\$777	\$928	\$1,006	\$1,085	\$896	\$774	\$986	\$1,042	\$1,282	\$1,544	\$1,710	\$1,802	\$1,893	\$2,192	\$2,381	\$1,554	\$1,715	\$1,512	\$1,536	\$1,355	\$1,759	\$1,648	\$1,865	\$2,148	\$2,300	\$2,325	\$2,250	\$2,265	\$2,350			
KLAC	\$670	\$570	\$477	\$504	\$565	\$580	\$461	\$528	\$523	\$731	\$562	\$684	\$721	\$737	\$761	\$762	\$798	\$841	\$829	\$852	\$730	\$691	\$831	\$895	\$835	\$798	\$891	\$935	\$910	\$910	\$910	\$910			
TEL	\$1,467	\$967	\$909	\$726	\$1,054	\$822	\$1,059	\$867	\$894	\$819	\$1,428	\$1,193	\$1,630	\$1,528	\$1,841	\$1,609	\$2,387	\$2,013	\$2,504	\$1,495	\$1,932	\$1,188	\$1,854	\$1,944	\$2,096	\$2,094	\$2,383	\$2,094	\$2,043	\$1,922	\$2,466	\$2,332			
JPY																										\$2,264	\$2,220	\$2,526	\$2,200	\$2,154	\$2,026	\$2,601	\$2,460		
FX																						1.08	1.06	1.06	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05			
ex TEL	\$4,621	\$4,627	\$3,805	\$4,105	\$4,458	\$4,478	\$4,124	\$3,762	\$3,828	\$4,920	\$5,113	\$5,435	\$5,963	\$6,504	\$7,131	\$7,803	\$8,037	\$8,391	\$7,112	\$7,612	\$6,461	\$6,604	\$7,070	\$8,943	\$6,789	\$8,360	\$9,745	\$9,835	\$9,740	\$9,421	\$9,527	\$9,722			
ind TEL	\$6,087	\$5,595	\$4,714	\$4,831	\$5,513	\$5,300	\$5,184	\$4,628	\$4,722	\$5,739	\$6,541	\$6,628	\$7,594	\$8,032	\$8,972	\$9,412	\$10,425	\$10,404	\$9,617	\$9,107	\$8,394	\$7,793	\$8,924	\$10,886	\$8,885	\$10,454	\$12,127	\$11,929	\$11,783	\$11,343	\$11,993	\$12,054			
Big 3 US	\$3,211	\$2,894	\$2,633	\$2,727	\$3,053	\$3,221	\$3,040	\$2,796	\$2,885	\$3,503	\$3,731	\$4,116	\$4,669	\$4,979	\$4,994	\$5,501	\$4,526	\$4,500	\$4,488	\$4,468	\$5,050	\$5,579	\$6,109	\$6,685	\$6,535	\$6,210	\$6,075	\$6,260							
Memory																																			
ASML	\$939	\$953	\$228	\$896	\$773	\$591	\$607	\$425	\$284	\$406	\$221	\$514	\$608	\$823	\$684	\$1,220	\$1,516	\$1,207	\$1,403	\$1,111	\$774	\$821	\$542	\$591	\$470	\$1,057	\$763	\$897	\$942	\$944	\$1,015	\$1,017			
AMAT	\$632	\$563	\$407	\$742	\$886	\$1,144	\$751	\$650	\$1,298	\$642	\$477	\$1,406	\$1,250	\$1,342	\$1,216	\$1,765	\$2,039	\$1,649	\$1,385	\$1,270	\$917	\$1,159	\$967	\$900	\$1,129	\$1,312	\$1,289								
LRCX	\$632	\$500	\$362	\$554	\$758	\$747	\$830	\$554	\$702	\$742	\$665	\$850	\$1,127	\$1,248	\$1,189	\$1,457	\$1,841	\$1,905	\$1,197	\$1,355	\$984	\$983	\$867	\$914	\$923	\$1,138	\$1,246								
KLAC	\$155	\$131	\$219	\$222	\$96	\$359	\$170	\$253	\$105	\$212	\$236	\$287	\$260	\$236	\$350	\$541	\$622	\$580	\$473	\$520	\$277	\$352	\$258	\$319	\$276	\$346	\$1,043	\$1,048	\$1,032	\$1,397	\$1,177				
TEL	\$479	\$333	\$345	\$538	\$529	\$378	\$519	\$416	\$492	\$401	\$614	\$477	\$790	\$1,113	\$988	\$1,695	\$1,590	\$1,653	\$1,091	\$1,407	\$927	\$739	\$671	\$1,068	\$1,191										
ex TEL	\$2,357	\$2,147	\$1,336	\$2,413	\$2,513	\$2,841	\$2,359	\$1,883	\$2,498	\$2,092	\$1,599	\$3,057	\$3,245	\$3,649	\$3,438	\$4,983	\$6,018	\$5,441	\$4,459	\$4,256	\$2,953	\$3,215	\$2,733	\$2,763	\$2,781	\$3,826	\$3,575	\$1,243	\$942	\$944	\$1,015	\$1,017			
ind TEL	\$2,836	\$2,480	\$1,771	\$2,951	\$3,052	\$3,220	\$2,878	\$2,299	\$2,990	\$2,493	\$2,213	\$3,534	\$4,044	\$4,520	\$4,543	\$5,971	\$7,713	\$7,032	\$6,111	\$5,347	\$4,093	\$3,803	\$3,660	\$3,502	\$3,452	\$4,894	\$4,766	\$2,286	\$1,990	\$1,976	\$2,412	\$2,195			
DRAM % of Memory (reported)	52%	59%	56%	67%	66%	48%	45%	61%	38%	39%	34%	36%	37%	28%	32%	37%	40%	37%	42%	36%	46%	46%	48%	42%	41%	42%	44%	44%	44%	44%	44%	44%			
NAND % of Memory (reported)	46%	41%	44%	33%	34%	52%	55%	39%	62%	62%	66%	64%	63%	72%	68%	63%	60%	63%	58%	64%	54%	54%	52%	58%	59%	58%	56%	54%	55%	55%	54%	54%			
F/L																																			
ASML	\$559	\$774	\$753	\$485	\$649	\$1,160	\$448	\$438	\$626	\$885	\$1,101	\$717	\$881	\$1,087	\$1,209	\$1,186	\$533	\$1,114	\$1,016	\$1,666	\$1,161	\$1,284	\$2,040	\$2,885	\$1,269	\$1,724	\$2,872	\$2,443	\$2,263	\$2,267	\$2,437	\$2,444			
AMAT	\$1,032	\$1,002	\$907	\$684	\$818	\$863	\$693	\$625	\$1,573	\$1,356	\$1,351	\$1,514	\$1,190	\$1,216	\$1,082	\$960	\$1,099	\$924	\$998	\$1,267	\$1,114	\$1,335	\$1,914	\$1,438	\$1,604	\$1,781									
LRCX	\$326	\$348	\$461	\$385	\$391	\$498	\$323	\$299	\$301	\$382	\$404	\$543	\$417	\$462	\$613	\$436	\$351	\$476	\$628	\$553	\$488	\$725	\$792												
KLAC	\$516	\$439	\$257	\$272	\$469	\$220	\$290	\$274	\$419	\$519	\$326	\$397	\$461	\$501	\$411	\$221	\$176	\$261	\$357	\$332	\$453	\$339	\$474	\$537	\$576	\$479	\$615	\$589							
TEL	\$719	\$646	\$532	\$496	\$584	\$444	\$540	\$451	\$402	\$418	\$814	\$716	\$832	\$657	\$737	\$606	\$692	\$423	\$851	\$404	\$792	\$701	\$927	\$1,205	\$1,425	\$1,026	\$1,191	\$1,043	\$995	\$889	\$1,069	\$1,155			
ex TEL	\$2,433	\$2,563	\$2,378	\$1,827	\$2,327	\$2,742	\$1,754	\$1,636	\$2,014	\$3,359	\$3,188	\$3,008	\$2,913	\$3,241	\$3,449	\$2,924	\$2,019	\$2,950	\$2,654	\$3,356	\$3,509	\$3,289	\$4,336	\$6,180	\$4,008	\$4,534	\$6,169	\$2,832	\$2,263	\$2,267	\$2,437	\$2,444			
ind TEL	\$3,151	\$3,209	\$2,910	\$2,323	\$2,910	\$3,186	\$2,294	\$2,087	\$2,416	\$3,777	\$4,001	\$3,724	\$3,745	\$3,898	\$4,185	\$3,530	\$2,711	\$3,372	\$3,505	\$3,760	\$4,301	\$3,990	\$5,263	\$3,784	\$5,433	\$5,560	\$7,361	\$3,875	\$3,258	\$3,157	\$3,507	\$3,599			
WFE																																			
Total	\$9,074	\$8,019	\$7,055	\$7,776	\$8,597	\$8,217	\$8,802	\$7,616	\$6,945	\$8,849	\$9,457	\$10,092	\$10,709	\$11,610	\$12,139	\$12,693	\$13,900	\$13,900	\$13,350	\$12,750	\$11,750	\$11,025	\$12,375	\$14,950	\$12,250	\$14,000	\$15,500	\$16,750	\$16,000	\$15,750	\$15,750	\$16,000			
Memory	\$3,400	\$3,000	\$2,150	\$4,199	\$4,242	\$4,459	\$4,108	\$3,208	\$3,964	\$7,738	\$3,294	\$5,962	\$5,480	\$6,162	\$7,044	\$7,714	\$9,788	\$9,200	\$8,000	\$7,150	\$6,000	\$5,600	\$5,350	\$5,200	\$5,000	\$6,500	\$5,600	\$9,100	\$8,600	\$8,600	\$8,600	\$8,700			
% total	37%	37%	30%	54%	49%	54%	47%	42%	57%	42%	35%	59%	51%	53%	58%	61%	70%	66%	60%	56%	51%	51%	43%	35%	41%	46%	42%	54%	54%	55%	55%	54%			
DRAM % (reported)																																			
DRAM	\$1,477	\$1,467	\$1,005	\$2,360	\$2,819	\$2,128	\$1,863	\$1,954	\$1,519	\$1,420	\$1,124	\$2,120	\$2,049	\$1,711	\$2,279	\$2,928	\$4,604	\$4,032	\$3,011	\$2,493	\$2,471	\$2,000	\$2,423	\$2,624	\$3,634	\$3,563	\$3,600	\$3,600	\$3,700						
NAND/other	\$1,923	\$1,533	\$1,145	\$1,839	\$1,424	\$2,331	\$2,44																												

Based on our model below, in C2020 we model ASML to lose a touch of WFE share but gain significant share in 2021 amid a solid upward trend. We model AMAT to gain some share in C2020, TEL to gain share in 2020 then lose share in 2021, and LRCX to be up slightly in 2020 but up significantly in 2021 back near prior peak levels.

Figure 65: WFE share by company.



Source : Company reports, UBSe

Figure 66: WFE share by company, data

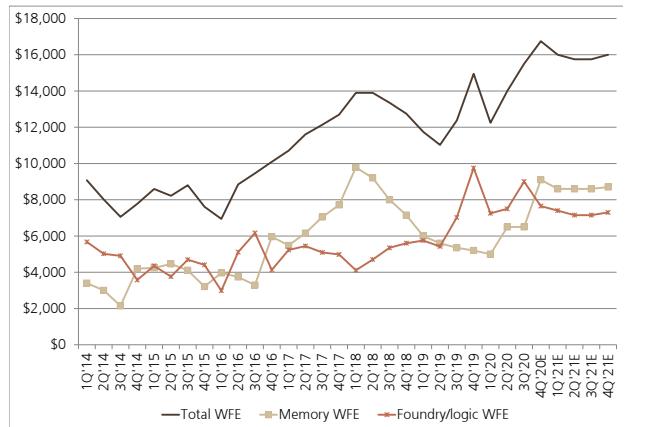
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020E	2021E
TEL	4,860	4,069	2,993	4,069	3,803	4,334	6,609	8,400	6,918	8,667	8,763
AMAT	5920.459	5161	5290	5940	6062	7650	10214	10324	9573	12,003	12,250
KLAC (PF)	2,518	2,373	2,255	2,221	2,133	2,500	2,981	3,320	3,303	3,673	3,860
ASML	6,491	4,996	5,350	5,692	4,711	5,061	7,258	9,666	10,097	11,304	13,330
LRCX	2,006	2,476	3,110	3,567	4,229	4,419	7,229	8,126	6,438	7,961	9,190
WFE	36,387	29,644	27,473	31,953	33,258	35,300	47,150	53,850	50,100	58,500	63,500
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020E	2021E
TEL	13.4%	13.7%	10.9%	12.7%	11.4%	12.3%	14.0%	15.6%	13.8%	14.8%	13.8%
AMAT	16.3%	17.4%	19.3%	18.6%	18.2%	21.7%	21.7%	19.2%	19.1%	20.5%	19.3%
KLAC (PF)	6.9%	8.0%	8.2%	7.0%	6.4%	7.1%	6.3%	6.2%	6.6%	6.3%	6.1%
ASML	17.8%	16.9%	19.5%	17.8%	14.2%	14.3%	15.4%	18.0%	20.2%	19.3%	21.0%
LRCX	5.5%	8.4%	11.3%	11.2%	12.7%	12.5%	15.3%	15.1%	12.9%	13.6%	14.5%

Source : Company reports, UBSe

WFE Run-Rate Analysis

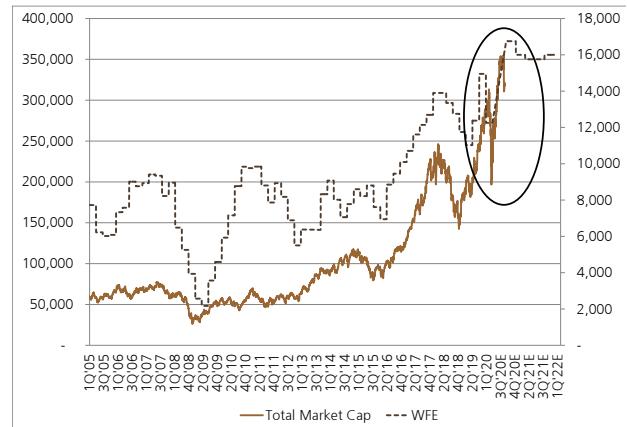
This shows our quarterly WFE estimates from the above tables. We can see from here that we estimate the industry is running at ~\$16.25B WFE in CQ4:20.

Figure 67: Quarterly WFE run-rate



Source : Company reports, UBS

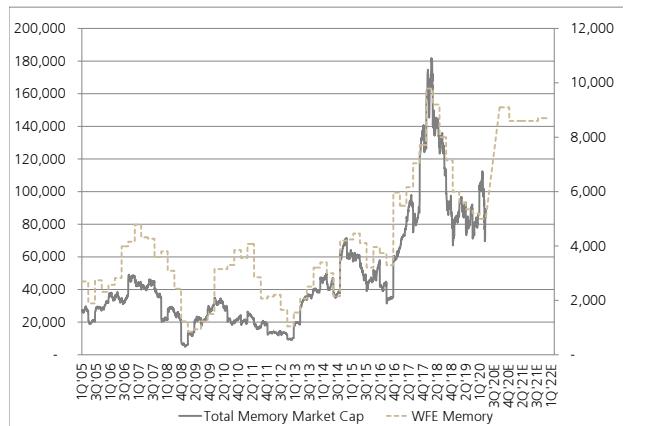
Figure 68: ... stocks are highly correlated to this metric



Source : Factset, Company reports, UBS

Note: Total market capitalization includes ASML, AMAT, KLAC, LRCX, and Tokyo Electron

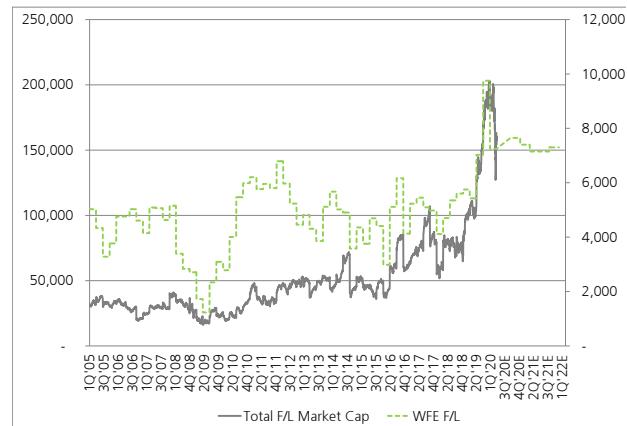
Figure 69: SPE stocks are well correlated to WFE run-rate, and memory appears biased higher...



Source : Factset, Company reports, UBS

Note: Total memory market capitalization is calculated by taking individual market capitalization segmented in any given quarter by reported memory split

Figure 70: ... but foundry/logic is not likely to grow much if any

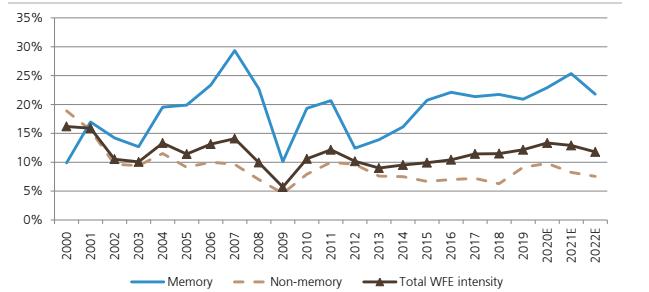


Source : Factset, Company Reports, UBS

Note: Total foundry/logic market capitalization is calculated by taking individual market capitalization segmented in any given quarter by reported foundry/logic split

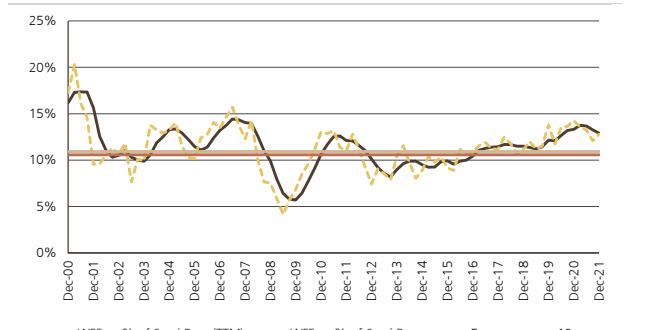
Capital Intensity Analysis

Figure 73: WFE intensity is rising in part due to a shift to memory in years past and a rise in foundry/logic intensity in recent Qs



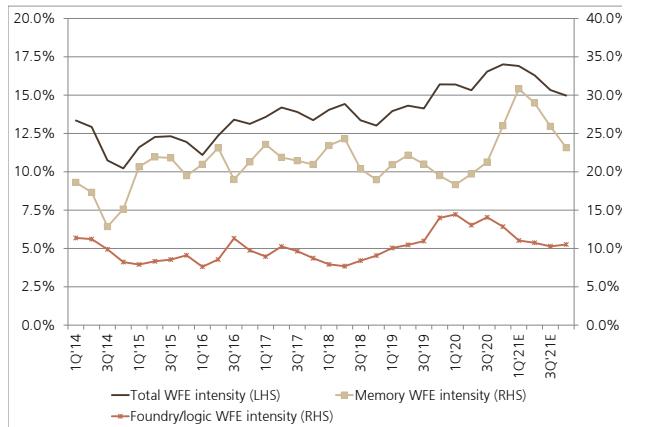
Source : Company reports, UBSe

Figure 75: 20yr WFE intensity has become less cyclical, but LT averages have not changed much and we are running above these levels



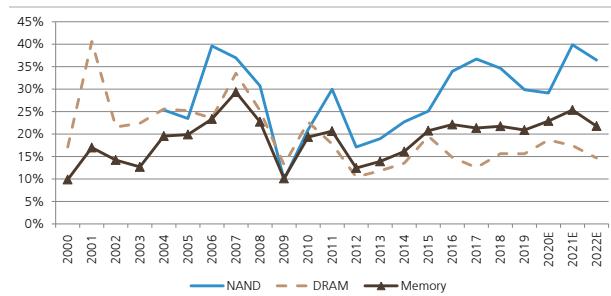
Source : Company reports, UBSe

Figure 77: Figure 78: WFE Intensity, trailing 6 mos



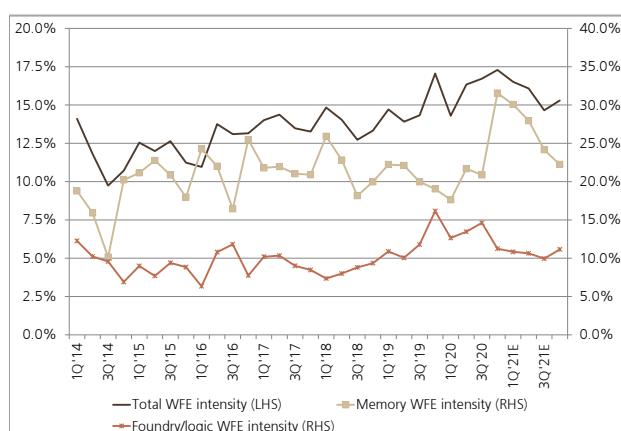
Source : Company reports, UBSe

Figure 74: Within memory, intensity remains benign with NAND down and DRAM still low



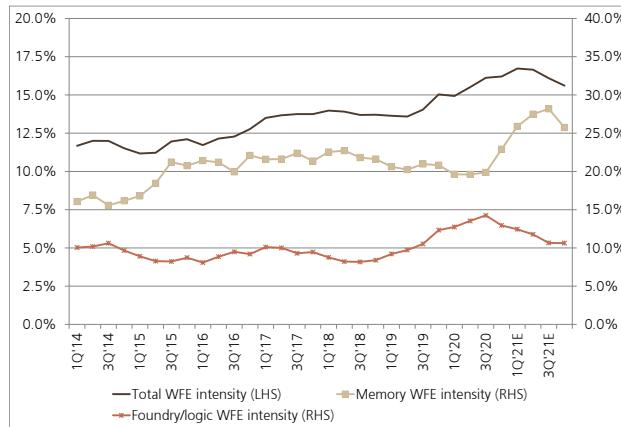
Source : Company reports, UBSe

Figure 76: WFE Intensity, Quarterly



Source : Company reports, UBSe

Figure 79: WFE Intensity, trailing 12 mos



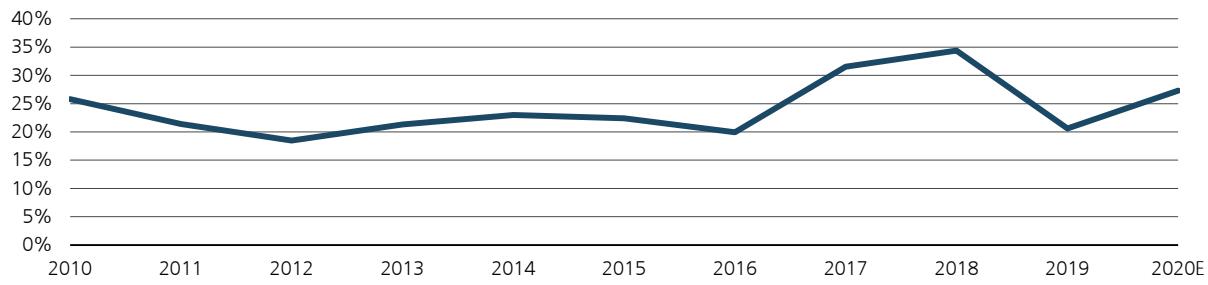
Source : Company reports, UBSe

Semiconductor Industry Profit Margins

Figure 80: Semis industry OpM has risen over the past few years...

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020E
Total Revenue	211,934	227,918	231,288	248,457	277,723	272,877	302,731	373,218	433,172	384,227	424,274
Total OP	54,694	48,808	42,758	52,982	63,878	61,183	60,368	117,634	149,008	79,238	115,792
OpM	26%	21%	18%	21%	23%	22%	20%	32%	34%	21%	27%

Revenue and OP include top chipmakers such as Samsung, Intel, SK hynix, MU, AVGO, QCOM, etc

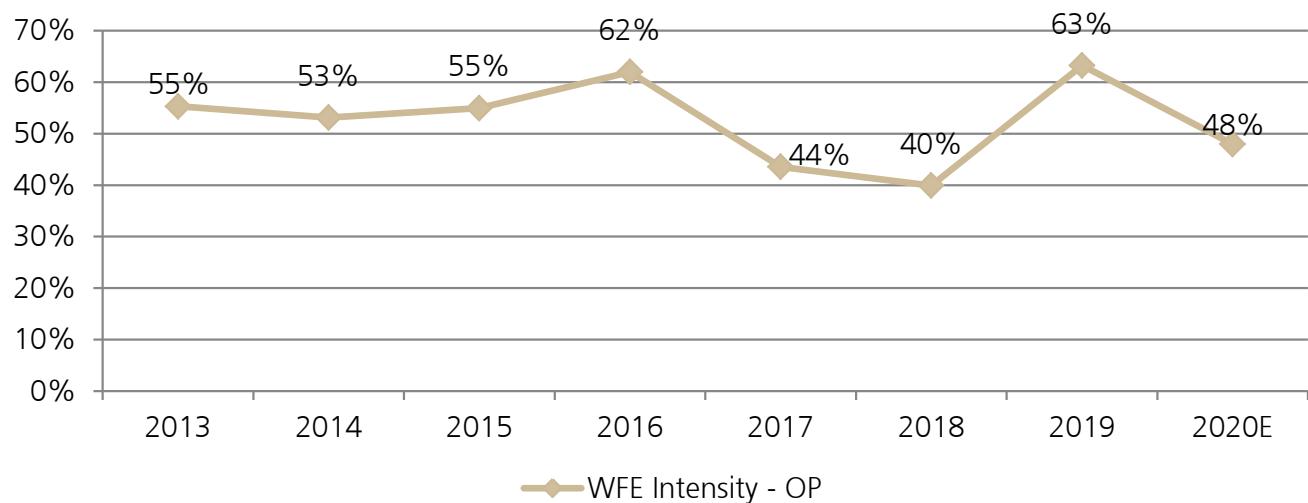


Source : Factset, Company reports, UBS

NOTE: Semis industry analysis includes Samsung (semis only), INTC, TSMC, SK Hynix, MU, AVGO, QCOM (QCT starting in 2014), TXN, STM, WDC, NXPI, IFX, NVDA, Mediatek, Renesas, Sony (semis), AMD, ADI, HiSilicon, ON, MCHP, SWKS, Rohm

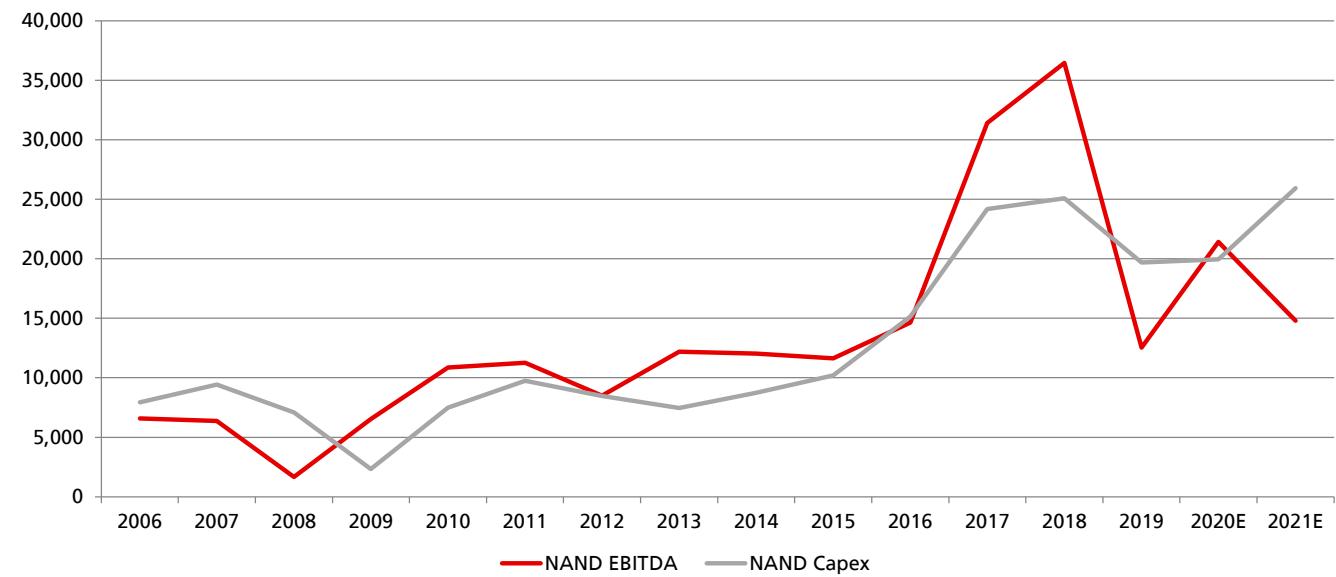
So when we consider WFE relative to industry OP, we do see that the WFE intensity is, in aggregate, more benign.

Figure 81: ...so this is generally more supportive that these annual WFE levels may be more sustainable



Source : Factset, Company reports, UBS

Figure 82: NAND industry Capex is running above the NAND industry EBITDA in C2021

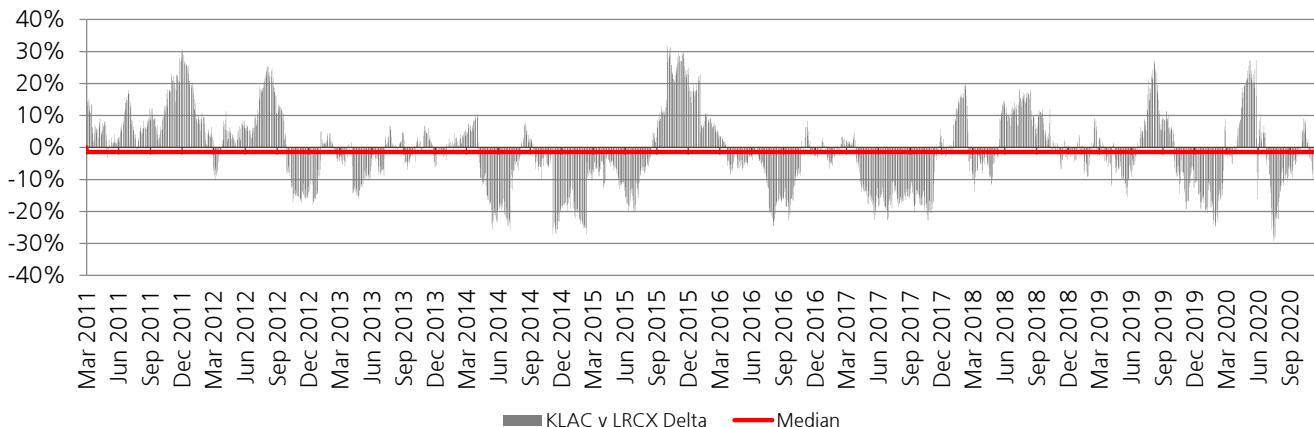


Source : Factset, Company Reports, UBS

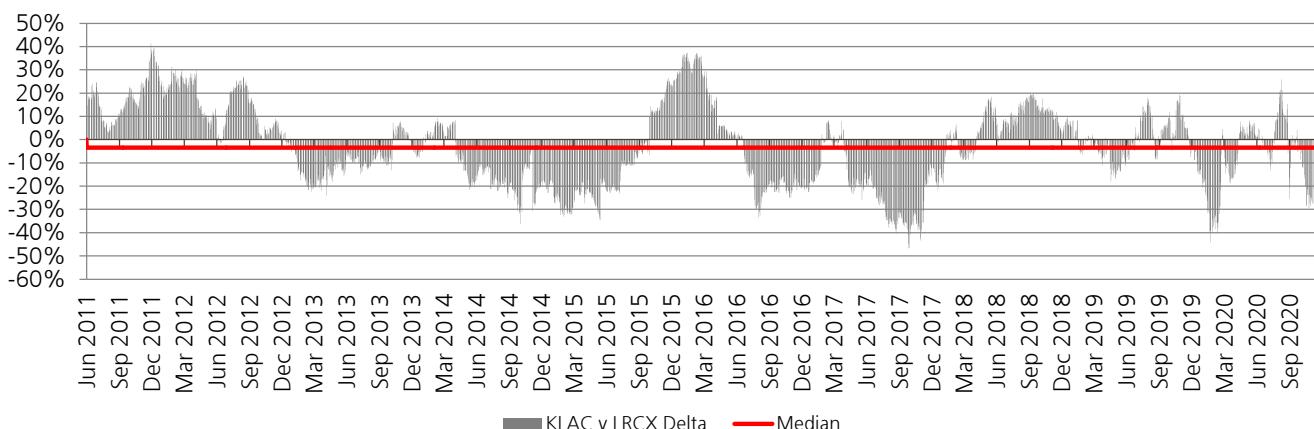
Stock Performance Data

Figure 83: KLAC v LRCX Trailing Stock Performance Delta

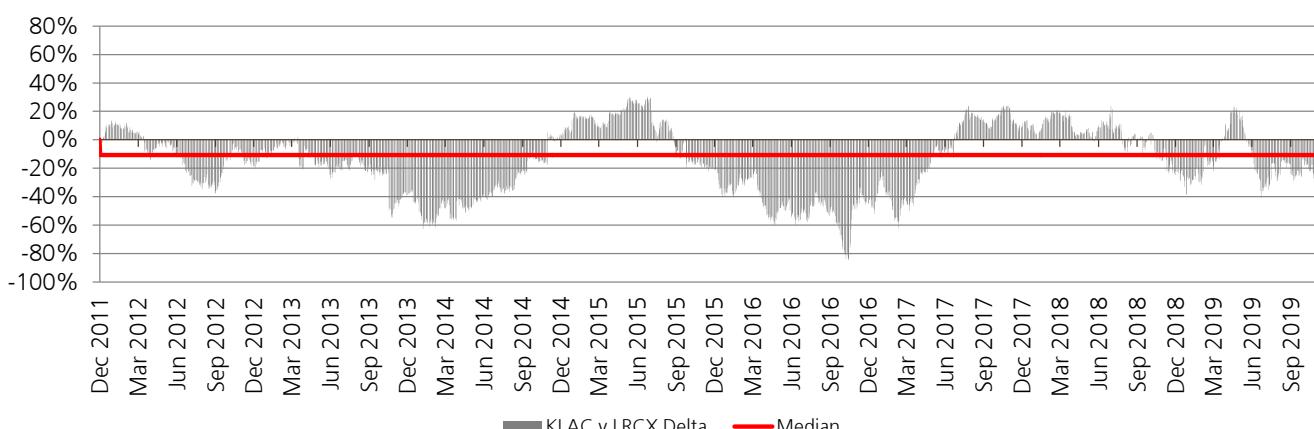
3-mo Trailing Stock Performance Delta



6-mo Trailing Stock Performance Delta



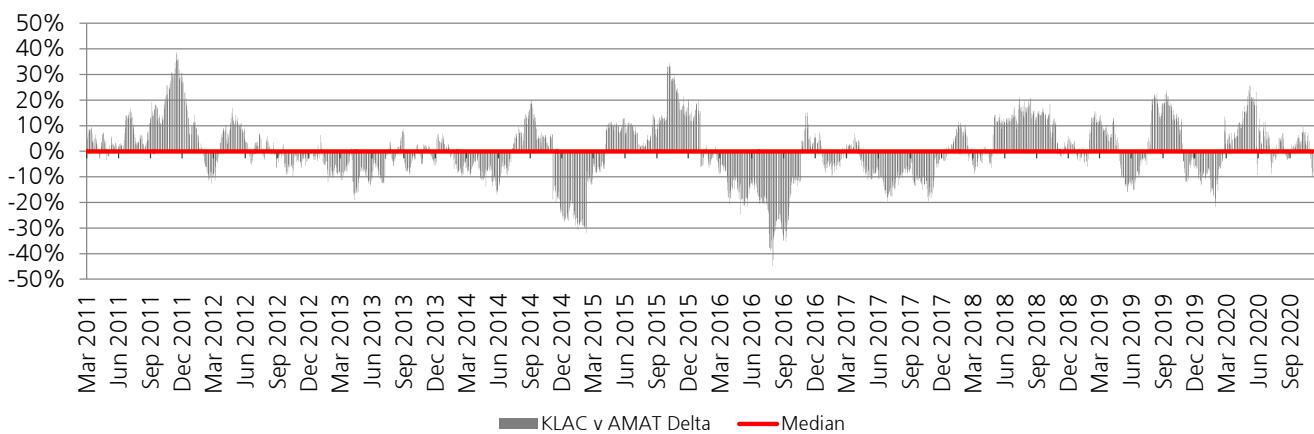
12-mo Trailing Stock Performance Delta



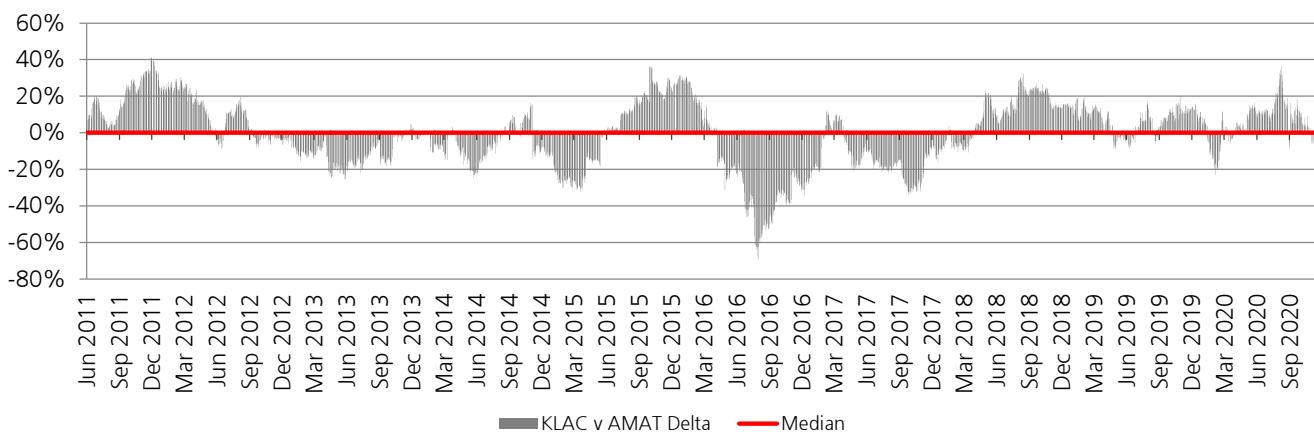
Source : Factset, UBS Analysis

Figure 84: KLAC v AMAT Trailing Stock Performance Delta

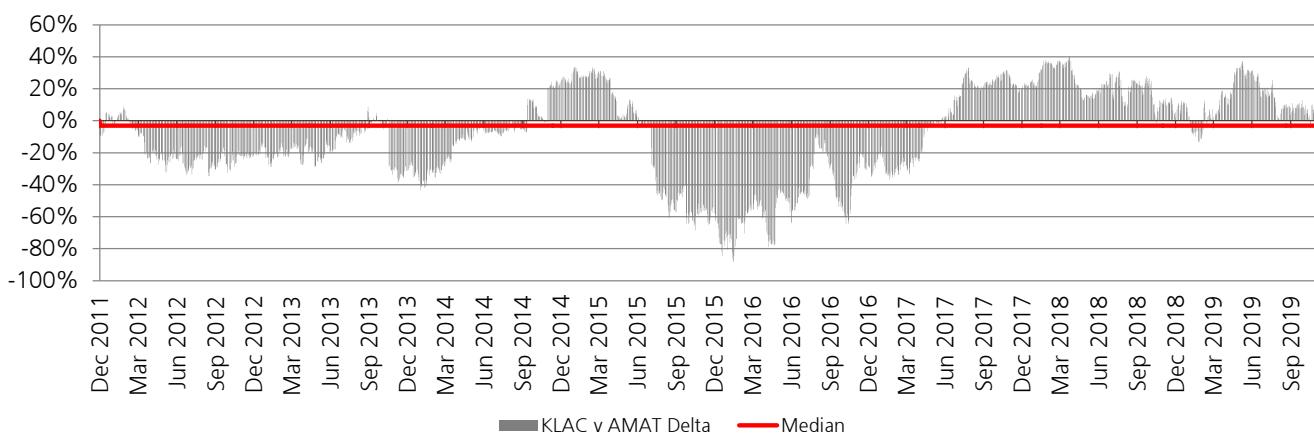
3-mo Trailing Stock Performance Delta



6-mo Trailing Stock Performance Delta



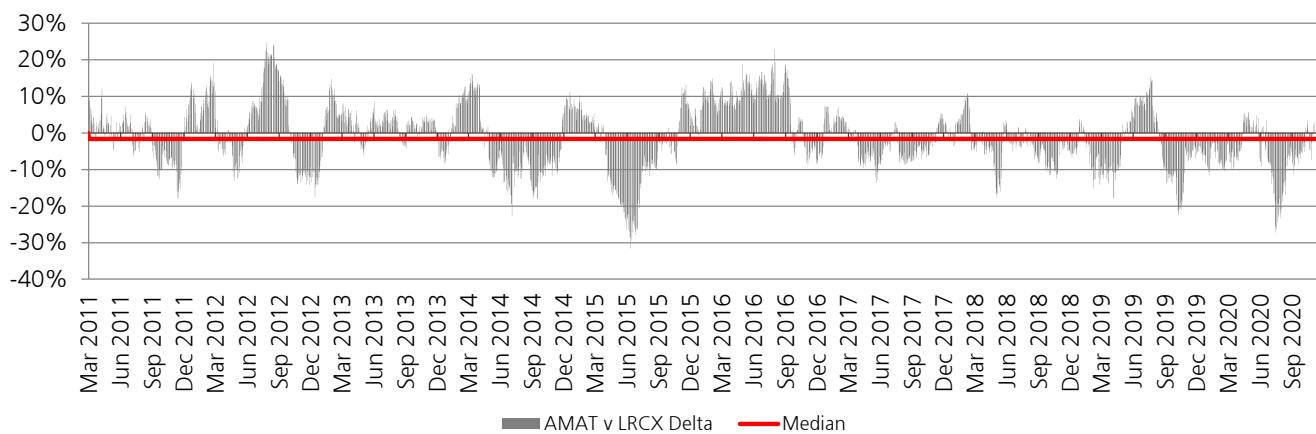
12-mo Trailing Stock Performance Delta



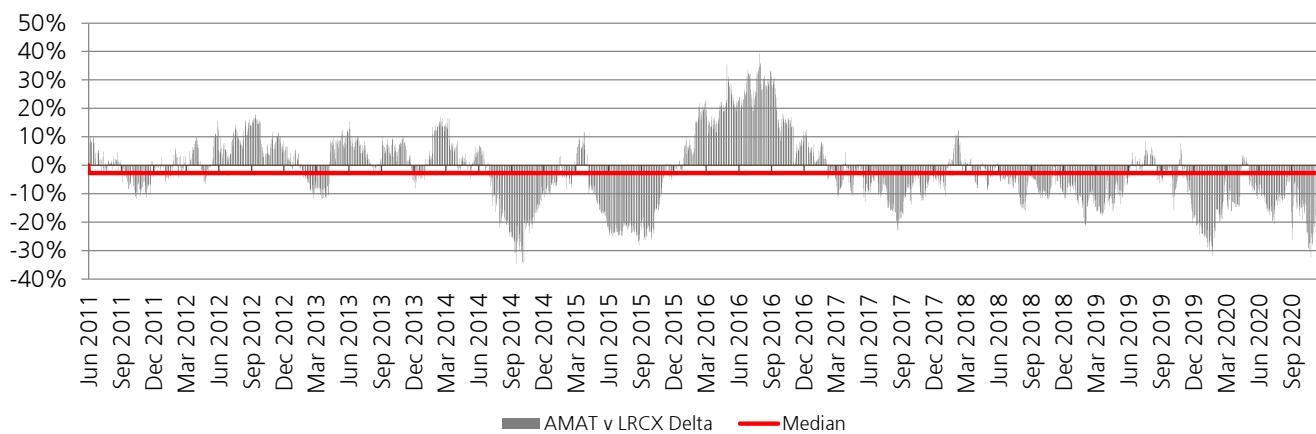
Source : Factset, UBS Analysis

Figure 85: AMAT v LRCX Trailing Stock Performance Delta

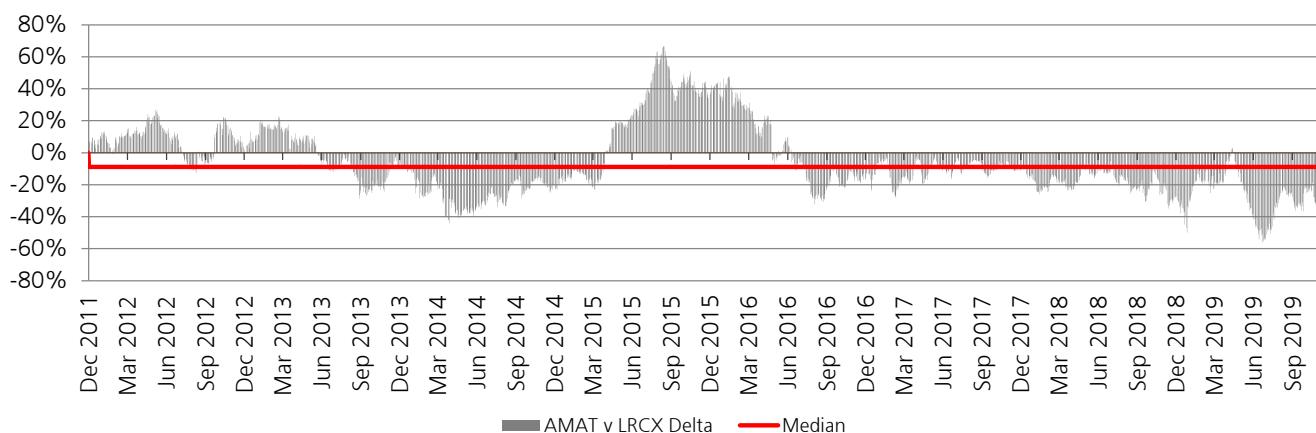
3-mo Trailing Stock Performance Delta



6-mo Trailing Stock Performance Delta



12-mo Trailing Stock Performance Delta



Source : Factset, UBS Analysis

KLAC

Figure 86: Key Debate + UBS View

Key Debate

More broadly, we see two key debates remaining on the stock. First, we remain puzzled why KLAC is not doing better in its core semis business given very favorable tailwinds from foundry/logic (F/L) spending mix over the past few years. F/L (KLAC's bread and butter) has gone from ~1/3 of WFE in 2018 to nearly 60% of WFE in 2019 and 2020, yet KLAC's share of WFE has barely grown over the period. We see some tailwinds in C21 from new applications like EUV print check, but memory spend (mostly NAND) is going to hockey stick higher so the mix will likely be less favorable. Second, KLAC remains subject to the overall sector concerns on US/China trade given the fact that we estimate ~80% of the ~\$10B in WFE growth from C2017-2020 is from domestic China and export control is likely here to stay.

UBS View

KLAC is fundamentally more exposed than peers to the foundry/logic segment where our concerns about peaking spending "run-rate" are most acute. We like the Orbotech semiconductor and PCB businesses, but the display asset is not exciting. Lastly, it is heavily exposed to TSMC where capex trajectory seems at risk. We may be overplaying the near-term risk as KLAC's memory share has improved in recent years. Additionally, the stock has under-performed many key peers meaning that some of our negative view may have already played out. Moreover, despite being nowhere near as exposed to SMIC as AMAT, KLAC seems to be taking advantage of its offshore locations to continue shipping to SMIC even as LRCX has halted shipments (to be fair, LRCX has very limited offshore shipping options). Ergo, this seems like a headwind of sorts for C2021 (or maybe a tailwind for LRCX if it decides to ship from offshore once it has the offshore capacity next year). Either way, the end market diversification story is interesting, but we just don't see enough reason to believe that KLAC can materially out-pace Street estimates to get excited here.

Source : Company reports, UBS

Links to Key UBS Research Notes:

- [FQ1:21 - The Song Remains The Same; Diversification Story A Good One, But Hard to See Premium Growth](#)
- [Prior Reports: FQ4:20 | FQ3:20 | Lowering Estimates on Intensifying Supply Chain Constraints | FQ2:20 | Highlights From UBS Global TMT Conference](#)

AMAT

Figure 87: Key Debate + UBS View

Key Debate

We see key debates on the stock as follows: 1) trend of WFE share which has been better recently as AMAT looks set to gain ~160bps of share this year; 2) outlook for display spending as OLED penetration for mobile applications appears close to saturated; 3) opportunities in new adjacencies where the company continues to invest; 4) overall WFE trends for C2021 and beyond and sustainability of recent growth in WFE intensity.

UBS View

AMAT should benefit from capital intensity growth, a more balanced customer profile, a cyclical recovery in display, and the 7/5nm capacity buildout next year. The stock has historically tracked quarterly revenue and in the near-term, fundamentals look to peaking but the recovery in memory capex is something to keep your eye as it unfolds providing upside to the stock. We could be too concerned about near-term revenue trends and missing the market's willingness to look through this and focusing on what we agree are attractive longer-term growth prospects. We may also be under-estimating its ability to gain WFE share in the coming years (we model very little gains) and also under-estimating the tailwinds from a recovery in DRAM. We estimate WFE share of ~20.7%, or +160bps Y/Y in C2020, getting back near the ~21.7% peaks of 2016/2017. This appears to have been driven largely by DRAM where AMAT has posted some impressive recent gains - this is a positive as we see DRAM WFE growing as much as ~30% Y/Y in 2021 - albeit off a very low base and in a year where we expect bit demand growth to snap back potentially even more than this.

Source : Company reports, UBSe

Links to Key UBS Research Notes:

- [FQ4:20 - Solid Share Gains Despite Customer Mix, But We Are Still Hard-Pressed To Build A Buy Case](#)
- [Prior Reports: Kokusai Deal Update | FQ3:20 | FQ3:20 \(Jul\) Earnings Preview | FQ2:20 | Lowering Estimates on Intensifying Supply Chain Constraints](#)

TER

Figure 88: Key Debate + UBS View

Key Debate

We see key debates for the stock as follows: 1) sustainability of growth in SOC and memory test in 2021 and beyond driven by 5G and new memory protocols; 2) TER share in semi test as determined largely by AAPL's buying pattern in 2021 after a very big year in 2020; 3) degree of snap-back in the industrial automation business and degree to which TER can remain ahead of the competition as it moves up-market and increasingly sees larger competitors; 4) M&A as it has historically been very disciplined but needs to build out IA and valuations are extended; 5) long-term profitability and growth potential of the IA segment.

UBS View

While TER continues to put up impressive Qs and is well positioned competitively, it is simply impossible for us to believe it is not materially over-earning for three key reasons: 1) the memory test share gains are durable, but TER is benefiting in SOC this year from mix shifting its way (e.g. an "on" year for iPhone that is being further juiced by new capacity buys for compute as AAPL brings Mac CPU in-house, direct share "gain" from Advantest as INTC is its core customer) – a factor which is adding ~500bps share (~\$0.24 EPS); 2) unsustainable opex leverage as TER is saving ~\$40MM/yr in COVID-related costs while revenue has inflected much higher than expected (especially in semi test) – these costs come back through '21 core opex ramps more aggressively as IA revenue snaps back (~\$0.19 EPS); and 3) the HDD portion of systems test is as much as ~\$100MM above normalized run-rate (~\$0.15 EPS). In sum, we estimate these add ~\$0.60 to C2020 EPS meaning that, all things equal, TER's true EPS this year is more like ~\$3.90 v the headline ~\$4.50. Importantly, this doesn't even account for any potential correction in the SOC mkt in '21 – which seems more likely than not given the amount of 5G test capacity added this year + the extra boost from Huawei/HiSilicon (and now Vivo/Oppo/Xiaomi in anticipation of share gains in '21). All told, we are not calling for EPS to fall off a cliff next year, but we see Street estimates as skewing very optimistic after the run the stock has had.

Source : Company reports, UBS

Links to Key UBS Research Notes:

- [FQ3:20 - Over-Earning Ahead of a Year Which May Very Well See Some Test Capacity Digestion; Sell](#)
- *Prior Reports:* [FQ3:20 First Read](#) | [FQ2:20](#) | [FQ2:20 First Read](#) | [FQ1:20](#) | [FQ1:20 First Read](#) | [FQ4:19](#)

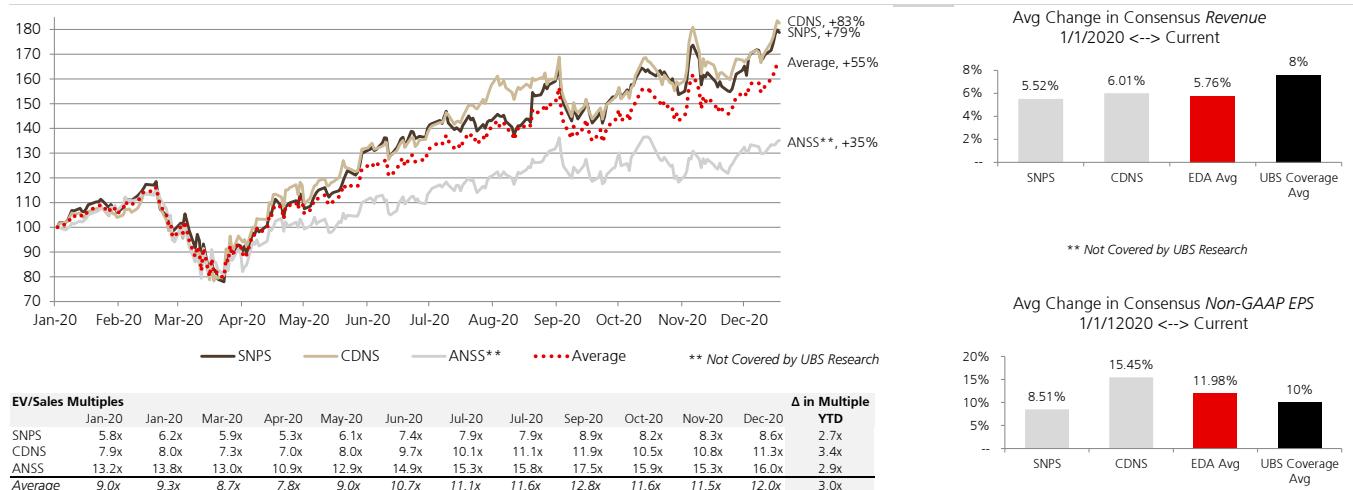
EDA Outlook

EDA +IP spend on track to exceed \$11B in C2021. China EDA+IP consumption looks to be elevated but China demand could have a long tail.

Following a very strong year in 2020 amid a challenging economic backdrop where UBS estimates Global Real GDP has contracted ~4% Y/Y, we fundamentally expect another strong year in C2021 with semis revenue growing another ~12% Y/Y to ~\$492B on the back of UBSe ~6% Y/Y growth in Real GDP.

Global design activity looks to be robust in C2021. If you assume an EDA Intensity (as % of semis revenue) of roughly 2.25%, that suggests to us that overall EDA+IP revenue for the industry should exceed \$11B in C2021. While China EDA revenue remains elevated (annualizing to ~\$1.2B-\$1.3B in CQ3), we think China demand could have a long tail as the R&D funnel in China expands beyond the traditional Tier 1's (Huawei, SMIC, Unigroup) to include smaller Tier 2 companies. Design complexity is also headed higher and we see a solid double digit growth trajectory for verification. We see a continuation of a solid ~12%-15% growth outlook for IP the ~\$4B IP market.

Figure 89: YTD Stock Performance (Base 100) and P/E Multiples



Source : Factset, UBSe

SNPS

Figure 90: Key Debate + UBS View

Key Debate

Key debates revolve around 1) Sustainability of China Revenue growth rates into C2021; 2) Margin guide while solid could ultimately prove to be conservative; 3) Security business outlook was tepid , but SNPS still remains confident about accelerating revenue growth in the back half of C21.

UBS View

With FY:21 guidance well above Street, there was very little to pick at (from a Semis perspective) barring the ~\$20MM light FQ1 guide. However, the directions of Semis and Security businesses are clearly diverging. First, Q4 beat as we expected (to a lesser extent than did CDNS) and Semis revenue grew a solid ~10% Y/Y, with China now ~13% of semis revenue. Second, SNPS backlog +~11% (LTM) still grew faster than revenue, suggesting a strong set up for 2021. Third, SNPS is now guiding F21 Op margins 29%- 30%, +150bps Y/Y at the mid point, the delta almost entirely driven by the Semis business, meaning guidance now implies F21 semis op margins ~31.5%, suggesting that SNPS semis is closing the gap to CDNS ~34-35% margins. Yes, the Security business though is clearly in flux as it gets sculpted to ultimately target >\$500MM in revenue and this is evidenced by its uninspiring F21 outlook (+HSD Y/Y growth, flat margins) . However, it is targeting a large and fast growing nascent market and, despite its challenges, still continues to be stubbornly profitable, meaning we think it still offers investors an attractive optionality with potential revenue acceleration in 2022E.

Source : Company reports, UBSe

Links to Key UBS Research Notes:

- [FQ4:20: Solid Semis Guide; Security Still A Work-In-Progress, But Don't Miss the Forest For The Trees.](#)
- [Prior Reports: FQ4:20 Earnings Preview | Moortec Acquisition | INTC Exposure a Positive, Verification Strength Sustainable | Quantifying Impact of INTC Product & Process Roadmaps Shifts on EDA | FQ3:20 \(July\) Earnings Preview | Qualtera Acquisition | Initiation](#)

CDNS

Figure 91: Key Debate + UBS View

Key Debate

Key debates revolve around 1) Sustainability of China revenue growth into C2021; 2) Digital Share gain trajectory; 3) Outlook for Verification ; 4) Margin trajectory

UBS View

Although the Q3 benefited from China 1xers SNPS report suggests to us that China demand could yet have a long tail. While CDNS is clearly setting expectations for roughly 10% Y/Y growth in C21, implying a guide of ~\$2.81B with margins flat Y/Y. The company has a track record of guiding conservatively and we think there could be some upside to the guide especially should top line growth translate into 50% incremental margins. System Analysis traction has been mixed – on the one hand AWR/Integrand is seeing strong customer adoption (>15 customers) even as Clarity is outperforming on benchmarks, but in our view ANSS tools still remain hard (but not impossible) to dislodge, and when this coupled with CDNS ratable model , we think it will take multiple quarters to move the needle on revenue (>5% share of \$700MM TAM). Net-net with the stock now trading at >12x NTM Revenue, we think the story remains well appreciated.

Source : Company reports, UBSe

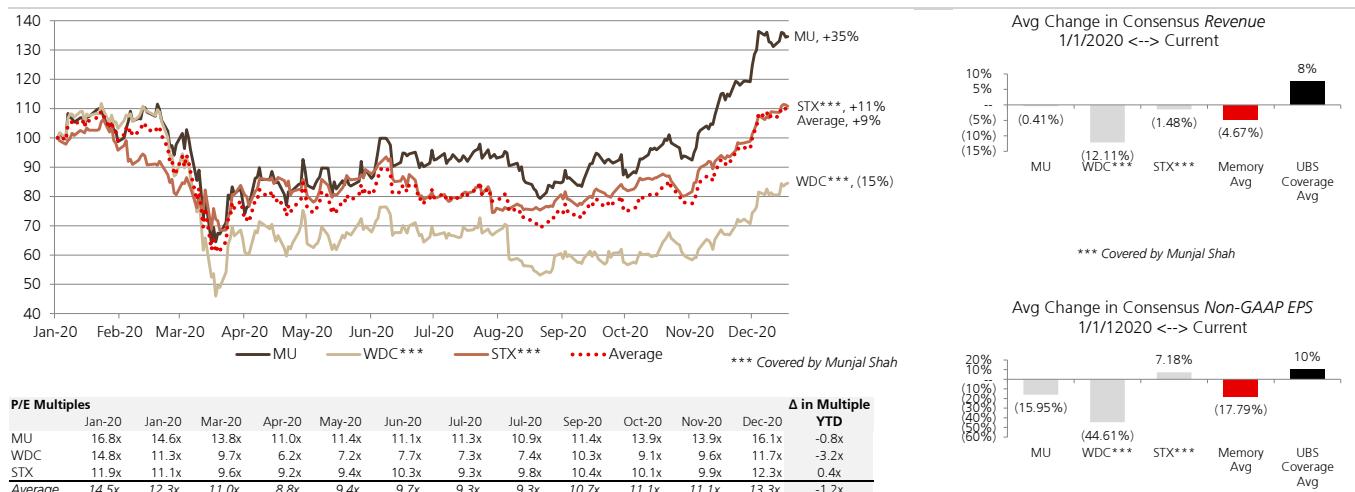
Links to Key UBS Research Notes:

- [FQ3:20 - Amid a Lot of Moving Parts Core Growth Prospects Remain Strong, But Are Well Appreciated.](#)
- [Prior Reports: Verification Could Be On A Longer Term Uptrend | On the \(Virtual\) Road With Management – Key Takeaways | FQ2:20 | Initiation](#)

Memory Outlook

MU remains our top idea for 2021. Strong demand from Chinese mobile OEMs continues to drive upside to demand + industry DRAM contract pricing for CQ4 (now -4% Q/Q and +4% Q/Q for CQ1:21). While some correction from these customers is possible, the market was already headed to undersupply in 2021 even before this recent demand improvement. For server, we continue to see \$108-118 for 32GB (-12% Q/Q on avg) but we see ASP likely flat in CQ1 w/bias to the upside that should gather pace. NAND remains far more challenging, though we recently increased CQ1 ASP from -15% Q/Q to -10% on the back of better smartphone demand but we still see Samsung aggressively adding capacity in 2021 and remain cautious on pricing.

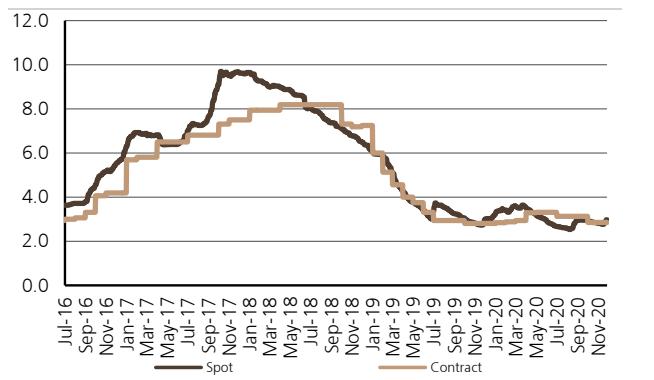
Figure 92: YTD Stock Performance (Base 100) and P/E Multiples



Source : Factset, UBS

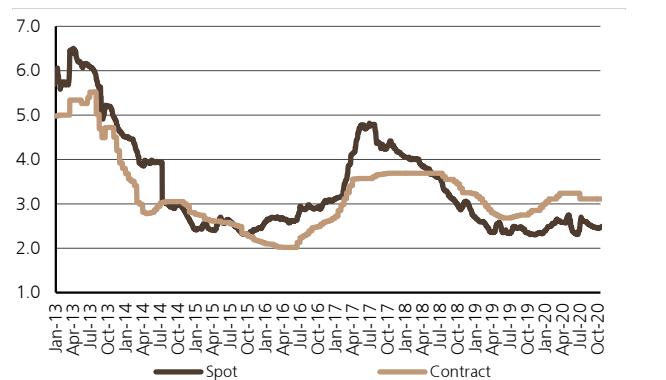
Memory Analysis

Figure 93: DRAM spot vs. contract price (DDR4 8Gb, US\$)



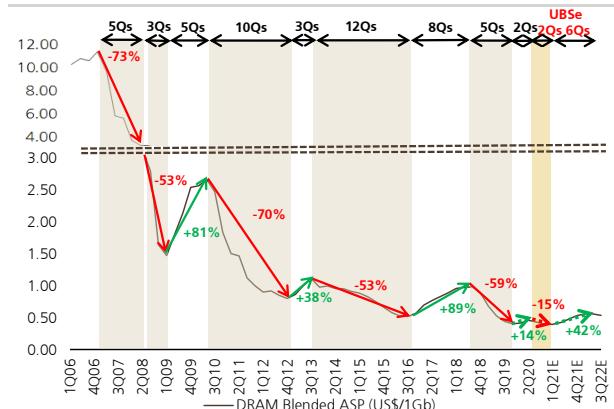
Source : DRAMeXchange

Figure 94: NAND spot vs. contract price (64Gb MLC, US\$)



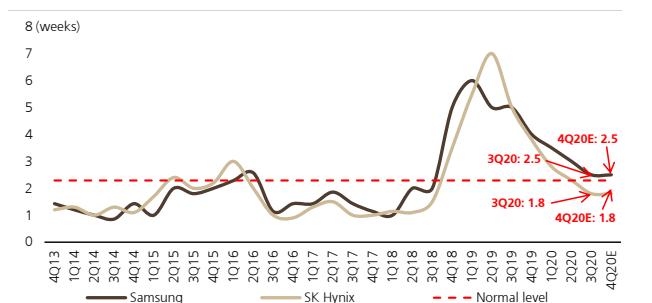
Source : DRAMeXchange

Figure 95: DRAM cycles in context



Source : Company data, UBS estimates

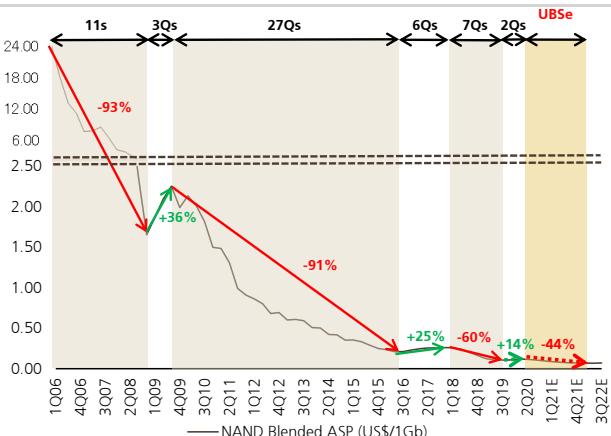
Figure 97: Samsung and SK Hynix – DRAM finished wafers and dies inventories



Source : Company data, UBS estimates

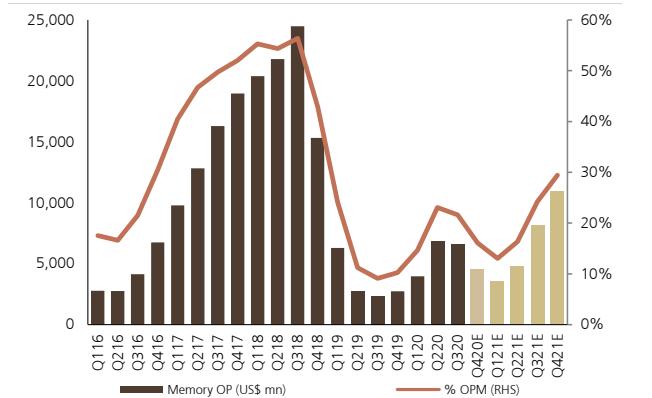
Figure 98: Samsung and SK Hynix – NAND finished wafers and dies inventories

Figure 96: NAND cycles in context



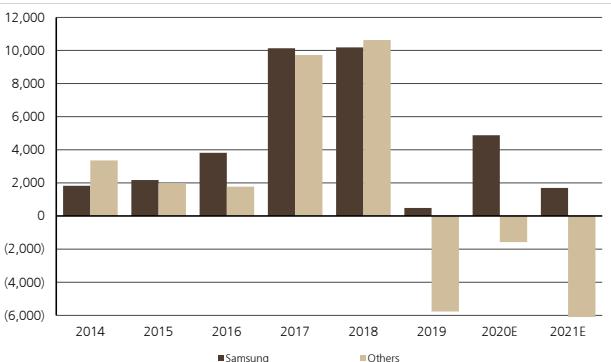
Source : Company data, UBS estimates

Figure 99: Memory industry OP and % OP margin



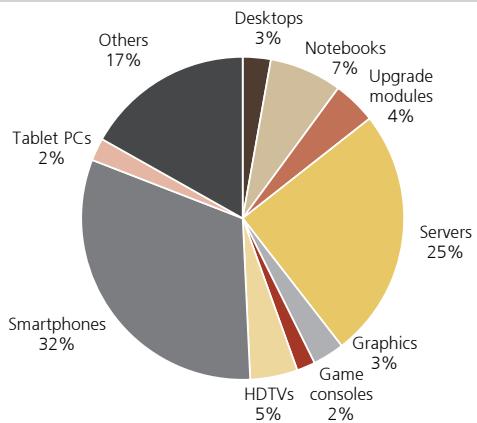
Source : Company data, UBS estimates

Figure 100: NAND OP – Samsung vs others (US\$m)



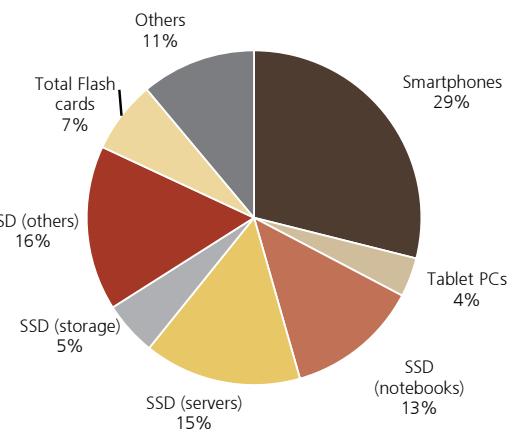
Source : Company data, UBS estimates

Figure 101: DRAM bit demand per application (2020E)



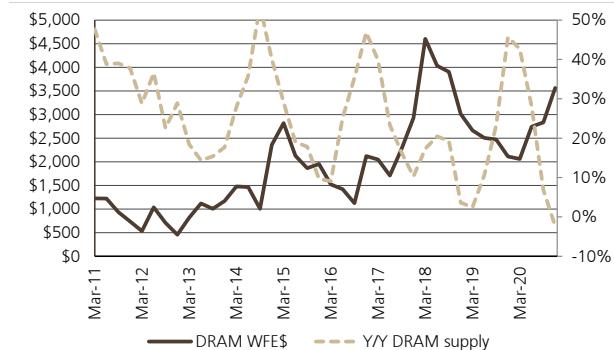
Source : Company data, UBS estimates

Figure 102: NAND bit demand per application (2020E)



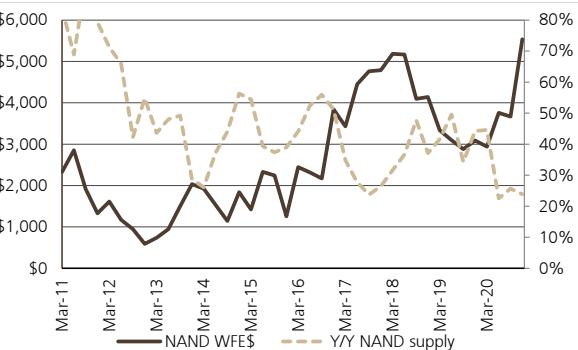
Source : Company data, UBS estimates

Figure 103: DRAM WFE vs Supply Y/Y



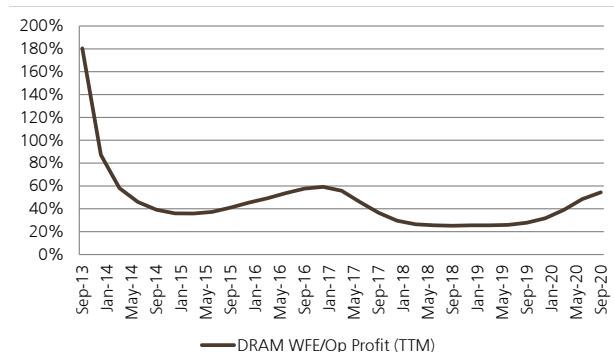
Source : UBS

Figure 104: NAND WFE vs Supply Y/Y



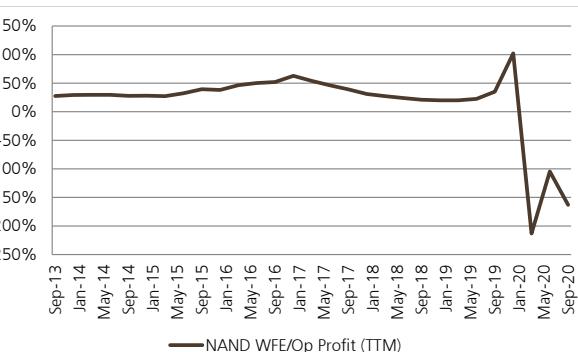
Source : UBS

Figure 105: DRAM WFE as a % of Op profit



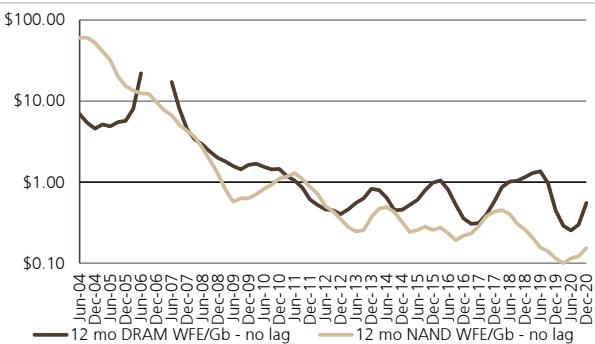
Source : UBS

Figure 106: NAND WFE as a % of Op profit



Source : UBS

Figure 107: 12 mo DRAM vs NAND WFE/Gb



Source : UBS

Figure 108: UBS DRAM supply/demand summary

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Revenues (\$ mil)	72,802	99,308	62,475	14,667	16,869	17,255	15,952	64,743	16,302	18,430	22,481	25,853	83,066
% QoQ				-2.1%	15.0%	2.3%	-7.6%		2.2%	13.1%	22.0%	15.0%	
% YoY	76.8%	36.4%	-37.1%	-12.8%	11.6%	10.9%	6.4%	3.6%	11.2%	9.3%	30.3%	62.1%	28.3%
Supply (Shipments Based) (M 1Gb)	90,890	104,383	126,020	35,327	36,774	40,102	40,740	152,943	41,223	43,555	47,015	48,710	180,503
% QoQ				-4.9%	4.1%	9.0%	1.6%		1.2%	5.7%	7.9%	3.6%	
% YoY	20.7%	14.8%	20.7%	42.6%	28.3%	13.2%	9.7%	21.4%	16.7%	18.4%	17.2%	19.6%	18.0%
Demand (End Consumption) (M 1Gb)	92,455	106,235	127,110	32,851	34,986	39,613	40,660	148,110	38,346	42,656	48,133	51,405	180,540
% QoQ				-12.5%	6.5%	13.2%	2.6%		-5.7%	11.2%	12.8%	6.8%	
% YoY	21.2%	14.9%	19.6%	30.7%	21.7%	10.9%	8.4%	16.5%	16.7%	21.9%	21.5%	26.4%	21.9%
Inventory adjustment	850	-1,850	-5,150	2,700	2,800	0	-700	4,800	2,900	1,500	100	-1,700	2,800
Inventory Adj. Demand (M 1Gb)	93,305	104,385	121,960	35,551	37,786	39,613	39,960	152,910	41,246	44,156	48,233	49,705	183,340
% QoQ				-2.7%	6.3%	4.8%	0.9%		3.2%	7.1%	9.2%	3.1%	
% YoY	24.1%	11.9%	16.8%	50.1%	37.7%	15.5%	9.4%	25.4%	16.0%	16.9%	21.8%	24.4%	19.9%
Wafer out (k wpm, 12" equi.)	1,118	1,182	1,249	1,238	1,260	1,299	1,319	1,279	1,331	1,339	1,354	1,390	1,353
% QoQ				0.1%	1.8%	3.1%	1.5%		0.9%	0.6%	1.1%	2.7%	
% YoY	5.0%	5.7%	5.7%	-1.7%	0.2%	4.7%	6.6%	2.4%	7.5%	6.2%	4.2%	5.4%	5.8%
% Sufficiency Ratio	-2.6%	0.0%	3.3%	-0.6%	-2.7%	1.2%	2.0%	0.0%	-0.1%	-1.4%	-2.5%	-2.0%	-1.5%
DRAM ASP (\$/Gb)	0.80	0.95	0.50	0.42	0.46	0.43	0.39	0.42	0.40	0.42	0.48	0.53	0.46
% QoQ				2.9%	10.5%	-6.2%	-9.0%		1.0%	7.0%	13.0%	11.0%	
% YoY	46.4%	18.8%	-47.9%	-38.9%	-13.0%	-2.0%	-2.9%	-14.6%	-4.7%	-7.8%	11.1%	35.6%	8.7%
PC DRAM ASP (\$/Gb)	0.80	0.97	0.43	0.36	0.41	0.39	0.36	0.38	0.36	0.39	0.45	0.49	0.43
% QoQ				3.2%	13.8%	-5.2%	-7.7%		0.0%	8.3%	15.4%	8.9%	
% YoY	104.6%	21.8%	-55.8%	-43.6%	-8.6%	11.4%	2.9%	-11.5%	-0.3%	-5.2%	15.4%	36.1%	11.9%

Source : Company data, UBS estimates

Figure 109: DRAM vendors' market share in bit shipments

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Samsung	46.0%	44.9%	45.6%	45.7%	45.0%	43.3%	44.8%	44.7%	45.4%	45.1%	45.2%	43.8%	44.8%
SK Hynix	28.1%	29.4%	29.5%	30.2%	29.6%	28.2%	29.2%	29.3%	28.7%	28.4%	28.2%	28.8%	28.5%
Micron	22.9%	22.4%	21.9%	20.6%	21.8%	25.0%	22.4%	22.5%	22.1%	22.4%	22.2%	22.5%	22.3%
Nanya Tech	2.3%	2.7%	2.5%	2.9%	2.9%	2.6%	2.6%	2.7%	2.5%	2.5%	2.6%	2.6%	2.6%
CXMT (Innotron)	0.0%	0.0%	0.1%	0.1%	0.2%	0.4%	0.7%	0.4%	0.9%	1.2%	1.5%	1.9%	1.4%
Others	0.6%	0.6%	0.5%	0.5%	0.5%	0.4%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%
Total Supply	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source : Gartner, Company data, UBS estimates

Figure 110: DRAM vendors bit shipments QoQ and YoY growth

	2017	YoY	2018	YoY	2019	YoY	Q120	QoQ	Q220	QoQ	Q320	QoQ	Q420E	QoQ	2020E	YoY	Q121E	QoQ	Q221E	QoQ	Q321E	QoQ	Q421E	QoQ	2021E	YoY
Samsung	14.1%		12.1%		22.5%		-5.0%		2.4%		5.0%		5.0%		19.0%		2.5%		5.1%		8.1%		0.6%		18.5%	
SK Hynix	24.6%		20.2%		21.0%		-4.0%		2.0%		4.0%		5.0%		20.5%		-0.5%		4.5%		7.3%		5.6%		15.0%	
Micron	34.1%		12.2%		18.1%		-8.0%		10.0%		25.0%		-9.0%		24.6%		0.0%		7.0%		7.0%		5.0%		16.9%	
Nanya Tech	2.3%		31.8%		10.4%		12.0%		5.6%		-2.5%		0.0%		35.1%		0.0%		5.0%		10.0%		5.0%		10.5%	
CXMT (Innotron)					398.1%		2.1%		153.4%		89.8%		60.2%		411.8%		37.0%		39.8%		33.7%		35.7%		347.7%	
Others	8.5%		6.1%		4.9%		-5.4%		0.0%		2.9%		2.8%		11.7%		-5.4%		2.9%		2.8%		2.7%		2.1%	
Bit supply Growth	20.7%		14.8%		20.7%		-4.9%		4.1%		9.0%		1.6%		21.4%		1.2%		5.7%		7.9%		3.6%		18.0%	

Source : Gartner, Company data, UBS estimates

Figure 111: DRAM vendors wafers out (k wpm, 12 inch equivalent)

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Samsung	426	458	509	495	508	530	535	517	545	549	553	572	554
SK Hynix	305	334	351	345	348	355	359	352	356	352	356	362	356
Micron	276	269	262	270	270	270	270	270	270	270	270	270	270
Nanya Tech	61	68	72	73	73	73	73	73	73	73	73	73	73
CXMT (Innotron)	0	10	10	5	12	21	32	25	38	45	53	64	65
Other	50	50	50	50	50	50	50	50	50	50	50	50	50
Total	1,118	1,189	1,254	1,238	1,260	1,299	1,319	1,286	1,331	1,339	1,354	1,390	1,369
% YoY	5.0%	5.7%	5.7%	-1.7%	0.2%	4.7%	6.6%	2.4%	7.5%	6.2%	4.2%	5.4%	5.8%

Source : Gartner, Company data, UBS estimates

Figure 112: DRAM bit demand growth by application

	2017	YoY	2018	YoY	2019	YoY	Q120	QoQ	Q220	QoQ	Q320	QoQ	Q420E	QoQ	2020E	YoY	Q121E	QoQ	Q221E	QoQ	Q321E	QoQ	Q421E	QoQ	2021E	YoY
Total PC DRAM	1.8%		-0.4%		4.1%		-16.3%		17.5%		2.0%		-2.4%		13.7%		-16.7%		18.0%		14.6%		2.4%		5.5%	
Desktops	-2.4%		5.8%		13.5%		-21.8%		-5.8%		18.9%		8.0%		-10.2%		-13.2%		2.6%		6.4%		3.6%		4.4%	
Notebooks	3.5%		8.2%		15.2%		-25.6%		46.3%		-2.9%		1.0%		18.5%		-27.0%		29.7%		12.5%		5.0%		4.1%	
Upgrade Modules	2.4%		-13.0%		-16.8%		3.3%		-3.5%		1.6%		-15.0%		27.2%		1.6%		11.7%		23.6%		-2.2%		8.6%	
Servers	45.6%		38.5%		21.1%		-16.0%		12.6%		1.2%		0.5%		24.5%		6.2%		18.7%		8.4%		1.2%		31.7%	
Graphics	53.2%		-6.7%		17.8%		-17.9%		13.7%		21.6%		-9.3%		18.7%		-21.5%		11.4%		24.9%		2.9%		1.8%	
Game Consoles	32.1%		-5.6%		-14.3%		-0.3%		33.7%		22.1%		12.0%		40.1%		2.5%		-5.9%		16.2%		8.2%		36.3%	
HDTVs	15.9%		37.4%		21.3%		-28.7%		2.9%		29.1%		32.5%		16.7%		-28.9%		4.3%		27.2%		30.8%		24.8%	
Total Mobile DRAM	30.1%		20.5%		19.3%		-24.4%		2.0%		31.4%		2.4%		6.1%		-10.3%		5.6%		16.0%		7.7%		19.7%	
Smartphones	33.1%		21.9%		21.4%		-25.1%		0.7%		32.9%		1.7%		5.3%		-8.9%		5.2%		16.8%		7.0%		21.0%	
Apple	17.4%		8.8%		13.8%		-41.1%		-12.5%		25.7%		109.4%		21.4%		-34.3%		-17.4%		44.2%		56.5%		40.0%	
Samsung	12.2%		5.5%		36.3%		2.1%		-16.1%		57.8%		-20.8%		7.7%		32.8%		7.3%		17.3%		-13.8%		45.9%	
Non-Apple/Samsung	45.5%		29.7%		19.0%		-28.2%		8.8%		27.3%		-6.2%		2.0%		-12.4%		9.7%		11.7%		4.6%		9.7%	
Tablet PCs	9.8%		10.3%		-6.2%		-13.7%		23.4%		13.2%		8.4%		20.2%		-27.2%		15.1%		4.9%		13.8%		1.3%	
Others	16.8%		-3.9%		44.9%		48.2%		-4.7%		3.5%		3.8%		29.8%		7.0%		10.2%		7.4%		11.1%		27.2%	
Total Bit Demand	21.2%		14.9%		19.6%		-12.5%		6.5%		13.2%		2.6%		16.5%		-5.7%		11.2%		12.8%		6.8%		21.9%	

Source : Gartner, Company data, UBS estimates

Figure 113: DRAM content assumptions (MB/unit) by application

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Total PC	5,049	5,500	6,373	6,826	7,185	7,245	7,349	7,159	7,391	7,633	7,808	8,039	7,739
% YoY	2%	9%	16%	14%	16%	11%	10%	12%	9%	6%	8%	9%	8%
Desktops	4,821	5,231	5,904	6,298	6,464	6,564	6,664	6,505	6,864	7,064	7,264	7,464	7,168
Notebooks	5,809	6,303	7,160	7,799	8,093	8,193	8,293	8,114	8,493	8,693	8,893	9,093	8,821
Upgrade Modules	4,545	4,861	5,663	6,200	6,300	6,400	6,400	6,320	6,500	6,600	6,800	7,000	6,742
Servers	198,839	243,546	303,609	352,200	357,650	368,863	376,012	363,843	413,000	427,348	459,369	474,875	444,593
% YoY	42%	22%	25%	63%	37%	7%	-1%	20%	17%	19%	25%	26%	22%
Smartphones	2,772	3,342	4,150	4,618	4,605	4,818	4,900	4,750	5,203	5,277	5,539	5,623	5,424
% YoY	28%	21%	24%	19%	13%	13%	13%	14%	13%	15%	15%	15%	14%
Apple	2,440	2,781	3,399	3,750	3,750	4,400	4,700	4,256	4,700	4,700	5,600	5,900	5,322
Samsung	2,478	2,850	3,820	4,967	4,477	4,770	4,790	4,758	5,546	5,514	5,854	5,721	5,665
Non-Apple/Samsung	2,965	3,628	4,422	4,700	4,800	4,900	5,000	4,860	5,200	5,300	5,400	5,500	5,358

Source : Gartner, Company data, UBS estimates

Figure 114: UBS NAND Flash supply/demand summary

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Revenues (\$ mil)	47,227	54,227	40,095	12,820	12,188	12,909	12,252	50,169	11,435	11,404	12,160	12,434	47,434
% QoQ				12.5%	-4.9%	5.9%	-5.1%		-6.7%	-0.3%	6.6%	2.2%	
% YoY	47.5%	14.8%	-26.1%	38.1%	30.8%	27.8%	7.5%	25.1%	-10.8%	-6.4%	-5.8%	1.5%	-5.5%
Supply (Shipments Based) (M 1GB)	185,718	257,437	365,829	107,946	107,844	121,860	128,501	466,151	133,264	146,049	167,454	180,233	627,000
% QoQ				1.2%	-0.1%	13.0%	5.5%		3.7%	9.6%	14.7%	7.6%	
% YoY	27.7%	38.6%	42.1%	44.4%	23.7%	25.4%	20.5%	27.4%	23.5%	35.4%	37.4%	40.3%	34.5%
Demand (End Consumption) (M 1GB)	174,706	251,376	362,675	96,411	107,816	123,828	136,016	464,072	126,092	142,598	165,954	182,979	617,623
% QoQ				-12.1%	11.8%	14.9%	9.8%		-7.3%	13.1%	16.4%	10.3%	
% YoY	30.6%	43.9%	44.3%	27.2%	31.5%	30.1%	24.0%	28.0%	30.8%	32.3%	34.0%	34.5%	33.1%
Inventory adjustment	11,850	970	-2,500	14,000	-1,000	-3,400	-10,000	-400	4,600	900	-800	-4,600	100
Inventory Adj. Demand (M 1GB)	186,556	252,346	360,175	110,411	106,816	120,428	126,016	463,672	130,692	143,498	165,154	178,379	617,723
% QoQ				2.7%	-3.3%	12.7%	4.6%		3.7%	9.8%	15.1%	8.0%	
% YoY	28.4%	35.3%	42.7%	54.9%	26.0%	24.7%	17.2%	28.7%	18.4%	34.3%	37.1%	41.6%	33.2%
Wafer out (k wpm, 12" equi.)	1,535	1,589	1,497	1,519	1,557	1,568	1,588	1,558	1,571	1,673	1,652	1,734	1,657
% QoQ				7.2%	2.5%	0.7%	1.3%		-1.1%	6.5%	-1.3%	5.0%	
% YoY	9.8%	3.5%	-5.8%	-7.0%	3.5%	9.5%	12.0%	4.1%	3.4%	7.5%	5.3%	9.2%	6.4%
% Sufficiency Ratio	-0.4%	2.0%	1.6%	-2.2%	1.0%	1.2%	2.0%	0.5%	2.0%	1.8%	1.4%	1.0%	1.5%
NAND ASP (\$/1GB)	0.25	0.21	0.11	0.12	0.11	0.10	0.11	0.11	0.09	0.08	0.07	0.07	0.08
% QoQ				11.1%	-4.8%	-6.3%	-10.0%		-10.0%	-9.0%	-7.0%	-5.0%	
% YoY	15.5%	-17.2%	-48.0%	-4.3%	5.8%	1.9%	-10.8%	-1.8%	-27.7%	-30.9%	-31.4%	-27.6%	-29.7%

Source : Company data, UBS estimates

Figure 115: NAND Flash vendors market share in bit shipments

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Samsung	46.0%	44.5%	46.3%	43.7%	42.2%	43.7%	43.6%	43.3%	43.2%	43.8%	43.8%	43.4%	43.5%
Japan Memory	15.8%	16.5%	15.5%	15.9%	15.1%	16.7%	17.8%	16.4%	16.6%	15.2%	15.9%	16.0%	15.9%
Western Digital (SanDisk)	13.5%	14.0%	12.0%	13.2%	14.3%	12.8%	12.1%	13.0%	12.3%	12.3%	12.3%	12.3%	12.3%
SK Hynix	13.0%	12.9%	13.7%	14.9%	15.7%	15.1%	14.7%	15.1%	15.4%	16.2%	15.8%	15.6%	15.7%
Micron	10.0%	9.7%	9.6%	9.3%	9.5%	8.4%	7.9%	8.7%	8.4%	8.4%	8.1%	8.1%	8.3%
Intel	1.7%	2.3%	2.9%	2.8%	3.0%	2.9%	2.9%	2.9%	2.8%	2.7%	2.6%	2.5%	2.6%
YMTC	0.0%	0.0%	0.1%	0.2%	0.3%	0.4%	1.0%	0.5%	1.3%	1.4%	1.6%	2.0%	1.6%
Total Bit Supply	100%												

Source : Gartner, Company data, UBS estimates

Figure 116: NAND Flash bit shipments QoQ and YoY growth

	2017 YoY	2018 YoY	2019 YoY	Q120 QoQ	Q220 QoQ	Q320 QoQ	Q420E QoQ	2020E YoY	Q121E QoQ	Q221E QoQ	Q321E QoQ	Q421E QoQ	2021E YoY
Samsung	26.1%	34.1%	47.7%	-4.0%	-3.5%	17.1%	5.0%	19.3%	2.8%	11.1%	14.6%	6.8%	35.2%
Japan Memory	19.4%	45.2%	33.0%	4.0%	-5.0%	25.0%	12.0%	35.5%	-3.0%	0.0%	20.0%	8.5%	30.0%
Western Digital (SanDisk)	44.9%	43.6%	22.0%	7.0%	8.0%	1.0%	0.0%	38.4%	5.0%	10.0%	15.0%	7.0%	26.8%
SK Hynix	17.3%	37.1%	50.9%	12.0%	5.0%	9.0%	2.8%	40.4%	8.3%	15.3%	11.6%	6.9%	40.3%
Micron	25.7%	35.6%	40.1%	-1.0%	1.9%	0.0%	0.0%	15.6%	10.0%	10.0%	10.0%	8.0%	27.5%
Intel	535.6%	88.1%	74.8%	1.0%	5.0%	10.0%	5.0%	28.4%	1.0%	5.0%	10.0%	5.0%	22.5%
YMTC		1228.0%	42.2%	54.4%	46.4%	169.5%	572.0%	35.7%	18.2%	27.2%	35.4%	334.2%	
Total Bit Supply	27.7%	38.6%	42.1%	1.2%	-0.1%	13.0%	5.5%	27.4%	3.7%	9.6%	14.7%	7.6%	34.5%

Source : Gartner, Company data, UBS estimates

Figure 117: NAND Flash vendors wafers out (k wpm, 12 inch equi.)

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Samsung	483	493	464	439	469	510	530	487	535	546	568	601	562
Western Digital JV	555	558	495	550	550	520	500	530	470	550	490	510	505
SK Hynix	240	249	227	215	209	206	203	208	202	203	206	212	206
Micron	217	235	229	223	235	235	235	232	235	240	245	250	243
Intel	40	55	75	80	80	80	80	80	80	80	80	80	80
YMTC	0	10	13	12	14	17	40	25	50	54	63	81	68
Total	1,535	1,589	1,497	1,519	1,557	1,568	1,588	1,558	1,571	1,673	1,652	1,734	1,657
% YoY	9.8%	3.5%	-5.8%	-7.0%	3.5%	9.5%	12.0%	4.1%	3.4%	7.5%	5.3%	9.2%	6.4%

Source : Gartner, Company data, UBS estimates

Figure 118: NAND Flash bit demand growth by application

	2017 YoY	2018 YoY	2019 YoY	Q120 QoQ	Q220 QoQ	Q320 QoQ	Q420E QoQ	2020E YoY	Q121E QoQ	Q221E QoQ	Q321E QoQ	Q421E QoQ	2021E YoY
Total Embedded	42.6%	49.7%	47.0%	-12.2%	12.6%	15.0%	10.4%	29.4%	-7.4%	13.4%	16.3%	10.6%	34.0%
Smartphones	61.6%	37.9%	40.5%	-25.4%	1.4%	33.0%	14.6%	15.3%	-13.5%	3.4%	27.2%	11.4%	31.1%
iPhones	32.1%	20.0%	24.5%	-40.9%	-11.6%	3.0%	110.3%	11.0%	-34.3%	-17.4%	60.0%	48.6%	36.6%
Samsung	27.9%	67.7%	82.5%	-7.1%	-20.9%	61.4%	-19.6%	-11.1%	33.0%	5.1%	29.2%	-18.0%	50.8%
Non- iPhone/Samsung	111.9%	40.6%	33.8%	-21.8%	18.7%	36.0%	-1.4%	31.4%	-14.2%	12.7%	14.6%	7.2%	21.7%
Tablet PCs	51.8%	24.7%	37.9%	-17.9%	51.9%	18.3%	6.4%	56.6%	-35.4%	28.0%	6.4%	25.7%	6.1%
SSD-Total	30.1%	50.2%	53.5%	-6.7%	25.7%	7.3%	8.5%	42.1%	-3.5%	18.9%	11.5%	8.5%	38.1%
SSD (notebooks)	12.6%	33.7%	22.6%	-19.3%	58.6%	4.1%	6.5%	45.3%	-23.9%	34.9%	19.0%	9.4%	27.4%
SSD (servers)	73.6%	74.1%	39.8%	-5.1%	22.0%	7.0%	6.8%	38.2%	4.2%	22.9%	7.5%	4.0%	45.4%
SSD (storage)	53.9%	83.1%	20.8%	11.8%	8.8%	8.5%	8.1%	34.0%	10.0%	7.4%	7.1%	6.9%	37.6%
SSD (others)	11.3%	27.3%	155.5%	-4.1%	13.7%	10.0%	12.1%	46.2%	1.9%	9.4%	11.6%	12.9%	39.9%
Total Flash cards	-15.9%	5.7%	19.1%	-11.6%	2.5%	12.5%	2.4%	11.4%	-5.2%	9.2%	17.6%	5.2%	21.4%
Mobile Phones - Flash cards	-15.2%	5.9%	19.9%	-13.1%	-6.7%	36.4%	13.6%	12.1%	-15.2%	0.1%	4.4%	7.8%	10.0%
Total Bit Demand	30.6%	43.9%	44.3%	-12.1%	11.8%	14.9%	9.8%	28.0%	-7.3%	13.1%	16.4%	10.3%	33.1%

Source : Gartner, Company data, UBS estimates

Figure 119: NAND Flash content assumptions (MB/unit) by application

	2017	2018	2019	Q120	Q220	Q320	Q420E	2020E	Q121E	Q221E	Q321E	Q421E	2021E
Smartphones - Blended	39,584	56,428	79,996	98,701	101,278	105,897	108,761	104,229	119,510	124,233	143,648	129,385	129,479
% YoY	46%	43%	42%	39%	46%	29%	12%	30%	21%	23%	36%	19%	24%
iPhones	95,298	119,789	160,193	185,467	187,433	180,224	193,331	183,484	193,331	193,331	255,590	255,590	223,849
Samsung	31,065	56,766	101,854	112,473	95,508	104,148	106,162	104,710	123,148	120,023	140,280	130,472	128,875
Non- iPhone/Samsung	35,846	47,545	65,178	79,000	88,000	96,000	103,000	92,322	105,000	110,000	115,000	120,000	112,912
SSD - Notebook PCs	248,013	264,144	284,368	318,830	338,897	356,678	391,641	354,027	398,590	403,212	421,815	460,899	423,922
% YoY	4%	7%	8%	16%	28%	25%	28%	24%	25%	19%	18%	18%	20%
SSD- Servers	987,853	1,493,504	1,775,669	2,000,690	2,200,690	2,400,690	2,600,690	2,305,286	2,800,690	3,000,690	3,200,690	3,400,690	3,109,849
% YoY	21%	51%	19%	21%	29%	32%	37%	30%	40%	36%	33%	31%	35%
SSD- Storage	2,129,203	3,360,154	3,761,869	4,042,281	4,242,281	4,442,281	4,642,281	4,351,053	4,942,281	5,142,281	5,342,281	5,542,281	5,249,973
% YoY	39%	58%	12%	10%	14%	17%	21%	16%	22%	21%	20%	19%	21%

Source : Gartner, Company data, UBS estimates

MU

Figure 120: Key Debate + UBS View

Key Debate

Key Debates on MU revolve around: 1) Server DRAM demand/supply dynamics in 2021; 2) Sustainability of Mobile DRAM pricing in C2021 smart phone inventory remains a concern but this is likely short lived; 3) MU cost downs trajectory on both DRAM and NAND and GM implications given that the stock is correlated to GMs.

UBS View

MU positive pre'd FQ1:21 (Nov) owing to broad-based strength from Mobile, Autos, Industrial and PC end markets. The company indicated this has positively impacted volumes & ASPs for both DRAM and NAND w/EPS now \$0.71 midpt v prior guide of ~\$0.50. We have long been suggesting that industry tailwinds are intensifying and we see more proof points playing out to support our view that MU remains well positioned into C2021: 1) Demand is clearly inflecting higher as a combination of server platform refresh and 5G drives content increases; 2). Further, the Inotera fab outage could yet tip Server DRAM negotiations in its favor. 3) While smartphone inventory could yet normalize in C2021, this should still be short lived and MU remains well positioned as it has already provided for a longer than necessary (in our view) time period to re-qualify Huawei bits. 4) Supply (DRAM) on the other hand continues to remain constrained; 5) GMs should be helped by MU seeing an accelerating cost curve as it ramps 1a DRAM, even as its Gen2 RG NAND is closing the cost gap with industry leader, meaning with the stock being correlated to GMs' we see ample upside from here on and MU remains our top pick into C2021.

Source : Company reports, UBS

Links to Key UBS Research Notes:

- [Tweaking Model Post Positive Pre; Nudge PT To \\$82, Maintain Buy](#)
- *Prior Reports: [An Improving House In An Improving Neighborhood](#) | [Thoughts On China Memory Headlines](#) | [FQ4:20](#)*

Valuation Method and Risk Statement

We use various valuation techniques such as P/E, EV/FCF for valuing the companies in this report. 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

This report has been prepared by UBS Securities LLC, an affiliate of UBS AG. UBS AG, its subsidiaries, branches and affiliates are referred to herein as UBS.

For information on the ways in which UBS manages conflicts and maintains independence of its research product; historical performance information; certain additional disclosures concerning UBS research recommendations; and terms and conditions for certain third party data used in research report, please visit www.ubs.com/disclosures. The figures contained in performance charts refer to the past; past performance is not a reliable indicator of future results. Additional information will be made available upon request. UBS Securities Co. Limited is licensed to conduct securities investment consultancy businesses by the China Securities Regulatory Commission. UBS acts or may act as principal in the debt securities (or in related derivatives) that may be the subject of this report. This recommendation was finalized on: 21 December 2020 01:55 AM GMT. UBS has designated certain Research department members as Derivatives Research Analysts where those department members publish research principally on the analysis of the price or market for a derivative, and provide information reasonably sufficient upon which to base a decision to enter into a derivatives transaction. Where Derivatives Research Analysts co-author research reports with Equity Research Analysts or Economists, the Derivatives Research Analyst is responsible for the derivatives investment views, forecasts, and/or recommendations. **Quantitative Research Review:** UBS publishes a quantitative assessment of its analysts' responses to certain questions about the likelihood of an occurrence of a number of short term factors in a product known as the 'Quantitative Research Review'. Views contained in this assessment on a particular stock reflect only the views on those short term factors which are a different timeframe to the 12-month timeframe reflected in any equity rating set out in this note. For the latest responses, please click <https://neo.ubs.com/quantitative>, or speak to your UBS sales representative for access to the report.

Analyst Certification:

Each research analyst primarily responsible for the content of this research report, in whole or in part, certifies that with respect to each security or issuer that the analyst covered in this report: (1) all of the views expressed accurately reflect his or her personal views about those securities or issuers and were prepared in an independent manner, including with respect to UBS, and (2) no part of his or her compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed by that research analyst in the research report.

UBS Investment Research: Global Equity Rating Definitions

12-Month Rating	Definition	Coverage ¹	IB Services ²
Buy	FSR is > 6% above the MRA.	50%	31%
Neutral	FSR is between -6% and 6% of the MRA.	38%	29%
Sell	FSR is > 6% below the MRA.	12%	19%
Short-Term Rating	Definition	Coverage ³	IB Services ⁴
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 30 September 2020.

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.

3:Percentage of companies under coverage globally within the Short-Term rating category.

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

KEY DEFINITIONS: Forecast Stock Return (FSR) is defined as expected percentage price appreciation plus gross dividend yield over the next 12 months. In some cases, this yield may be based on accrued dividends. **Market Return Assumption (MRA)** is defined as the one-year local market interest rate plus 5% (a proxy for, and not a forecast of, the equity risk premium). **Under Review (UR)** Stocks may be flagged as UR by the analyst, indicating that the stock's price target and/or rating are subject to possible change in the near term, usually in response to an event that may affect the investment case or valuation. **Short-Term Ratings** reflect the expected near-term (up to three months) performance of the stock and do not reflect any change in the fundamental view or investment case. **Equity Price Targets** have an investment horizon of 12 months.

EXCEPTIONS AND SPECIAL CASES: UK and European Investment Fund ratings and definitions are: **Buy:** Positive on factors such as structure, management, performance record, discount; **Neutral:** Neutral on factors such as structure, management, performance record, discount; **Sell:** Negative on factors such as structure, management, performance record, discount. **Core Banding Exceptions (CBE):** Exceptions to the standard +/-6% bands may be granted by the Investment Review Committee (IRC).

Factors considered by the IRC include the stock's volatility and the credit spread of the respective company's debt. As a result, stocks deemed to be very high or low risk may be subject to higher or lower bands as they relate to the rating. When such exceptions apply, they will be identified in the Company Disclosures table in the relevant research piece.

Research analysts contributing to this report who are employed by any non-US affiliate of UBS Securities LLC are not registered/qualified as research analysts with FINRA. Such analysts may not be associated persons of UBS Securities LLC and therefore are not subject to the FINRA restrictions on communications with a subject company, public appearances, and trading securities held by a research analyst account. The name of each affiliate and analyst employed by that affiliate contributing to this report, if any, follows.

UBS Securities LLC: Diana Chang, Pradeep Ramani, Seth Gilbert, Timothy Arcuri.

Company Disclosures

Company Name	Reuters	12-month rating	Price	Price date
Advanced Micro Devices Inc ^{16,20}	AMD.O	Neutral (CBE)	US\$96.84	17 Dec 2020
Applied Materials Inc ^{16,20}	AMAT.O	Neutral (CBE)	US\$87.50	17 Dec 2020
Broadcom Limited ¹⁶	AVGO.O	Buy	US\$426.10	17 Dec 2020
Cadence Design Systems ¹⁶	CDNS.O	Neutral	US\$127.30	17 Dec 2020
Intel Corp. ^{16,7,6a,6b}	INTC.O	Buy	US\$50.65	17 Dec 2020
KLA Corporation ¹⁶	KLAC.O	Neutral	US\$259.68	17 Dec 2020
Marvell Technology Group ¹⁶	MRVL.O	Buy	US\$47.10	17 Dec 2020
Micron Technology Inc ¹⁶	MU.O	Buy	US\$72.26	17 Dec 2020
NVIDIA Corp ¹⁶	NVDA.O	Buy	US\$533.65	17 Dec 2020
Qorvo Inc ¹⁶	QRVO.O	Neutral	US\$159.60	17 Dec 2020
Qualcomm Inc. ¹⁶	QCOM.O	Neutral	US\$149.53	17 Dec 2020
Skyworks Solutions Inc ¹⁶	SWKS.O	Neutral	US\$145.53	17 Dec 2020
Synopsys Inc ¹⁶	SNPS.O	Buy	US\$250.29	17 Dec 2020
Teradyne Inc ¹⁶	TER.O	Sell	US\$119.35	17 Dec 2020
Texas Instruments Inc ¹⁶	TXN.O	Neutral	US\$162.69	17 Dec 2020

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

Ratings in this table are the most current published ratings prior to this report. They may be more recent than the stock pricing date

- 6a. This company/entity is, or within the past 12 months has been, a client of UBS Securities LLC, and non-investment banking securities-related services are being, or have been, provided.
- 6b. This company/entity is, or within the past 12 months has been, a client of UBS Securities LLC, and non-securities services are being, or have been, provided.
- 7. Within the past 12 months, UBS Securities LLC and/or its affiliates have received compensation for products and services other than investment banking services from this company/entity.
- 16. UBS Securities LLC makes a market in the securities and/or ADRs of this company.
- 20. Because this security exhibits higher-than-average volatility, the FSR has been set at 15% above the MRA for a Buy rating, and at -15% below the MRA for a Sell rating (compared with 6-6% under the normal rating system).

Unless otherwise indicated, please refer to the Valuation and Risk sections within the body of this report. For a complete set of disclosure statements associated with the companies discussed in this report, including information on valuation and risk, please contact UBS Securities LLC, 1285 Avenue of Americas, New York, NY 10019, USA, Attention: Investment Research.

The Disclaimer relevant to Global Wealth Management clients follows the Global Disclaimer.

Global Disclaimer

This document has been prepared by UBS Securities LLC, an affiliate of UBS AG. UBS AG, its subsidiaries, branches and affiliates are referred to herein as UBS.

This Document is provided solely to recipients who are expressly authorized by UBS to receive it. If you are not so authorized you must immediately destroy the Document.

Global Research is provided to our clients through UBS Neo, and in certain instances, UBS.com and any other system or distribution method specifically identified in one or more communications distributed through UBS Neo or UBS.com (each a system) as an approved means for distributing Global Research. It may also be made available through third party vendors and distributed by UBS and/or third parties via e-mail or alternative electronic means. The level and types of services provided by Global Research to a client may vary depending upon various factors such as a client's individual preferences as to the frequency and manner of receiving communications, a client's risk profile and investment focus and perspective (e.g., market wide, sector specific, long-term, short-term, etc.), the size and scope of the overall client relationship with UBS and legal and regulatory constraints.

All Global Research is available on UBS Neo. Please contact your UBS sales representative if you wish to discuss your access to UBS Neo.

When you receive Global Research through a system, your access and/or use of such Global Research is subject to this Global Research Disclaimer and to the UBS Neo Platform Use Agreement (the "Neo Terms") together with any other relevant terms of use governing the applicable System.

When you receive Global Research via a third party vendor, e-mail or other electronic means, you agree that use shall be subject to this Global Research Disclaimer, the Neo Terms and where applicable the UBS Investment Bank terms of business (<https://www.ubs.com/global/en/investment-bank/regulatory.html>) and to UBS's Terms of Use/Disclaimer (<http://www.ubs.com/global/en/legalinfo2/disclaimer.html>). In addition, you consent to UBS processing your personal data and using cookies in accordance with our Privacy Statement (<http://www.ubs.com/global/en/legalinfo2/privacy.html>) and cookie notice (<http://www.ubs.com/global/en/homepage/cookies/cookie-management.html>).

If you receive Global Research, whether through a System or by any other means, you agree that you shall not copy, revise, amend, create a derivative work, provide to any third party, or in any way commercially exploit any UBS research provided via Global Research or otherwise, and that you shall not extract data from any research or estimates provided to you via Global Research or otherwise, without the prior written consent of UBS.

This document is for distribution only as may be permitted by law. It is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation or would subject UBS to any registration or licensing requirement within such jurisdiction.

This document is a general communication and is educational in nature; it is not an advertisement nor is it a solicitation or an offer to buy or sell any financial instruments or to participate in any particular trading strategy. Nothing in this document constitutes a representation that any investment strategy or recommendation is suitable or appropriate to an investor's individual circumstances or otherwise constitutes a personal recommendation. By providing this document, none of UBS or its representatives has any responsibility or authority to provide or have provided investment advice in a fiduciary capacity or otherwise. Investments involve risks, and investors should exercise prudence and their own judgment in making their investment decisions. None of UBS or its representatives is suggesting that the recipient or any other person take a specific course of action or any action at all. By receiving this document, the recipient acknowledges and agrees with the intended purpose described above and further disclaims any expectation or belief that the information constitutes investment advice to the recipient or otherwise purports to meet the investment objectives of the recipient. The financial instruments described in the document may not be eligible for sale in all jurisdictions or to certain categories of investors.

Options, structured derivative products and futures (including OTC derivatives) are not suitable for all investors. Trading in these instruments is considered risky and may be appropriate only for sophisticated investors. Prior to buying or selling an option, and for the complete risks relating to options, you must receive a copy of "The Characteristics and Risks of Standardized Options." You may read the document at <http://www.theocc.com/publications/risks/riskchap1.jsp> or ask your salesperson for a copy. Various theoretical explanations of the risks associated with these instruments have been published. Supporting documentation for any claims, comparisons, recommendations, statistics or other technical data will be supplied upon request. Past performance is not necessarily indicative of future results. Transaction costs may be significant in option strategies calling for multiple purchases and sales of options, such as spreads and straddles. Because of the importance of tax considerations to many options transactions, the investor considering options should consult with his/her tax advisor as to how taxes affect the outcome of contemplated options transactions.

Mortgage and asset-backed securities may involve a high degree of risk and may be highly volatile in response to fluctuations in interest rates or other market conditions. Foreign currency rates of exchange may adversely affect the value, price or income of any security or related instrument referred to in the document. For investment advice, trade execution or other enquiries, clients should contact their local sales representative.

The value of any investment or income may go down as well as up, and investors may not get back the full (or any) amount invested. Past performance is not necessarily a guide to future performance. Neither UBS nor any of its directors, employees or agents accepts any liability for any loss (including investment loss) or damage arising out of the use of all or any of the information.

Prior to making any investment or financial decisions, any recipient of this document or the information should take steps to understand the risk and return of the investment and seek individualized advice from his or her personal financial, legal, tax and other professional advisors that takes into account all the particular facts and circumstances of his or her investment objectives.

Any prices stated in this document are for information purposes only and do not represent valuations for individual securities or other financial instruments. There is no representation that any transaction can or could have been effected at those prices, and any prices do not necessarily reflect UBS's internal books and records or theoretical model-based valuations and may be based on certain assumptions. Different assumptions by UBS or any other source may yield substantially different results.

No representation or warranty, either expressed or implied, is provided in relation to the accuracy, completeness or reliability of the information contained in any materials to which this document relates (the "Information"), except with respect to Information concerning UBS. The Information is not intended to be a complete statement or summary of the securities, markets or developments referred to in the document. UBS does not undertake to update or keep current the Information. Any opinions expressed in this document may change without notice and may differ or be contrary to opinions expressed by other business areas or groups, personnel or other representative of UBS. Any statements contained in this report attributed to a third party represent UBS's interpretation of the data, information and/or opinions provided by that third party either publicly or through a subscription service, and such use and interpretation have not been reviewed by the third party. In no circumstances may this document or any of the Information (including any forecast, value, index or other calculated amount ("Values")) be used for any of the following purposes:

- (i) valuation or accounting purposes;
- (ii) to determine the amounts due or payable, the price or the value of any financial instrument or financial contract; or
- (iii) to measure the performance of any financial instrument including, without limitation, for the purpose of tracking the return or performance of any Value or of defining the asset allocation of portfolio or of computing performance fees.

By receiving this document and the Information you will be deemed to represent and warrant to UBS that you will not use this document or any of the Information for any of the above purposes or otherwise rely upon this document or any of the Information.

UBS has policies and procedures, which include, without limitation, independence policies and permanent information barriers, that are intended, and upon which UBS relies, to manage potential conflicts of interest and control the flow of information within divisions of UBS and among its subsidiaries, branches and affiliates. For further information on the ways in which UBS manages conflicts and maintains independence of its research products, historical performance information and certain additional disclosures concerning UBS research recommendations, please visit www.ubs.com/disclosures.

Research will initiate, update and cease coverage solely at the discretion of UBS Research Management, which will also have sole discretion on the timing and frequency of any published research product. The analysis contained in this document is based on numerous assumptions. All material information in relation to published research reports, such as valuation methodology, risk statements, underlying assumptions (including sensitivity analysis of those assumptions), ratings history etc. as required by the Market Abuse Regulation, can be found on UBS Neo. Different assumptions could result in materially different results.

The analyst(s) responsible for the preparation of this document may interact with trading desk personnel, sales personnel and other parties for the purpose of gathering, applying and interpreting market information. UBS relies on information barriers to control the flow of information contained in one or more areas within UBS into other areas, units, groups or affiliates of UBS. The compensation of the analyst who prepared this document is determined exclusively by research management and senior management (not including investment banking). Analyst compensation is not based on investment banking revenues; however, compensation may relate to the revenues of UBS and/or its divisions as a whole, of which investment banking, sales and trading are a part, and UBS's subsidiaries, branches and affiliates as a whole.

For financial instruments admitted to trading on an EU regulated market: UBS AG, its affiliates or subsidiaries (excluding UBS Securities LLC) acts as a market maker or liquidity provider (in accordance with the interpretation of these terms under English law or, if not carried out by UBS in the UK the law of the relevant jurisdiction in which UBS determines it carries out the activity) in the financial instruments of the issuer save that where the activity of liquidity provider is carried out in accordance with the definition given to it by the laws and regulations of any other EU jurisdictions, such information is separately disclosed in this document. For financial instruments admitted to trading on a non-EU regulated market: UBS may act as a market maker save that where this activity is carried out in the US in accordance with the definition given to it by the relevant laws and regulations, such activity will be specifically disclosed in this document. UBS may have issued a warrant the value of which is based on one or more of the financial instruments referred to in the document. UBS and its affiliates and employees may have long or short positions, trade as principal and buy and sell in instruments or derivatives identified herein; such transactions or positions may be inconsistent with the opinions expressed in this document.

Within the past 12 months UBS AG, its affiliates or subsidiaries may have received or provided investment services and activities or ancillary services as per MiFID II which may have given rise to a payment or promise of a payment in relation to these services from or to this company.

Where Global Research refers to "UBS Evidence Lab Inside" or has made use of data provided by UBS Evidence Lab you understand that UBS Evidence Lab is a separate department to Global Research and that UBS Evidence Lab does not provide research, investment recommendations or advice. UBS Evidence Lab may provide services to

other internal and external clients.

United Kingdom: This material is distributed by UBS AG, London Branch to persons who are eligible counterparties or professional clients. UBS AG, London Branch is authorised by the Prudential Regulation Authority and subject to regulation by the Financial Conduct Authority and limited regulation by the Prudential Regulation Authority.

Europe: Except as otherwise specified herein, these materials are distributed by UBS Europe SE, a subsidiary of UBS AG, to persons who are eligible counterparties or professional clients (as detailed in the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) Rules and according to MiFID) and are only available to such persons. The information does not apply to, and should not be relied upon by, retail clients. UBS Europe SE is authorised by the European Central Bank (ECB) and regulated by the BaFin and the ECB.

Germany: Where an analyst of UBS Europe SE has contributed to this document, the document is also deemed to have been prepared by UBS Europe SE. In all cases it is distributed by UBS Europe SE and UBS AG, London Branch.

Luxembourg, the Netherlands, Belgium and Ireland: Where an analyst of UBS Europe SE has contributed to this document, the document is also deemed to have been prepared by UBS Europe SE. In all cases it is distributed by UBS Europe SE and UBS AG, London Branch.

Turkey: Distributed by UBS AG, London Branch. No information in this document is provided for the purpose of offering, marketing and sale by any means of any capital market instruments and services in the Republic of Turkey. Therefore, this document may not be considered as an offer made or to be made to residents of the Republic of Turkey. UBS AG, London Branch is not licensed by the Turkish Capital Market Board under the provisions of the Capital Market Law (Law No. 6362). Accordingly, neither this document nor any other offering material related to the instruments/services may be utilized in connection with providing any capital market services to persons within the Republic of Turkey without the prior approval of the Capital Market Board. However, according to article 15 (d) (ii) of the Decree No. 32, there is no restriction on the purchase or sale of the securities abroad by residents of the Republic of Turkey.

Poland: Distributed by UBS Europe SE (spółka z ograniczoną odpowiedzialnością) Oddział w Polsce regulated by the Polish Financial Supervision Authority. Where an analyst of UBS Europe SE (spółka z ograniczoną odpowiedzialnością) Oddział w Polsce has contributed to this document, the document is also deemed to have been prepared by UBS Europe SE (spółka z ograniczoną odpowiedzialnością) Oddział w Polsce.

Russia: Prepared and distributed by UBS Bank (OOO). "Should not be construed as an individual Investment Recommendation for the purpose of the Russian Law" - Federal Law #39-FZ ON THE SECURITIES MARKET Articles 6, 1-6.2.

Switzerland: Distributed by UBS AG to persons who are institutional investors only. UBS AG is regulated by the Swiss Financial Market Supervisory Authority (FINMA).

Italy: Prepared by UBS Europe SE and distributed by UBS Europe SE and UBS Europe SE, Italy Branch. Where an analyst of UBS Europe SE, Italy Branch has contributed to this document, the document is also deemed to have been prepared by UBS Europe SE, Italy Branch.

South Africa: Distributed by UBS South Africa (Pty) Limited (Registration No. 1995/011140/07), an authorised user of the JSE and an authorised Financial Services Provider (FSP 7328).

Saudi Arabia: This document has been issued by UBS AG (and/or any of its subsidiaries, branches or affiliates), a public company limited by shares, incorporated in Switzerland with its registered offices at Aeschenvorstadt 1, CH-4051 Basel and Bahnhofstrasse 45, CH-8001 Zurich. This publication has been approved by UBS Saudi Arabia (a subsidiary of UBS AG), a Saudi closed joint stock company incorporated in the Kingdom of Saudi Arabia under commercial register number 1010257812 having its registered office at Tatweer Towers, P.O. Box 75724, Riyadh 11588, Kingdom of Saudi Arabia. UBS Saudi Arabia is authorized and regulated by the Capital Market Authority to conduct securities business under license number 08113-37.

UAE / Dubai: The information distributed by UBS AG Dubai Branch is only intended for Professional Clients and/or Market Counterparties, as classified under the DFSA rulebook. No other person should act upon this material/communication. The information is not for further distribution within the United Arab Emirates. UBS AG Dubai Branch is regulated by the DFSA in the DIFC. UBS is not licensed to provide banking services in the UAE by the Central Bank of the UAE, nor is it licensed by the UAE Securities and Commodities Authority.

Israel: This Material is distributed by UBS AG, London Branch. UBS Securities Israel Ltd is a licensed Investment Markete that is supervised by the Israel Securities Authority (ISA). UBS AG, London Branch and its affiliates incorporated outside Israel are not licensed under the Israeli Advisory Law. UBS may engage among others in issuance of Financial Assets or in distribution of Financial Assets of other issuers for fees or other benefits. UBS AG, London Branch and its affiliates may prefer various Financial Assets to which they have or may have an Affiliation (as such term is defined under the Israeli Advisory Law). Nothing in this Material should be considered as investment advice under the Israeli Advisory Law. This Material is being issued only to and/or is directed only at persons who are Eligible Clients within the meaning of the Israeli Advisory Law, and this Material must not be furnished to, relied on or acted upon by any other persons.

United States: Distributed to US persons by either UBS Securities LLC or by UBS Financial Services Inc., subsidiaries of UBS AG; or by a group, subsidiary or affiliate of UBS AG that is not registered as a US broker-dealer (a 'non-US affiliate') to major US institutional investors only. UBS Securities LLC or UBS Financial Services Inc. accepts responsibility for the content of a report prepared by another non-US affiliate when distributed to US persons by UBS Securities LLC or UBS Financial Services Inc. All transactions by a US person in the securities mentioned in this report must be effected through UBS Securities LLC or UBS Financial Services Inc., and not through a non-US affiliate. UBS Securities LLC is not acting as a municipal advisor to any municipal entity or obligated person within the meaning of Section 15B of the Securities Exchange Act (the "Municipal Advisor Rule"), and the opinions or views contained herein are not intended to be, and do not constitute, advice within the meaning of the Municipal Advisor Rule.

Canada: Distributed by UBS Securities Canada Inc., a registered investment dealer in Canada and a Member-Canadian Investor Protection Fund, or by another affiliate of UBS AG that is registered to conduct business in Canada or is otherwise exempt from registration.

Brazil: Except as otherwise specified herein, this material is prepared by UBS Brasil CCTVM S.A.¹ to persons who are eligible investors residing in Brazil, which are considered to be Investidores Profissionais, as designated by the applicable regulation, mainly the CVM Instruction No. 539 from the 13th of November 2013 (determines the duty to verify the suitability of products, services and transactions with regards to the client's profile).

¹UBS Brasil CCTVM S.A. is a subsidiary of UBS BB Servicos de Assessoria Financeira e Participacoes S.A. ("UBS BB"). UBS BB is an association between UBS AG and Banco do Brasil, of which UBS AG is the majority owner.

Mexico: This report has been distributed and prepared by UBS Casa de Bolsa, S.A. de C.V., a subsidiary of UBS AG. This document is intended for distribution to institutional or sophisticated investors only. Research reports only reflect the views of the analysts responsible for the report. Analysts do not receive any compensation from the persons or entities different from UBS Casa de Bolsa, S.A. de C.V., or different from entities belonging to the same financial group or business group of such

Hong Kong: Distributed by UBS Securities Asia Limited. Please contact local licensed persons of UBS Securities Asia Limited in respect of any matters arising from, or in connection with, the analysis or document.

Singapore: Distributed by UBS Securities Pte. Ltd. [MCI (P) 003/08/2020 and Co. Reg. No.: 198500648C] or UBS AG, Singapore Branch. Please contact UBS Securities Pte. Ltd., an exempt financial adviser under the Singapore Financial Advisers Act (Cap. 110); or UBS AG, Singapore Branch, an exempt financial adviser under the Singapore Financial Advisers Act (Cap. 110) and a wholesale bank licensed under the Singapore Banking Act (Cap. 19) regulated by the Monetary Authority of Singapore, in respect of any matters arising from, or in connection with, the analysis or document. The recipients of this document represent and warrant that they are accredited and institutional investors as defined in the Securities and Futures Act (Cap. 289).

Japan: Distributed by UBS Securities Japan Co., Ltd. to professional investors (except as otherwise permitted). Where this report has been prepared by UBS Securities Japan Co., Ltd., UBS Securities Japan Co., Ltd. is the author, publisher and distributor of the report. Distributed by UBS AG, Tokyo Branch to Professional Investors (except as otherwise permitted) in relation to foreign exchange and other banking businesses when relevant.

Australia: Clients of UBS AG: Distributed by UBS AG (ABN 47 088 129 613 and holder of Australian Financial Services License No. 231087). Clients of UBS Securities Australia Ltd: Distributed by UBS Securities Australia Ltd (ABN 62 008 586 481 and holder of Australian Financial Services License No. 231098). This Document contains general information and/or general advice only and does not constitute personal financial product advice. As such, the Information in this document has been prepared without taking into account any investor's objectives, financial situation or needs, and investors should, before acting on the Information, consider the appropriateness of the Information, having regard to their objectives, financial situation and needs. If the Information contained in this document relates to the acquisition, or potential acquisition of a particular financial product by a 'Retail' client as defined by section 761G of the Corporations Act 2001 where a Product Disclosure Statement would be required, the retail client should obtain and consider the Product Disclosure Statement relating to the product before making any decision about whether to acquire the product.

New Zealand: Distributed by UBS New Zealand Ltd. UBS New Zealand Ltd is not a registered bank in New Zealand. You are being provided with this UBS publication or material because you have indicated to UBS that you are a "wholesale client" within the meaning of section 5C of the Financial Advisers Act 2008 of New Zealand (Permitted Client). This publication or material is not intended for clients who are not Permitted Clients (non-permitted Clients). If you are a non-permitted Client you must not rely on this publication or material. If despite this warning you nevertheless rely on this publication or material, you hereby (i) acknowledge that you may not rely on the content of this publication or material and that any recommendations or opinions in such this publication or material are not made or provided to you, and (ii) to the maximum extent permitted by law (a) indemnify UBS and its associates or related entities (and their respective Directors, officers, agents and Advisors) (each a 'Relevant Person') for any loss, damage, liability or claim any of them may incur or suffer as a result of, or in connection with, your unauthorised reliance on this publication or material and (b) waive any rights or remedies you may have against any Relevant Person for (or in respect of) any loss, damage, liability or claim you may incur or suffer as a result of, or in connection with, your unauthorised reliance on this publication or material.

Korea: Distributed in Korea by UBS Securities Pte. Ltd., Seoul Branch. This material is intended for professional/institutional clients only and not for distribution to any retail clients.

Malaysia: This material is authorized to be distributed in Malaysia by UBS Securities Malaysia Sdn. Bhd (Capital Markets Services License No.: CMSL/A0063/2007). This material is intended for professional/institutional clients only and not for distribution to any retail clients.

India: Distributed by UBS Securities India Private Ltd. (Corporate Identity Number U67120MH1996PTC097299) 2/F, 2 North Avenue, Maker Maxity, Bandra Kurla Complex, Bandra (East), Mumbai (India) 400051. Phone: +912261556000. It provides brokerage services bearing SEBI Registration Number: INZ2000259830; merchant banking services bearing SEBI Registration Number: INM000010809 and Research Analyst services bearing SEBI Registration Number: INH000001204. UBS AG, its affiliates or subsidiaries may have debt holdings or positions in the subject Indian company/companies. Within the past 12 months, UBS AG, its affiliates or subsidiaries may have received compensation for non-investment banking securities-related services and/or non-securities services from the subject Indian company/companies. The subject company/companies may have been a client/clients of UBS AG, its affiliates or subsidiaries during the 12 months preceding the date of distribution of the research report with respect to investment banking and/or non-investment banking securities-related services and/or non-securities services. With regard to information on associates, please refer to the Annual Report at: http://www.ubs.com/global/en/about_ubs/investor_relations/annualreporting.html

Taiwan: Except as otherwise specified herein, this material may not be distributed in Taiwan. Information and material on securities/instruments that are traded in a Taiwan organized exchange is deemed to be issued and distributed by UBS Securities Pte. LTD., Taipei Branch, which is licensed and regulated by Taiwan Financial Supervisory Commission. Save for securities/instruments that are traded in a Taiwan organized exchange, this material should not constitute "recommendation" to clients or recipients in Taiwan for the covered companies or any companies mentioned in this document. No portion of the document may be reproduced or quoted by the press or any other person without authorisation from UBS.

Indonesia: This report is being distributed by PT UBS Sekuritas Indonesia and is delivered by its licensed employee(s), including marketing/sales person, to its client. PT UBS Sekuritas Indonesia, having its registered office at Sequis Tower Level 22 unit 22-1, Jl.Jend. Sudirman, kav.71, SCBD lot 11B, Jakarta 12190, Indonesia, is a subsidiary company of UBS AG and licensed under Capital Market Law no. 8 year 1995, a holder of broker-dealer and underwriter licenses issued by the Capital Market and Financial Institution Supervisory Agency (now Otoritas Jasa Keuangan/OJK). PT UBS Sekuritas Indonesia is also a member of Indonesia Stock Exchange and supervised by Otoritas Jasa Keuangan (OJK). Neither this report nor any copy hereof may be distributed in Indonesia or to any Indonesian citizens except in compliance with applicable Indonesian capital market laws and regulations. This report is not an offer of securities in Indonesia and may not be distributed within the territory of the Republic of Indonesia or to Indonesian citizens in circumstance which constitutes an offering within the meaning of Indonesian capital market laws and regulations.

The disclosures contained in research documents produced by UBS AG, London Branch or UBS Europe SE shall be governed by and construed in accordance with English law. UBS specifically prohibits the redistribution of this document in whole or in part without the written permission of UBS and in any event UBS accepts no liability whatsoever for any redistribution of this document or its contents or the actions of third parties in this respect. Images may depict objects or elements that are protected by third party copyright, trademarks and other intellectual property rights. © UBS 2020. The key symbol and UBS are among the registered and unregistered trademarks of UBS. All rights reserved.

Global Wealth Management Disclaimer

You receive this document in your capacity as a client of UBS Global Wealth Management. This publication has been distributed to you by UBS Switzerland AG (regulated by FINMA in Switzerland) or its affiliates ("UBS") with whom you have a banking relationship with. The full name of the distributing affiliate and its competent authority can be found in the country-specific disclaimer at the end of this document.

The date and time of the first dissemination of this publication is the same as the date and time of its publication.

Risk information:

You agree that you shall not copy, revise, amend, create a derivative work, provide to any third party, or in any way commercially exploit any UBS research, and that you shall not extract data from any research or estimates, without the prior written consent of UBS.

This document is for distribution only as may be permitted by law. It is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation or would subject UBS to any registration or licensing requirement within such jurisdiction.

This document is a general communication and is educational in nature; it is not an advertisement nor is it a solicitation or an offer to buy or sell any financial instruments or to participate in any particular trading strategy. Nothing in this document constitutes a representation that any investment strategy or recommendation is suitable or appropriate to an investor's individual circumstances or otherwise constitutes a personal recommendation. By providing this document, none of UBS or its representatives has any responsibility or authority to provide or have provided investment advice in a fiduciary capacity or otherwise. Investments involve risks, and investors should exercise prudence and their own judgment in making their investment decisions. None of UBS or its representatives is suggesting that the recipient or any other person take a specific course of action or any action at all. By receiving this document, the recipient acknowledges and agrees with the intended purpose described above and further disclaims any expectation or belief that the information constitutes investment advice to the recipient or otherwise purports to meet the investment objectives of the recipient. The financial instruments described in the document may not be eligible for sale in all jurisdictions or to certain categories of investors.

Options, derivative products and futures are not suitable for all investors, and trading in these instruments is considered risky. Mortgage and asset-backed securities may involve a high degree of risk and may be highly volatile in response to fluctuations in interest rates or other market conditions. Foreign currency rates of exchange may adversely affect the value, price or income of any security or related instrument referred to in the document. For investment advice, trade execution or other enquiries, clients should contact their local sales representative.

The value of any investment or income may go down as well as up, and investors may not get back the full (or any) amount invested. Past performance is not necessarily a guide to future performance. Neither UBS nor any of its directors, employees or agents accepts any liability for any loss (including investment loss) or damage arising out of the use of all or any of the information (as defined below).

Prior to making any investment or financial decisions, any recipient of this document or the information should take steps to understand the risk and return of the investment and seek individualized advice from his or her personal financial, legal, tax and other professional advisors that takes into account all the particular facts and circumstances of his or her investment objectives.

Any prices stated in this document are for information purposes only and do not represent valuations for individual securities or other financial instruments. There is no representation that any transaction can or could have been effected at those prices, and any prices do not necessarily reflect UBS's internal books and records or theoretical model-based valuations and may be based on certain assumptions. Different assumptions by UBS or any other source may yield substantially different results.

No representation or warranty, either expressed or implied, is provided in relation to the accuracy, completeness or reliability of the information contained in any materials to which this document relates (the "Information"), except with respect to Information concerning UBS. The Information is not intended to be a complete statement or summary of the securities, markets or developments referred to in the document. UBS does not undertake to update or keep current the Information. Any opinions expressed in this document may change without notice and may differ or be contrary to opinions expressed by other business areas or groups, personnel or other representative of UBS. Any statements contained in this report attributed to a third party represent UBS's interpretation of the data, information and/or opinions provided by that third party either publicly or through a subscription service, and such use and interpretation have not been reviewed by the third party. In no circumstances may this document or any of the Information (including any forecast, value, index or other calculated amount ("Values")) be used for any of the following purposes:

- (i) valuation or accounting purposes;
- (ii) to determine the amounts due or payable, the price or the value of any financial instrument or financial contract; or
- (iii) to measure the performance of any financial instrument including, without limitation, for the purpose of tracking the return or performance of any Value or of defining the asset allocation of portfolio or of computing performance fees.

By receiving this document and the Information you will be deemed to represent and warrant to UBS that you will not use this document or any of the Information for any of the above purposes or otherwise rely upon this document or any of the Information.

UBS has policies and procedures, which include, without limitation, independence policies and permanent information barriers, that are intended, and upon which UBS relies, to manage potential conflicts of interest and control the flow of information within divisions of UBS (including between Global Wealth Management and UBS Global Research) and among its subsidiaries, branches and affiliates. For further information on the ways in which UBS manages conflicts and maintains independence of its research products, historical performance information and certain additional disclosures concerning UBS research recommendations, please visit www.ubs.com/disclosures.

Research will initiate, update and cease coverage solely at the discretion of research management, which will also have sole discretion on the timing and frequency of any published research product. The analysis contained in this document is based on numerous assumptions. Different assumptions could result in materially different results.

The analyst(s) responsible for the preparation of this document may interact with trading desk personnel, sales personnel and other parties for the purpose of gathering, applying and interpreting market information. UBS relies on information barriers to control the flow of information contained in one or more areas within UBS into other areas, units, groups or affiliates of UBS. The compensation of the analyst who prepared this document is determined exclusively by research management and senior management (not including investment banking). Analyst compensation is not based on investment banking revenues; however, compensation may relate to the revenues of UBS and/or its divisions as a whole, of which investment banking, sales and trading are a part, and UBS's subsidiaries, branches and affiliates as a whole.

For financial instruments admitted to trading on an EU regulated market: UBS AG, its affiliates or subsidiaries (excluding UBS Securities LLC) acts as a market maker or liquidity provider (in accordance with the interpretation of these terms in the UK) in the financial instruments of the issuer save that where the activity of liquidity provider is carried out in accordance with the definition given to it by the laws and regulations of any other EU jurisdictions, such information is separately disclosed in this document. For financial instruments admitted to trading on a non-EU regulated market: UBS may act as a market maker save that where this activity is carried out in the US in accordance with the definition given to it by the relevant laws and regulations, such activity will be specifically disclosed in this document. UBS may have issued a warrant the value of which is based on one or more of the financial instruments referred to in the document. UBS and its affiliates and employees may have long or short positions, trade as principal and buy and sell in instruments or derivatives identified herein; such transactions or positions may be inconsistent with the opinions expressed in this document.

Options and futures are not suitable for all investors, and trading in these instruments is considered risky and may be appropriate only for sophisticated investors. Prior to buying or selling an option, and for the complete risks relating to options, you must receive a copy of "Characteristics and Risks of Standardized Options". You may read the document at <https://www.theocc.com/about/publications/character-risks.jsp> or ask your financial advisor for a copy.

Investing in structured investments involves significant risks. For a detailed discussion of the risks involved in investing in any particular structured investment, you must read the relevant offering materials for that investment. Structured investments are unsecured obligations of a particular issuer with returns linked to the performance of an underlying asset. Depending on the terms of the investment, investors could lose all or a substantial portion of their investment based on the performance of the underlying asset. Investors could also lose their entire investment if the issuer becomes insolvent. UBS Financial Services Inc. does not guarantee in any way the obligations or the financial condition of any issuer or the accuracy of any financial information provided by any issuer. Structured investments are not traditional investments and investing in a structured investment is not equivalent to investing directly in the underlying asset. Structured investments may have limited or no liquidity, and investors should be prepared to hold their investment to maturity. The return of structured investments may be limited by a maximum gain, participation rate or other feature. Structured investments may include call features and, if a structured investment is called early, investors would not earn any further return and may not be able to reinvest in similar investments with similar terms. Structured investments include costs and fees which are generally embedded in the price of the investment. The tax treatment of a structured investment may be complex and may differ from a direct investment in the underlying asset. UBS Financial Services Inc. and its employees do not provide tax advice. Investors should consult their own tax advisor about their own tax situation before investing in any securities.

Important Information About Sustainable Investing Strategies: Sustainable investing strategies aim to consider and incorporate environmental, social and governance (ESG) factors into investment process and portfolio construction. Strategies across geographies and styles approach ESG analysis and incorporate the findings in a variety of ways. Incorporating ESG factors or Sustainable Investing considerations may inhibit the portfolio manager's ability to participate in certain investment opportunities that otherwise would be consistent with its investment objective and other principal investment strategies. The returns on a portfolio consisting primarily of sustainable investments may be lower or higher than portfolios where ESG factors, exclusions, or other sustainability issues are not considered by the portfolio manager, and the investment opportunities available to such portfolios may differ. Companies may not necessarily meet high performance standards on all aspects of ESG or sustainable investing issues; there is also no guarantee that any company will meet expectations in connection with corporate responsibility, sustainability, and/or impact performance.

Within the past 12 months UBS Switzerland AG, its affiliates or subsidiaries may have received or provided investment services and activities or ancillary services as per MiFID II which may have given rise to a payment or promise of a payment in relation to these services from or to this company.

If you require detailed information on disclosures of interest or conflict of interest as required by Market Abuse Regulation please contact the mailbox MAR_disclosures_twopager@ubs.com. Please note that e-mail communication is unsecured.

External Asset Managers / External Financial Consultants: In case this research or publication is provided to an External Asset Manager or an External Financial Consultant, UBS expressly prohibits that it is redistributed by the External Asset Manager or the External Financial Consultant and is made available to their clients and/or third parties.

Distributed to US persons by UBS Financial Services Inc. or UBS Securities LLC, subsidiaries of UBS AG. UBS Switzerland AG, UBS Europe SE, UBS Bank, S.A., UBS Brasil Administradora de Valores Mobiliários Ltda, UBS Asesores Mexico, S.A. de C.V., UBS Securities Japan Co., Ltd, UBS Wealth Management Israel Ltd and UBS Menkul Degerler AS are affiliates of UBS AG. UBS Financial Services Incorporated of Puerto Rico is a subsidiary of UBS Financial Services Inc. **UBS Financial Services Inc. accepts responsibility for the content of a report prepared by a non-US affiliate when it distributes reports to US persons. All transactions by a US person in the securities mentioned in this report should be effected through a US-registered broker dealer affiliated with UBS, and not through a non-US affiliate. The contents of this report have not been and will not be approved by any securities or investment authority in the United States or elsewhere. UBS Financial Services Inc. is not acting as a municipal advisor to any municipal entity or obligated person within the meaning of Section 15B of the Securities Exchange Act (the "Municipal Advisor Rule") and the opinions or views contained herein are not intended to be, and do not constitute, advice within the meaning of the Municipal Advisor Rule.**

Austria: This publication is not intended to constitute a public offer under Austrian law. It is distributed only for information purposes to clients of UBS Europe SE, Niederlassung Österreich, with place of business at Wächtergasse 1, A-1010 Wien. UBS Europe SE, Niederlassung Österreich is subject to the joint supervision of the European Central Bank ("ECB"), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Austrian Financial Market Authority (Finanzmarktaufsicht, FMA), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. **Bahrain:** UBS is a Swiss bank not licensed, supervised or regulated in Bahrain by the Central Bank of Bahrain and does not undertake banking or investment business activities in Bahrain. Therefore, clients have no protection under local banking and investment services laws and regulations. **Canada:** The information contained herein is not, and under no circumstances is to be construed as, a prospectus, an advertisement, a public offering, an offer to sell securities described herein, solicitation of an offer to buy securities described herein, in Canada or any province or territory thereof. Any offer or sale of the securities described herein in Canada will be made only under an exemption from the requirements to file a prospectus with the relevant Canadian securities regulators and only by a dealer properly registered under applicable securities laws or, alternatively, pursuant to an exemption from the dealer registration requirement in the relevant province or territory of Canada in which such offer or sale is made. Under no circumstances is the information contained herein to be construed as investment advice in any province or territory of Canada and is not tailored to the needs of the recipient. To the extent that the information contained herein references securities of an issuer incorporated, formed or created under the laws of Canada or a province or territory of Canada, any trades in such securities must be conducted through a dealer registered in Canada or, alternatively, pursuant to a dealer registration exemption. No securities commission or similar regulatory authority in Canada has reviewed or in any way passed upon these materials, the information contained herein or the merits of the securities described herein and any representation to the contrary is an offence. In Canada, this publication is distributed by UBS Investment Management Canada Inc. **China:** This research report is neither intended to be distributed to PRC investors nor to provide securities investment consultancy services within the territory of PRC. **Czech Republic:** UBS is not a licensed bank in the Czech Republic and thus is not allowed to provide regulated banking or investment services in the Czech Republic. Please notify UBS if you do not wish to receive any further correspondence. **Denmark:** This publication is not intended to constitute a public offer under Danish law. It is distributed only for information purposes to clients of UBS Europe SE, Denmark Branch, filial af UBS Europe SE, with place of business at Sankt Annæ Plads 13, 1250 Copenhagen, Denmark, registered with the Danish Commerce and Companies Agency, under No. 38 17 24 33. UBS Europe SE, Denmark Branch, filial af UBS Europe SE is subject to the joint supervision of the European Central Bank ("ECB"), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Danish Financial Supervisory Authority (Finanstilsynet), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. **Egypt:** Securities or other investment products are not being offered or sold by UBS to the public in Egypt and they have not been and will not be registered with the Egyptian Financial Supervisory Authority. **France:** This publication is distributed by UBS (France) S.A., French "société anonyme" with share capital of € 132.975.556, 69, boulevard Haussmann F-75008 Paris, R.C.S. Paris B 421 255 670, to its clients and prospects. UBS (France) S.A. is a provider of investment services duly authorized according to the terms of the "Code Monétaire et Financier", regulated by French banking and financial authorities as the "Autorité de Contrôle Prudentiel et de Résolution." **Germany:** This publication is not intended to constitute a public offer under German law. It is distributed only for information purposes to clients of UBS Europe SE, Germany, with place of business at Bockenheimer Landstrasse 2-4, 60306 Frankfurt am Main. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the European Central Bank ("ECB"), and supervised by the ECB, the German Central Bank (Deutsche Bundesbank) and the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), to which this publication has not been submitted for approval. **Greece:** UBS Switzerland AG and its affiliates (UBS) are not licensed as a bank or financial institution under Greek legislation and do not provide banking and financial services in Greece. Consequently, UBS provides such services from branches outside of Greece, only. This document may not be considered as a public offering made or to be made to residents of Greece. **Hong Kong:** This publication is distributed to clients of UBS AG Hong Kong Branch by UBS AG Hong Kong Branch, a licensed bank under the Hong Kong Banking Ordinance and a registered institution under the Securities and Futures Ordinance. UBS AG Hong Kong Branch is incorporated in Switzerland with limited liability. **Indonesia, Malaysia, Philippines, Thailand:** This material was provided to you as a result of a request received by UBS from you and/or persons entitled to make the request on your behalf. Should you have received the material erroneously, UBS asks that you kindly destroy/delete it and inform UBS immediately. Any and all advice provided and/or trades executed by UBS pursuant to the material will only have been provided upon your specific request or executed upon your specific instructions, as the case may be, and may be deemed as such by UBS and you. The material may not have been reviewed, approved, disapproved or endorsed by any financial or regulatory authority in your jurisdiction. The relevant investments will be subject to restrictions and obligations on transfer as set forth in the material, and by receiving the material you undertake to comply fully with such restrictions and obligations. You should carefully study and ensure that you understand and exercise due care and discretion in considering your investment objective, risk appetite and personal circumstances against the risk of the investment. You are advised to seek independent professional advice in case of doubt. **India:** UBS Securities India Private Ltd. (Corporate Identity Number U67120MH1996PTC097299) 2/F, 2 North Avenue, Maker Maxity, Bandra Kurla Complex, Bandra (East), Mumbai (India) 400051. Phone: +912261556000. It provides brokerage services bearing SEBI Registration Number INZ000259830; merchant banking services bearing SEBI Registration Number: INM000010809 and Research Analyst services bearing SEBI Registration Number: INH000001204. UBS AG, its affiliates or subsidiaries may have debt holdings or positions in the subject Indian company/companies. Within the past 12 months, UBS AG, its affiliates or subsidiaries may have received compensation for non-investment banking securities-related services and/or non-securities services from the subject Indian company/companies. The subject company/companies may have been a client/clients of UBS AG, its affiliates or subsidiaries during the 12 months preceding the date of distribution of the research report with respect to investment banking and/or non-investment banking securities-related services and/or non-securities services. With regard to information on associates, please refer to the Annual Report at: http://www.ubs.com/global/en/about_ubs/investor_relations/annualreporting.html. **Israel:** UBS is a premier global financial firm offering wealth management, asset management and investment banking services from its headquarters in Switzerland and its operations in over 50 countries worldwide to individual, corporate and institutional investors. In Israel, UBS Switzerland AG is registered as Foreign Dealer in cooperation with UBS Wealth Management Israel Ltd., a wholly owned UBS subsidiary. UBS Wealth Management Israel Ltd. is a Portfolio Manager licensee which engages also in Investment Marketing and is regulated by the Israel Securities Authority. This publication is intended for information only and is not intended as an offer to buy or solicitation of an offer. Furthermore, this publication is not intended as an investment advice and/or investment marketing and is not replacing any investment advice and/or investment marketing provided by the relevant licensee which is adjusted to each person needs. No action has been, or will be, taken in Israel that would permit an offering of the product(s) mentioned in this document or a distribution of this document to the public in Israel. In particular, this document has not been reviewed or approved by the Israeli Securities Authority. The product(s) mentioned in this document is/are being offered to a limited number of sophisticated investors who qualify as one of the investors listed in the first supplement to the Israeli Securities Law, 5728-1968. This document may not be reproduced or used for any other purpose, nor be furnished to any other person other than those to whom copies have been sent. Anyone who purchases the product(s) mentioned herein shall do so for its own benefit and for its own account and not with the aim or intention of distributing or offering the product(s) to other parties. Anyone who purchases the product(s) shall do so in accordance with its own understanding and discretion and after it has received any relevant financial, legal, business, tax or other advice or opinion required by it in connection with such purchase(s). The word "advice" and/or any of its derivatives shall be read and construed in conjunction with the definition of the term "investment marketing" as defined under the Israeli Regulation of Investment Advice, Investment Marketing and Portfolio Management Law, 1995. **Italy:** This publication is not intended to constitute a public offer under Italian law. It is distributed only for information purposes to clients of UBS Europe SE, Succursale Italia, with place of business at Via del Vecchio Politecnico, 3-20121 Milano. UBS Europe SE, Succursale Italia is subject to the joint supervision of the European Central Bank ("ECB"), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Bank of Italy (Banca d'Italia) and the Italian Financial Markets Supervisory Authority (CONSOB - Commissione Nazionale per le Società e la Borsa), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. **Jersey:** UBS AG, Jersey Branch, is regulated and authorized by the Jersey Financial Services Commission for the conduct of banking, funds and investment business. Where services are provided from outside Jersey, they will not be covered by the Jersey regulatory regime. UBS AG, Jersey Branch is a branch of UBS AG a public company limited by shares, incorporated in Switzerland whose registered offices are at Aeschenvorstadt 1, CH-4051 Basel and Bahnhofstrasse 45, CH 8001 Zurich. UBS AG, Jersey Branch's principal place business is 1, IFC Jersey, St Helier, Jersey, JE2 3BX. **Luxembourg:** This publication is not intended to constitute a public offer under Luxembourg law. It is distributed only for information purposes to clients of UBS Europe SE, Luxembourg Branch, with place of business at 33A, Avenue J. F. Kennedy, L-1855 Luxembourg. UBS Europe SE, Luxembourg Branch is subject to the joint

supervision of the European Central Bank ("ECB"), the German Central bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Luxembourg supervisory authority (Commission de Surveillance du Secteur Financier), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. **Mexico:** This information is distributed by UBS Asesores México, S.A. de C.V. ("UBS Asesores"), an affiliate of UBS Switzerland AG, incorporated as a non-independent investment advisor under the Securities Market Law due to the relation with a Foreign Bank. UBS Asesores is a regulated entity and it is subject to the supervision of the Mexican Banking and Securities Commission ("CNBV"), which exclusively regulates UBS Asesores regarding the rendering of portfolio management, as well as on securities investment advisory services, analysis and issuance of individual investment recommendations, so that the CNBV has no surveillance faculties nor may have over any other service provided by UBS Asesores. UBS Asesores is registered before CNBV under Registry number 30060. You are being provided with this UBS publication or material because you have indicated to UBS Asesores that you are a Sophisticated Qualified Investor located in Mexico. The compensation of the analyst(s) who prepared this report is determined exclusively by research management and senior management of any entity of UBS Group to which such analyst(s) render services. **Nigeria:** UBS Switzerland AG and its affiliates (UBS) are not licensed, supervised or regulated in Nigeria by the Central Bank of Nigeria or the Nigerian Securities and Exchange Commission (SEC) and do not undertake banking or investment business activities in Nigeria. The investment products mentioned in this material are not being offered or sold by UBS to the public in Nigeria and they have not been submitted for approval nor registered with the Nigerian SEC. If you are interested in products of this nature, please let us know and we will direct you to someone who can advise you. The investment products mentioned in this material are not being directed to, and are not being made available for subscription by any persons within Nigeria other than the selected investors to whom the offer materials have been addressed as a private sale or domestic concern within the exemption and meaning of Section 69(2) of the Investments and Securities Act, 2007 (ISA). **Poland:** UBS is a premier global financial services firm offering wealth management services to individual, corporate and institutional investors. UBS is established in Switzerland and operates under Swiss law and in over 50 countries and from all major financial centres. UBS Switzerland AG is not licensed as a bank or as an investment firm under Polish legislation and is not permitted to provide banking and financial services in Poland. **Portugal:** UBS Switzerland AG is not licensed to conduct banking and financial activities in Portugal nor is UBS Switzerland AG supervised by the portuguese regulators (Bank of Portugal "Banco de Portugal" and Portuguese Securities Exchange Commission, "Comissão do Mercado de Valores Mobiliários"). **Russia:** This document or information contained therein is for information purposes only and constitute neither a public nor a private offering, is not an invitation to make offers, to sell, exchange or otherwise transfer any financial instruments in the Russian Federation to or for the benefit of any Russian person or entity and does not constitute an advertisement or offering of securities in the Russian Federation within the meaning of Russian securities laws. **Singapore:** This material was provided to you as a result of a request received by UBS from you and/or persons entitled to make the request on your behalf. Should you have received the material erroneously, UBS asks that you kindly destroy/delete it and inform UBS immediately. Clients of UBS AG Singapore branch are asked to please contact UBS AG Singapore branch, an exempt financial adviser under the Singapore Financial Advisers Act (Cap. 110) and a wholesale bank licensed under the Singapore Banking Act (Cap. 19) regulated by the Monetary Authority of Singapore, in respect of any matters arising from, or in connection with, the analysis or report. **Spain:** This publication is not intended to constitute a public offer under Spanish law. It is distributed only for information purposes to clients of UBS Europe SE, Sucursal en España, with place of business at Calle María de Molina 4, C.P. 28006, Madrid. UBS Europe SE, Sucursal en España is subject to the joint supervision of the European Central Bank ("ECB"), the German Central bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Spanish supervisory authority (Banco de España), to which this publication has not been submitted for approval. Additionally it is authorized to provide investment services on securities and financial instruments, regarding which it is supervised by the Comisión Nacional del Mercado de Valores as well. UBS Europe SE, Sucursal en España is a branch of UBS Europe SE, a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. **Sweden:** This publication is not intended to constitute a public offer under Swedish law. It is distributed only for information purposes to clients of UBS Europe SE, Sweden Bankfilial, with place of business at Regeringsgatan 38, 11153 Stockholm, Sweden, registered with the Swedish Companies Registration Office under Reg. No 516406-1011. UBS Europe SE, Sweden Bankfilial is subject to the joint supervision of the European Central Bank ("ECB"), the German Central bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Swedish supervisory authority (Finansinspektionen), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. **Taiwan:** This material is provided by UBS AG, Taipei Branch in accordance with laws of Taiwan, in agreement with or at the request of clients/prospects. **Turkey:** No information in this document is provided for the purpose of offering, marketing and sale by any means of any capital market instruments and services in the Republic of Turkey. Therefore, this document may not be considered as an offer made or to be made to residents of the Republic of Turkey in the Republic of Turkey. UBS Switzerland AG is not licensed by the Turkish Capital Market Board (the CMB) under the provisions of the Capital Market Law (Law No. 6362). Accordingly neither this document nor any other offering material related to the instruments/services may be utilized in connection with providing any capital market services to persons within the Republic of Turkey without the prior approval of the CMB. However, according to article 15 (d) (ii) of the Decree No. 32 there is no restriction on the purchase or sale of the instruments by residents of the Republic of Turkey. **United Arab Emirates** : UBS is not licensed in the UAE by the Central Bank of UAE or by the Securities & Commodities Authority. The UBS AG Dubai Branch is licensed in the DIFC by the Dubai Financial Services Authority as an authorised firm. **United Kingdom:** This document is issued by UBS Wealth Management, a division of UBS AG which is authorised and regulated by the Financial Market Supervisory Authority in Switzerland. In the United Kingdom, UBS AG is authorised by the Prudential Regulation Authority and is subject to regulation by the Financial Conduct Authority and limited regulation by the Prudential Regulation Authority. Details about the extent of regulation by the Prudential Regulation Authority are available from us on request. A member of the London Stock Exchange. This publication is distributed to retail clients of UBS Wealth Management. **Ukraine:** UBS is not registered and licensed as a bank/financial institution under Ukrainian legislation and does not provide banking and other financial services in Ukraine. UBS has not made and will not make any offer of the mentioned products to the public in Ukraine. No action has been taken to authorize an offer of the mentioned products to the public in Ukraine and the distribution of this document shall not constitute financial services for the purposes of the Law of Ukraine "On Financial Services and State Regulation of Financial Services Markets" dated 12 July 2001. Accordingly, nothing in this document or any other document, information or communication related to the mentioned products shall be interpreted as containing an offer or invitation to offer, or solicitation of securities in the territory of Ukraine. Electronic communication must not be considered as an offer to enter into an electronic agreement or electronic instrument within the meaning of the Law of Ukraine "On Electronic Commerce" dated 3 September 2015. This document is strictly for private use by its holder and may not be passed on to third parties or otherwise publicly distributed.

© UBS 2020. The key symbol and UBS are among the registered and unregistered trademarks of UBS. All rights reserved.

