

Technology sector

COMMENT

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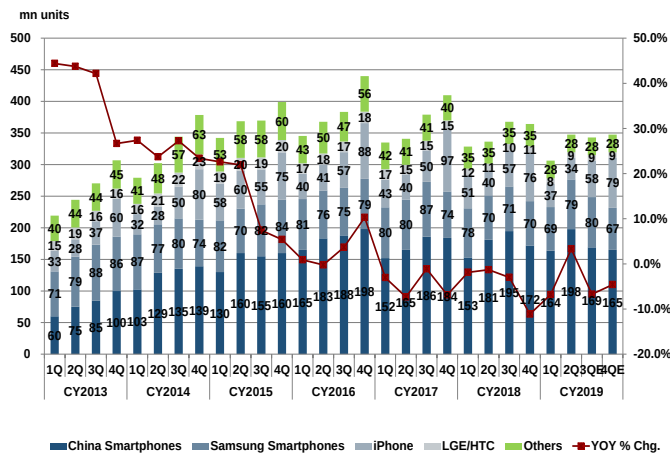
Asia feedback (Hardware): “5G fanfare” in 2020 albeit short-term adjustment risk at Jan–Mar

- **Summary:** We conducted our periodic survey of the Korean, Taiwanese and Chinese tech markets in late Aug–early Sep. As in our previous survey, end demand shows no sign of picking up. Despite ongoing inventory adjustments, chiefly in Greater China, channel inventories of automotive applications remain a burden, but we see improvement in MLCCs and other IT-related products. On the other hand, we expect a rush in smartphone, PC, TV, and other hardware demand ahead of US tariffs, and makers are likely to expedite component procurement and finished-product output in preparation for the Lunar New Year. Add in the risk of LTE-smartphone output adjustments before 5G rollout, and we see a risk of output adjustments heading into Jan–Mar. That said, expectations for 5G are rising sharply as 2020 approaches; 2020 production plans point to total 5G chipset output over 500mn units, and the industry seems increasingly upbeat on the outlook for 5G smartphones.
- **Focal points in hardware & devices:** (1) Makers target 5G-chipset output of 500mn units in 2020, and 5G smartphone output is likely to reach 250–300mn units—a boon for RF front ends; (2) Chinese smartphone output plans point to only a slight QoQ decline in Oct–Dec, but we flag the risk of LTE smartphone output adjustments before full rollout of 5G models in Mar–Apr CY20; (3) Apple apparently plans to produce 200mn iPhones in 2019 but is likely to follow its usual habit of revising forecasts after watching new model sales and has likely expedited production (mainly previous models) from Jan–Mar CY20, when we see a risk of adjustments before the new iPhone SE launches. iPhone plans as of early September call for output of 208mn units in 2019 (including 81mn for 2019 models). (4) Smartphone-related makers continue to upgrade CIS and camera module specs.
- **Stock calls:** In electronic components, device-maker inventories remain high. We expect further adjustment in automotive component inventory but are upbeat on normalizing channel inventories for IT-related applications (especially MLCCs) as the sector looks ready to emerge from its trough. Notable near-term risks heading into Jan–Mar CY20 are a snapback decline in device procurement and finished-product output (expedited before tariff hikes and the Lunar New Year), and iPhone adjustments. Fundamentals have not improved, but component stocks markedly underperformed over the past year. It now seems wise to start building investment positions that anticipate inventory adjustments ending and 5G-related upside over the next six months. Our three top picks are Murata Mfg (6981), Taiyo Yuden (6976), and Rohm (6963)—the beneficiary of a cyclical recovery. Our top pick in the semiconductor/SPE sector is Anritsu (6754), a core holding in the 5G space. Advantest (6857) also tends to be a market favorite, though it is richly valued. We advise caution with respect to SPE stocks given the risk of LTE smartphone inventory destocking. In the consumer-electronics sector, Sony (6758) remains our top pick.

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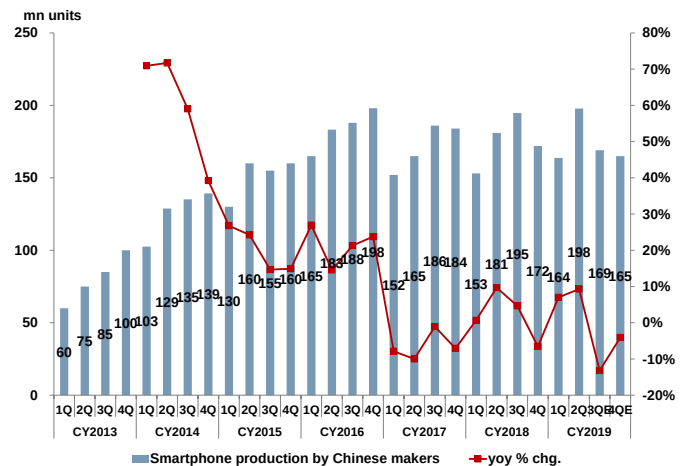
Key charts

Figure 1: Global smartphone production volume (quarterly)



Source: Credit Suisse estimates

Figure 2: Smartphone production volume by Chinese makers (quarterly)



Source: Credit Suisse estimates

Figure 3: iPhone production forecasts (as of March, June, September 2019)

iPhone production mn units	CY2017				CY2018				As of March 19 CY2019				As of June 19 CY2019				As of Sept 19 CY2019				CY17	CY18	CY19 as of 19/6	CY19 as of 19/9	FY3/18	FY3/19
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1QE	2QE	3QE	4QE	1Q	2QE	3QE	4QE	1Q	2Q	3QE	4QE						
iPhone 5s/5c/4s	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
iPhone SE	1.8	3.7	3.9	3.9	3.8	1.5	2.1	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	7.4	0.0	0.0	15.4	3.6
iPhone 6	2.1	6.5	5.5	5.3	6.0	2.5	2.1	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4	10.5	0.0	0.0	23.3	4.5
iPhone 6 plus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
iPhone 6s	4.1	3.6	2.4	2.2	3.4	1.5	1.4	4.2	5.0	3.0	NA	NA	4.3	1.7	1.9	0.1	4.3	1.4	2.3	0.2	12.3	10.4	8.0	8.2	11.6	11.4
iPhone 6s Plus	1.4	2.1	2.5	1.5	1.0	1.2	0.6	1.3	1.6	0.8	NA	NA	1.4	0.6	0.4	0.1	1.4	0.5	0.7	0.1	7.4	4.1	2.5	2.7	7.1	4.4
iPhone 7	16.5	13.1	9.9	9.1	3.1	3.4	2.8	3.5	4.3	3.5	NA	NA	5.0	3.6	3.8	3.2	5.0	3.3	3.9	6.0	48.5	12.7	15.6	18.2	35.1	14.7
iPhone 7 Plus	15.9	11.0	6.1	3.8	2.3	1.8	1.1	0.6	1.3	1.4	NA	NA	1.1	0.8	0.9	1.1	1.1	0.8	1.0	1.1	36.8	5.8	3.9	4.0	23.2	4.6
iPhone 8	0.0	0.0	9.6	18.5	9.0	10.6	8.4	7.6	6.0	5.0	NA	NA	5.7	4.2	4.5	4.5	5.7	4.1	3.7	4.8	28.1	35.5	18.9	18.3	37.1	32.3
iPhone 8 Plus	0.0	0.0	9.8	16.1	11.0	8.6	6.6	4.7	3.1	1.8	NA	NA	2.8	1.7	1.2	1.7	2.8	1.3	1.1	1.1	25.9	30.9	7.4	6.3	36.9	22.7
iPhone X	0.0	0.0	0.0	36.8	11.6	8.4	4.1	4.3	1.2	0.4	NA	NA	1.2	0.6	0.0	0.0	1.2	0.6	0.0	0.0	36.8	28.4	1.8	1.8	48.5	18.0
iPhone XR	0.0	0.0	0.0	0.0	0.0	0.0	3.3	27.5	11.5	14.3	NA	NA	10.0	14.8	10.5	8.9	10.0	13.5	11.1	11.9	—	30.8	44.2	46.4	0.0	40.8
iPhone XS	0.0	0.0	0.0	0.0	0.0	0.0	10.6	8.9	3.0	2.7	NA	NA	2.6	4.1	2.3	1.6	2.6	3.6	1.5	2.6	—	19.5	10.6	10.4	0.0	22.1
iPhone XS Max	0.0	0.0	0.0	0.0	0.0	0.0	13.9	13.0	2.8	2.6	NA	NA	2.9	5.4	2.3	0.0	2.9	5.0	2.2	0.0	—	26.9	10.6	10.1	0.0	29.8
iPhone XI R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA	NA	NA	0.0	0.1	15.5	23.8	0.0	0.0	14.6	24.9	—	—	39.4	39.5	0.0	0.0
iPhone XI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA	NA	NA	0.0	0.0	6.8	10.2	0.0	0.0	6.8	11.1	—	—	17.1	17.9	0.0	0.0
iPhone XI Max	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA	NA	NA	0.0	0.0	8.8	14.2	0.0	0.0	8.8	15.3	—	—	23.0	24.1	0.0	0.0
Total	43.4	40.1	49.7	97.3	51.1	39.5	56.9	75.5	39.8	35.5	NA	NA	37.1	37.8	59.0	69.3	37.1	34.1	57.7	79.0	230.4	223.0	203.1	207.9	238.1	208.9

Source: Credit Suisse estimates

Figure 4: 5G Chipsets production plan

5G SOC, BB+AP production forecast				2019		2020	
AP/BB/SOC	Product name	Process	Foundry	mn units	mn units	Customer	
Hisilicon	Balong 5000(+Kirin 980/985/710)	7nm Pro	TSMC	5	15	Huawei	
Hisilicon	Kirin 990	7nm EUV	TSMC	17	50	Huawei	
Hisilicon	Kirin 820	7nm EUV	TSMC	1	100	Huawei	
Qualcomm	X50(+SDM855)	8nm	Samsung	4	0	Mainly China, Samsung, LG	
Qualcomm	X55(+SDM865)	7nm Pro	TSMC	11	60	Mainly China, Samsung, LG	
Qualcomm	X55(+Apple A13/14)	AP5nm/7nm Pro+BB7nm Pro	TSMC	0	90	Apple	
Qualcomm	SDM7250	7nm EUV	Samsung	4	90	Mainly China, Samsung, LG, others	
Qualcomm	SDM6250 (3Q20 MP)	8nm/7nm?	Samsung	NA	NA	Mainly China, Samsung, LG, others	
Samsung LSI	Exynos 9630	8nm	Samsung	3	50	Samsung, Lenovo, Xiaomi, vivo	
Samsung LSI	5G Modem + AP	7nm EUV/5nmEUV	Samsung	0	15	Samsung Flagship	
Mediatek	M70 SoC (1Q-2Q20), Midend SoC (3Q20)	7nm EUV	TSMC	1	45	Mainly China	
Total				46	515		

Source: Credit Suisse estimates

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Overview

Inventory adjustment continues, no sign of recovery

Smartphones

Our Japanese technology team estimates global smartphone production totaled 1,464mn units (-5% YoY) in CY17 and 1,396mn (-5%) in CY18. For CY19, our estimate has increased slightly from 1,332mn units (-5%) at the time of the March survey (1,343mn, -4% at the time of the previous June survey), to 1,344mn (-4%) now.

We estimate quarterly production in CY18 at 326mn units (-20% QoQ, -3% YoY) in Jan-Mar, 336mn (+3%, -2%) in Apr-Jun, 365mn (+9%, -4%) in Jul-Sep, and 363mn (-1%, -11%) in Oct-Dec. Our CY19 estimates in the June survey were 306mn units (-16% QoQ, -7% YoY) for Jan-Mar, 355mn (+16%, +5%) for Apr-Jun, 350mn (-1%, -5%) for Jul-Sep, and 322mn (-5%, -9%) for Oct-Dec. We now revise these estimates to 306mn units (-16% QoQ, -7% YoY) for Jan-Mar, 347mn (+13%, +3%) for Apr-Jun, 343mn (-1%, -7%) for Jul-Sep, and 347mn (+1%, -5%) for Oct-Dec.

As of early September, Apple's annual CY19 production plan for the iPhone is a total of 208mn units (-7% YoY), comprising 37mn units (-51% QoQ, -28% YoY) in Jan-Mar, 34mn (-8%, -14%) in Apr-Jun, 58mn (+59%, +1%) in Jul-Sep, and 79mn (+37%, +5%) in Oct-Dec. In new models, the company evidentially plans to make a total of 81mn units in new models this year (40mn units of the iPhone 11, 18mn units of the iPhone 11 Pro, 24mn units of the iPhone 11 Pro Max) with quarterly output of zero units in Apr-Jun, 30mn units (14.5mn, 6.5-7mn, 8.5-9mn) in Jul-Sep, and 51mn (25mn, 11mn, 15-15.5mn) in Oct-Dec.

This survey's three key takeaways for smartphones are: (1) Planned CY20 production of 5G chipsets exceeds 500mn units, and output of 5G handsets may reach 250-300mn. (2) Chinese smartphone production plans are for a slight QoQ decline in Oct-Dec, but with a risk of LTE smartphone production adjustment ahead of full-scale 5G model launch in Mar-Apr 2020. (3) iPhone production is planned for over 200mn units in CY19, but given that production plans are usually revised after new model launches and that the 2019 plan is likely to include some front-loading of Jan-Mar 2020 production (mainly old models), there is a risk of a production adjustment during this Jan-Mar period ahead of the new iPhone SE launch.

Please refer to the report published on August 28 2019 for the smartphone market view of CS Asia team ([link](#)).

Tablets

There has been no noteworthy change to production plans. Output is stable.

Apple's annual CY19 production plan for the iPad is a total of 53mn units (flat YoY), comprising 12mn units (-21% QoQ, -20% YoY) in Jan-Mar, 11mn units (-6%, -3%) in Apr-Jun, 18mn units (+62%, +46%) in Jul-Sep, and 12mn units (-30%, -16%) in Oct-Dec.

PCs

There has been no noteworthy change to annual production plans. However, Apr-Jun and Jul-Sep appear to have seen some front-loading of production and related materials procurement ahead of the hike in US tariffs on Chinese imports, which could result in a snapback decline from Jan-Mar 2020.

Nintendo Switch

Switch output in 2019 is planned at 18-20mn units on a CY base and 20-22mn units on an FY base. It appears that production of existing models is expected to reach 1.5-1.6mn

units in Apr–Jun, 5.0–5.1mn in Jul–Sep, and 3.5–3.6mn in Oct–Dec. Production of new models (Switch Lite) started in March and is projected at around 1.7–1.8mn units in Apr–Jun, more than 4.5mn units in Jul–Sep, and fewer than 3.5mn units in Oct–Dec. Based on the part procurement volume, production looks set to reach around 18mn units in CY19.

Devices in short supply

CISs remain in tight supply owing to an increase in die size and the number of cameras per smartphone. We also seem to be seeing a tightening of supply for TCXOs and tuning fork-type crystal oscillators. This appears to be due to Japanese crystal makers restricting the supply of unprofitable items, as well as to an increase in the use of NB-IOT modules in the manufacture of a range of meters and fire alarms in China.

MLCCs

Distribution stage inventory

Some sales agencies continue to hold excess inventory due to the offloading of inventory by MLCC makers. However, with Chinese sales agents moving to clearing their excesses, overall it looks like distribution stage inventory will return to a healthy level at the end of Jul–Sep. While capacity utilization remains low, the level of orders from Chinese sales agents, among other indicators, suggests a gradual recovery. For automotive MLCCs, inventory adjustment remains severe among Chinese Tier 1 suppliers, and there are no signs of recovery among European and US Tier 1 suppliers either. Nevertheless, an end to inventory adjustment during Oct–Dec appears to be widely anticipated.

Capacity utilization

MLCC capacity utilization in Jul–Sep appears to be in the 30–50% range for Taiwanese makers, 70–80% percent for Korean makers, and around 70–90% for Japanese makers. Some Japanese makers that do not manufacture general-use MLCCs continue to operate at full capacity.

Pricing

By the end of Jul–Sep, price reductions since Oct–Dec 2018 have already driven the prices of some products manufactured by Taiwanese and Korean makers down to where they were before supplies grew tight. Our survey indicates that it would be hard for makers to drop prices further. The prices of Taiwanese and Korean makers' MLCCs appear to have fallen by 50–70% from the Jul–Sep 2018 peak for low-end products and by around 30–50% for midrange products (however, Taiwanese and Korean makers previously raised their prices more than Japanese makers did, making it unlikely that Japanese makers will face demands for similarly steep price reductions).

Some Japanese MLCC makers have also implemented price reductions from Jul–Sep. However, their ASPs appear to have only fallen by up to 5% or so QoQ, rather than the 10–15% the stock market has been anticipating.

Demand by market

Demand for MLCCs for use in base stations remains brisk at present. We expect demand to grow through 2020, as the number of MLCCs required rises in conjunction with an increased provision of 5G base stations (Huawei has between 400,000 and 500,000 5G RRH base stations in CY19, and plans to increase this by a factor of 3–4 in CY20). For smartphone MLCCs, there is also apparently moderate growth in demand from Chinese makers, as well as for the iPhone.

Increase in 5G-related MLCC use

Yageo anticipates an increase in 5G smartphone-related MLCC demand of 10–20% for sub-6GHz and 20–30% for millimeter wave networks, while Korean makers project an increase of around 200 units of MLCCs per base station for sub-6GHz services. Demand growth from sub-6GHz base stations is expected to be chiefly RF-related, while millimeter wave demand growth is likely to be driven by PMIC peripherals as well as RF.

Hardware production trends' implications for stocks

Electronic component sector

Device makers' in-house inventory is still high and inventory adjustment remains ongoing at automotive component makers. However, the return to normal of IT-related distribution stage inventory (particularly MLCCs) is encouraging, and we believe that the downside is reducing overall.

Notes of caution in the near term are the possibility of a snapback decline in Jan–Mar 2020 following the front-loading of device procurement and set production ahead of the tariff hike and Chinese New Year, as well as a possible iPhone production adjustment. Neither is there any sign of improvement in the fundamentals. However, electronic component stocks have greatly underperformed over the last year, and we see the coming six months as the time to start buying on weakness in anticipation of an end to inventory adjustments and growth in 5G base stations and smartphones. We forecast that sales and orders will return to YoY growth perhaps as early as December and by February 2020 at the latest, and that share prices will start to emerge from their trough after the Jul–Sep results round.

Our three top stock picks are Murata (6981) and Taiyo Yuden (6976), which stand to benefit from 5G expansion (MLCCs for both, RF FEMs for Murata), and Rohm (6963), as a beneficiary of a cyclical recovery.

Semiconductor and SPE sector

We understand that 5G chip production is planned at 500mn units in CY20. We therefore expect to see growth in the 5G-related businesses of Advantest (6857), driven by rising demand for semiconductor testing equipment, and Anritsu (6754), thanks to growth in 5G smartphone production that outstrips our estimates.

In 2019, 5G chips are being mass-produced using the 7nm/8nm process and the 7nm EUV process. We expect the volume of this production to increase and for 5nm process mass-production to start in 2020. Since both TSMC and the Samsung System LSI business will complete investment in capacity expansion for these cutting-edge processes in 1Q CY20, we think 5G expansion is unlikely to trigger an increase in foundry and logic capex. If new customers other than Apple and HiSilicon were to adopt the 5nm process, or HiSilicon were to extend its use beyond its flagship models, this might necessitate investment in capacity expansion. Currently, TSMC has no concrete plans to invest in 5nm process expansion from 2Q CY20, and we forecast that foundry investment will peak in 4Q CY19–1Q CY20.

We remain cautious on the semiconductor and SPE equipment sector. In the near term, we are wary of a possible decline in semiconductor capacity utilization triggered by LTE smartphone production and inventory adjustments ahead of 5G expansion. In the memory arena, there is a risk of DRAM oversupply in 4Q due to the shift in production from server DRAM to mobile RAM, while demand for high-capacity (256GB/512GB) NAND is waning. Memory could be facing a structural decline due to falling demand for smartphone data storage capacity as users switch to cloud storage. We should bear in mind that, with around 50% of NAND demand coming from smartphone makers, a slowdown in smartphone NAND capacity growth could limit overall NAND bit growth to 20–25%, which could be met purely through investment in increasing the number of 3D NAND layers, with no need to invest in new production capacity.

CIS/display sector

In the smartphone CIS space, recent trends toward more cameras per phone, higher image resolutions, and larger sensor form factors have been accelerating. In 2Q19, multi-camera models' share of total smartphone shipments rose more than we had anticipated, with phones equipped with at least three cameras accounting for a 20% share and multi-camera models (3+-camera plus dual-camera models) accounting for 63%. We now assume multi-cameras will account for 65% of 2019 shipments and 75% of 2020 shipments (revised from 60% and 70% previously), up from 40% in 2018. For triple-camera models, our corresponding assumptions are 20% for 2019 and 30% for 2020 (previously 20% and 27.5%), up from 2% in 2018. Additionally, phones with a camera resolution of at least 20MP now account for 20% of total smartphone shipments. Migration to even higher-resolution CISs, such as 64MP, is expected to accelerate.

Such smartphone camera spec upgrades are a bullish sign for Sony's CIS business, whose earnings should be driven by smartphone CISs for a while. With 2020 iPhone models expected to feature ToF (time-of-flight) cameras, adoption of these cameras may accelerate among other smartphone makers as well. While Sony's game business is in a late stage of the console cycle, Sony has maintained a high level of overall earnings by controlling costs and growing its network service revenues. Its music and movie businesses also are performing well. Over the medium- to long-term, AI should give rise to greater synergies across Sony's content portfolio. Sony remains our top pick in the consumer electronics sector.

Display materials maker Nitto Denko delivered an earnings beat in 1Q FY3/20, by virtue in part of a recovery in sales to Chinese makers of midrange smartphones. However, it faces a headwind in the form of migration to on-cell touch panels (Y-OCTA OLEDs). Two of the three 2020 iPhone models will feature on-cell. Although Nitto Denko's rationalization program is making steady progress, we currently doubt it can fully offset top-line weakness. On the upside, if BOE Display's shipments of flexible OLEDs to Apple and other major smartphone makers ramp up faster than expected, Nitto Denko should benefit from growth in its sales of polarizing film for OLEDs.

Figure 5: Hardware production forecasts (PCs, smartphones, tablet PCs as of September 2019)

Production data by CS Japan Tech	CY16				CY17				CY18				CY19				CY14					
mn units	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3QE	4QE	1Q	2Q	3Q	4Q	1Q	2Q
NB	35.0	37.0	41.0	42.0	37.0	37.0	42.0	45.0	37.0	36.0	41.0	43.0	37.0	38.0	42.0	44.0	173.4	160.0	155.0	161.0	157.0	161.0
YoY % chg.	-8%	-3%	-2%	0%	6%	0%	2%	7%	0%	-3%	-2%	-4%	0%	6%	2%	2%	-2%	-8%	-3%	4%	-2%	3%
QoQ % chg.	-17%	6%	11%	2%	-12%	0%	14%	7%	-18%	-3%	14%	5%	-14%	3%	11%	5%	-	-	-	-	-	-
MB	24.0	25.0	27.0	25.0	23.0	23.0	25.0	26.0	23.0	24.5	25.0	26.0	24.0	24.0	24.0	25.0	131.3	111.0	101.0	97.0	98.5	97.0
YoY % chg.	-14%	-7%	-7%	-7%	-4%	-8%	-7%	4%	0%	7%	0%	0%	4%	-2%	-4%	-4%	-2%	-15%	-9%	-4%	2%	-2%
QoQ % chg.	-11%	4%	8%	-7%	-8%	0%	9%	4%	-12%	7%	2%	4%	-8%	0%	0%	4%	-	-	-	-	-	-
Tablet PC (Korea, US and TW Brands)	22.3	22.2	26.0	35.0	23.5	24.7	26.7	32.2	24.7	21.3	25.7	31.3	21.1	22.1	31.0	27.6	138.4	114.1	105.5	107.1	103.1	101.8
YoY % chg.	-11%	-6%	-4%	-9%	5%	11%	3%	-8%	5%	-14%	-4%	-3%	-15%	4%	21%	-12%	-9%	-18%	-8%	2%	-4%	-1%
QoQ % chg.	-42%	0%	17%	35%	-33%	5%	8%	21%	-23%	-14%	21%	22%	-33%	5%	40%	-11%	-	-	-	-	-	-
Smartphones	345.3	367.7	383.3	440.0	334.8	340.7	379.0	409.7	328.6	336.3	367.7	364.2	306.2	347.4	343.0	347.4	1,087.7	1,479.4	1,536.3	1,464.3	1,396.7	1,344.0
YoY % chg.	1%	0%	4%	10%	-3%	-7%	-1%	-7%	-2%	-1%	-3%	-11%	-7%	3%	-7%	-5%	25%	36%	4%	-5%	-5%	-4%
QoQ % chg.	-13%	6%	4%	15%	-24%	2%	11%	8%	-20%	2%	9%	-1%	-16%	13%	-1%	1%	-	-	-	-	-	-
Total	426.6	451.9	477.3	542.0	418.3	425.4	472.7	512.9	413.2	418.2	459.4	464.5	388.3	431.5	440.0	444.0	1,530.7	1,864.1	1,897.6	1,829.4	1,755.3	1,730.3
YoY % chg.	-2%	-1%	2%	7%	-2%	-6%	-1%	-5%	-1%	-2%	-3%	-9%	-6%	3%	-4%	-4%	15%	22%	2%	-4%	-4%	-1%
QoQ % chg.	-16%	6%	6%	14%	-23%	2%	11%	9%	-19%	1%	10%	1%	-16%	11%	2%	1%	-	-	-	-	-	-

Worldwide Shipment (by IDC)	CY16				CY17				CY18				CY19				CY14					
mn units	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3QE	4QE	1Q	2Q	3Q	4Q	1Q	2Q
Notebook PC	34.9	36.5	40.7	43.3	36.8	37.0	42.3	44.0	37.4	38.6	43.5	44.1	36.5	41.1			173.4	161.4	155.4	160.2	163.6	-
YoY % chg.	-12%	-2%	-3%	2%	6%	1%	4%	2%	2%	4%	3%	0%	-3%	6%			-2%	-7%	-4%	3%	2%	-
QoQ % chg.	-18%	4%	12%	6%	-15%	0%	14%	4%	-15%	3%	13%	1%	-17%	13%			-	-	-	-	-	-
Desk top PC	24.2	25.0	25.7	25.9	22.6	22.5	24.6	25.6	22.0	22.3	23.7	23.1	21.2	22.5			131.3	110.7	100.8	95.2	91.2	-
YoY % chg.	-14%	-8%	-7%	-7%	-7%	-10%	-5%	-1%	-2%	-1%	-4%	-9%	-4%	1%			-2%	-16%	-9%	-6%	-4%	-
QoQ % chg.	-13%	3%	3%	0%	-13%	0%	9%	4%	-14%	1%	6%	-2%	-8%	6%			-	-	-	-	-	-
Tablet PC	39.6	39.2	42.3	53.8	35.9	38.2	39.9	49.9	31.7	33.9	36.9	43.7	30.1	32.5			230.1	207.2	174.8	163.8	146.2	-
YoY % chg.	-15%	-11%	-16%	-19%	-9%	-3%	-6%	-7%	-12%	-11%	-7%	-12%	-5%	-4%			5%	-10%	-16%	-6%	-11%	-
QoQ % chg.	-40%	-1%	8%	27%	-33%	7%	4%	25%	-37%	7%	9%	19%	-31%	8%			-	-	-	-	-	-
Smartphones	331.5	346.0	361.9	430.1	344.7	348.5	377.8	394.6	332.7	341.2	355.6	373.1	313.0	332.2			1,301.5	1,437.6	1,469.5	1,465.5	1,402.6	-
YoY % chg.	-1%	1%	1%	7%	4%	1%	4%	-8%	-3%	-2%	-6%	-5%	-6%	-3%			28%	10%	-2%	0%	-4%	-
QoQ % chg.	-17%	4%	5%	19%	-20%	1%	8%	4%	-16%	3%	4%	5%	-16%	6%			-	-	-	-	-	-
Feature Phone	121.8	125.2	129.4	125.0	120.3	121.7	129.0	141.2	133.1	118.1	116.3	117.6	103.4	99.9			665.1	542.5	501.4	512.1	485.1	-
YoY % chg.	-8%	2%	-12%	-11%	-1%	-3%	0%	13%	11%	-3%	-10%	-17%	-22%	-15%			-20%	-18%	-8%	2%	-5%	-
QoQ % chg.	-13%	3%	3%	-3%	-4%	1%	6%	9%	-6%	-11%	-2%	1%	-12%	-3%			-	-	-	-	-	-
Total	552.1	571.8	600.0	678.1	560.2	567.8	613.5	655.2	556.9	554.2	576.0	601.7	504.1	528.2			2,501.4	2,459.4	2,401.9	2,396.7	2,288.7	-
YoY % chg.	-5%	0%	-4%	0%	1%	-1%	2%	-3%	-1%	-2%	-6%	-8%	-9%	-5%			5%	-2%	-2%	0%	-5%	-
QoQ % chg.	-19%	4%	5%	13%	-17%	1%	8%	7%	-15%	0%	4%	4%	-16%	5%			-	-	-	-	-	-

Source: Company data, Credit Suisse estimates

Figure 6: Sentiment outlook by application

		2019				2020			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Applications	PC	 Intel MPU supply issue ends but a little seasonal adjustment	 flat	 seasonal recovery and production buildup before tariff increase	 seasonal recovery and production buildup before tariff increase	 Seasonal adjustment and downturn from production buildup	 Flat	 Seasonal recovery	 Seasonal recovery
	Smartphones	 Huawei is performing well but other makers are slow mainly iPhone	 Huawei increases production	 Overproduction of iPhone but Huawei adjustment	 Overproduction of iPhone but Huawei adjustment	 LTE adjustment and downturn from iPhone overproduction	 New models of iPhone SE and production buildup for China 5G	 New models of iPhone and production buildup for China 5G	 New models of iPhone and production buildup for China 5G
	Tablets	 seasonal adjustment	 flat	 seasonal recovery	 seasonal recovery	 seasonal adjustment	 flat	 seasonal recovery	 seasonal recovery
	LCD TVs	 seasonal adjustment	 Slightly decrease as China's seasonal adjustment and slow momentum in Europe	 seasonal recovery	 Seasonal recovery	 Seasonal adjustment	 Seasonal adjustment, slight decrease	 seasonal recovery	 Seasonal recovery

Source: Credit Suisse estimates

Figure 7: Sentiment outlook by subsector

		2019				2020			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Components	Semiconductors (logic/Foundry)	 Soft demand expect for smartphones	 Inventory adjustment continues. No utilization recovery yet	 Low utilization of early 80% at peak	 AP inventory adjustment for LTE smartphones	 Continued inventory adjustments for LTE smartphones before 5G	 Production buildup for iPhone 5nm. Increased production for 5G chip	 Production buildup for 5G	 Production buildup for 5G
	DRAM	 inventory adjustment for data center. Seasonal adjustment for hardware	 Hyperscale inventory adjustment ends but disappointing demand for Cascade Lake	 restocking of PC DRAM but demand recovery for server DRAM is slow	 Risks of operating loss in server DRAM. Oversupply of mobile DRAM	 Downturn from restocking	 Expectation for end of inventory adjustments	 Production buildup for 5G	 Production buildup for 5G. Maybe increased demand for data center?
	NAND	 Price competition intensifies	 Multiple makers reduce production. Power outage in Toshiba memory Yokkaichi plant	 Demand pull-in and increased demand due to restocking	 OEM price increases temporarily	 Downturn from restocking	 5G smartphone production buildup but continued inventory adjustment for LTE	 New models of iPhone will install 1TB. Excess inventory ends	 Slow bit growth rate for increased smartphone capacity
	PC-related electronic components	 Adjustment risk due to Intel MPU supply issue	 Flat	 Seasonal recovery. Production buildup before tariff increase	 Seasonal recovery. Production buildup before tariff increase	 Seasonal adjustment. Downturn from production buildup	 Flat	 Seasonal recovery	 Seasonal recovery
	Smartphone-related electronic components	 Huawei is performing well but other makers are slow mainly iPhone	 Huawei increases production	 Overproduction of iPhone but Huawei adjustments	 Overproduction of iPhone but Huawei adjustments	 Inventory adjustments for LTE. Downturn from overproduction of iPhone	 New models of iPhone SE and production buildup for China 5G	 New models of iPhone and production buildup for China 5G	 New models of iPhone and production buildup for China 5G
	LCD panels (for smartphone)	 iPhone and Chinese smartphone adjustment	 iPhone LCD model adjustment continues	 New iPhone LCD model launch	 Mass production of new iPhone LCD model	 Seasonal adjustments	 Ramp up for new model of iPhone SE	 Production for iPhone down but China smartphones up	 Production for iPhone down but China smartphones up

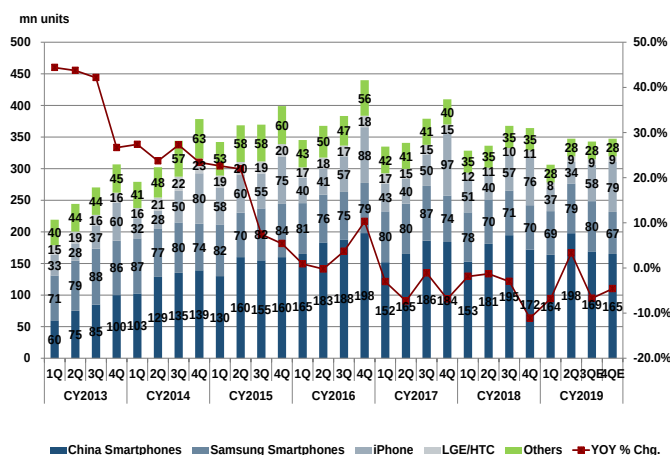
Source: Credit Suisse estimates

Smartphone production

5G bonanza coming in 2020, but we also see risk of LTE inventory adjustments and Jan-Mar iPhone correction

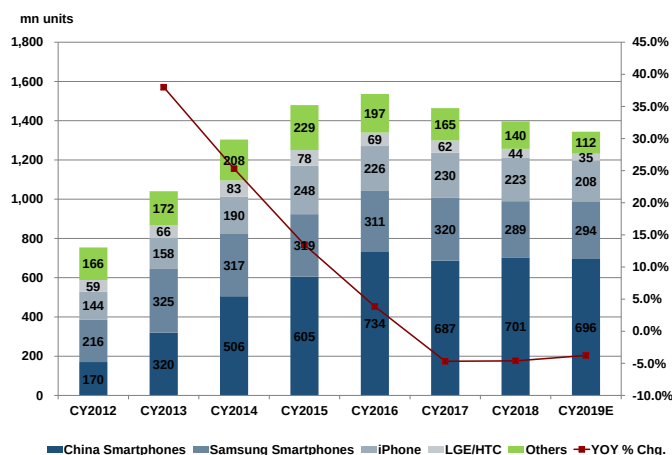
- The Japan tech team estimates that global smartphone production totaled 1,396mn units (-5% YoY) in CY18, down from 1,464mn (-5%) in 2017. We now forecast 1,344mn units (-4% YoY) in CY19, up from 1,332mn (-5%) as of our March survey and 1,343mn (-4%) as of our June survey.
- On a quarterly basis, CY18 production was 326mn units in Jan-Mar (-20% QoQ, -3% YoY), 336mn in Apr-Jun (+3%, -2%), 365mn in Jul-Sep (+9%, -4%), and 363mn in Oct-Dec (-1%, -11%). For CY19, we now forecast production of 306mn units in Jan-Mar (-16%, -7%), 347mn in Apr-Jun (+13%, +3%), 343mn in Jul-Sep (-1%, -7%), and 347mn in Oct-Dec (+1%, -5%). This compares with our June estimates of 306mn units in Jan-Mar (-16%, -7%), 355mn in Apr-Jun (+16%, +5%), 350mn in Jul-Sep (-1%, -5%), and 322mn in Oct-Dec (-5%, -9%).
- Key takeaways from our latest survey are as follows: (1) production schedules have 5G chipset output topping 500mn units in CY20 and 5G smartphone production potentially reaching 250-300mn units; (2) Chinese smartphone makers target only a modest QoQ decline in Oct-Dec output, but we see risk of an adjustment in LTE phone production ahead of the full-scale ramp of 5G models in March and April 2020; (3) iPhone production schedules have CY19 output above 200mn units, but this tends to be revised following the launch of new models and we also see risk of a correction in Jan-Mar 2020 ahead of the new iPhone SE ramp if production of older models is brought forward from Jan-Mar 2020.

Figure 8: Global smartphone production volume forecasts (quarterly)



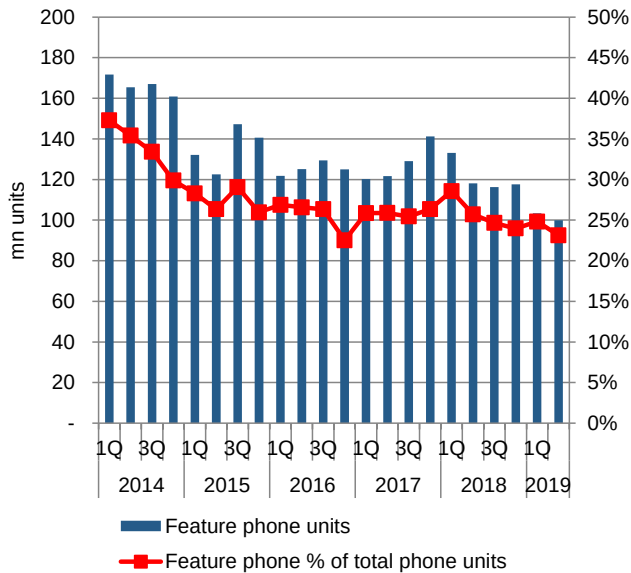
Source: Credit Suisse estimates

Figure 9: Global smartphone production volume forecasts (annual)



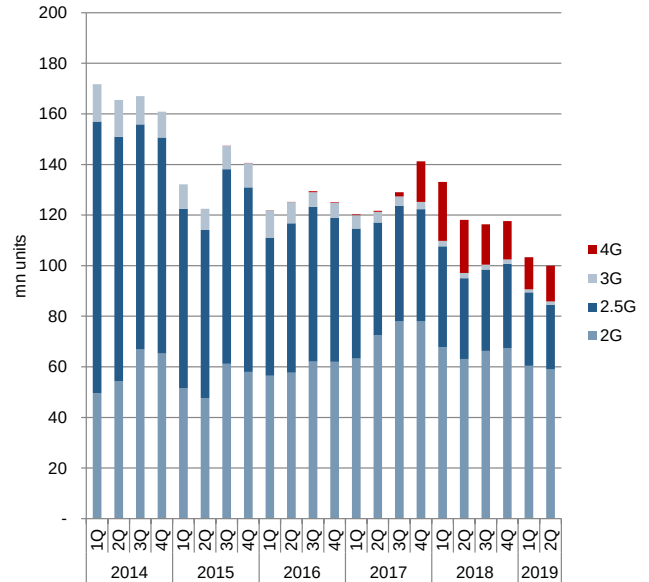
Source: Credit Suisse estimates

Figure 10: Feature phone shipment volume and ratio



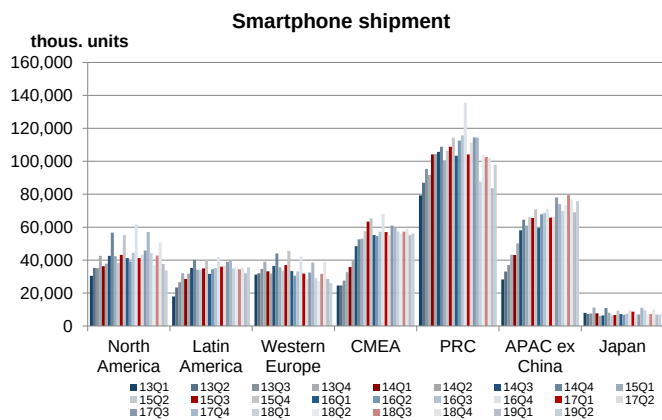
Source: IDC, Credit Suisse

Figure 11: Feature phone: shipment volume by generations



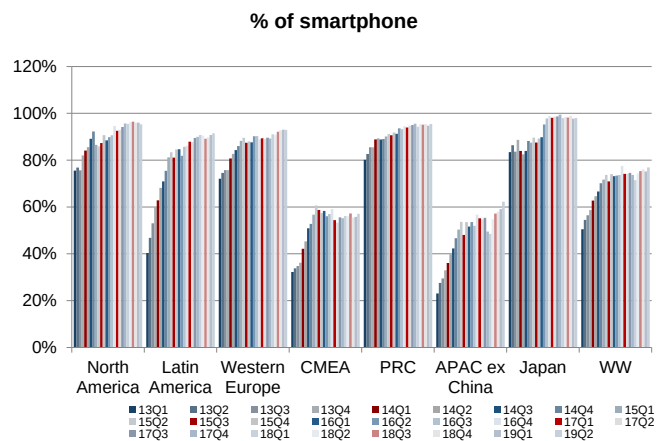
Source: IDC, Credit Suisse

Figure 12: Smartphone shipment volume by region



Source: IDC, Credit Suisse

Figure 13: Smartphone ratio by region



Source: IDC, Credit Suisse

iPhone production trend

Key takeaways

- iPhone production volume peaked at 248mn units (+31% YoY) in CY15, then totaled 226mn units (-9%) in CY16, 230mn units (+2%) in CY17, and 223mn units (-3%) in CY18. As of our current survey in early September, suppliers are evidently planning for production volume in CY19 to total 208mn units (-7%), versus an estimate of 203mn units (-9%) as of our previous June survey.
- On a quarterly basis, scheduled production for CY19 was as follows as of our June 2019 survey: Jan-Mar 37mn units (-51% QoQ, -28% YoY), Apr-Jun 38mn units (+2%, -4%), Jul-Sep 59mn units (+56%, -4%), and Oct-Dec 69mn units (+17%, -8%). As of the present survey (early September) it is as follows: Jan-Mar 37mn units (-51% QoQ, -28% YoY), Apr-Jun 34mn units (-8%, -14%), Jul-Sep 58mn units (+59%, +1%), and Oct-Dec 79mn units (+37%, +5%).
- Planned production for CY19 probably includes production volume brought forward into Oct-Dec to avoid higher US tariffs on China and to prepare for the Lunar New Year, which will start in late January in 2020.
- In 2020, Apple is likely to unveil a new iPhone SE model in early spring and three OLED models in autumn. We see a strong likelihood that the three OLED models will feature 5G compatibility (millimeter wave compatibility in Japan and the US in particular) from device point of view.

iPhone production schedule

Quarterly production volume: September figures above level for CY19 production, possibly being brought forward from Jan-Mar CY20

Quarterly iPhone production volume in CY18 was as follows: Jan-Mar 51mn units (-47% QoQ, +18% YoY), Apr-Jun 40mn units (-23%, -1%), Jul-Sep 57mn units (+44%, +14%), and Oct-Dec 76mn units (+33%, -22%).

Scheduled production for CY19 as of our June survey was as follows: Jan-Mar 37mn units (-51% QoQ, -28% YoY), Apr-Jun 38mn units (+2%, -4%), Jul-Sep 59mn units (+56%, -4%), and Oct-Dec 69mn units (+17%, -8%). As of the present survey (early September) it is as follows: Jan-Mar 37mn units (-51% QoQ, -28% YoY), Apr-Jun 34mn units (-8%, -14%), Jul-Sep 58mn units (+59%, +1%), and Oct-Dec 79mn units (+37%, +5%).

Planned production volume for CY19 is now 208mn units versus 203mn units in the June survey, which may include some volume being brought forward from Jan-Mar 2020.

On a full-year basis, iPhone production volume (typically 6-7% higher than shipment volume) peaked at 248mn units (+31% YoY) in CY15, then totaled 226mn units (-9%) in CY16, 230mn units (+2%) in CY17, and 223mn units (-3%) in CY18. At the time of our survey in March, Apple had not issued a production plan for the latter half of the year, but most suppliers expected CY19 production volume to total 180-190mn units. At the time of the previous survey in June, they were evidently planning for production volume of 203mn units (-9%), and as of the current survey in early September, plans call for 208mn units (-7%).

The uptick in production plans for Oct-Dec CY19 may include some volume being brought forward to avoid higher US tariffs on China, and to prepare for the Lunar New Year which will start relatively early in late January in 2020.

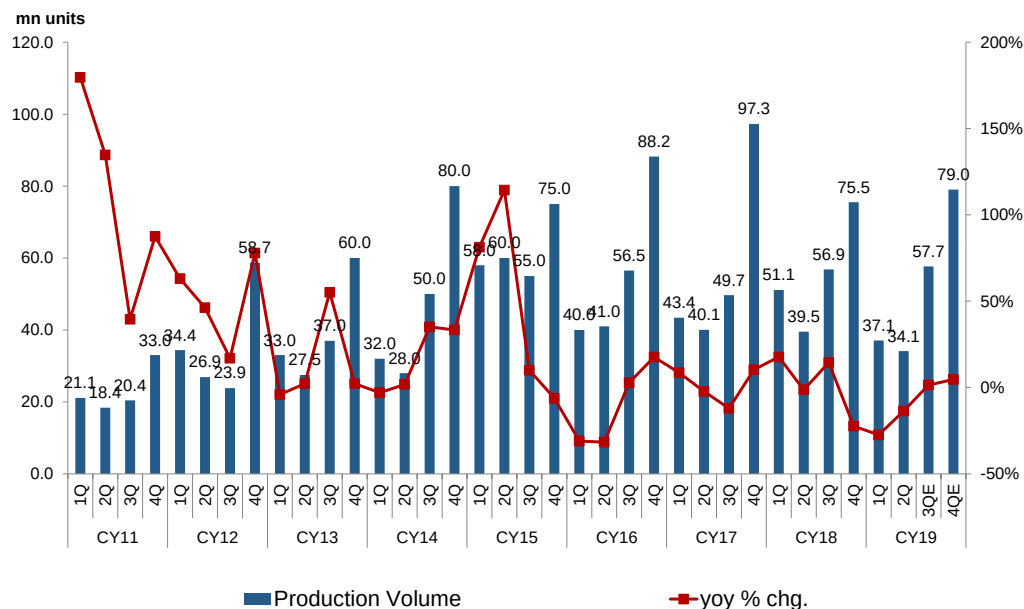
Production plans have not been presented for all of Jan-Mar 2020 yet, but it seems volume could decline to around 30mn units. Production of the new iPhone SE model is likely to start around March and ramp up volume from April, so parts demand could

temporarily weaken over the short term around January or February (company forecasted production volume in CY2020 is around 20mn units). As of Apr–Jun 2019, many parts manufacturers had noted demand being brought forward for mainly older models so trend is moving towards as expected.

However, it looks like volume is on pace to beat the 180–190mn units that had been forecast for CY19 (or FY3/20) by device makers around March.

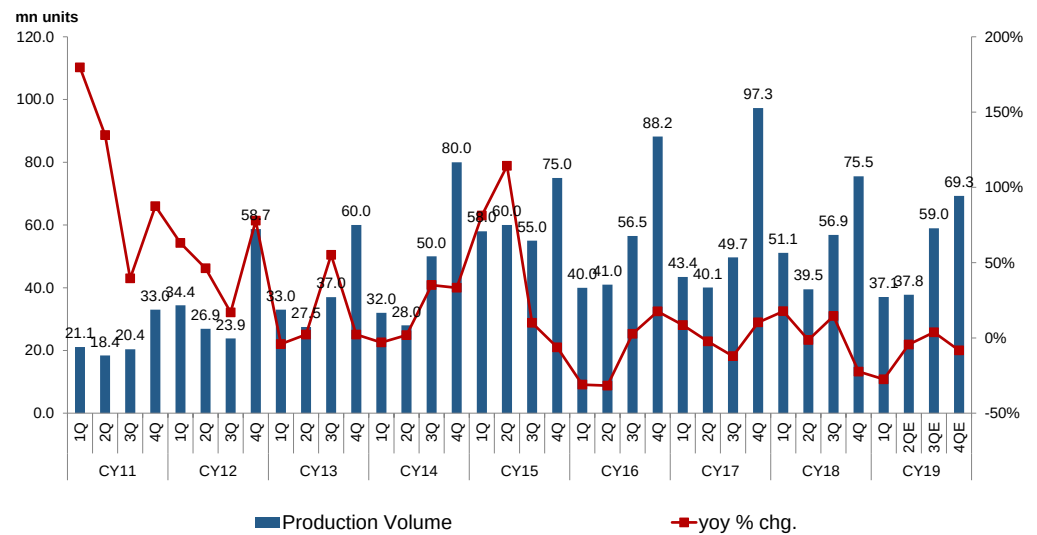
Our analyst covering Apple forecasts iPhone shipments will be 179mn units (~15% YoY) in 2019 versus 209mn units (~3%) in 2018 ([link](#)).

Figure 14: iPhone production volume forecast (as of early September 2019)



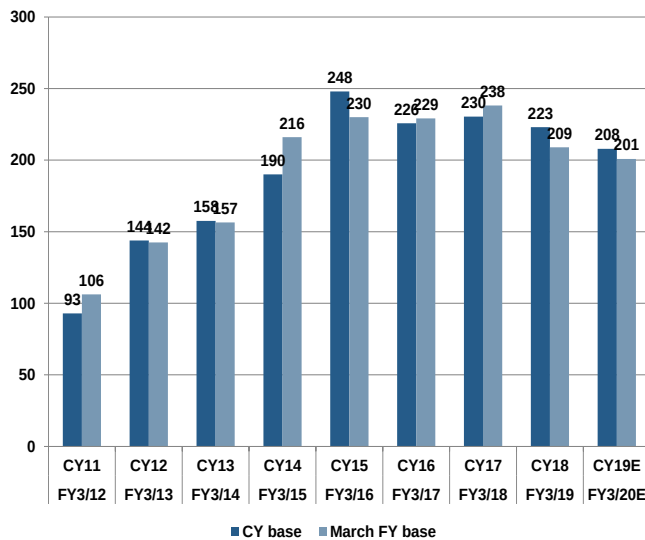
Source: Credit Suisse estimates

Figure 15: iPhone production volume forecast (as of early June 2019)



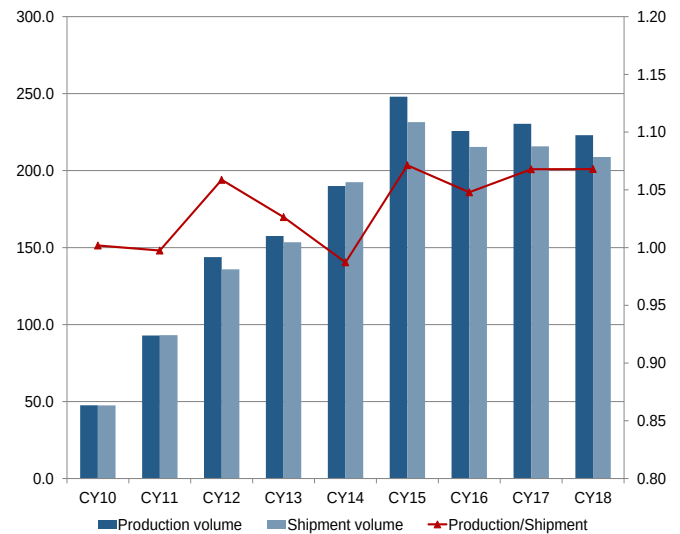
Source: Credit Suisse estimates

Figure 16: iPhone: Annual production volume (CY vs. Mar year-end basis; mn units)



Source: Credit Suisse estimates

Figure 17: iPhone: Shipment volume vs. production volume (mn units)



Source: Credit Suisse estimates

Trends by model

Older models: iPhone 6S/7 up; iPhone 7 Plus/8/8 Plus/X down slightly

The latest production forecasts by model are outlined below.

- There is no plan to produce the iPhone SE and iPhone 6/6 Plus in 2019. A new SE model is expected out in CY20, with mass production trials starting around March 2020 and ramping up from April for a release date sometime during Apr–Jun (The forecasted production volume in CY2020 is around 20mn units).
- **iPhone 6S/6S Plus:** CY18 production was 14.5mn units (Jan–Mar: 4.5mn, Apr–Jun: 2.5–3mn, Jul–Sep: 2mn, Oct–Dec: 5.5mn). The previous survey in June had 6mn units for Jan–Mar, 2mn for Apr–Jun, and 2mn for Jul–Sep, with EOL projected in Oct–Dec, but new estimates are 4–4.5mn units for Jan–Mar, 1–1.5mn for Apr–Jun, 2–2.5mn for Jul–Sep, and up to 0.5mn units for Oct–Dec, with EOL projected after November.
- **iPhone 7/7 Plus:** CY18 production was 18–18.5mn units (Jan–Mar: 5–5.5mn, Apr–Jun: 5–5.5mn, Jul–Sep: 4mn, Oct–Dec: 4mn). For CY19, the previous survey in June had 6mn units for Jan–Mar, 4mn for Apr–Jun, 5mn for Jul–Sep, and 4mn for Oct–Dec, for a total of 20mn units in CY19. New estimates are 6mn units for Jan–Mar, 4–4.5mn for Apr–Jun, 4.5–5mn for Jul–Sep, and 7mn units for Oct–Dec, for a total of 22mn units with production of the iPhone 7 in particular trending higher.
- **iPhone 8/8 Plus:** CY18 production was 66mn units (Jan–Mar: 20mn, Apr–Jun: 19mn, Jul–Sep: 15mn, Oct–Dec: 12mn). For CY19, the survey in June had around 8mn units for Jan–Mar, 6mn for Apr–Jun, 6mn for Jul–Sep, and 6mn for Oct–Dec, for a CY19 total of 26mn, but new estimates are around 8.5mn units for Jan–Mar, 5–5.5mn for Apr–Jun, 4.5–5mn for Jul–Sep, and 5.5–6mn for Oct–Dec, for a total of 25mn. The iPhone 8 series seems highly likely to reach EOL in late Jan–Mar or in Apr–Jun 2020.
- **iPhone X:** CY18 production totaled 29mn units (Jan–Mar: 11.5mn, Apr–Jun: 8.5mn, Jul–Sep: 4mn, Oct–Dec: 4.5mn). For CY19, the survey in June had 1mn units for Jan–Mar and 1mn for Apr–Jun, with EOL projected from Jul–Sep, whereas the latest survey has 1mn units for Jan–Mar and 0.5–1mn for Apr–Jun, with EOL projected from Jul–Sep.
- **iPhone XR:** CY18 production was 31mn units (Jul–Sep: 3mn, Oct–Dec: 28mn). For CY19, the survey in June had 10mn units for Jan–Mar, 15mn for Apr–Jun, 11mn for Jul–Sep, and 9mn for Oct–Dec, for a total of 44mn, but new estimates are 10mn units for Jan–Mar, 13.5mn for Apr–Jun, 11mn for Jul–Sep, and 12mn for Oct–Dec, for a total of 46mn. For devices with a long lead time, production since Apr–Jun 2019 is apparently based on parts already procured and held as inventory.
- **iPhone XS:** CY18 production was 20mn units (Jul–Sep: 11mn, Oct–Dec: 9mn). For CY19, the survey in June had 3mn units for Jan–Mar, 4mn for Apr–Jun, 2mn for Jul–Sep, and 2mn for Oct–Dec, for a total of 11mn units, whereas the latest survey has 2.5–3mn units for Jan–Mar, 3.5–4mn for Apr–Jun, 1.5mn for Jul–Sep, and 2.5–3mn for Oct–Dec, for a CY19 total of 10–11.5mn units.
- **iPhone XS Max:** CY18 production amounted to 27mn units (Jul–Sep: 14mn, Oct–Dec: 13mn). The survey in June had 3mn units for Jan–Mar, 5mn for Apr–Jun, 2mn for Jul–Sep, and EOL in Oct–Dec, for a CY19 total of 11mn, but new estimates are 3mn units for Jan–Mar, 5mn for Apr–Jun, 2–2.5mn for Jul–Sep, and EOL in Oct–Dec, for a CY19 total of 10mn.
- **New 2019 models in aggregate:** The June survey had projected production of less than 1mn units in Apr–Jun, 31mn in Jul–Sep (11: 15mn, 11 Pro: 7mn, 11 Pro Max: 9mn), and 48mn in Oct–Dec (24mn/10mn/14mn), for a CY19 total of 79mn units (39mn/17mn/23mn). The latest survey has zero units in Apr–Jun, 30mn units in Jul–

2019 and 2020 models

Apple announced new iPhone models on 10 September (US time) with unsurprising specs. For details, see our 11 September [report](#).

Our current view of likely specs for 2020 models is as follows.

- **Displays:** Our Japan tech team assumes four new models will be introduced in 2020, with a successor to the iPhone SE (LCD) in early Apr–Jun and three new OLED models in September.
- **Force sensor/Touch sensor:** The 2018 LCD models did not feature force sensors (the two OLED models did) and the 2019 OLED models will drop the sensors. For 2020 models, we see a high likelihood of out-cell touch sensors in the LCD models and two of the three OLED models (successors of 11 Pro and 11 Pro Max) featuring Y-OCTA technology.
- **Application processors:** As in our previous survey, we believe the A13 for 2019 models will be based on the 7nm Pro. Opinions were divided when it comes to the 2020 models. Some believed only the model with the largest display (the XI Max) will use a 5nm processor, with the remaining two models featuring 7nm+ processors. Others expected all three models to have 5nm processors. In our current survey, there seems to be a high confidence that the successor to the iPhone SE will have the A13 processor and the OLED models will all sport the 5nm A14 processor.
- **Cameras:** OLED models for 2019 will likely feature a triple-lens rear camera (12MP), and we expect the LCD models to be upgraded to a dual-camera configuration. For lens actuators and OIS, the LCD models will probably use Single OIS and fixed-focus actuators, and the OLED models should have Dual OIS and fixed-focus actuators. For the 2020 models, Apple is apparently considering CIS and larger lenses for the successor to the iPhone 11 Pro Max (CIS pitch of 1.6 μm , versus 1.44 μm currently), and it seems likely that the models will have AF actuators for the lenses and sensor-shift OIS. Also, if the new models are iPhone SE, they seem likely to have dual cameras and OIS and fixed focus actuators installed.
- **ToF:** We expect Direct ToF for rear-facing cameras to be adopted after 2020 rather than in 2019. Previously, we saw a strong likelihood that Indirect ToF would be adopted by Apple, but our most recent survey points to the likely use of Direct ToF.
- **DRAM:** We believe all three 2019 models will have 4GB, compared with 3GB for LCD models and 4GB for OLED models in 2018. We believe 2020 models will very likely feature 3GB for the iPhone SE successor, 4GB for 6.1-inch handsets and 6GB for 5.85-inch and 6.46-inch handsets. We surmise that Korean and Chinese smartphone manufacturers will use LP-DDR5 in their 2020 models but expect that Apple will not do so until after 2021.
- **NAND:** We see no change in installed capacity for the 2019 models. Apple is evaluating 1TB but is not expected to adopt it until after 2020.
- **Cellular:** Modems in 2019 models will not be 5G-compatible, but given that they will be sold for the next 2–3 years, some survey respondents think specs could be changed to the A13 processor with Qualcomm's Snapdragon X55 modem. In our previous survey, it was noted that some 2020 models could offer some 5G bandwidth, or that not all models would be 5G-compatible—only the 6.7-inch premium model. Our most recent survey indicates, however, that Apple is apparently considering having all new models except the iPhone SE be compatible with 5G, and the iPhone SE could also offer the same 5G compatibility as the 2019 model by the views from device makers. Basically, they would be compatible with sub-6GHz frequencies, but Apple is apparently

considering millimeter wave compatibility for Japan and the US, for example. However, BOM cost is likely to increase almost \$50 to gain millimeter wave compatibility.

Figure 20: iPhone specifications

	iPhone7	iPhone7 Plus	iPhone SE	iPhone8 4.7"	iPhone8 5.5"	iPhone X 5.8"	iPhone XS	iPhone XS Max	iPhone XR	iPhone 11	iPhone 11 Pro	iPhone 11 Pro Max
Announce	9/7/2016	9/7/2016	3/21/2017	9/12/2017	9/12/2017	9/12/2017	9/12/2018	9/12/2018	9/12/2018	2019/09/10	2019/09/10	2019/09/10
Release	9/16/2016	9/16/2016	3/21/2017	9/22/2017	9/22/2017	11/9/2017	9/21/2018	9/21/2018	10/26/2018	2019/9/20	2019/9/20	2019/9/20
Height (mm)	138.3	158.2	123.8	138.4	158.4	143.6	143.6	157.5	150.9	150.97	144	158
Width (mm)	67.1	77.9	58.6	67.3	78.1	70.9	70.9	77.4	75.7	75.7	71.4	77.8
Thickness (mm)	7.1	7.3	7.6	7.3	7.5	7.7	7.7	7.7	8.3	8.3	8.1	8.1
Weight (g)	138	188	113	148	202	174	177	208	194	194	188	226
Display size (inch)	4.7" in-cell	5.5" in-cell	4"	4.7" in-cell	5.5" in-cell	5.8" OLED Film TouchForce Notch (3D sensor)	5.8" OLED	6.5" OLED	6.1" LCD	6.1" LCD	5.8" OLED	6.5" OLED
Display resolution (px)	1334x750px	1920x1080px	h	1334x750px	1920x1080px	2436x1125px	2436x1125px	2688x1242px	1792x828px	1792x828px	2436x1125px	2688x1242px
Display (ppi)	326ppi	401ppi	326ppi	326ppi	401ppi	458ppi	458ppi	458ppi	326ppi	326ppi	458ppi	458ppi
Camera (main)	12MP OIS	12MP OIS (Wide Angle) 12MP VCM (Telephoto)	12MP	12MP OIS	12MP OIS (Wide Angle) 12MP VCM (Telephoto)	12MP OIS (Wide Angle) 12MP OIS (Telephoto)	12MP OIS (Wide Angle) 12MP OIS (Telephoto)	12MP OIS (Wide Angle) 12MP OIS (Telephoto)	12MP OIS	12MP OIS (Wide Angle OIS) 12MP (Ultrawide)	12MP (Wide Angle OIS) 12MP (telephoto OIS) 12MP (Ultrawide)	12MP (Wide Angle OIS) 12MP (telephoto OIS) 12MP (Ultrawide)
	F1.8	Wide-Angle F1.8 Telephoto F2.8	F2.2, 1/3", 1.22 µm	F1.8	Wide-Angle F1.8 Telephoto F2.8	Wide-Angle F1.8 Telephoto F2.4	Wide-Angle F1.8 Telephoto F2.4	Wide-Angle F1.8 Telephoto F2.4	F1.8	Wide-Angle F1.8 Ultrawide F2.4	Wide-Angle F1.8 Telephoto F2.0 Ultrawide F2.4	Wide-Angle F1.8 Telephoto F2.0 Ultrawide F2.4
Camera (front)	7MP	7MP	1.2M	7MP	7MP	7MP Face ID	7MP Face ID	7MP Face ID	7MP Face ID	12MP TOF 3D camera Face ID	12MP TOF 3D camera Face ID	12MP TOF 3D camera Face ID
Wifi	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Wi-Fi 802.11 a/b/g/n/ac, hotspot	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Dual band 802.11a/b/g/n/ac Wi-Fi (MIMO)	Dual band 802.11 a/b/g/n/ac/ax Wi-Fi (MIMO)	Dual band 802.11 a/b/g/n/ac/ax Wi-Fi (MIMO)	Dual band 802.11 a/b/g/n/ac/ax Wi-Fi (MIMO)
Bluetooth	Bluetooth 4.2	Bluetooth 4.2	Bluetooth 4.2	Bluetooth 5.0	Bluetooth 5.0	Bluetooth 5.0	Bluetooth 5.0	Bluetooth 5.0	Bluetooth 5.0	Bluetooth 5.0	Bluetooth 5.0	Bluetooth 5.0
CPU clock	Quad Core A10 2x Hurricane + 2x Zephyr		A9	Hexa Core (Quad + Dual Core) A11 Bionic Chip			A12 Bionic Chip			A13 Bionic Chip (7 nm+)		
CPU Core	64bit	64bit	64bit	64bit	64bit	64bit	64bit	64bit	64bit	64bit	64bit	64bit
CPU Die size	125 sqmm	125 sqmm	96 sqmm	NA	NA	NA	NA	NA	NA	NA	NA	NA
GPU Core	NA	NA	PowerVR GT7600 (six-core graphics)	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAND	32/128/256GB		16/32/64/128GB	64GB/256GB			64/256/512GB		64GB/128GB/256GB	64/128/256GB	64/256/512 GB	64/256/512 GB
DRAM	2GB	3GB	2GB	2GB	3GB	3GB	4GB	4GB	3GB	4 GB	4 GB	4 GB
Battery capacity	1960 mAh	2900 mAh	1642 mAh	1821mAh	2691mAh	2716mAh	2658mAh	3,174mAh	2942mAh	NA	NA	NA
Casing	Aluminum (jet black/black/rose gold/gold/silver)	Aluminum (jet black/black/rose gold/gold/silver)	Aluminum (rose gold/space grey/gold/silver)	Main Body Glass Accents Aluminum	Main Body Glass Accents Aluminum	Main Body Glass Accents Aluminum	Stainless (Gold, Silver)	Stainless (Gold, Silver)	Aluminum (Red, Yellow, White, Coral, Black, Blue)	Main body glass, aluminum frame (Black, Green, Yellow, Purple, Red, White)	Main body glass, aluminum frame (Space Gray, Silver, Gold, Midnight Green)	Main body glass, aluminum frame (Space Gray, Silver, Gold, Midnight Green)

Source: Company data, Credit Suisse

Samsung Electronics smartphone production: Outlook slightly scaled back

Key takeaways

- Samsung's 2019 smartphone production plan calls for flat volume YoY of 293mn units. For a time, the company had indicated to device makers that it may raise its production volume to around 320mn units following the sanctions on Huawei, but volume outlook appears to have eventually settled at just 300mn units.
- Heading into 2020, most observers see Samsung production hinging on Huawei's sales trend outside of China.
- Faster adoption of multi-camera models

Samsung production schedule

Quarterly production trends

In CY17, Samsung's smartphone production volume totaled roughly 80mn units (+1% QoQ, unchanged YoY) in Jan–Mar, 80mn (–1%, +5%) in Apr–Jun, 87mn (+9%, +16%) in Jul–Sep, and 73.5mn (–15%, –8%) in Oct–Dec.

In CY18, production volume was 78mn units (–4% YoY, +6% QoQ) in Jan–Mar, 70mn (–11%, –10%) in Apr–Jun, 71mn (–19%, +1%) in Jul–Sep, and 70mn (–4%, –1%) in Oct–Dec.

Samsung's CY19 volume outlook as of our June survey was 69mn units (–11% YoY, –2% QoQ) in Jan–Mar, 79mn (+13%, +14%) in Apr–Jun, 72mn (+3%, –8%) in Jul–Sep, and 69mn (–2%, –5%) in Oct–Dec, but as of our latest survey in September, Samsung's volume outlook stands at 69mn (–11% YoY, –2% QoQ) in Jan–Mar, 79mn (+13%, +14%) in Apr–Jun, 80mn (+13%, +1%) in Jul–Sep, and 67mn (–5%, –16%) in Oct–Dec.

Production on pace for just over 290mn units in CY19

Samsung's annual smartphone production volume totaled 311mn (–3% YoY) in CY16, 320mn (+3%) in CY17, and 289mn (–10%) in CY18. As of June, Samsung's CY19 production plan called for 290mn. The company had briefly indicated to device makers prospects for raising its production volume to around 320mn units after sanction were announced on Huawei, but as of our latest survey, Samsung's volume outlook appears to have settled at 294mn (+2% YoY).

In CY18, production volume of the Galaxy S9 totaled 34mn, Galaxy S8 13mn, Galaxy Note 9 11mn, Galaxy Note 8 4mn. The combined production volume totaled 63mn for the Galaxy S and Note series, 36mn for the A series, and 145mn for the J series.

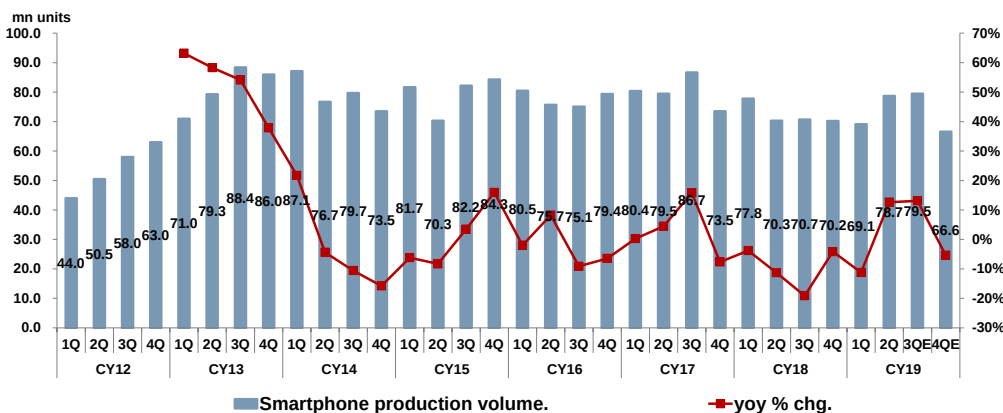
As of our June survey, Samsung's CY19 production plan by model was the Galaxy S10 34–35mn and Galaxy Note 10 11mn, 45mn for the Galaxy S and Note series combined, over 170mn for the A series, and around 50mn for the J series. As of our latest survey, Samsung's revised production plan calls for 33–34mn for the Galaxy S10 series, 12mn for the Galaxy Note 10, just over 180mn for the A series, just over 45mn for the J series, and just under 9mn for the M series.

For CY20, most observers believe Samsung's production volume will hinge on Huawei's sales trend outside of China. Samsung's sales registered a one-off increase after the US government announced sanctions on Huawei, but we understand Huawei's market share is recovering gradually, mainly in Europe. However, Huawei may have to continue selling old models if it loses access to Google Mobile Services for its new models in 2020. We

believe this could hit the company's competitiveness. In light of the above, we see Huawei's sales situation having a sizable impact on Samsung's CY20 production volume.

Keon Han, our analyst covering Samsung Electronics, forecasts total smartphone shipment volume of 293mn units in CY19 ([link](#)).

Figure 21: Samsung: Smartphone production forecasts



Source: Credit Suisse estimates

Trends by model

Premium models: Production down YoY

Combined production volume for the premium Galaxy S and Note series was 21mn units in Jan–Mar CY18 (+38% QoQ, +94% YoY), 13mn in Apr–Jun (–39%, –45%), 16mn in Jul–Sep (+27%, –4%), and 13mn in Oct–Dec (–18%, –13%), for a yearly total of 63mn (–5% YoY). Volume by model was 49mn for the S series, 14.1mn for the Note series, with 33–34mn S9s and 10–11mn Note 9s produced.

As of our June survey, Samsung's CY19 production plan for premium models was 18mn in Jan–Mar (+38% QoQ, –12% YoY), 11mn in Apr–Jun (–42%, –16%), 15mn in Jul–Sep (–36%, –10%) and 11mn in Oct–Dec (–26%, –19%) for a combined annual total of around 55mn (–14% YoY) including 35mn for the Galaxy S10 series and 10.5mn for the Note 10 series. As of our latest survey, Samsung revised its production outlook for premium models to 18mn in Jan–Mar (+38% QoQ, –12% YoY), 11mn in Apr–Jun (–42%, –16%), 14mn in Jul–Sep (+32%, –13%) and 10mn in Oct–Dec (–29%, –25%) for a combined annual total of around 53mn (–16% YoY) including 33–34mn for the Galaxy S10 series and 12mn for the Note 10 series. Overall, production volume of older premium models declined in 2019 versus a year earlier.

Galaxy Note 10 upbeat, but production of S10 and older models muted

For the Galaxy S10 series, our March survey indicated production of around 13.5–14mn in Jan–Mar, 12–12.5mn in Apr–Jun for a total of roughly 26mn in Jan–Jun CY19 which would have the S10 trending more than 20% above the S9's 21mn units in Jan–Jun CY18.

In our June survey, we reported a production outlook of 14mn in Jan–Mar, 9mn in Apr–Jun, 6mn in Jul–Sep, and 6mn in Oct–Dec, for a combined total of 35mn in CY19, but indicated that volume would track in line with or below S9's CY18 volume due to a sharp demand slowdown from Apr–Jun. Our latest survey shows a production outlook of 13.5mn

in Jan–Mar, 9mn in Apr–Jun, 5.5–5.7mn in Jul–Sep, and 5–5.5mn in Oct–Dec, for a combined total of 33.5mn in CY19, which puts it on par with S9’s CY18 production volume.

On the other hand, our latest survey shows Samsung rolling out small-lot production for the Note 10 series starting in June, with volume outlook of 7.5mn in Jul–Sep and 4–4.5mn in Oct–Dec and a combined total of 11.5–12mn over CY19. This puts the Note 10 production volume more than 10% above the Note 9’s 10.5mn units in CY18.

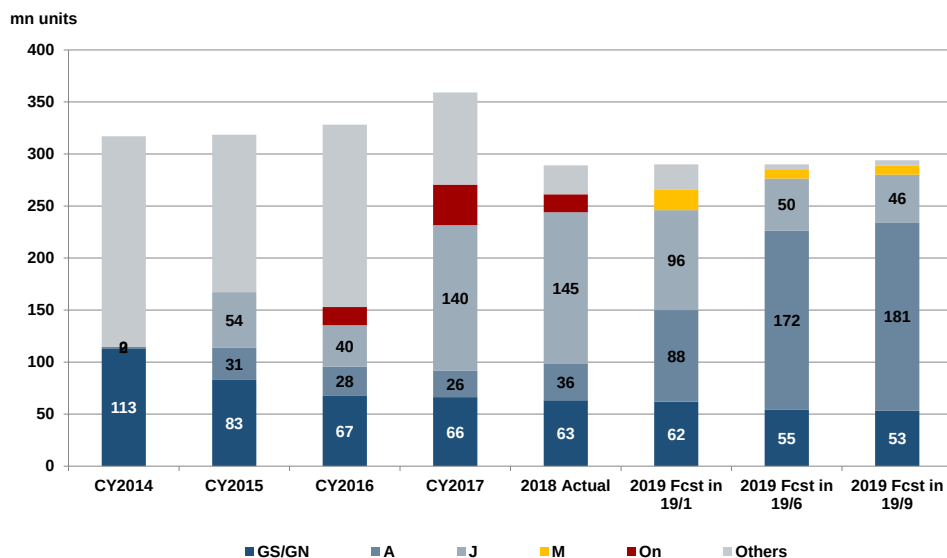
A-series output centered on A10 and A20 models

Samsung’s CY18 production of non-premium smartphones totaled 36mn units (+39% YoY) for the A series, 145mn (+4%) for the J series, 17mn (–56%) for the ON series, and 30mn (–40%) for others.

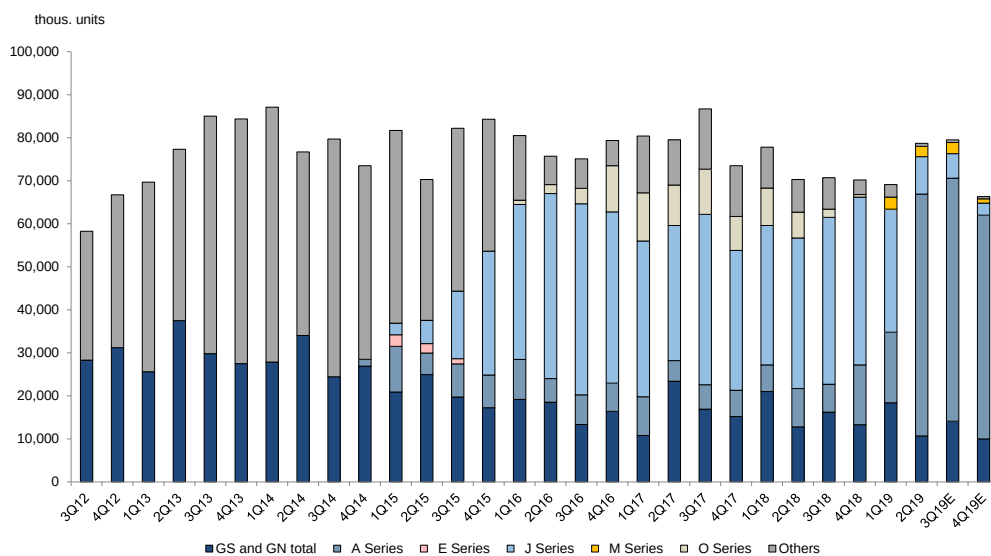
Initial plans for CY19 targeted annual output of 88mn units (+148% YoY) for the A series, 96mn (–34%) for the J series, and 20mn for the M series (launched in CY19), but our March survey already showed the A series surging to 52mn units in Apr–Jun from 13mn in Jan–Mar. In our June survey, we reported non-premium smartphone production volume outlook of roughly 170mn for the A series, 50mn for the J series, 8mn for the M series, and roughly 5mn for others. Our latest survey shows annual volume outlook of 181mn for the A series, 46mn for the J series, 9mn for the M series, and 5mn for others.

As of our June survey, production plan for the A series called for 16mn in Jan–Mar, 57mn in Apr–Jun, around 49mn in Jul–Sep, 50mn in Oct–Dec, and a combined annual total of 170mn in CY19, but our latest survey shows production outlook of 16mn in Jan–Mar, 56mn in Apr–Jun, 57mn in Jul–Sep, 52mn in Oct–Dec, and a combined annual total of 181mn in CY19.

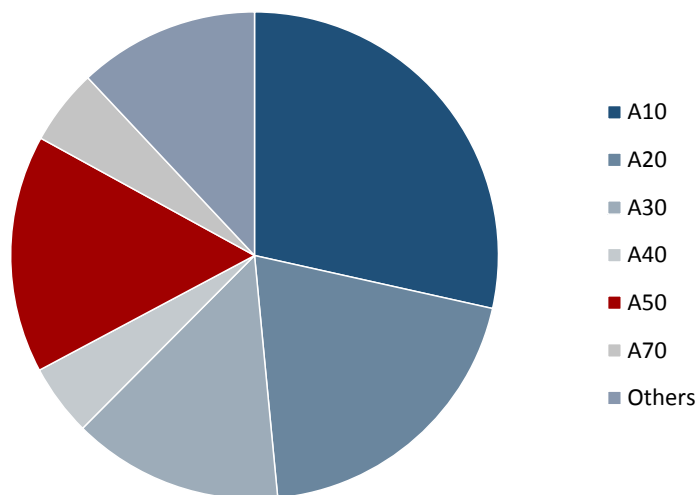
A breakdown of A-series production in CY19 by model shows the A10 series at over 50mn, the A20 series at over 35mn, the A50 series at just under 30mn, the A30 series at 25mn, with the lower-end A10–30 series accounting for roughly 60% of overall A series production. Conversely, the production outlook for the higher-end A70, A80, and A90 series is just around 30mn in total.

Figure 22: Smartphone production trend by models (annual)

Source: Credit Suisse estimates

Figure 23: Smartphone production trend by models (quarterly)

Source: Credit Suisse estimates

Figure 24: A series mode mix (production units base)

Source: Credit Suisse estimates

Samsung Electronics – Key points

Samsung's smartphone business: We note the following focal points for device makers.

Growth in consignment production of the low-end A series to a Chinese ODM

Samsung put smartphone consignment production on the main track starting with the 2019 model A10s and A20s to a Chinese ODM (Wingtech). The scale of consignment production is expected at around 20–25mn units in 2019.

ODMs will reportedly handle component selection and procurement for consigned models. We understand MediaTek's Helio P22 is currently used in the A10s and that a Qualcomm AP will be used in the A20s.

While some observers expect annual ODM production to reach 100mn units in CY20 (total A10 and A20 volume) on the Chinese side, observers in Korea expect annual ODM volume to total around 40mn. As device procurement channels will differ based on the choice of ODM or in-house production, we think it is necessary to monitor trends for devices related to Samsung's A10 and A20 series.

Cameras, CMOS Image Sensors (CIS): Multi-camera smartphones gaining momentum

The proportion of Samsung phones with multi-cameras (rear cameras) rose from 3% in CY17 to 21% in CY18. By quarter, the CY18 ratio climbed from 12% in Jan–Mar CY18, to 14% in Apr–Jun, 26% in Jul–Sep, and 35% in Oct–Dec.

We note a further acceleration in the ratio of multi-camera phones since the start of CY19. In Jan–Mar, the ratio of rear multi-camera phones reached 52% (26% dual cameras and 24% triple cameras). In Apr–Jun, the ratio increased to 59% (31% and 28%). Triple camera adoption has grown markedly since the start of 2H CY19 and has now broadened to include the A30 series.

Triple camera systems on flagship smartphones, like those on iPhones, are evolving toward a large sensor with larger pitch consisting of a combination of 12MP/12MP/16MP cameras.

Samsung is apparently considering a 108MP sensor for the high-end A Series phones in CY20. A 108MP sensor made by Samsung LSI was first used by Xiaomi, but the 108MP

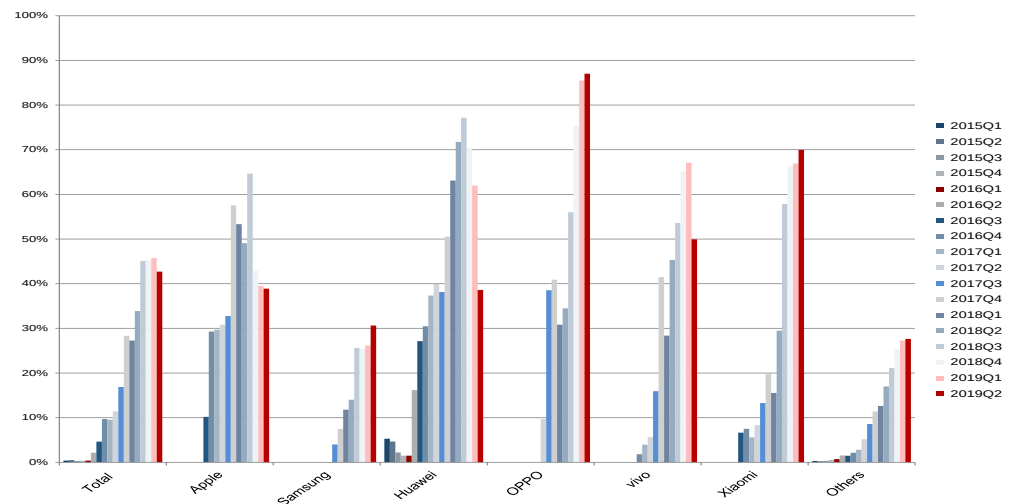
CIS to be used on Samsung smartphones will apparently come with the new ISOCELL image sensor that offers better specs.

In CY19, triple-cameras on the high-end A series consist of 48MP+8MP+5MP units. The range will likely include 64MP+12MP+5MP/2MP cameras in CY20.

We believe Samsung is also examining the use of folded optics in CY20.

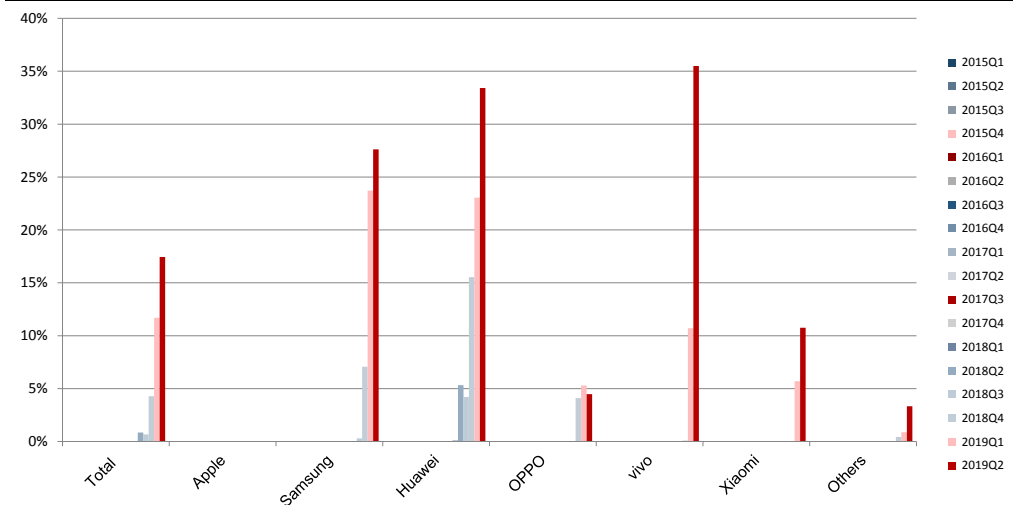
As only four models introduced in CY19 were non-multi-camera smartphones, we look for a rapid increase in the ratio of multi-camera devices heading into CY20.

Figure 25: Rear Dual Camera ratio

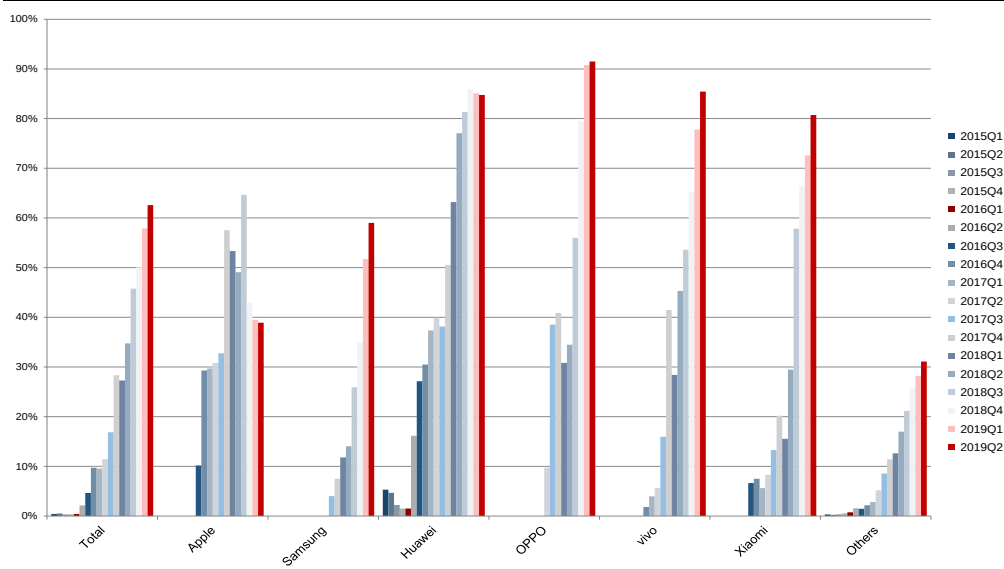


Source: IDC, Credit Suisse

Figure 26: Rear Triple Camera ratio



Source: IDC, Credit Suisse

Figure 27: Rear Multi Camera ratio (Dual, Triple, Quad, Quint, Six cameras)

Source: IDC, Credit Suisse

Application processor and 5G trends

In the premium category, the Galaxy S9 and S9 Plus use the 10nm LPP-based Exynos 9810, and SDM845 (models in the S8-series featured either the Exynos 8895 or SDM835 based on the 10nm LPE process). The S10 uses the Exynos 9820, now at the 8nm node, or the Qualcomm SDM855, a 7nm AP.

The Galaxy Note 10 is equipped with the 7nm Exynos 9825 or SDM855 (with the S5100 modem on the Exynos and an X50 modem on the SDM, both for 5G compatibility).

Among CY19 A-series models, the high-end and 5G models are powered by SDM855, 730, and 675, while the midrange and low-end models mainly use the Exynos 9610, 7885, and 7884 chipsets.

Among CY19 models announced so far, the high-end A series models (A60 and above) use Qualcomm chipsets, while the midrange and low-end A series models and the M series use Exynos chipsets exclusively. Meanwhile, flagship models use either Exynos or Qualcomm chipsets. The Exynos installation rate appears to be on the rise at Samsung LSI.

It appears the flagship Galaxy S11 will come in both 4G LTE and 5G versions. Models based on the Exynos chipset will use a similar combination as the Galaxy Note 11, while models based on the Qualcomm chipset will apparently use the SDM865 (4G) or SDM865+X55 (5G).

Also, the startup of the Exynos 9630, an 8nm AP for midrange 5G models, is likely from 4Q CY19.

At present, Samsung expects to manufacture around 30–40mn 5G models in CY20, mainly Galaxy S and Galaxy Note phones. Given Samsung's low market share in China, a country that looks highly likely to bring forward its 5G launch, we see the company potentially lagging Chinese smartphone makers in the shift to 5G.

Others

Samsung is considering 16GB DRAM on some Galaxy S11 models.

Figure 28: Samsung Galaxy S/N/A/C/J/E series lineup (2018 and 2019)

Model 2019	Size	PPI	Display Technology	AP Makers	Cores	Memory Embedded NAND	SD Slot	DRAM	Battery mAh	Camera Rear MP	Camera Front MP	USB
Major Model in CY19												
Galaxy Note10	6.3	401	Dynamic AMOLED	Exynos9825/SDM855	8	256GB	N/A	8GB	3500	12MP/12MP/16MP	10MP	Type-C
Galaxy Note10 5G	6.3	401	Dynamic AMOLED	Exynos9825/SDM855	8	256GB	N/A	12GB	3500	12MP/12MP/16MP	10MP	Type-C
Galaxy Note10+	6.8	498	Dynamic AMOLED	Exynos9825/SDM855	8	256GB/512GB	up to 1TB	12GB	4300	12MP/12MP/16MP/TOF	10MP	Type-C
Galaxy Note10+ 5G	6.8	498	Dynamic AMOLED	Exynos9825/SDM855	8	256GB/512GB	up to 1TB	12GB	4300	12MP/12MP/16MP/TOF	10MP	Type-C
Galaxy S10e	5.8	438	Dynamic AMOLED	Exynos 9820/SDM855	8	128GB/256GB	up to 512 GB	6/8GB	3100	12MP/16MP	10MP	Type-C
Galaxy S10	6.1	550	Dynamic AMOLED	Exynos 9820/SDM855	8	128GB/512GB	up to 512 GB	8GB	3400	12MP/12MP/16MP	10MP	Type-C
Galaxy S10+	6.4	522	Dynamic AMOLED	Exynos 9820/SDM855	8	128GB/512GB/1TB	up to 512 GB	8/12GB	4100	12MP/12MP/16MP	10MP/8MP	Type-C
Galaxy S10 5G	6.7	502	Dynamic AMOLED	Exynos 9820/SDM855	8	256GB	N/A	8GB	4500	12MP/12MP/16MP	10MP/TOF	Type-C
Galaxy Fold	7.3	414	Dynamic AMOLED (main), Super AMOLED (cover)	SDM855	8	512GB	N/A	12GB	4380	12MP/12MP/16MP	10MP/8MP(main), 8MP(cover)	Type-C
Galaxy A90 5G	6.7	393	Super AMOLED	SDM855	8	128GB	up to 512 GB	6/8GB	4500	48MP/8MP/5MP	32MP	Type-C
Galaxy A80	6.7	393	Super AMOLED	SDM730	8	128GB	N/A	8GB	3700	48MP/8MP/TOF	Motorized pop-up, rotating main camera	Type-C
Galaxy A70	6.7	393	Super AMOLED	SDM675	4	128GB	up to 1 TB	6/8GB	4500	32MP/8MP/2MP	32 MP	Type-C
Galaxy A60	6.3	409	PLS TFT	SDM 675	4	128GB	up to 1 TB	6 GB	3500	32MP/8MP/5MP	16 MP	Type-C
Galaxy A50	6.4	403	Super AMOLED	Exynos 9610	8	64GB/128GB	up to 512 GB	4/6GB	4000	25MP/8MP/5MP	25MP	Type-C
Galaxy A50s	6.4	403	Super AMOLED	Exynos 9610	8	64GB/128GB	up to 1 TB	4/6GB	4000	48MP/8MP/5MP	32 MP	Type-C
Galaxy A40	5.9	437	Super AMOLED	Exynos 7885	8	64 GB	up to 1 TB	4 GB	3100	16MP/5MP	25MP	Type-C
Galaxy A30	6.4	403	Super AMOLED	Exynos 7885	8	32GB/64GB	up to 512 GB	3/4GB	4000	16MP/5MP	16MP	Type-C
Galaxy A30s	6.4	268	Super AMOLED	Exynos 7885	8	32GB/64GB/128GB	up to 1TB	3/4GB	4000	25MP/8MP/5MP	16MP	Type-C
Galaxy A20	6.4	268	Super AMOLED	Exynos 7884	8	32 GB	up to 1 TB	3GB	4000	13MP/5MP	8MP	Type-C
Galaxy A20e	5.8	296	PLS TFT	Exynos 7884	8	32 GB	up to 1 TB	3GB	3000	13MP/5MP	8MP	Type-C
Galaxy A10	6.2	271	IPS LCD	Exynos 7884	8	32GB	up to 512 GB	2GB	3400	13MP	5MP	micro USB
Galaxy A10e	5.8	295	PLS TFT	Exynos 7884	8	32GB	up to 512 GB	2GB	3000	8MP or 5MP	5MP or 2MP	micro USB
Galaxy A10s	6.2	271	IPS LCD	MT6762 Helio P22	8	32GB	up to 512 GB	2GB	4000	13MP/2MP	8MP	micro USB
Galaxy A2 Core	5.0	220	IPS LCD	Exynos 7870	8	8/16GB	up to 1 TB	1GB	2600	5MP	5MP	micro USB
Galaxy M10	6.2	270	PLS TFT	Exynos 7870	8	16GB/36GB	up to 512 GB	2/3GB	3400	13MP/5MP	5MP	micro USB
Galaxy M20	6.3	409	PLS TFT	Exynos 7904	8	32GB/64GB	up to 512 GB	3/4GB	5000	13MP/5MP	8MP	Type-C
Galaxy M30	6.4	394	Super AMOLED	Exynos 7904	8	64GB/128GB	up to 512 GB	4/6GB	5000	13MP/5MP/5MP	16MP	Type-C
Galaxy M30s	6.4	411	Super AMOLED	Exynos 9610	8	64/128GB	up to 1 TB	4/6GB	6000	48MP/8MP/5MP	16MP	Type-C
Galaxy X Cover 4s	5.0	294	PLS TFT	Exynos 7885	8	32GB	up to 1 TB	3GB	2800	16MP	5MP	Type-C
Major Model in CY18												
Galaxy S9	5.8	570	Super AMOLED	Exynos 9810/SDM845	8	64GB/128GB/256GB	up to 400GB	4GB	3000	12MP	8MP	Type-C
Galaxy S9+	6.2	529	Super AMOLED	Exynos 9810/SDM845	8	64GB/128GB/256GB	up to 400GB	6GB	3500	12MP/12MP	8MP	Type-C
Galaxy Note9	6.4	516	Super AMOLED	Exynos 9810/SDM845	8	128GB/512GB	up to 512GB	6GB/8GB	4000	12MP/12MP	8MP	Type-C
Galaxy S light Luxury	5.8	426	Super AMOLED	SDM660	8	64GB	up to 400GB	4GB	3000	16MP	8MP	Type-C
Galaxy A9 (2018)	6.3	392	Super AMOLED	SDM660	8	128GB	up to 512GB	6/8GB	3800	5MP/8MP/10MP/24MP	24MP	Type-C
Galaxy A8s	6.4	403	IPS-LCD	SDM710	8	128GB	up to 512GB	6/8GB	3400	24MP/10MP/5MP	NA	Type-C
Galaxy A8 Star	6.3	392	Super AMOLED	SDM660	8	64GB	up to 400GB	4GB	3700	24MP/16MP	24MP	Type-C
Galaxy A8 (2018)	5.6	441	Super AMOLED	Exynos 7885	8	32GB/64GB	up to 256GB	4GB	3000	16MP	16MP/8MP	Type-C
Galaxy A8+ (2018)	6.0	411	Super AMOLED	Exynos 7885	8	32GB/64GB	up to 256GB	4GB/6GB	3500	16MP	16MP/8MP	Type-C
Galaxy A7 (2018)	6.0	411	Super AMOLED	Exynos 7885	8	64GB/128GB	up to 512GB	4GB/6GB	3300	5MP/8MP/24MP	24MP	micro USB
Galaxy A6s	6.0	402	Super AMOLED	SDM660	8	64GB/128GB	up to 512GB	6GB	3300	2MP/12MP	12MP	Type-C
Galaxy A6+ (2018)	6.0	411	Super AMOLED	SDM450	8	32GB/64GB	up to 256GB	3GB/4GB	3500	16MP/5MP	24MP	micro USB
Galaxy A6 (2018)	5.6	294	Super AMOLED	Exynos 7870	8	32GB/64GB	up to 256GB	3GB/4GB	3000	16MP	16MP	micro USB
Galaxy J8	6.0	274	Super AMOLED	SDM450	8	64GB	up to 256GB	4GB	3500	16MP/5MP	16MP	micro USB
Galaxy J7 (2018)	5.5	267	Super AMOLED	NA	NA	NA	NA	NA	NA	13MP	13MP	micro USB
Galaxy J7 Duo	5.5	267	Super AMOLED	Exynos 7885	8	32GB	up to 256GB	4GB	3000	13MP/5MP	8MP	micro USB
Galaxy J6+	6.0	274	TFT-LCD	MSM8917	4	32GB/64GB	up to 512GB	3GB/4GB	3300	13MP/5MP	8MP	micro USB
Galaxy J6	5.6	294	Super AMOLED	Exynos 7870	8	32GB/64GB	up to 256GB	3GB/4GB	3000	13MP	8MP	micro USB
Galaxy J4+	6.0	274	TFT-LCD	MSM8917	4	16GB/32GB	up to 512GB	2GB/3GB	3300	13MP	5MP	micro USB
Galaxy J4	5.5	267	Super AMOLED	Exynos 7570	4	16GB	up to 256GB	2GB	3000	13MP	5MP	micro USB
Galaxy J4 Core	6.0	274	TFT-LCD	MSM8917	4	16GB	up to 512GB	1GB	3300	8MP	5MP	micro USB
Galaxy J3 (2018)	5.0	294	TFT-LCD	Exynos 7570	4	16GB	up to 256GB	2GB	2600	8MP	5MP	micro USB
Galaxy J7 Prime2	5.5	401	TFT-LCD	Exynos 7870	8	32G	up to 256GB	3GB	3300	13MP	13MP	micro USB
Galaxy J2 Pro (2018)	5.0	220	Super AMOLED	MSM8917	4	16GB	up to 256GB	1.5GB	2600	8MP	5MP	micro USB
Galaxy J2 Core	5.0	220	Super AMOLED	Exynos 7570	4	8GB	up to 256GB	1GB	2600	8MP	5MP	micro USB
Galaxy On7 Prime	5.5	401	TFT-LCD	Exynos 7880	8	64GB	up to 256GB	4GB	3300	13MP	13MP	micro USB
Galaxy On6	5.6	294	Super AMOLED	Exynos 7870	8	32GB/64GB	up to 256GB	3GB/4GB	3000	13MP	8MP	micro USB

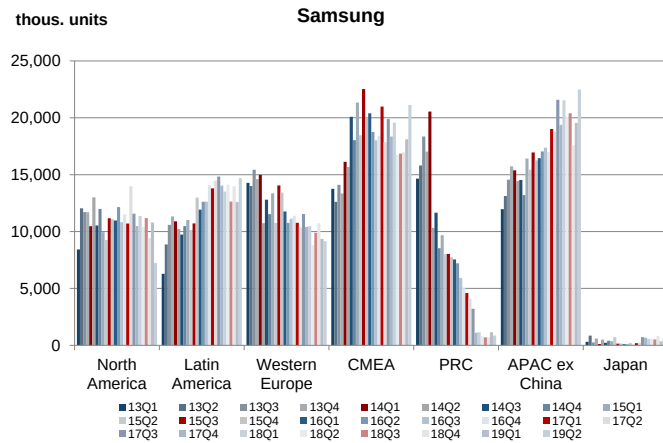
Source: Company data, Credit Suisse

Figure 29: Galaxy S/N series specification

	Galaxy S9	Galaxy S9 Plus	Galaxy Note9	Galaxy S10	Galaxy S10 Plus	Galaxy S10e	Galaxy S10 5G	Galaxy Fold	Galaxy Note10	Galaxy Note10 5G	Galaxy Note10+	Galaxy Note10+ 5G
Announce	2018/2	2018/2	2018/8	2019/2	2019/2	2019/2	2019/2	2019/2	2019/8	2019/8	2019/8	2019/8
Height (mm)	147.7	158.1	151.9	149.9	157.6	142.2	162.6	-	151	151	162.3	162.3
Width (mm)	68.7	73.8	76.4	70.4	74.1	69.9	77.1	-	71.8	71.8	77.2	77.2
Thickness (mm)	8.5	8.5	8.8	7.8	7.8	7.9	7.9	-	7.9	7.9	7.9	7.9
Weight (g)	163	189	201	157	175 g / 198 g (ceramic)	150	198	-	168	168	196	198
Main Body	Glass	Glass	Glass	Glass	Glass	Glass	Glass	-	Glass	Glass	Glass	Glass
Display size (inch)	5.8"	6.2"	6.4"	6.1"	6.4"	5.8"	6.7"	Main display: 7.3" QXGA, Cover display: 4.6" HD	6.3	6.3	6.8	6.8
Display resolution (px)	2960x1440 px	2960x1440 px	2960x1440 px	3040x1440 px	3040x1440 px	2280x1080 px	3040x1440 px	2152x1536 px	2280x1080 px	2280x1080 px	3040x1440 px	3040x1440 px
Display (ppi)	570ppi (Super AMOLED)	529ppi (Super AMOLED)	516ppi (Super AMOLED)	550ppi (Dynamic AMOLED)	526ppi (Dynamic AMOLED)	438ppi (Dynamic AMOLED)	502ppi (Dynamic AMOLED)	Main display: 414ppi (Dynamic AMOLED), Cover display: Super AMOLED	401ppi (Dynamic AMOLED)	401ppi (Dynamic AMOLED)	498ppi (Dynamic AMOLED)	498ppi (Dynamic AMOLED)
Camera (main)	12 MP, f/1.5-2.4, 26mm, 1/2.5", 1.4 µm, Dual Pixel PDAF, phase detection autofocus, OIS, LED flash	12 MP, f/1.5-2.4, 26mm, 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12MP, f/2.4, 52mm, 1/3.6", 1 µm, AF, OIS, phase detection autofocus, 2x optical zoom, LED flash	12 MP, f/1.5-2.4, 26mm, 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.4, 52mm, 1/3.6", 1 µm, AF, OIS, 2x optical zoom	12 MP, f/1.5-2.4, 26mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.4, 52mm (telephoto), 1/3.6", 1.0 µm, AF, OIS, 2x optical zoom + 16 MP, f/2.2, 12mm (ultrawide)	12 MP, f/1.5-2.4, 26mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.4, 52mm (telephoto), 1/3.6", 1.0 µm, AF, OIS, 2x optical zoom + 16 MP, f/2.2, 12mm (ultrawide)	12 MP, f/1.5-2.4, 26mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 16 MP, f/2.2, 12mm (ultrawide)	12 MP, f/1.5-2.4, 26mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.4, 52mm (telephoto), 1/3.6", 1.0 µm, AF, OIS, 2x optical zoom + 16 MP, f/2.2, 12mm (ultrawide) TOF camera	12 MP, f/1.5-2.4, 26mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.4, 52mm (telephoto), 1/3.6", 1.0 µm, AF, OIS, 2x optical zoom + 16 MP, f/2.2, 12mm (ultrawide) TOF camera	12 MP, f/1.5-2.4, 26mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.4, 52mm (telephoto), 1/3.6", 1.0 µm, AF, OIS, 2x optical zoom + 16 MP, f/2.2, 12mm (ultrawide) TOF camera	12 MP, f/1.5-2.4, 27mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.1, 52mm (telephoto), 1/3.6", 1.0 µm, PDAF, OIS, 2x optical zoom, 16 MP, f/2.2, 12mm (ultrawide), 1.0 µm, Super Steady video	12 MP, f/1.5-2.4, 27mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.1, 52mm (telephoto), 1/3.6", 1.0 µm, PDAF, OIS, 2x optical zoom, 16 MP, f/2.2, 12mm (ultrawide), 1.0 µm, Super Steady video, TOF 3D VGA camera	12 MP, f/1.5-2.4, 27mm (wide), 1/2.55", 1.4 µm, Dual Pixel PDAF, OIS + 12 MP, f/2.1, 52mm (telephoto), 1/3.6", 1.0 µm, PDAF, OIS, 2x optical zoom, 16 MP, f/2.2, 12mm (ultrawide), 1.0 µm, Super Steady video, TOF 3D VGA camera
Camera (front)	12MP	12MP	8MP	10 MP, f/1.9, Dual Pixel PDAF	10 MP, f/1.9, Dual Pixel PDAF + 8 MP, f/2.2, depth sensor	10 MP, f/1.9, Dual Pixel PDAF	10 MP+10MP, f/1.9, Dual Pixel PDAF TOF camera	10 MP, f/2.2, PDAF + 8 MP, f/1.9, depth sensor Cover camera: 10 MP, f/2.2	10 MP, f/2.2, 26mm (wide), 1.22µm, Dual Pixel PDAF	10 MP, f/2.2, 26mm (wide), 1.22µm, Dual Pixel PDAF	10 MP, f/2.2, 26mm (wide), 1.22µm, Dual Pixel PDAF	10 MP, f/2.2, 26mm (wide), 1.22µm, Dual Pixel PDAF
Wi-Fi	Wi-Fi 802.11 a/b/g/n/ac, (2.4/5GHz), MIMO	Wi-Fi 802.11 a/b/g/n/ac, (2.4/5GHz), MIMO	Wi-Fi 802.11 a/b/g/n/ac, (2.4/5GHz), MIMO	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot
Network	LTE Cat18 1200/200 Mbps	LTE Cat18 1200/200 Mbps	LTE Cat.18	Enhanced 4x4 MIMO, Up to 7CA, LAA, LTE Cat.20	Enhanced 4x4 MIMO, Up to 7CA, LAA, LTE Cat.20	Enhanced 4x4 MIMO, Up to 7CA, LAA, LTE Cat.20	LTE Cat.20, Standalone (NSA), Sub6 / mmWave (28G, 39G)	-	Enhanced 4x4 MIMO, Up to 7CA, LAA, LTE Cat.20	Enhanced 4x4 MIMO, Up to 7CA, LAA, LTE Cat.20, 5G Non-Standalone (NSA), Sub6 / mmWave	Enhanced 4x4 MIMO, Up to 7CA, LAA, LTE Cat.20	Enhanced 4x4 MIMO, Up to 7CA, LAA, LTE Cat.20, 5G Non-Standalone (NSA), Sub6 / mmWave
Bluetooth	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	5.0, A2DP, LE, aptX	5.0, A2DP, LE, aptX
OS	Android OS, v8.0 (Oreo)	Android 8.0 (Oreo)	Android 8.1 (Oreo)	Android 9.0 (Pie); One UI	Android 9.0 (Pie); One UI	Android 9.0 (Pie); One UI	Android 9.0 (Pie); One UI	Android 9.0 (Pie)	Android 9.0 (Pie); One UI	Android 9.0 (Pie); One UI	Android 9.0 (Pie); One UI	Android 9.0 (Pie); One UI
CPU	Exynos 9810 Octa - EMEA Qualcomm MSM8998 Snapdragon 845 - USA & China	Exynos 9810 Octa - EMEA Qualcomm MSM8998 Snapdragon 845 - USA & China	Exynos 9810 Octa - EMEA Qualcomm SDM855 Snapdragon 845 - USALATAM, China	Exynos 9820 Octa (8 nm) EMEA Qualcomm SDM855 Snapdragon 855 (7 nm) - USALATAM, China	Exynos 9820 Octa (8 nm) EMEA Qualcomm SDM855 Snapdragon 855 (7 nm) - USALATAM, China	Exynos 9820 Octa (8 nm) EMEA Qualcomm SDM855 Snapdragon 855 (7 nm) - USALATAM, China	Exynos 9820 Octa (8 nm) EMEA Qualcomm SDM855 Snapdragon 855 (7 nm) - USALATAM, China	Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/China	Exynos 9825 (7 nm) - EMEA/LATAM, Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/China	Exynos 9825 (7 nm) - EMEA/LATAM, Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/China	Exynos 9825 (7 nm) - EMEA/LATAM, Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/China	Exynos 9825 (7 nm) - EMEA/LATAM, Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/China
CPU clock	Octa-core (4x2.8 GHz Mongoose M3 & 4x1.7 GHz Cortex-A55) - EMEA Octa-core (4x2.7 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver) - USA & China	Octa-core (4x2.8 GHz Mongoose M3 & 4x1.7 GHz Cortex-A55) - EMEA Octa-core (4x2.7 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver) - USA & China	Octa-core (4x2.7 GHz Mongoose M3 & 4x1.8 GHz Cortex-A55) - EMEA Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver) - USALATAM, China	Octa-core (2x2.7 GHz Mongoose M4 & 2x2.3 GHz Cortex-A55) - EMEA Octa-core (1x2.8 GHz Kryo 485 & 3x2.4 GHz Kryo 485) - USALATAM, China	Octa-core (2x2.7 GHz Mongoose M4 & 2x2.3 GHz Cortex-A55) - EMEA Octa-core (1x2.8 GHz Kryo 485 & 3x2.4 GHz Kryo 485) - USALATAM, China	Octa-core (2x2.7 GHz Mongoose M4 & 2x2.3 GHz Cortex-A55) - EMEA Octa-core (1x2.8 GHz Kryo 485 & 3x2.4 GHz Kryo 485) - USALATAM, China	Octa-core (2x2.7 GHz Mongoose M4 & 2x2.3 GHz Cortex-A55) - EMEA Octa-core (1x2.8 GHz Kryo 485 & 3x2.4 GHz Kryo 485) - USALATAM, China	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485)	Octa-core (2x2.73 GHz Mongoose M4 & 2x2.4 GHz Cortex-A75 & 4x1.9 GHz Cortex-A55) - EMEA/LATAM, Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485) - USA/China	Octa-core (2x2.73 GHz Mongoose M4 & 2x2.4 GHz Cortex-A75 & 4x1.9 GHz Cortex-A55) - EMEA/LATAM, Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485) - USA/China	Octa-core (2x2.73 GHz Mongoose M4 & 2x2.4 GHz Cortex-A75 & 4x1.9 GHz Cortex-A55) - EMEA/LATAM, Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485) - USA/China	Octa-core (2x2.73 GHz Mongoose M4 & 2x2.4 GHz Cortex-A75 & 4x1.9 GHz Cortex-A55) - EMEA/LATAM, Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485) - USA/China
GPU Core	Mali-G72 MP18 - EMEA Adreno 630	Mali-G72 MP18 - EMEA Adreno 630	Mali-G72 MP18 - EMEA Adreno 630 - USALATAM, China	Mali-G76 MP12 - EMEA Adreno 640 - USALATAM, China	Mali-G76 MP12 - EMEA Adreno 640 - USALATAM, China	Mali-G76 MP12 - EMEA Adreno 640 - USALATAM, China	Mali-G76 MP12 - EMEA Adreno 640 - USALATAM, China	Adreno 640	Mali-G76 MP12 - EMEA/LATAM, Adreno 640 - USA/China	Mali-G76 MP12 - EMEA/LATAM, Adreno 640 - USA/China	Mali-G76 MP12 - EMEA/LATAM, Adreno 640 - USA/China	Mali-G76 MP12 - EMEA/LATAM, Adreno 640 - USA/China
NAND	64/128/256 GB	64/128/256 GB	128GB/512GB	128/512 GB	128GB/512GB/1 TB	128GB/256GB	256GB	512GB	256GB	256GB	256GB/512GB	256GB/512GB
DRAM	4GB	6GB	6GB/8GB	8 GB	8GB/12GB	6GB/8GB	8GB	12GB	8GB	12GB	8GB	12GB
Battery capacity	3000 mAh	3500 mAh	4000 mAh	3400 mAh	4100 mAh	3100 mAh	4500 mAh	4380 mAh	3500 mAh	3500 mAh	4300 mAh	4300 mAh

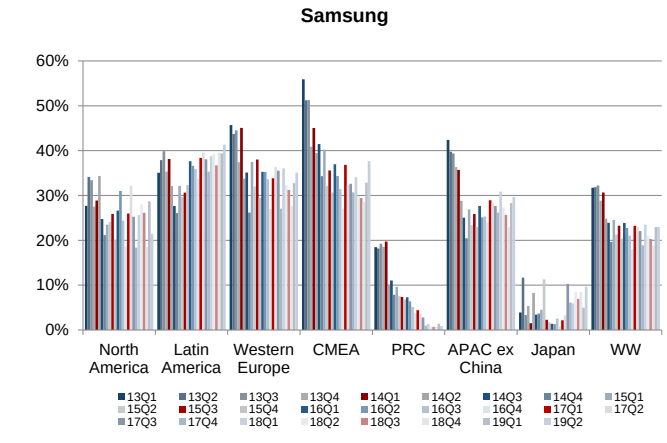
Source: Company data, Credit Suisse

Figure 30: Samsung: Smartphone shipments by region



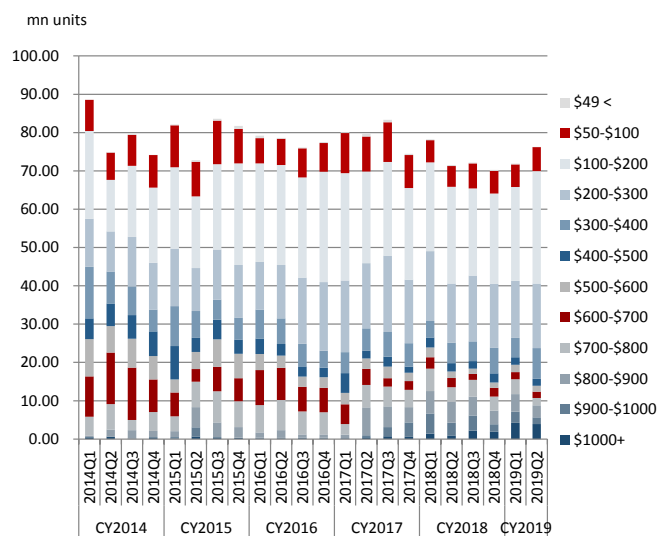
Source: IDC, Credit Suisse

Figure 31: Samsung: smartphone market share by region



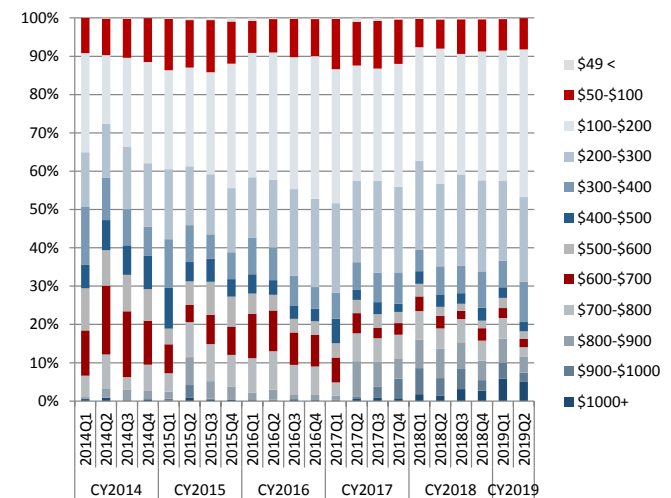
Source: IDC, Credit Suisse

Figure 32: Samsung: smartphone shipments by price range



Source: IDC, Credit Suisse

Figure 33: Samsung: smartphone shipment mix by price range



Source: IDC, Credit Suisse

Chinese smartphone production

Key takeaways

- Per our latest survey in September, Chinese smartphone makers' CY19 production plans total 696mn units (-1% YoY), nearly unchanged from June. Quarterly subtotals in units for Jan-Mar through Oct-Dec are 164mn (+7% YoY, -5% QoQ), 198mn (+9%, +21%), 169mn (-13%, -15%), and 165mn (-4%, -2%), respectively.
- All Chinese smartphone makers appear to be expediting expansion of 5G smartphone production. Huawei is being especially aggressive, forcing the others to follow suit.
- However, concerns about short-term cutbacks in production of 4G LTE models in Oct-Dec CY19 and Jan-Mar CY20 seem to be escalating. One factor behind such concern is that Oct-Dec production fell well short of production plans in both CY18 and CY17. Another is that the Huawei-led shift to 5G in the Chinese market is set to accelerate in CY20.
- Among the major Chinese smartphone makers, Huawei's planned CY19 production is 230-240mn units, Xiaomi's is 115mn, Oppo's is 110mn, and Vivo's is 105mn. Huawei's CY20 production outlook hinges on whether Huawei will be able to use Google Mobile Services in export models. The entire Chinese smartphone industry is closely watching developments involving Huawei.

Market update

Chinese smartphone production outlook

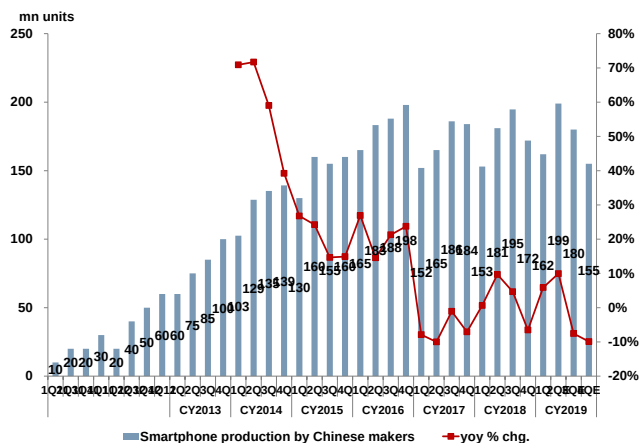
In CY17, Chinese smartphone production (including exports) was down 6% YoY to 687mn units. Quarterly production in handset units in Jan-Mar through Oct-Dec was 152mn (-8% YoY, -23% QoQ), 186mn (-10%, +9%), 186mn (-1%, +13%) and 184mn (-7%, -1%), respectively.

The corresponding CY18 production volumes were 701mn units (+2% YoY) for the year with quarterly figures of 153mn units (-1% YoY, -16% QoQ), 181mn (+10%, +18%), 195mn (+5%, +8%), and 172mn (-7%, -12%), respectively.

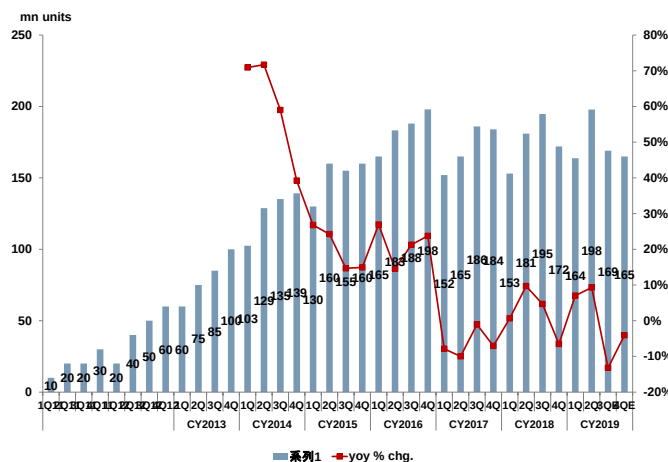
Planned CY19 production per our June survey was 696mn units (-1% YoY) with quarterly subtotals of 162mn units (+6% YoY, -6% QoQ), 199mn (+10%, +23%), 185mn (-5%, -7%) and 150mn (-13%, -19%), respectively.

Per our latest survey, planned CY19 production remains unchanged at 696mn units (-1% YoY) with the quarterly subtotals adjusted to 164mn (+7% YoY, -5% QoQ), 198mn (+9%, +21%), 169mn (-13%, -15%) and 165mn (-4%, -2%), respectively.

However, concerns about short-term cutbacks in production of 4G LTE models in Oct-Dec CY19 seem to be escalating. One factor behind such concern is that Oct-Dec production fell well short of production plans in both CY18 and CY17. Another is that the Huawei-led shift to 5G in the Chinese market is set to accelerate in CY20.

Figure 34: Chinese smartphone production (as of June 2019)

Source: Credit Suisse estimates

Figure 35: Chinese smartphone production (as of Sep 2019)

Source: Credit Suisse estimates

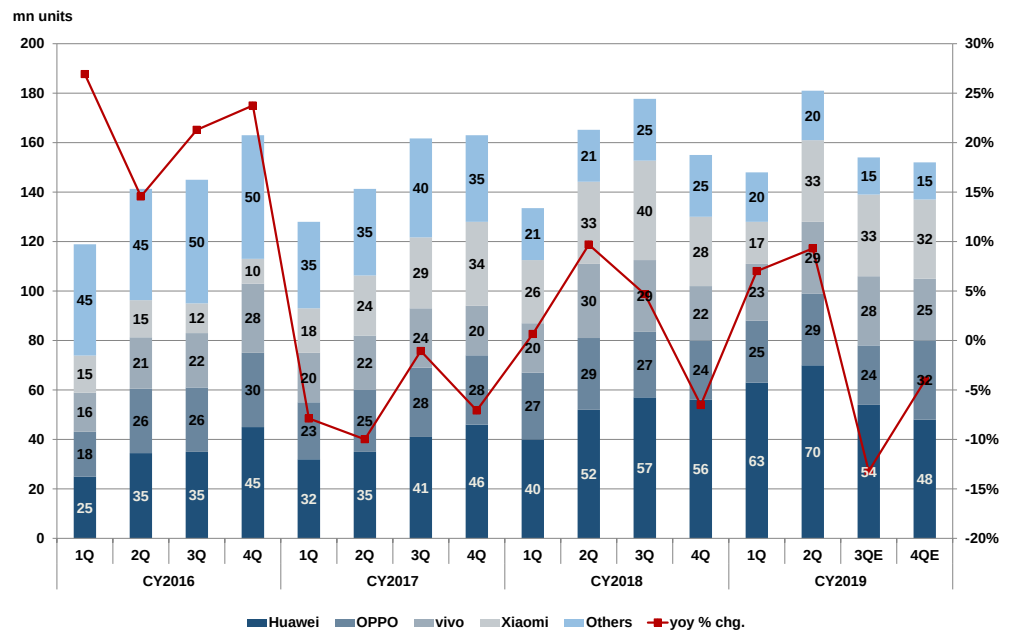
Individual smartphone makers' production

In the March survey, we reported Huawei's planned CY19 smartphone production at 260–270mn units (+25–30% YoY), Vivo's at 100mn (–1%), Oppo's at 105mn (–1%), and Xiaomi's at 115mn (–10%), which took account of a planned downsizing of Xiaomi's footprint in the low-end segment.

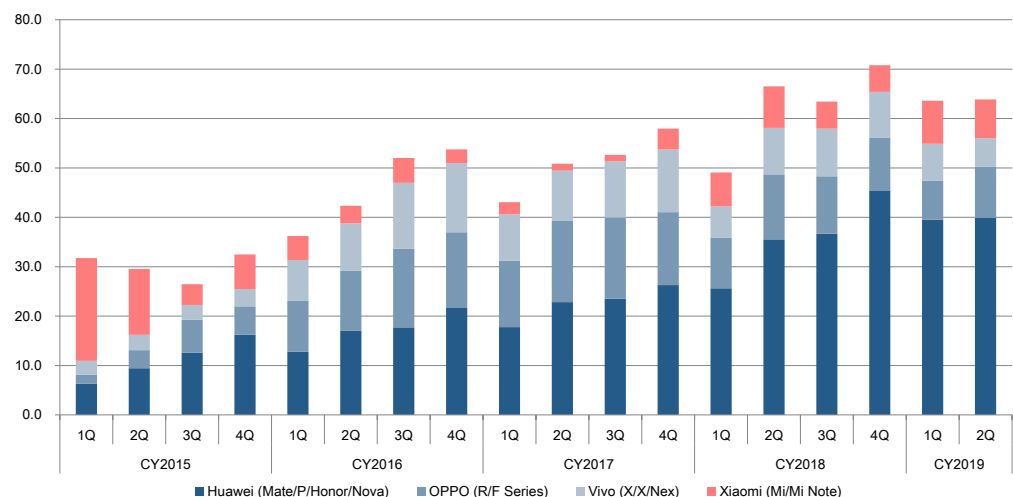
As of June, Huawei's planned CY19 production was around 240mn units. Between March and June, it had increased this figure to 300mn units (140–150mn in Jan–Jun, 150–160mn in Jul–Dec) as it had pulled forward production from Jan–Feb CY20 into CY19 before sanctions were imposed by the US government. We reported Xiaomi, Oppo and Vivo's planned CY19 production as of June at around 120mn, 110–115mn, and 105mn units, respectively.

In September, Huawei's planned CY19 production is at 230–240mn units after apparently dipping as low as around 210mn between June and September. Meanwhile, Xiaomi, Oppo, and Vivo now plan to respectively produce 115mn, 110mn and 105mn smartphones in CY19.

Overall, Huawei is gaining share in the Chinese market, Oppo and Vivo are targeting ASEAN markets to compensate for slower sales in China, and Xiaomi is targeting Europe to offset stagnant sales in the Chinese and Indian markets.

Figure 36: Chinese smartphone production by maker

Source: Company data, Credit Suisse estimates

Figure 37: Volume for Huawei/Oppo/Vivo/Xiaomi flagship models (mn units)

Source: Company data, Credit Suisse estimates

New features and technologies in Chinese smartphones

We summarize noteworthy Chinese smartphone trends below. A 5G update is presented farther below.

Camera spec upgrades accelerating

In June, we forecast that growth in smartphone models equipped with triple cameras and 48MP sensors would accelerate, mainly in the high-end segment. Our latest survey confirmed that such acceleration is indeed taking place. Meanwhile, some smartphone makers are starting to extend 48MP and/or triple camera specs to midrange models also.

Expectations heading into 2020 include growing use of 48MP sensors in midrange models and 64MP or 108MP sensors in high-end models. Smartphone makers are reportedly starting to look into upgrading front-facing camera specs from 32MP to 40MP by utilizing sensors with a 0.7µm pitch.

In CY19, Huawei and Oppo upgraded their flagship models with folded optics. Other smartphone makers apparently plan to follow suit but only in high-end models.

Growing use of more lenses and larger lenses seems to be driving growth in demand for SMA (shape memory alloy) OIS (optical image stabilization), and ball-guided OIS instead of wire actuators and OIS. Additionally, in lens units for models with 108MP sensors or sensors with an aperture size of f/1.4 or below, smartphone makers are apparently working on replacing one of the lenses with a glass lens. Overall, migration to larger CISs is increasing the probability of acceleration in demand for SMA OIS and/or ball-guided OIS. Huawei in particular apparently plans to broaden its use of SMA OIS.

As of early June, Huawei had one smartphone model equipped with a pop-up selfie camera while Oppo had five such models, Vivo six, and Xiaomi three. The pop-up camera has become a standard feature in Oppo's Reno, F, and K Series phones and Vivo's V and X Series phones. Huawei now appears to be adding a pop-up selfie camera to its Y Series and Enjoy 10 Plus phones. Vivo, however, seems to have lost enthusiasm for pop-up cameras after embracing them in 1H CY19.

Mobile memory prices remain stable, facilitating camera-related spec upgrades, but transition to 5G is expected to increase BOM costs, including modem and RF front-end module costs.

DRAM and NAND

Regarding NAND, fresh concerns have emerged regarding not any new functionality but a slowdown in trend. While Huawei had previously been keen on increasing storage capacity in its phones, weak demand for high-capacity models as users migrate to cloud storage has it now thinking that 128GB is sufficient for volume-zone midrange phones. We accordingly see the risk of slower growth in phone storage capacity going forward.

Components in short supply

CIS supplies remain tight in the wake of migration to multi-camera phones and the trend toward ever larger CISs. Supplies of liquid crystal devices also seem to be starting to tighten in response to growth in narrow-band IoT-connected devices (such as various meters and smoke detectors) and Japanese manufacturers' pruning of unprofitable products from their line-ups.

Huawei: Plans to keep 2019 smartphone production at 230–240mn units. In 2020, it aims to expand 5G phone sales in China but exports are a question mark.

Production outlook

In CY18, Huawei produced 205mn smartphones, up from 154–155mn in CY17 and 140mn in CY16.

In the March survey, we reported Huawei's expected CY19 smartphone production at 260–270mn units. Huawei subsequently raised its CY19 production plan to as high as 300mn units inclusive of an inventory build-up in preparation for the 2020 Chinese New Year holidays. By the time of our June survey, however, Huawei had cut its planned production to around 240mn units in response to US sanctions. Huawei then briefly reduced its planned production to around 210mn units. Most recently, its plan is reportedly back up to 230–240mn units.

In CY17, Huawei's quarterly smartphone production in CY17 was 32–33mn, 35mn, 41mn, and 46mn units in Jan–Mar through Oct–Dec. Its CY18 quarterly production was 40mn, 52mn, 57mn, and 56mn units, respectively.

As of June 2019, Huawei was expected to increase its CY19 quarterly production to 67mn units in Jan–Mar and 75mn in Apr–Jun before throttling back to around 50mn in Jul–Sep and around 45mn in Oct–Dec. As of September, these quarterly numbers have reportedly been adjusted to 63mn, 70mn, 54mn and 48mn, respectively.

CY20 outlook

In September, Huawei will apparently inform its main component suppliers of its planned CY20 production volume. It reportedly aims to increase its Chinese market share to 45% in CY19 and to around 50% in CY20 basically to compensate for decreased exports.

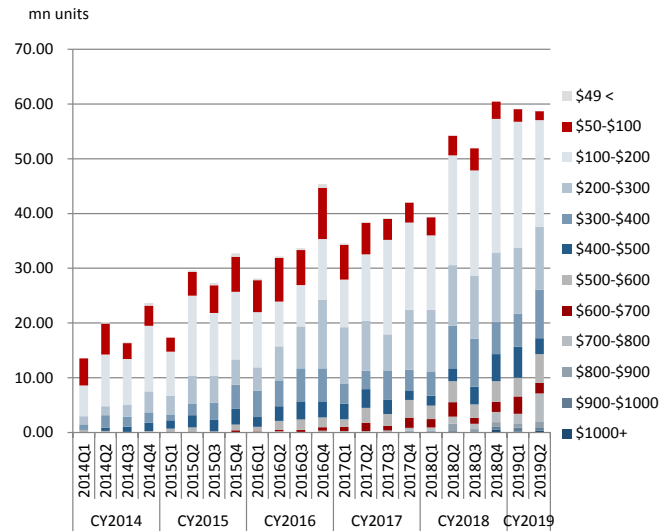
After the US sanctions on Huawei were announced, its non-China market share temporarily plummeted (particularly in developed Asia, Western Europe and Central & Eastern Europe). Currently, its non-China market share appears to be in a recovery trend, mainly in Europe (its Central & Eastern European market share is now even higher than before the US sanctions).

In CY20, however, Huawei will likely be unable to use Google Mobile Services in its new models. It will therefore have to continue selling existing models. If so, its products would likely lose competitiveness. For P Series and Mate models in particular, Huawei apparently plans to focus on domestic sales.

5G developments

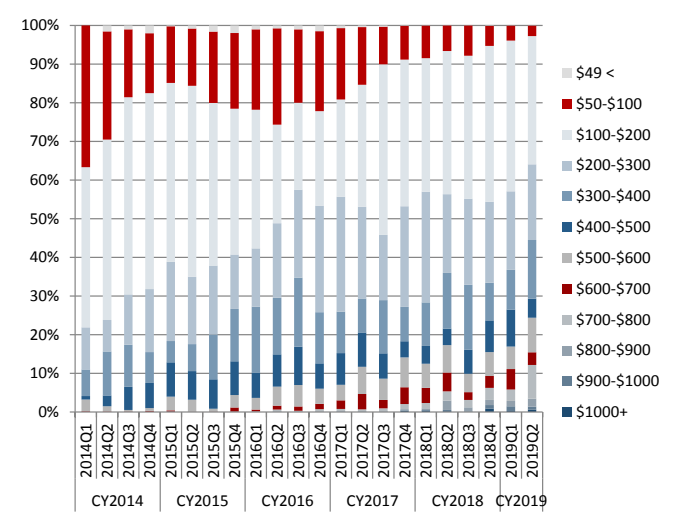
Huawei has become even more aggressive on 5G. Its subsidiary HiSilicon has reportedly ordered 165mn chips from foundries for CY20, up from 23–24mn in CY19. With no new LTE chipset in the pipeline, Huawei will have to use 5G chipsets in CY20 even in its LTE models. While not all of the SoCs ordered from foundries will be used in 5G smartphones, Huawei's CY20 Honor, Nova, P Series, and Mate models are looking increasingly likely to be 5G-compatible. We were told that Huawei could very well ship over 100mn 5G handsets in CY20.

Figure 41: Huawei: Smartphone shipments by price range



Source: IDC, Credit Suisse

Figure 42: Huawei: Smartphone shipment mix by price range



Source: IDC, Credit Suisse

Figure 43: Huawei's smartphone specs (models announced in Jan–Jun 2018)

	Honor 7C	Y9 (2018)	Y7 Prime (2018)	Y7 Pro (2018)	P20 Lite	P20	P20 Pro	Mate RS Porsche Design	Y6 (2018)	Honor 7A	Honor 10	Y3	Y5 Prime (2018)	Honor 7s	Honor 9i	Honor Play
Announce	Mar 2018	Mar 2018	Mar 2018	Mar 2018	Mar 2018	Mar 2018	Mar 2018	Mar 2018	April 2018	April 2018	May 2018	May 2018	May 2018	May 2018	June 2018	June 2018
Release	April 2018	April 2018	April 2018	April 2018	Mar 2018	April 2018	April 2018	April 2018	May 2018	April 2018	May 2018	May 2018	June 2018	May 2018	June 2018	June 2018
Height (mm)	158.3	157.2	158.3	158.3	148.6	149.1	155	152.9	152.4	152.4	149.6	145.1	146.5	146.5	149.2	157.9
Width (mm)	76.7	75.3	76.7	76.7	71.2	70.8	73.9	72.5	73	73	71.2	73.7	70.9	70.9	71.8	74.3
Thickness (mm)	7.8	7.89	7.8	7.8	7.4	7.7	7.8	8.5	7.8	7.8	7.7	9.5	8.3	8.3	7.7	7.5
Weight (g)	164	170	155	155	145	165	180	183	150	150	153	175	142	142	152	176
Display size (inch)	5.99	5.93	5.99	5.99	5.84	5.8	6.1	6	5.7	5.7	5.84	5	5.45	5.45	5.84	6.3
Display resolution (px)	720 x 1440	1080 x 2160	720 x 1440	720 x 1440	1080 x 2280	1080 x 2244	1080 x 2244	1440 x 2880	720 x 1440	720 x 1440	1080 x 2280	480 x 854	720 x 1440	720 x 1440	1080 x 2280	1080 x 2340
Display (ppi)	269	407	269	269	432	428	408	538	282	282	432	196	295	295	432	409
Display	IPS LCD	IPS LCD	IPS LCD	IPS LCD	LTPS IPS LCD	LTPS IPS LCD	AMOLED	AMOLED	S-IPS LCD	IPS LCD	IPS LCD	IPS LCD	LCD	LCD	IPS LCD	IPS LCD
Camera (main)	Dual 13MP+2MP	Dual 16MP+2MP	Dual 13MP+2MP	Dual 13MP+2MP	Dual 16MP+2MP	Dual 12MP+20MP	Triple 40MP+20MP+8 MP	Triple 40MP+20MP+8 MP	13 MP	Dual 13MP+2MP	Dual 16MP+24MP	8 MP	13 MP	13 MP	Dual 13MP+2MP	Dual 16MP+2MP
f factor	NA	2.20	NA	NA	2.20	1.8/1.6	1.9/1.6/2.4	1.9/1.6/2.4	N/A	2.20	1.80	2.00	N/A	N/A	N/A	N/A
CIS size	NA	NA	NA	NA	NA	1/2.3"	1/1.7"	1/1.7"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CIS Pitch (um)	NA	NA	NA	NA	NA	1.55	NA	NA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OIS (Y/N)	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N
Dual Camera (Y/N)	Y	Y	Y	Y	Y	Y	Y (Triple)	Y (Triple)	N	Y	Y	N	N	N	Y	Y
Camera (front)	8 MP	Dual 13MP+2MP	8 MP	8 MP	16 MP	24 MP	24 MP	24 MP	5 MP	8 MP	24 MP	2 MP	5 MP	5 MP (Global), 24 MP (China)	16MP	16MP
WiFi	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot
Bluetooth	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.0	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2
CPU clock	Octa-core 1.8 GHz Cortex-A53	Octa-core (4x2.36 GHz Cortex-A53 & 4x1.7 GHz Cortex-A53)	Octa-core 1.4 GHz Cortex-A53	Octa-core 1.4 GHz Cortex-A53	Octa-core (4x2.36 GHz Cortex-A53 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.8 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.8 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.8 GHz Cortex-A53)	Quad-core 1.4 GHz Cortex-A53	Octa-core (4x1.5 GHz Cortex-A53 & 4x1.2 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.8 GHz Cortex-A53)	Quad-core 1.1 GHz Cortex-A53	Quad-core 1.5 GHz Cortex-A53	Quad-core 1.5 GHz Cortex-A53	Octa-core (4x2.36 GHz Cortex-A53 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.8 GHz Cortex-A53)
CPU	SDM450	Kirin 659	MSM8937	MSM8937	Kirin 659	Kirin 970	Kirin 970	Kirin 970	MSM8917	MSM8937	Kirin 970	MT6737M	MT6739	MT6739	Kirin 659	Kirin 970
GPU Core	Adreno 506	Mali-T830 MP2	Adreno 505	Adreno 505	Mali-T830 MP2	Mali-G72 MP12	Mali-G72 MP12	Mali-G72 MP12	Adreno 308	Adreno 505	Mali-G72 MP12	Mali-T720MP2	PowerVR GE8100	PowerVR GE8100	Mali-T830 MP2	Mali-G72 MP12
NAND	32/64GB	32/64/128GB	32GB	32 GB	64/128GB	128 GB	128 GB	256/512GB	16 GB	32 GB	64/128 GB	8 GB	16 GB	16 GB	64/128 GB	64 GB
Card slot	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (uses SIM 2 slot)	N/A	N/A	NA	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	N/A	microSD, up to 128 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)
DRAM	3/4GB	3/4GB	3GB	3 GB	4GB	4GB	6GB	6GB	2GB	2/3 GB	4/6 GB	1 GB	2 GB	2 GB	4 GB	4/6 GB
Battery capacity	3000	4000	3000	3000	3000	3400	4000	4000	3000	3000	3400	2280	3020	3020	3000	3750
USB Connector	microUSB v2.0	microUSB v2.0	microUSB v2.0	microUSB v2.0	USB2.0, Type-C 1.0 reversible connector	microUSB v3.1, Type-C 1.0 reversible connector	microUSB v3.1, Type-C 1.0 reversible connector	USB2.0, Type-C 1.0 reversible connector	microUSB v2.0	microUSB v2.0	USB2.0, Type-C 1.0 reversible connector, USB On-The-Go	microUSB v2.0	microUSB v2.0	microUSB v2.0	microUSB 2.0, USB On-The-Go	USB2.0, Type-C 1.0 reversible connector

Source: Company data, Credit Suisse estimates

Figure 44: Huawei's smartphone specs (models announced in Jul-Dec 2018)

	Nova 3	Nova 3 (P Smart+)	Honor 9N (N)	Honor Note10	Mate 20 Lite	Honor EX Max	Honor EX	Y5 (2018)	Honor 8C	Mate 20	Mate 20 Pro	Mate 20 X	Mate 20 RS Porsche design	Honor Magic 2	Honor 10 Lite	Y Max	Enjoy 9	P smart 2018	nova 4	Y5 Re (2018)	
Announce	July 2018	July 2018	July 2018	July 2018	Aug 2018	Sep 2018	Sep 2018	Oct 2018	Oct 2018	Oct 2018	Oct 2018	Oct 2018	Oct 2018	Oct 2018	Nov 2018	Nov 2018	Dec 2018	Dec 2018	Dec 2018	Dec 2018	
Release	Aug 2018	Aug 2018	July 2018	Aug 2018	Sep 2018	Sep 2018	Sep 2018	Oct 2018	Oct 2018	Nov 2018	Nov 2018	Nov 2018	Dec 2018	Nov 2018	Nov 2018	Dec 2018	Dec 2018	Dec 2018	Dec 2018	Dec 2018	
Height (mm)	157	157.6	149.2	177	156.3	177.6	160.4	162.4	156.7	156.2	157.8	174.6	157.8	157.3	154.8	177.6	158.9	155.2	157	146.5	
Width (mm)	73.7	75.2	71.8	85	75.3	86.3	76.6	77.1	75.9	77.2	72.3	85.4	72.3	75.1	73.6	86.2	76.9	73.4	75.1	70.9	
Thickness (mm)	7.3	7.6	7.7	7.7	7.6	8.1	7.8	8.1	8	8.3	8.6	8.2	9.7	8.3	8	8.5	8.1	8	7.8	8.3	
Weight (g)	166	169	152	230	172	210	175	173	167	188	189	232	187	206	162	210	168	160	172	142	
Display size (inch)	5.96	6.3	5.84	6.95	6.3	7.12	6.5	6.5	6.26	6.53	6.39	7.2	6.39	6.39	6.21	7.12	6.26	6.21	6.4	5.45	
Display resolution (px)	1080 x 2340	1080 x 2340	1080 x 2280	1080 x 2220	1080 x 2340	1080 x 2244	1080 x 2340	1080 x 2340	720 x 1520	1440 x 3120	1080 x 2244	1440 x 3120	1080 x 2340	1080 x 2340	1080 x 2244	720 x 1520	1080 x 2340	1080 x 2310	720 x 1440		
Display (ppi)	409	409	432	355	409	350	397	396	269	381	538	346	538	403	415	350	269	415	398	295	
Display	IPS LCD	IPS LCD	IPS LCD	AMOLED	LTPS IPS LCD	IPS LCD	LTPS IPS LCD	IPS LCD	IPS LCD	IPS LCD	AMOLED	AMOLED	AMOLED	AMOLED	IPS LCD	IPS LCD	IPS LCD	LTPS IPS LCD	LTPS IPS LCD	LCD	
Camera (main)	Dual 16 MP+24MP	Dual 16MP+2MP	Dual 13MP+2MP	Dual 16MP+24MP	Dual 20MP+2MP	Dual 16MP+2MP	Dual 20MP+2MP	Dual 16MP+2MP	Dual 13MP+2MP	Triple 12MP+16MP+8MP	Triple 40MP+20MP+8MP	Triple 40MP+20MP+8MP	Triple 40MP+20MP+8MP	Triple 16MP+16MP+24MP (P-Mechanical pop-up)	Dual 13MP+2MP	Dual 16MP+2MP	Dual 13MP+2MP	Dual 13MP+2MP	Triple 48MP+16MP+2MP	8 MP	
f factor	1.8/1.8	2.30	N/A	1.80	1.80	2.9/2.4	1.80	2.9/2.4	1.8/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.8	1.80	2.9/2.4	1.8/2.4	1.80	18/2.2/2.4	2.00	
CIS size	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.2"	1/1.7", 1/2.7", 1/4"	1/1.7", 1/2.7", 1/4"	1/1.7", 1/2.7", 1/4"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
CIS Pixels (um)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
CIS (Y/N)	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	
Dual Camera (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y	Y	Y	Y	Y (Triple)	N	
Camera (front)	Dual 24 MP+2MP	Dual 24MP+2MP	16MP	13MP	Dual 24MP+2MP	8MP	16MP	Dual 13MP+2MP	8MP	24MP	24MP	24MP	24MP	Mechanical pop-up 16MP+2MP+2MP	24MP	8 MP	8 MP	16 MP	25 MP	5 MP	
Wi-Fi	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual band, Wi-Fi Direct, hotspot	
Bluetooth	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	
CPU clock	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.8 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.36 GHz Cortex-A53 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core 1.8 GHz Kryo 260	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x1.8 GHz Kryo 260)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.9 GHz Cortex-A53 & 4x1.8 GHz Kryo 260)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.9 GHz Cortex-A53 & 4x1.8 GHz Kryo 260)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.9 GHz Cortex-A53 & 4x1.8 GHz Kryo 260)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.9 GHz Cortex-A53 & 4x1.8 GHz Kryo 260)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.9 GHz Cortex-A53 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core 1.8 GHz Cortex-A53	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.4 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Quad-core 1.5 GHz Cortex-A53
CPU	Kirin 970	Kirin 710	Kirin 659	Kirin 970 (10nm)	Kirin 710 (12 nm)	SOM36 Snapdragon 636 (14 nm)	Kirin 710 (12 nm)	Kirin 710 (12 nm)	SOM32 Snapdragon 632 (14 nm)	Kirin 980 (7 nm)	Kirin 980 (7 nm)	Kirin 980 (7 nm)	Kirin 980 (7 nm)	Kirin 980 (7 nm)	Kirin 710 (12 nm)	Qualcomm Snapdragon 660 (14 nm)	Qualcomm Snapdragon 660 (14 nm)	HiSilicon Kirin 710 (12 nm)	HiSilicon Kirin 970 (10 nm)	Mediatek MT6739 (28 nm)	
GPU Core	Mali-G72 MP12	Mali-G51 MP4	Mali-T628 MP2	Mali-G72 MP12	Mali-G51 MP4	Adreno 509	Mali-G51 MP4	Mali-G51 MP4	Adreno 506	Mali-G76 MP10	Mali-G76 MP10	Mali-G76 MP10	Mali-G76 MP10	Mali-G76 MP10	Mali-G51 MP4	Adreno 512	Adreno 506	Mali-G51 MP4	Mali-G72 MP12	PowerVR GE8300	
RAM	64/128 GB	64/128 GB	32/64/128 GB	64/128 GB	34 GB	64/128 GB	64/128 GB	64/128 GB	32/64 GB	128 GB	128/256 GB	128 GB	256/512 GB	128/256 GB	64/128 GB	128 GB	32/64 GB	32/64 GB	128 GB	16 GB	
Card slot	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 400 GB (dedicated slot)	microSD, up to 400 GB	microSD, up to 400 GB	microSD, up to 256 GB (dedicated slot)	microSD, up to 256GB (uses SIM 2)	microSD, up to 256GB (uses SIM 2)	microSD, up to 256GB (uses SIM 2)	microSD, up to 256GB (uses SIM 2)	microSD, up to 256 GB (uses SIM 2)	microSD, up to 512 GB (uses SIM 2 slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 512 GB	microSD, up to 512 GB (uses SIM 2 slot)	NA	microSD, up to 256 GB (dedicated slot)	
DRAM	6 GB	4/6 GB	3/4 GB	6/8 GB	6 GB	4/6 GB	4/6 GB	4/6 GB	4 GB	4/6 GB	6/8 GB	6 GB	8 GB	6/8 GB	4/6 GB	4 GB	3/4 GB	3 GB	8 GB	1 GB	
Battery capacity	3750	3340	3000	5000	2750	5000	2750	4000	4000	4000	4300	5000	4200	3500	3400	5000	4000	3400	3750	3030	
USB Connector	USB2.0, Type-C 1.0 reversible connector	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	USB3.1, Type-C 1.0 reversible connector, USB On-The-Go	USB2.0, Type-C 1.0 reversible connector, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0	microUSB 2.0, USB On-The-Go	USB3.1, Type-C 1.0 reversible connector, USB On-The-Go	USB3.1, Type-C 1.0 reversible connector, USB On-The-Go	USB3.1, Type-C 1.0 reversible connector, USB On-The-Go	USB3.1, Type-C 1.0 reversible connector, USB On-The-Go	USB2.0, Type-C 1.0 reversible connector, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	USB2.0, Type-C 1.0 reversible connector	microUSB 2.0	

Source: Company data, Credit Suisse

Figure 45: Huawei's smartphone specs (models released in 2019)

	Y7 Pro (2019)	Y7 Prime (2019)	Y6 Pro (2019)	Mate X	nova 4e	Enjoy 9s	Enjoy 9e	P30	P30 Pro	P Smart Z	Mate 20 X (5G)	Y9 Prime (2019)	P20 lite (2019)	nova 5i	nova 5	nova 5 Pro	nova 5i Pro	nova 5T	Enjoy10 Plus
Announce	Jan 2019	Jan 2019	Feb 2019	Feb 2019	Mar 2019	Mar 2019	Mar 2019	Mar 2019	Mar 2019	May 2019	May 2019	May 2019	June 2019	June 2019	June 2019	June 2019	July 2019	Aug 2019	Sep 2019
Release	Jan 2019	Jan 2019	Feb 2019	Exp. Nov 2019	Mar 2019	Mar 2019	Apr 2019	Apr 2019	Apr 2019	May 2019	July 2019	Aug 2019	July 2019	June 2019	June 2019	June 2019	July 2019	Sep 2019	Sep 2019
Height (mm)	158.9	158.9	156.3	161.3	152.9	156.2	156.3	149.1	158	163.5	174.6	163.5	159.1	159.1	157.4	157.4	156.1	154.3	163.5
Width (mm)	76.9	76.9	73.5	78.3 (Folded), 146.2 (Unfolded)	72.7	73.4	73.5	71.4	73.4	77.3	85.4	77.3	75.9	75.9	74.8	74.8	73.9	74	77.3
Thickness (mm)	8.1	8.1	8	11 (Folded), 5.4 (Unfolded)	7.4	8	8	7.6	8.4	8.8	8.2	8.8	8.3	8.3	7.3	7.3	8.3	7.8	8.8
Weight (g)	168	168	150	295	159	160	150	165	192	196.8	232	196.8	178	178	171	171	178	174	163.5
Display size (inch)	6.26	6.26	6.09	8	6.15	6.21	6.09	6.1	6.47	6.59	7.2	6.59	6.4	6.4	6.39	6.39	6.26	6.26	6.59
Display resolution (px)	720 x 1520	720 x 1520	720 x 1560	2200 x 2480	1080 x 2312	1080 x 2340	720 x 1560	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2344	1080 x 2340	1080 x 2310	1080 x 2310	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340
Display (ppi)	269	269	282	414	415	415	282	422	398	391	346	391	398	398	403	403	412	412	391
Display	IPS LCD	IPS LCD	IPS LCD	AMOLED	IPS LCD	LTPS IPS LCD	IPS LCD	OLED	OLED	LTPS IPS LCD	OLED	LTPS IPS LCD	LTPS IPS LCD	IPS LCD	OLED	OLED	LTPS IPS LCD	IPS LCD	IPS LCD
Camera (main)	Dual 13MP+2MP	Dual 13MP+2MP	13 MP	Quad 40MP+16MP+8MP+2MP P+TOF camera	Triple 24MP+16MP+2MP	Triple 24MP+16MP+2MP	13 MP	Triple 40MP+16MP+8MP	Quad 40MP+20MP+Periscope 8MP+1TOF 30 camera	Dual 2MP+16MP	Triple 40MP+20MP+8MP	Triple 16MP+8MP+2MP	Quad 16MP+8MP+UltraWide+2MP	Quad 24MP+8MP+2MP	Quad 48MP+16MP+2MP P+2MP	Quad 48MP+16MP+2MP P+2MP	Quad 48MP+8MP+2MP P+2MP	Quad 48MP+16MP+2MP P+2MP	Triple 48MP+8MP+2MP
f factor	1.80	1.80	1.80	1.8/2.2/2.4	1.8/2.4	N/A	1.80	1.8/2.2/2.4	1.6/2.2/3.4	2.4/1.8	1.8/2.2/2.4	1.8/2.4	1.8/2.4/2.4	1.8/2.4/2.4	1.8/2.2/2.4/2.4	1.8/2.2/2.4/2.4	1.8/2.2/2.4/2.4	1.8/2.2/2.4/2.4	1.8/2.4/2.4
CIS size	N/A	N/A	N/A	1.70	N/A	N/A	N/A	1.71/1.4	1.71/1.4	N/A	1.71/1.4	N/A	N/A	N/A	2	2	2	2	2
CIS Pitch (µm)	N/A	N/A	N/A	N	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.8	0.8	0.8	0.8	0.8
OIS (VIB)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Dual Camera (VIN)	Y	Y	N	Y (Quad)	Y (Triple)	Y (Triple)	N	Y (Triple)	Y (Quad)	Y	Y (Triple)	Y (Triple)	Y (Quad)	Y (Quad)	Y (Quad)	Y (Quad)	Y (Quad)	Y (Quad)	Y (Triple)
Camera (front)	16 MP	16 MP	8 MP	N	32 MP	8 MP	8 MP	32 MP	32 MP	Motorized pop-up 16MP	24 MP	Motorized pop-up 16 MP	16MP	24MP	32 MP	32 MP	32 MP	32 MP	Motorized pop-up 16 MP 102.1
Wifi	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, DLNA, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot - STK-AL, Wi-Fi Direct, hotspot - STK-TL100
Bluetooth	Bluetooth v4.2, A2DP, LE	Bluetooth v4.2, A2DP, LE	Bluetooth v4.2, A2DP, LE	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v4.2, A2DP, LE, aptX HD	Bluetooth v4.2, A2DP, LE, aptX HD	Bluetooth v4.2, A2DP, LE	Bluetooth v5.0, A2DP, aptX HD, LE	Bluetooth v5.0, A2DP, aptX HD, LE	Bluetooth v5.0, A2DP, LE	Bluetooth v5.0, A2DP, aptX HD, LE	Bluetooth v5.0, A2DP, LE	Bluetooth v5.0, A2DP, LE	Bluetooth v4.2, A2DP, LE	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, LE	Bluetooth v5.0, A2DP, LE	Bluetooth v4.2, A2DP, LE
CPU clock	Octa-core 1.8 GHz Cortex-A53	Octa-core 1.8 GHz Cortex-A53	Quad-core 2.0 GHz Cortex-A53	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.92 GHz Cortex-A76 & 4x1.8 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Quad-core 2.0 GHz Cortex-A53	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.92 GHz Cortex-A76 & 4x1.8 GHz Cortex-A53)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.92 GHz Cortex-A76 & 4x1.8 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.92 GHz Cortex-A76 & 4x1.8 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)	Octa-core (2x2.7 GHz Cortex-A76 & 6x1.88 GHz Cortex-A53)	Octa-core (2x2.7 GHz Cortex-A76 & 6x1.88 GHz Cortex-A53)	Octa-core (2x2.7 GHz Cortex-A76 & 6x1.88 GHz Cortex-A53)	Octa-core (2x2.7 GHz Cortex-A76 & 6x1.88 GHz Cortex-A53)	Octa-core (4x2.2 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)
CPU	Qualcomm SDM450 Snapdragon 450 (14 nm)	Qualcomm SDM450 Snapdragon 450 (14 nm)	MediaTek MT6761 Helio A22 (12 nm)	HiSilicon Kirin 980 (7 nm)	HiSilicon Kirin 710 (12 nm)	HiSilicon Kirin 710 (12 nm)	MediaTek MT6763 Helio A22 (12 nm)	HiSilicon Kirin 980 (7 nm)	HiSilicon Kirin 980 (7 nm)	HiSilicon Kirin 710F (12 nm)	HiSilicon Kirin 980 (7 nm)	HiSilicon Kirin 710F (12 nm)	HiSilicon Kirin 710 (12 nm)	HiSilicon Kirin 710F (12 nm)	HiSilicon Kirin 810 (7 nm)	HiSilicon Kirin 810 (7 nm)	HiSilicon Kirin 810 (7 nm)	HiSilicon Kirin 980 (7 nm)	HiSilicon Kirin 710F (12 nm)
GPU Core	Adreno 506	Adreno 506	PowerVR GE8320	Mali-G76 MP10	Mali-G51 MP4	Mali-G51 MP4	PowerVR GE8320	Mali-G76 MP10	Mali-G76 MP10	Mali-G51 MP4	Mali-G76 MP10	Mali-G51 MP4	Mali-G51 MP4	Mali-G51 MP4	Mali-G52 MP6	Mali-G76 MP10	Mali-G52 MP6	Mali-G76 MP10	Mali-G51 MP4
NAND	32 GB	32 GB	32 GB	512 GB	128 GB	64/128 GB	32 GB	64/128/256 GB	128/256/512 GB	64 GB	128 GB	64/128 GB	64/128 GB	128 GB	128 GB	128/256 GB	128/256 GB	128 GB	128 GB, UFS
Card slot	microSD, up to 512 GB (uses SIM 2 slot)	microSD, up to 512 GB (uses SIM 2 slot)	microSD, up to 512 GB (dedicated slot)	NM (Nano Memory), up to 256GB (uses SIM 2)	microSD, up to 512 GB (uses SIM 2 slot)	microSD, up to 512 GB (dedicated slot)	NM (Nano Memory), up to 256GB (uses SIM 2)	NM (Nano Memory), up to 256GB (uses SIM 2)	NM (Nano Memory), up to 256GB (uses SIM 2)	microSD, up to 1 TB	NM (Nano Memory), up to 256GB (uses shared SIM slot)	microSD, up to 1 TB	microSD, up to 256 GB (uses shared SIM slot)	microSD, up to 512 GB (uses shared SIM slot)	NM (Nano Memory), up to 256GB (uses shared SIM slot)	NM (Nano Memory), up to 256GB (uses shared SIM slot)	NM (Nano Memory), up to 256GB (uses shared SIM slot)	N/A	microSD, up to 1 TB (uses shared SIM slot)
DRAM	3 GB	3 GB	3 GB	8 GB	4/6 GB	4 GB	3 GB	6/8 GB	6/8 GB	4 GB	6 GB	4 GB	4 GB	6/8 GB	8 GB	8 GB	6/8 GB	8 GB	4/6/8 GB
Battery capacity	4000	4000	3020	4500mAh	3540mAh	3400mAh	3020 mAh	3650 mAh	4200 mAh	4000 mAh	4200 mAh	4000 mAh	4000 mAh	4000 mAh	3500mAh	3500mAh	4000mAh	3750mAh	4000mAh
USB Connector	microUSB 2.0	microUSB 2.0	microUSB 2.0	3.1, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector, USB On-The-Go	microUSB 2.0	microUSB 2.0	3.1, Type-C 1.0 reversible connector	3.1, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector	3.1, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go

Source: Company data, Credit Suisse

Figure 46: Huawei's main models' pricing trends

Huawei													
Mate Series	Release Date	Memory	Front camera	Rear camera	Price	Note	Honor Series	Release Date	Memory	Front camera	Rear camera	Price	Note
Mate 8	Nov 2015	3GB/32GB	8MP	16MP	599 €		Honor6	June 2014	3GB/16GB	5MP	13MP	1,999RMB	
	Nov 2015	4GB/64GB	8MP	16MP	699 €			June 2014	3GB/32GB	5MP	13MP	2,299RMB	
Mate 9	Nov 2016	4GB/64GB	8MP	12MP+20MP	699 €		Honor7	June 2015	3GB/16GB	8MP	20MP	1,999RMB	(China Mobile)
Mate 9	Nov 2016	6GB/256GB	8MP	12MP+20MP	1,395 €	Porche Design		June 2015	3GB/16GB	8MP	20MP	2,199RMB	
Mate 9 Pro	Nov 2016	4GB/64GB	8MP	12MP+20MP	644 €			June 2015	3GB/64GB	8MP	20MP	2,499RMB	
	Nov 2016	6GB/128GB	8MP	12MP+20MP	726 €		Honor8	July 2016	3GB/32GB	8MP	12MP	1,999RMB	
Mate10	Nov 2017	4GB/64GB	8MP	12MP+20MP	699 €			July 2016	4GB/32GB	8MP	12MP	2,299RMB	
Mate10	Nov 2017	6GB/256GB	8MP	12MP+20MP	1,385 €	Porche Design	Honor9	June 2017	4GB/64GB	8MP	20MP+12MP	2,299RMB	
Mate10 Pro	Nov 2017	6GB/128GB	8MP	12MP+20MP	799 €			June 2017	6GB/128GB	8MP	20MP+12MP	2,699RMB	
Mate RS	April 2018	6GB/256GB	24MP	40MP+20MP+8MP	1,685 €	Porche Design		June 2017	6GB/128GB	8MP	20MP+12MP	2,999RMB	
	April 2018	6GB/512GB	24MP	40MP+20MP+8MP	2,095 €	Porche Design	Honor 7X	Dec 2017	4GB/32GB	8MP	16MP+2MP	1,299RMB	
Mate 20 Lite	Sep 2018	6GB/64GB	24MP+2MP	20MP+2MP	379 €			Dec 2017	4GB/64GB	8MP	16MP+2MP	1,699RMB	
	Nov 2018	4GB/128GB	24MP	12MP+16MP+8MP	799 €			Dec 2017	4GB/128GB	8MP	16MP+2MP	1,999RMB	
Mate 20	Nov 2018	6GB/128GB	24MP	12MP+16MP+8MP	849 €			Dec 2017	4GB/64GB	13MP	16MP+20MP	2,699RMB	
Mate 20 Pro	Nov 2018	6GB/128GB	24MP	40MP+20MP+8MP	1,049 €		Honor V10	Dec 2017	6GB/64GB	13MP	16MP+20MP	2,999RMB	
Mate 20 X	Nov 2018	6GB/128GB	24MP	40MP+20MP+8MP	899 €			Dec 2017	6GB/128GB	13MP	16MP+20MP	2,999RMB	
Mate 20 RS	Dec 2018	8GB/256GB	24MP	40MP+20MP+8MP	1,685 €	Porche Design	honor 7A	April 2018	2GB/32GB	8MP	13MP+2MP	799RMB	
	Dec 2018	8GB/512GB	24MP	40MP+20MP+8MP	2,095 €	Porche Design		April 2018	3GB/32GB	8MP	13MP+2MP	899RMB	
Mate X	Feb 2019	8GB/512GB	N/A	40MP+16MP+8MP+TOF	2,299 €		Honor 7C	May 2018	3GB/32GB	8MP	13MP+2MP	899RMB	
Mate 20 X 5G	May 2019	6GB/128GB	24MP	40MP+20MP+8MP	NA	GBP 999		May 2018	4GB/64GB	8MP	13MP+2MP	1,299RMB	
							Honor 10	May 2018	6GB/64GB	24MP	16MP+24MP	2,599RMB	
P Series	Release Date	Memory	Front camera	Rear camera	Price	Note		May 2018	6GB/128GB	24MP	16MP+24MP	2,999RMB	
P8	April 2015	3GB/16GB	8MP	13MP	499 €		Honor 9i	June 2018	4GB/64GB	16MP	13MP+2MP	1,399RMB	
P8Max	April 2015	3GB/32GB	8MP	13MP	599 €			June 2018	4GB/128GB	16MP	13MP+2MP	1,699RMB	
	April 2015	3GB/64GB	5MP	13MP	549 €		Honor Play	June 2018	4GB/64GB	16MP	16MP+2MP	1,999RMB	
P9	Apr 2016	3GB/32GB	8MP	12MP+12MP	599 €			June 2018	6GB/64GB	16MP	16MP+2MP	2,399RMB	
	Apr 2016	4GB/64GB	8MP	12MP+12MP	649 €		Honor 9N	July 2018	4GB/64GB	16MP	13MP+2MP	1,399RMB	
P9 Plus	May 2016	4GB/64GB	8MP	12MP+12MP	749 €			July 2018	4GB/128GB	16MP	13MP+2MP	1,699RMB	
P10	Feb 2017	4GB/64GB	8MP	12MP+20MP	649 €		Honor Note10	Aug 2018	6GB/64GB	13MP	16MP+24MP	2,799RMB	
P10 plus	Feb 2017	4GB/64GB	8MP	12MP+20MP	699 €			Aug 2018	6GB/128GB	13MP	16MP+24MP	3,199RMB	
	Feb 2017	4GB/128GB	8MP	12MP+20MP	799 €			Aug 2018	8GB/128GB	13MP	16MP+24MP	3,599RMB	
P20 Lite	Mar 2018	4GB/64GB	16MP	16MP+2MP	369 €		Honor 8X Max	Sep 2018	4GB/64GB	8MP	16MP+2MP	1,499RMB	
P20	April 2018	4GB/128GB	24MP	12MP+20MP	649 €		Honor 8X	Sep 2018	4GB/128GB	8MP	16MP+2MP	1,799RMB	
P20 Pro	April 2018	6GB/128GB	24MP	40MP+20MP+8MP	889 €			Sep 2018	6GB/64GB	16MP	20MP+2MP	1,399RMB	
P Smart Z	May 2019	4GB/64GB	16MP	2MP+16MP	289 €			Sep 2018	6GB/128GB	16MP	20MP+2MP	1,999RMB	
							Honor 8C	Oct 2018	4GB/32GB	8MP	12MP+2MP	1,099RMB	
Nova	Release Date	Memory	Front camera	Rear camera	Price	Note		Oct 2018	4GB/64GB	8MP	13MP+2MP	1,399RMB	
Nova	Sep-16	3GB/32GB	8MP	12MP	2,099RMB		Honor Magic2	Nov 2018	6GB/128GB	16MP+2MP	16MP+16MP+24MP	3,799RMB	
NovaPlus	Sep-16	4GB/64GB	8MP	12MP	2,399RMB			Nov 2018	8GB/128GB	16MP+2MP	16MP+16MP+24MP	4,299RMB	
	Sep 2016	3GB/32GB	8MP	16MP	NA	429EUR		Nov 2018	8GB/256GB	16MP+2MP	16MP+16MP+24MP	4,799RMB	
Nova2	May 2017	3GB/64GB	20MP	12MP+8MP	2,499RMB		honor 10 Lite	Nov 2018	4GB/64GB	24MP	13MP+2MP	1,399RMB	
Nova2Plus	May 2017	4GB/128GB	20MP	12MP+8MP	2,899RMB			Nov 2018	6GB/64GB	24MP	13MP+2MP	1,699RMB	
Nova 2s	Dec 2017	4GB/64GB	20MP+2MP	16MP+20MP	2,699RMB			Nov 2018	6GB/128GB	24MP	13MP+2MP	1,899RMB	
	Dec 2017	6GB/128GB	20MP+2MP	16MP+20MP	2,999RMB								
Nova 3	Aug 2018	6GB/128GB	24MP+2MP	16MP+24MP	2,999RMB								
Nova 3i	Aug 2018	4GB/128GB	24MP+2MP	16MP+2MP	1,999RMB								
	Aug 2018	6GB/64GB	24MP+2MP	16MP+2MP	1,999RMB								
Nova 4	Dec 2018	8GB/128GB	25MP	48MP+16MP+2MP	3,999RMB								
Nova5	June 2019	8GB/128GB	32MP	48MP+16MP+2MP+2MP	2,799RMB								
Nova5 Pro	June 2019	8GB/128GB	32MP	48MP+16MP+2MP+2MP	2,999RMB								
	June 2019	8GB/256GB	32MP	48MP+16MP+2MP+2MP	3,399RMB								
Nova5i	June 2019	6GB/128GB	24MP	24MP+8MP+2MP+2MP	1,999RMB								
	June 2019	8GB/128GB	24MP	24MP+8MP+2MP+2MP	2,199RMB								
	July 2019	6GB/128GB	32MP	48MP+8MP+2MP+2MP	2,199RMB								
Nova5i Pro	July 2019	8GB/128GB	32MP	48MP+8MP+2MP+2MP	2,499RMB								
	July 2019	8GB/256GB	32MP	48MP+8MP+2MP+2MP	2,799RMB								

Source: Company data, Credit Suisse

Oppo: Flagship models struggling, sales sluggish in ASEAN region

Production volume trends

Production volume at Oppo totaled 100mn units in CY16, 105mn units in CY17, and 105mn units in CY18. Forecasts for CY19 were 105mn units as of the March survey, 110–115mn units as of the June survey, and around 110mn units as of the current (September) survey.

Quarterly production volume in CY17 totaled 23mn units in Jan–Mar, 25mn units in Apr–Jun, 28mn units in Jul–Sep, and 28mn units in Oct–Dec. In CY18, quarterly production volume was 27mn units in Jan–Mar, 29mn units in Apr–Jun, 27mn units in Jul–Sep, and 24mn units in Oct–Dec.

As of our June survey, planned production volume in CY19 was 25mn units in Jan–Mar, 30mn units in Apr–Jun, 31mn units in Jul–Sep, and 27mn units in Oct–Dec. As of our current (September) survey, however, planned production volume is 25mn units in Jan–Mar, 29mn units in Apr–Jun, 24mn units in Jul–Sep, and 32mn units in Oct–Dec.

Trends by model

Sales of flagship models remain anemic.

However, sales of low-end models are growing, and market share is expanding in places like Thailand, Indonesia, the Philippines, and the Middle East & Africa. Oppo is recovering market share in India.

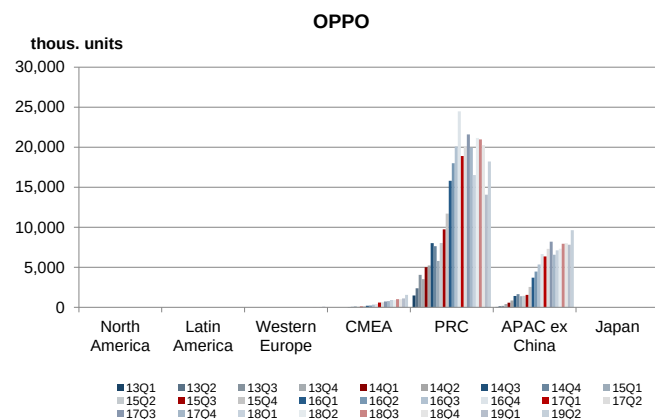
In 5G handsets, Oppo launched the Reno 5G in May and is evidently asking chipset vendors to start supplying single-chip SoCs from around December for its 2020 models.

Figure 47: Oppo: Global shipments by model

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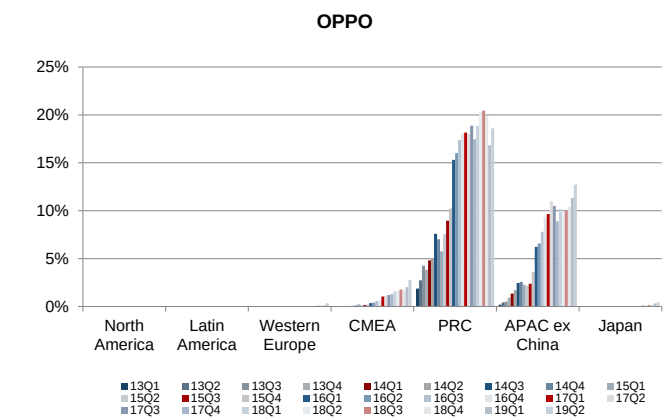
Source: IDC, Credit Suisse

Figure 48: Oppo: Smartphone shipments by region

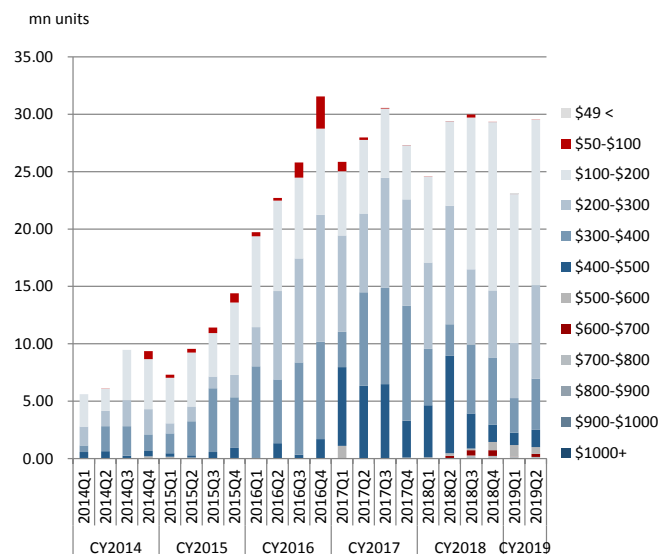


Source: IDC, Credit Suisse

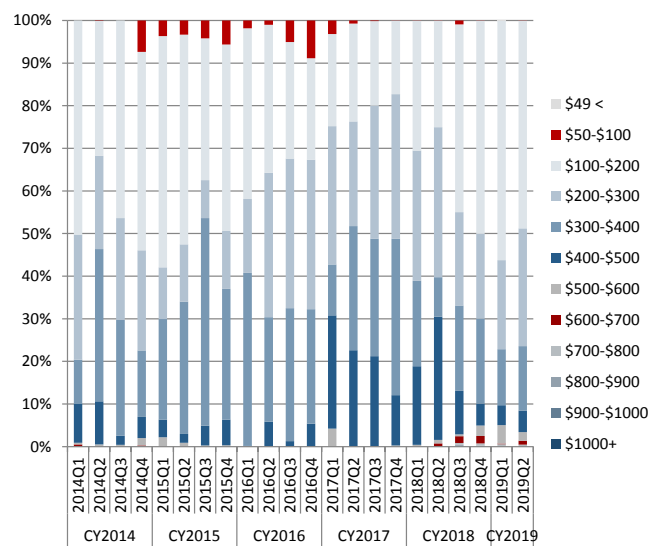
Figure 49: Oppo: Smartphone market share by region



Source: IDC, Credit Suisse

Figure 50: Oppo: Smartphone shipments by price band

Source: IDC, Credit Suisse

Figure 51: Oppo: Smartphone shipment mix by price band

Source: IDC, Credit Suisse

Figure 52: Oppo: Smartphone specs (Jan–Jun 2018 models)

	A83	A71 (2018)	A1	R15	R15 Dream Mirror Edition	F7	A3	Realme 1	F7 Youth	Find X	Find X Lamborghini Edition
Announce	Jan 2018	Feb 2018	Mar 2018	Mar 2018	Mar 2018	Mar 2018	April 2018	May 2018	May 2018	June 2018	June 2018
Release	Jan 2018	Feb 2018	Apr 2018	Apr 2018	Apr 2018	April 2018	May 2018	May 2018	June 2018	July 2018	Aug 2018
Height (mm)	150.5	148.1	150.5	155.1	155.3	156	156	156.5	156.5	156.7	156.7
Width (mm)	73.1	73.8	73.1	75.2	75	75.3	75.3	75.2	75.2	74.2	74.2
Thickness (mm)	7.7	7.6	7.7	7.4	7.5	7.8	7.8	7.8	7.8	9.6	9.6
Weight (g)	143	137	143	175	175	158	159	155	155	186	186
Display size (inch)	5.7	5.2	5.7	6.28	6.28	6.23	6.2	6	6	6.42	6.42
Display resolution (px)	720 x 1440	720 x 1280	720 x 1440	1080 x 2280	1080 x 2280	1080 x 2280	1080 x 2280	1080 x 2160	1080 x 2160	1080 x 2340	1080 x 2340
Display (ppi)	282	282	282	401	401	405	405	402	402	401	401
Display	IPS LCD	IPS LCD	S-IPS LCD	AMOLED	AMOLED	LTPS IPS LCD	LTPS IPS LCD	IPS LCD	LTPS IPS LCD	AMOLED	AMOLED
Camera (main)	13 MP	13 MP	13 MP	Dual 16 MP + 5 MP	Dual 16 MP + 20 MP	16 MP	16 MP	13 MP	13 MP	Dual 16 MP + 20 MP	Dual 16 MP + 20 MP
f factor	2.2	2.2	2.2	1.7/2.2	1.7	1.8	1.8	2.2	2.2	2.0/2.2	2.0/2.2
CIS size	NA	1/3"	1/3"	1/2.6"	1/2.6", 1/2.8"	NA	NA	NA	NA	NA	NA
CIS Pitch (um)	NA	1.12	1.12	1.22	1/1.22	NA	NA	NA	NA	NA	NA
OIS(Y/N)	N	N	N	N	N	N	N	N	N	Y	Y
Dual Lens (Y/N)	N	N	N	Y	Y	N	N	N	N	Y	Y
Camera (front)	8MP	5 MP	8 MP	20 MP	20 MP	25 MP	8 MP	8 MP	8 MP	Motorized pop-up 25 MP	Motorized pop-up 25 MP
Wifi	Wi-Fi 802.11 a/b/g/n, dual-band, WiFi Direct, hotspot Bluetooth 4.2, A2DP, LE	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot
Bluetooth	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0
CPU clock	Octa-core 2.5 GHz Cortex-A53	Octa-core 1.8 GHz Cortex-A53	2.5GHz Quad Core Cortex-A53 + 1.65GHz Quad Core Cortex-A53	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver)	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver)
CPU Core	MT6763T Helio P23	SDM450	MT6763T Helio P23	MT6771 Helio P60	SDM660	MT6771 Helio P60	MT6771 Helio P60	MT6771 Helio P60	MT6771 Helio P60	SDM845	SDM845
GPU Core	Mali-G71 MP2	Adreno 506	Mali-G71 MP2	Mali-G72 MP3	Adreno 512	Mali-G72 MP3	Mali-G72 MP3	Mali-G72 MP3	Mali-G72 MP3	Adreno 630	Adreno 630
NAND	32GB	16GB	64GB	128 GB	128 GB	64/128GB	128 GB	32/64/128 GB	64 GB	256 GB	512 GB
Card slot	up to 256 GB	up to 256 GB (dedicated slot)	up to 128 GB	up to 256 GB (uses SIM 2 slot)	up to 256 GB (uses SIM 2 slot)	up to 256 GB (dedicated slot)	up to 256 GB (dedicated slot)	up to 256 GB (dedicated slot)	up to 256 GB (dedicated slot)	NA	NA
DRAM	3/4 GB	3 GB(India only), 2GB	4 GB	6 GB	6 GB	4/6 GB	4 GB	3/4/6 GB	4 GB	8 GB	8 GB
Battery capacity	3180mAh	3000mAh	3180 mAh	3450 mAh	3400 mAh	3400 mAh	3400mAh	3410mAh	3410mAh	3730mAh	3400mAh
USB Connector	microUSB v2.0	microUSB v2.0	microUSB v2.0	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go

Source: Company data, Credit Suisse

Figure 53: Oppo: Smartphone specs (Jul–Dec 2018 models)

	A5	A3s	F9 Pro (F9)	R17	R17 Pro	A7x	K1	R17 Neo	R15x	A7
Announce	July 2018	July 2018	Aug 2018	Aug 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Oct 2018	Nov 2018
Release	July 2018	July 2018	Aug 2018	Aug 2018	Nov 2018	Sep 2018	Oct 2018	Nov 2018	Nov 2018	Nov 2018
Height (mm)	156.2	156.2	156.7	157.5	157.6	156.7	158.3	158.3	158.3	155.9
Width (mm)	75.6	75.6	74	74.9	74.6	74	75.5	75.5	75.5	75.4
Thickness (mm)	8.2	8.2	8	7.5	7.9	8	7.4	7.4	7.4	8.1
Weight (g)	168	168	169	182	183	169	156	156	156	168
Display size (inch)	6.2	6.2	6.3	6.4	6.4	6.3	6.4	6.41	6.41	6.2
Display resolution (px)	720 x 1520	720 x 1520	1080 x 2340	1080 x 2280	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	720 x 1520
Display (ppi)	271	271	409	394	402	409	402	402	402	271
Display	IPS LCD	IPS LCD	LTPS IPS LCD	AMOLED	AMOLED	LTPS IPS LCD	Super AMOLED	Super AMOLED	Super AMOLED	IPS LCD
Camera (main)	Dual 13MP + 2 MP	Dual 13MP + 2 MP	Dual 16MP + 2MP	Dual 16MP + 5 MP	Dual 12MP + 20MP	Dual 16MP+2MP	Dual 16MP+2MP	Dual 16MP+2MP	Dual 16MP+2MP	Dual 13MP+2MP
f factor	2.2/2.4	2.2/2.4	1.8/2.4	1.8	1.5-2.4/2.6	1.8/2.4	1.7/2.4	1.7/2.4	1.7	2.2/2.4
CIS size	NA	NA	NA	2.6	2.55	3.1	2.8	2.8	2.8	NA
CIS Pitch (um)	NA	NA	NA	1.22	1.4	1	1.12	1.12	1.12	NA
OIS(Y/N)	N	N	N	N	Y	N	N	N	N	N
Dual Lens (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Camera (front)	8 MP	8 MP	25 MP	25 MP	25 MP	16 MP	25 MP	25 MP	25 MP	16 MP
Wifi	Wi-Fi 802.11 b/g/n, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n, WiFi Direct, hotspot
Bluetooth	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2
CPU clock	Octa-core 1.8 GHz Cortex-A53	Octa-core 1.8 GHz Cortex-A53	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (2x2.0 GHz 360 Gold & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.2 GHz 360 Gold & 6x1.7 GHz Kryo 360 Silver)	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (4x2.0 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.0 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.0 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core 1.8 GHz Cortex-A53
CPU Core	SDM450	SDM450	MT6771 Helio P60	SDM710 Snapdragon 670	SDM710	MT6771 Helio P60 (12 nm)	SDM660 Snapdragon 660 (14 nm)	SDM660 Snapdragon 660 (14 nm)	SDM660 Snapdragon 660 (14 nm)	SDM450 Snapdragon 450 (14 nm)
GPU Core	Adreno 506	Adreno 506	Mali-G72 MP3	Adreno 615	Adreno 616	Mali-G72 MP3	Adreno 512	Adreno 512	Adreno 512	Adreno 506
NAND	64 GB	16 GB	64 GB	128 GB	128 GB	128 GB	64 GB	128 GB	128 GB	32/64 GB
Card slot	microSD, up to 256 GB	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (dedicated slot)	NA	microSD, up to 256 GB	NA	microSD, up to 256 GB (dedicated slot)
DRAM	4 GB	2 GB	4/6 GB	8 GB	8 GB	4 GB	4/6 GB	4 GB	6 GB	3/4 GB
Battery capacity	4230mAh	4230mAh	3500mAh	3500mAh	3700mAh	3500mAh	3600mAh	3600mAh	3600mAh	4230mAh
USB Connector	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	3.1, Type-C 1.0 reversible connector, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go

Source: Company data, Credit Suisse

Vivo: No noteworthy changes

Production volume trends

Production volume at Vivo totaled 85mn units in CY16, 85mn units in CY17, and 100mn units in CY18. Forecasts for CY19 were 105mn units as of the June survey, and around 105mn units as of the current (September) survey.

Quarterly production volume in CY17 totaled 20mn units in Jan–Mar, 22–23mn units in Apr–Jun, 24mn units in Jul–Sep, and 20mn units in Oct–Dec. Quarterly production volume in CY18 was 20mn units in Jan–Mar, 30mn units in Apr–Jun, 29mn units in Jul–Sep, and 22mn units in Oct–Dec.

As of our June survey, planned production volume in CY19 was 23mn units in Jan–Mar, 29mn units in Apr–Jun, 27mn units in Jul–Sep, and 26mn units in Oct–Dec. As of our current (September) survey, however, planned production is 23mn units in Jan–Mar, 29mn units in Apr–Jun, 28mn units in Jul–Sep, and around 25mn units in Oct–Dec.

Other data

As with Oppo, Vivo's flagship models are struggling, but the company is ramping up production of midrange and low-models. The ratio of sub-\$200 handset sales is rising. Market share is expanding in the ASEAN region, especially in Malaysia, Thailand, and Indonesia.

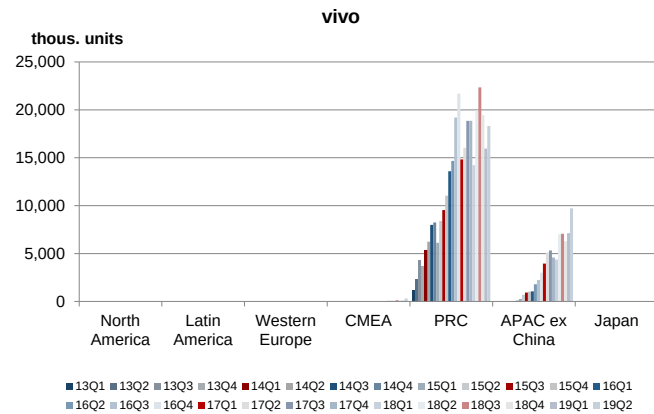
In 5G handsets, Vivo launched the iQOO Pro 5G in August. In addition to Qualcomm chips, the company is evidently thinking about including Samsung's Exynos 9630 5G SoC in its CY20 models.

Figure 56: Vivo: Global shipments by model

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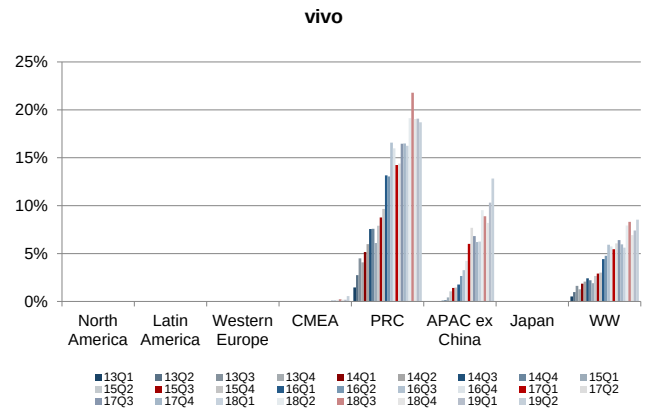
Source: IDC, Credit Suisse

Figure 57: Vivo: Smartphone shipments by region



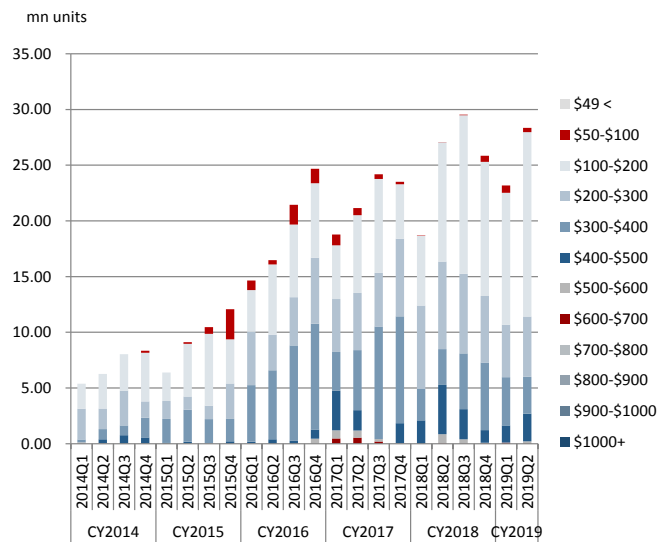
Source: IDC, Credit Suisse

Figure 58: Vivo: Smartphone market share by region



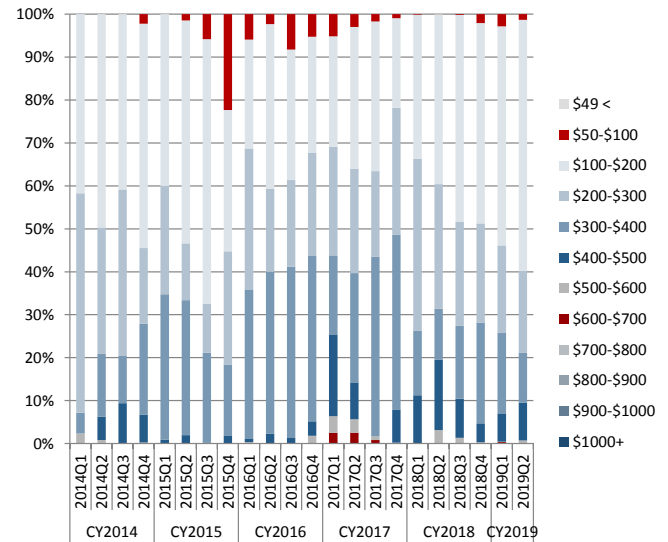
Source: IDC, Credit Suisse

Figure 59: Vivo: Smartphone shipments by price band



Source: IDC, Credit Suisse

Figure 60: Vivo: Smartphone shipment mix by price band



Source: IDC, Credit Suisse

Figure 61: Vivo: Smartphone specs (Jan–Jun 2018 models)

	X20 Plus UD	X21	X21 UD	V9	Y71	V9 Youth	Y53i	X21i	Y83	Z1	NEX A (NEX)	NEX S (NEX Ultimate)	V9 (6GB)
Announce	Jan 2018	Mar 2018	Mar 2018	Mar 2018	April 2018	April 2018	April 2018	May 2018	May 2018	May 2018	June 2018	June 2018	June 2018
Release	Jan 2018	Mar 2018	Mar 2018	April 2018	April 2018	April 2018	April 2018	May 2018	May 2018	June 2018	June 2018	June 2018	July 2018
Height (mm)	155.3	154.5	154.5	154.8	155.9	154.8	144.2	154.4	155.2	154.8	162	162	154.8
Width (mm)	80.1	74.8	74.8	75.1	75.7	75.1	71.4	75	75.2	75.1	77	77	75.1
Thickness (mm)	7.5	7.4	7.4	7.9	7.8	7.9	7.6	7	7.7	7.9	8	8	7.9
Weight (g)	181.5	156.2	156.2	150	150	150	137	159	150	149.3	199	199	150
Display size (inch)	6.43	6.28	6.28	6.3	6	6.3	5	6.28	6.22	6.26	6.59	6.59	6.3
Display resolution (px)	1080 x 2160	1080 x 2280	1080 x 2280	1080 x 2280	720 x 1440	1080 x 2280	540 x 960	1080 x 2280	720 x 1520	1080 x 2280	1080 x 2316	1080 x 2316	1080 x 2280
Display (ppi)	376	402	402	400	268	400	220	402	270	403	388	388	400
Display	Super AMOLED	Super AMOLED	Super AMOLED	IPS LCD	IPS LCD	IPS LCD	IPS LCD	Super AMOLED	IPS LCD	IPS LCD	Super AMOLED	Super AMOLED	IPS LCD
Camera (main)	Dual 12MP+5MP	Dual 12MP+5MP	Dual 12MP+5MP	Dual 16MP+5MP	13 MP	Dual 16MP+2MP, 13MP+2MP (China only)	8 MP	Dual 12MP+5MP	13 MP	Dual 13MP+2MP	Dual 12MP+5MP	Dual 12MP+5MP	Dual 13MP+2MP
f factor	1.8	1.8/2.4	1.8/2.4	2	2.2	NA	2	1.8/2.0	2.2	NA	1.8/2.4	1.8/2.4	2.2
CIS size	NA	1/2.5"	1/2.5"	NA	NA	NA	NA	2.5	NA	NA	2.5	2.5	NA
CIS Pitch (um)	NA	1.4	1.4	NA	NA	NA	NA	1.4	NA	NA	1.4	1.4	NA
OIS(Y/N)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	NA
Dual Lens (Y/N)	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)	N	Y(Rear)	N	Y(Rear)	N	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)
Camera (front)	12MP	12MP	12MP	24 MP	5 MP	16 MP	5 MP	24 MP	8 MP	24 MP	Pop-up 8 MP	Pop-up 8 MP	12 MP
Wifi	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n, WiFi Direct, DLNA, hotspot	Wi-Fi 802.11 b/g/n, WiFi Direct, DLNA, hotspot	Wi-Fi 802.11 b/g/n, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot
Bluetooth	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2
CPU clock	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core 2.2 GHz Cortex-A53	Octa-core 1.8 GHz Cortex-A53	Octa-core 1.8 GHz Cortex-A53	Quad-core 1.4 GHz Cortex-A53	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core 2.0 GHz Cortex-A53	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (2x2.2 GHz Cortex-A75 & 6x1.7 GHz Cortex-A55)	Octa-core (4x2.7 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver)	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)
CPU Core	SDM660	SDM660	SDM660	MSM8953-Pro	MSM8917	SDM450	MSM8917	MT6771	MT6762	SDM660	SDM710	SDM845	SDM660
GPU Core	Adreno 512	Adreno 512	Adreno 512	Adreno 506	Adreno 308	Adreno 506	Adreno 306	Mali-G72 MP3	PowerVR GE8320	Adreno 512	Adreno 616	Adreno 630	Adreno 512
NAND	128GB	64/128GB	128 GB	64 GB	16/32 GB	32 GB	16 GB	64/128 GB	64 GB	64 GB	128 GB	128/256 GB	64 GB
Card slot	up to 256 GB	up to 256GB (uses SIM 2 slot)	up to 256GB (uses SIM 2 slot)	up to 256 GB (dedicated slot)	up to 256 GB (dedicated slot)	up to 256 GB (dedicated slot)	up to 256 GB (dedicated slot)	up to 256 GB (uses SIM 2 slot)	up to 256 GB	up to 256 GB (uses SIM 2 slot)	NA	NA	microSD, up to 256 GB (dedicated slot)
DRAM	4GB	6GB	6GB	4 GB	3 GB	4 GB	2 GB	4/6 GB	4 GB	4 GB	6 GB	8 GB	6 GB
Battery capacity	3900mAh	3200mAh	3200mAh	3260mAh	3360mAh	3260mAh	2500mAh	3425mAh	3260mAh	3260mAh	4000mAh	4000mAh	3260mAh
USB Connector	microUSB v2.0	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	microUSB 2.0, USB On-The-Go

Source: Company data, Credit Suisse

Figure 62: Vivo: Smartphone specs (Jul–Dec 2018 models)

	Z1i	Y83 Pro	V11 (V11 Pro, X21s)	X23	Y97	V11i	Y71i	Z3i	Z3	Y81i	Y93	Z1 Lite	Y95	Y93s	Y93 (Mediatek)	NEX Dual Display
Announce	July 2018	Sep 2018	Sep 2018	Sep 2018	Sep 2018	Sep 2018	Oct 2018	Oct 2018	Oct 2018	Oct 2018	Nov 2018	Nov 2018	Nov 2018	Dec 2018	Dec 2018	Dec 2018
Release	July 2018	Sep 2018	Sep 2018	Sep 2018	Sep 2018	Sep 2018	Oct 2018	Oct 2018	Oct 2018	Nov 2018	Nov 2018	Nov 2018	Nov 2018	Dec 2018	Jan 2018	Dec 2018
Height (mm)	154.8	155.2	157.9	157.7	155.9	156	155.9	156	156	155.1	155.1	154.8	155.1	155.1	155.1	157.2
Width (mm)	75.1	75.2	75	74.1	75.6	75.6	75.7	75.6	75.6	75	75.1	75	75.1	75.1	75.1	75.3
Thickness (mm)	7.9	7.7	7.9	7.5	8.1	8.1	7.8	8.1	8.1	7.8	8.3	7.9	8.3	8.3	8.3	8.1
Weight (g)	149.3	152	156	160.5	162	164	150	164	164	143	163.5	149.3	163.5	165	163.5	199
Display size (inch)	6.26	6.22	6.41	6.41	6.3	6.3	6	6.3	6.3	6.22	6.2	6.26	6.22	6.2	6.22	6.39
Display resolution (px)	1080 x 2280	720 x 1520	1080 x 2340	1080 x 2340	1080 x 2280	1080 x 2280	720 x 1440	1080 x 2280	1080 x 2280	720 x 1520	720 x 1520	1080 x 2280	720 x 1520	720 x 1520	720 x 1520	1080 x 2340
Display (ppi)	403	270	402	402	400	400	268	400	400	270	271	403	270	271	270	403
Display	IPS LCD	IPS LCD	Super AMOLED	Super AMOLED	S-IPS LCD	LTPS IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	Super AMOLED
Camera (main)	Dual 13MP+2MP	Dual 13MP+2MP	Dual 12MP+5MP	Dual 12MP+13MP	Dual 16MP+2MP	Dual 16MP+5MP	8MP	Dual 16MP+2MP	Dual 16MP+2MP	13 MP	Dual 13MP+2MP	Dual 16MP+2MP	Dual 13MP+2MP	Dual 13MP+2MP	Dual 13MP+2MP	Dual 12MP+2MP
f factor	NA	2.2/2.4	1.8/2.4	1.8/2.4	2.0/2.4	2.0/2.4	2.2	2.0/2.4	2.0/2.4	2.2	2.2/2.4	2	2.2/2.4	2.2/2.4	2.2/2.4	1.8/1.8
CIS size	NA	NA	2.8	2.55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.55
CIS Pitch (um)	NA	NA	NA	1.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4
OIS (V/N)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y
Dual Lens (Y/N)	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)	N	Y(Rear)	Y(Rear)	N	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)	Y(Rear)
Camera (front)	16 MP	8 MP	25 MP	12 MP	16 MP	25 MP	5 MP	24 MP	12 MP	5 MP	8 MP	16 MP	20 MP	8 MP	8 MP	N
Wifi	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot
Bluetooth	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0
CPU clock	Octa-core 1.8 GHz Kryo 260	Octa-core 2.0 GHz Cortex-A53	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.0 GHz Kryo 360 & 4x1.8 GHz Kryo 360)	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Quad-core 1.4 GHz Cortex-A5	Octa-core (4x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (2x2.2 GHz 360 gold & 6x2.2 GHz Kryo 360 Silver)	Quad-core 2.0 GHz Cortex-A53	Octa-core (2x1.95 GHz Cortex-A53 & 6x1.45 GHz Cortex-A53)	Octa-core 2.2 GHz Cortex-A53	Octa-core (2x1.95 GHz Cortex-A53 & 6x1.45 GHz Cortex-A53)	Octa-core 2.0 GHz Cortex-A53	Octa-core 2.0 GHz Cortex-A53	Octa-core (4x2.7 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver)
CPU Core	SDM636	MT6762 Helio P22 (12 nm)	SDM660 Snapdragon 660 (14 nm)	SDM670 Snapdragon 670 (10 nm)	MT6771 Helio P60 (12 nm)	MT6771 Helio P60 (12 nm)	MSM8917 Snapdragon 425 (28 nm)	MT6771 Helio P60 (12 nm)	SDM710 Snapdragon 710 (10 nm)	MT6761 Helio A22 (12 nm)	SDM439 Snapdragon 439 (12 nm)	MSM8953-Pro Snapdragon 626 (14 nm)	SDM439 Snapdragon 439 (12 nm)	Mediatek MT6762 Helio P22 (12 nm)	Mediatek MT6762 Helio P22 (12 nm)	Qualcomm SDM845 Snapdragon 845 (10 nm)
GPU Core	Adreno 509	PowerVR GE8320	Adreno 512	Adreno 615	Mali-G72 MP3	Mali-G72 MP3	Adreno 308	Mali-G72 MP3	Adreno 615	PowerVR GE8320	Adreno 505	Adreno 506	Adreno 505	PowerVR GE8320	PowerVR GE8320	Adreno 630
NAND	128 GB	64 GB	64/128 GB	128 GB	128 GB	128 GB	16 GB	128 GB	64/128 GB	16 GB	64 GB	32 GB	64 GB	128 GB	32 GB	128 GB
Card slot	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	NA	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB	microSD, up to 256 GB	microSD, up to 256 GB	microSD, up to 256 GB	microSD, up to 256 GB	microSD, up to 256 GB	NA
DRAM	4 GB	4 GB	6 GB	8 GB	4 GB	4 GB	2 GB	6 GB	6 GB	2 GB	4 GB	4 GB	4 GB	4 GB	4 GB	10 GB
Battery capacity	3260mAh	3260mAh	3400mAh	3400mAh	3315mAh	3315mAh	3360mAh	3315mAh	3315mAh	3260mAh	4030mAh	3260mAh	4030 mAh	4030 mAh	4030 mAh	3500 mAh
USB Connector	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go

Source: Company data, Credit Suisse

Figure 63: Vivo: Smartphone specs (2019 models)

	Y99	V15 Pro	IQOO	V15	X27	S1	X27 Pro	Y12	Y15	Y17	Z1x	S1 Pro	Z1x	IQOO Neo	Z1 Pro	S1	Z5	V17 Neo	Y90	IQOO Pro	IQOO Pro 5G	Z1X	
Announce	Jan 2019	Feb 2019	Mar 2019	Mar 2019	Mar 2019	Mar 2019	Apr 2019	June 2019	May 2019	April 2019	April 2019	May 2019	May 2019	July 2019	July 2019	July 2019	July 2019	Aug 2019	July 2019	Aug 2019	Aug 2019	Sep 2019	
Release	Jan 2019	Mar 2019	Mar 2019	Mar 2019	Mar 2019	Mar 2019	Apr 2019	April 2019	May 2019	April 2019	April 2019	May 2019	May 2019	July 2019	July 2019	July 2019	July 2019	Aug 2019	July 2019	Aug 2019	Aug 2019	Sep 2019	
Height (mm)	154.8	157.3	157.7	161.2	157.7	16	165.7	159.4	159.4	159.4	154.8	157.3	162.4	159.5	162.4	159.5	159.5	159.5	159.5	158.8	158.8	159.5	
Width (mm)	75	74.7	75.2	75.9	74.3	76	74.6	76.8	76.8	76.8	75	74.7	77.3	75.2	77.3	75.2	75.2	75.2	75.1	75.7	75.7	75.2	
Thickness (mm)	7.9	8.2	8.5	8.5	9	8.5	9	8.9	8.9	8.9	7.9	8.2	8.9	8.1	8.9	8.1	8.1	8.1	8.3	9.3	9.3	8.1	
Weight (g)	149.3	185	180	186	188	-	200	190.5	190.5	190.5	150	185	204.1	198.5	201	179	187	179	163.5	215	217	190	
Display size (inch)	6.26	6.39	6.41	6.53	6.39	6.53	6.7	6.35	6.35	6.35	6.26	6.39	6.53	6.39	6.35	6.38	6.38	6.38	6.22	6.41	6.41	6.38	
Display resolution (px)	1080 x 2280	1080 x 2316	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2460	720 x 1544	720 x 1544	720 x 1544	1080 x 2280	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	720 x 1520	1080 x 2340	1080 x 2340	1080 x 2340	
Display (ppi)	403	400	400	395	400	395	401	268	268	268	403	403	395	404	395	404	404	404	270	402	402	404	
Display	IPS LCD	Super AMOLED	AMOLED	IPS LCD	Super AMOLED	IPS LCD	Super AMOLED	IPS LCD	IPS LCD	IPS LCD	IPS LCD	Super AMOLED	IPS LCD	Super AMOLED	Super AMOLED	Super AMOLED	Super AMOLED	Super AMOLED	IPS LCD	Super AMOLED	Super AMOLED	Super AMOLED	
Camera (main)	Dual 16MP+2MP	Triple 48MP+8MP+5MP	Triple 12MP+13MP+2MP	Triple 12MP+8MP+5MP	Triple 12MP+8MP+5MP	Triple 12MP+8MP+5MP	Triple 48MP+13MP+2MP	Triple 13MP+8MP+2MP	Triple 13MP+8MP+2MP	Triple 13MP+8MP+2MP	Dual 13MP+2MP	Triple 48MP+8MP+5MP	Triple 12MP+8MP+2MP	Triple 12MP+8MP+2MP	Triple 12MP+8MP+2MP	Triple 12MP+8MP+2MP	Triple 12MP+8MP+2MP	8 MP	Triple 48MP+13MP+2MP	Triple 48MP+13MP+2MP	Triple 48MP+13MP+2MP		
f factor	2.0/2.4	1.8/2.4	1.8/2.4	1.8/2.2/2.4	1.8/2.4	NA	1.8/2.2/2.4	2.2/2.2/2.4	2.2/2.2/2.4	2.2/2.2/2.4	2.3/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	2	1.8/2.2/2.4	1.8/2.2/2.4	1.8/2.2/2.4	
CIS size	NA	2	2.55	NA	2	NA	2	NA	NA	NA	NA	2	NA	2.55	2.8	2.8	2.8	2.8	NA	2	2	2	
CIS Pitch (µm)	NA	0.8	1.4	NA	0.8	NA	0.8	NA	NA	NA	NA	0.8	NA	1.4	1.12	1.12	0.8	1.12	NA	0.8	0.8	0.8	
OS(VN)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dual Lens (YN)	Y	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	N	Y (Triple)	Y (Triple)	Y (Triple)	
Camera (front)	16 MP	Pop-up 32 MP	12 MP	Motorized pop-up 32 MP	Motorized pop-up 32 MP	Motorized pop-up 25 MP	Motorized pop-up 32 MP	8 MP	16 MP	24 MP-Catall 16MP-China	16 MP	Motorized pop-up 32 MP	16 MP	12 MP	32 MP	32 MP	32 MP	32 MP	5 MP	12 MP	12 MP	32 MP	
Wifi	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	NA	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	NA	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot		
Bluetooth	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v5.0	NA	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	NA	Bluetooth v5.0	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	Bluetooth v5.0, A2DP, LE, aptX	
CPU clock	Octa-core 2.2 GHz Cortex-A53	Octa-core (2x2.0 GHz Kryo 460 Gold & 6x1.7 GHz Kryo 460 Silver)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.41 GHz Kryo 485 & 4x1.7 GHz Kryo 485)	Octa-core (2x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (2x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (2x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (2x2.0 GHz Cortex-A73 & 4x2.0 GHz Cortex-A53)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.7 GHz Kryo 360 Silver)		
CPU Core	Qualcomm MSM8963-Pro Snapdragon 626 (14 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	Qualcomm SD845 Snapdragon 845 (7 nm)	
GPU Core	Adreno 506	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 512	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	Adreno 612	
NAND	64 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	64 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	128 GB	
Card slot	microSD, up to 256 GB	microSD, up to 256 GB	NA	microSD, up to 256 GB	microSD, up to 256 GB	microSD, up to 256 GB	NA	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (dedicated slot)		
DRAM	4 GB	6/8 GB	6/8/12 GB	6 GB	8 GB	6 GB	8 GB	3/4 GB	4 GB	4 GB	4 GB	6/8 GB	4/6 GB	4/6 GB	6/8 GB	4/6 GB	4/6 GB	4/6 GB	6 GB	2 GB	8/12 GB	8/12 GB	6 GB
Battery capacity	3260 mAh	3700 mAh	4000 mAh	4000 mAh	4000 mAh	3940 mAh	4000 mAh	5000 mAh	5000mAh	5000mAh	3260mAh	3700mAh	5000mAh	4500 mAh	5000mAh	4500 mAh	4500 mAh	4500 mAh	4030 mAh	4500 mAh	4500mAh	4500mAh	
USB Connector	microUSB 2.0, USB On-The-Go	microUSB 2.0	Type-C 1.0 reversible connector	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	

Source: Company data, Credit Suisse

Figure 64: Vivo: Prices for core smartphone models

Vivo							
Xplay Series	Feb 2016	Memory	Front camera	Rear camera	Price	Note	
Xplay 5	Mar 2016	4GB/128GB	8MP	16MP	3989RMB		
	Mar 2016	6GB/128GB	8MP	16MP	4288RMB		
Xplay 6	Nov 2016	6GB/128GB	16MP	12MP+12MP	4488RMB		
NEX series	Release Date	Memory	Front camera	Rear camera	Price	Note	
NEX A	June 2018	6GB/128GB	12MP+5MP	8MP	3989RMB		
NEX S	June 2018	8GB/128GB	12MP+5MP	8MP	4488RMB		
	June 2018	8GB/256GB	12MP+5MP	8MP	4998RMB		
NEX Dual Display	Dec 2018	10GB/128GB	12MP+2MP	N/A	4998RMB		
V Series	Release Date	Memory	Front camera	Rear camera	Price	Note	
V3	April 2016	3GB/32GB	8MP	13MP	N/A	1780Rs	
V3Max	April 2016	4GB/32GB	8MP	13MP	N/A	2380Rs	
V5	Nov 2016	4GB/32GB	20MP	13MP	N/A	1780Rs	
V5 Plus	Jan 2017	4GB/64GB	20MP+8MP	16MP	N/A	2780Rs	
V5s	April 2017	4GB/64GB	20MP	13MP	N/A	1890Rs	
V7 Plus	Sep 2017	4GB/64GB	24MP	16MP	N/A	2190Rs	
V7	Nov 2017	4GB/32GB	24MP	16MP	N/A	IDR 3,799,000	
V9	April 2018	4GB/64GB	24MP	16MP+5MP	N/A	2290Rs	
	July 2018	6GB/64GB	24MP	16MP+5MP	N/A	20592Rs	
V9 Youth	April 2018	4GB/32GB	16MP	16MP+2MP	N/A	1990Rs	
V11	Sep 2018	6GB/128GB	25MP	12MP+5MP	N/A	2330Rs	
V15	Mar 2019	6GB/128GB	32MP	12MP+8MP+5MP	N/A	2290Rs	
V15 Pro	Mar 2019	6GB/128GB	32MP	48MP+8MP+5MP	N/A	2890Rs	
V17 Neo	Aug 2019	6GB/128GB	32MP	15MP+8MP+2MP	N/A	2170Rs	
IQOO series	Release Date	Memory	Front camera	Rear camera	Price	Note	
IQOO Neo	July 2019	6GB/64GB	12MP	12MP+8MP+2MP	1,798RMB		
	July 2019	6GB/128GB	12MP	12MP+8MP+2MP	1,988RMB		
	July 2019	8GB/64GB	12MP	12MP+8MP+2MP	2,098RMB		
	July 2019	8GB/128GB	12MP	12MP+8MP+2MP	2,298RMB		
IQOO Pro 4G	Aug 2019	8GB/128GB	12MP	48MP+12MP+2MP	3,198RMB		
	Aug 2019	12GB/128GB	12MP	48MP+12MP+2MP	3,498RMB		
IQOO Pro 5G	Aug 2019	8GB/128GB	12MP	48MP+12MP+2MP	3,798RMB		
	Aug 2019	8GB/256GB	12MP	48MP+12MP+2MP	3,998RMB		
	Aug 2019	12GB/128GB	12MP	48MP+12MP+2MP	4,098RMB		
X Series	Release Date	Memory	Front camera	Rear camera	Price	Note	
X5	Aug 2014	2GB/16GB	5MP	13MP	2498RMB		
X5 Max	Dec 2014	2GB/16GB	5MP	13MP	2988RMB		
X5 Pro	May 2015	2GB/16GB	8MP	13MP	2598RMB		
X6	Nov 2015	4GB/32GB	8MP	13MP	2498RMB	CA version	
	Nov 2015	4GB/32GB	8MP	13MP	2598RMB	All carriers	
	Nov 2015	4GB/32GB	8MP	13MP	2998RMB	CA version	
X6 Plus	Nov 2015	4GB/32GB	8MP	13MP	3198RMB	All carriers	
X7	Jun 2016	4GB/64GB	16 MP	13 MP	2498RMB		
X7 Plus	Jun 2016	4GB/64GB	16 MP	13 MP	2798RMB		
X9	Nov 2016	4GB/128GB	20MP+8MP	16 MP	2788RMB		
	Nov 2016	6GB/128GB	20MP+8MP	16 MP	2988RMB		
X9 Plus	Nov 2016	6GB/128GB	20MP+8MP	16 MP	3488RMB		
X20	Sep 2017	4GB/64GB	12MP	12MP+5MP	2988RMB		
	Sep 2017	4GB/128GB	12MP	12MP+5MP	3488RMB		
X20 Plus	Sep 2017	4GB/64GB	12MP	12MP+5MP	3488RMB		
	Jan 2018	4GB/128GB	12MP	12MP+5MP	3588RMB		
X21	Mar 2018	6GB/64GB	12MP	12MP+5MP	2898RMB		
	Mar 2018	6GB/128GB	12MP	12MP+5MP	3198RMB		
X21 UD	Mar 2018	4GB/128GB	12MP	12MP+5MP	3588RMB		
	May 2018	6GB/128GB	24MP	12MP+5MP	2688RMB		
X21i	May 2018	4GB/128GB	24MP	12MP+5MP	2688RMB		
X23	Sep 2018	8GB/128GB	12MP	12MP+13MP	2898RMB		
X27 Pro	April 2019	8GB/256GB	32 MP	48MP+13MP+2MP	NA	280 EUR	
Y Series	Release Date	Memory	Front camera	Rear camera	Price	Note	
Y35	July 2015	2GB/16GB	5MP	13MP	1588RMB		
Y37	Aug 2015	2GB/16GB	5MP	13MP	1988RMB		
Y31	Sep 2015	1GB/8GB	2MP	8MP	N/A		
Y53	Mar 2017	2GB/16GB	5MP	8MP	899RMB		10990Rs
Y25	Mar 2017	1GB/8GB	2MP	5MP	N/A		
Y69	Aug 2017	3GB/32GB	16MP	13MP	N/A		15990Rs
Y71	April 2018	3GB/16GB	5MP	13MP	N/A		11990Rs
Y83	May 2018	4GB/64GB	8MP	13MP	1488RMB		15990Rs
	Sep 2018	4GB/64GB	8MP	13MP+2MP	N/A		16990Rs
Y87	Sep 2018	4GB/128GB	16MP	16MP+2MP	1988RMB		
Y71i	Oct 2018	2GB/16GB	5MP	13MP	N/A		9900Rs
Y81i	Nov 2018	2GB/16GB	5MP	13MP	N/A		10300Rs

Xiaomi: CY19 production plans fall back to initial levels

Production volume trends

Xiaomi produced about 52mn units in CY16, roughly 105mn units in CY17, and 127mn units in CY18. As of our March survey, plans called for production of 115mn units in CY19, lower than in CY18, owing to reductions in unprofitable low-end models. As of our June survey, production volume looked likely to be around 120–125mn units, largely unchanged from the previous year. As of our current (September) survey, however, this had fallen back to the initial projection of around 115mn units.

By quarter, production volume in CY17 was roughly 18mn units in Jan–Mar, 24mn units in Apr–Jun, 29mn units in Jul–Sep, and 34mn units in Oct–Dec. In CY18, production volume was 26mn units in Jan–Mar, 33mn units in Apr–Jun, 40mn units in Jul–Sep, and 28mn units in Oct–Dec. As of the previous (June) survey, planned production volume in CY19 was 17mn units in Jan–Mar, 35mn units in Apr–Jun, 42mn units in Jul–Sep, and 27mn units in Oct–Dec. As of the current (September) survey, however, planned production volume has fallen back to more realistic levels, at 17mn units in Jan–Mar, 33mn units in Apr–Jun, 33mn units in Jul–Sep, and around 32mn units in Oct–Dec. Market share is increasing gradually in Western Europe and Central & Eastern Europe, but is starting to stagnate in such places as China and Indonesia.

Other data

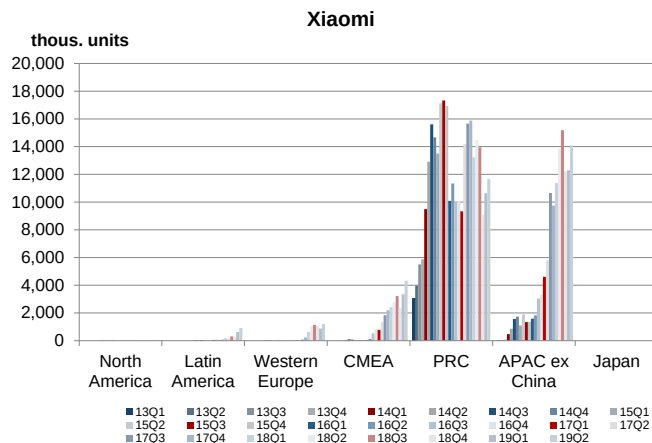
In new models, Xiaomi plans to aggressively increase camera resolutions, and is apparently considering 48MP, 64MP, and 108MP cameras in 2H CY19 and CY20 models.

Figure 65: Xiaomi: Global shipments by model

Model Name	CY2015				CY2016				CY2017				CY2018				CY2019		CY2014	CY2015	CY2016	CY2017	CY2018	
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	1Q	2Q								
M-1	0.03	0.03	0.00	0.01	0.01	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.81	0.07	0.12	0.00	0.00		
M-2	0.10	0.00	0.01	0.01	0.02	0.17	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.44	0.21	0.07	0.00	0.00		
M-3	0.03	0.03	0.00	0.01	0.01	0.06	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.81	0.07	0.12	0.00	0.00		
M-4	2.28	4.18	2.72	2.01	2.53	1.18	0.48	0.24	0.09	0.08	0.03	0.03	0.02	0.01	0.01	0.01	0.00	6.02	11.19	4.43	0.22	0.00		
M-5	0.00	0.00	0.00	0.00	1.12	0.00	1.21	0.81	0.68	1.04	2.71	2.83	1.81	0.45	0.04	0.01	0.00	0.00	0.00	4.05	7.86	2.30		
M-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.28	1.50	0.73	0.40	0.16	0.02	0.00	0.01	0.00	0.00	0.00	3.51	0.58		
M-6X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44	1.40	0.59	0.00	0.00	0.00	0.00	0.00	3.43		
M-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27	4.48	1.45	2.89	1.07	0.00	0.00	0.00	10.39		
M-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.63	1.40	0.00	0.00	0.00	0.00	0.00		
M-8 Lite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	1.62	1.10	0.50	0.00	0.00	0.00	2.13		
M-8 Pro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03		
M-8 SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.45	1.32	0.73	0.00	0.00	0.00	0.00	0.17		
M-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.58	2.47	0.00	0.00	0.00	0.00		
M-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	1.60	0.00	0.00	0.00		
M-9 SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.83	0.00	0.00	0.00		
M-9T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
M-A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	1.55	0.82	0.56	1.69	1.54	1.06	0.76	0.00	0.00	0.00	1.80	4.60	
M-A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	1.55	0.82	0.56	1.69	1.54	1.06	0.76	0.00	0.00	0.00	1.80	1.77	
M-A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
M-A2 Lite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.53	0.48	0.25	0.00	0.00	0.00	0.00	1.14	
M-Max	0.00	0.00	0.00	0.00	0.00	0.24	0.41	0.20	0.17	0.63	1.61	1.54	1.08	0.28	0.66	0.42	0.27	0.12	0.00	0.00	0.85	3.96	2.44	
M-Max	0.00	0.00	0.00	0.00	0.00	0.24	0.41	0.20	0.17	0.68	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.34	0.00	0.00	
M-Max 2	0.00	0.00	0.00	0.00	0.00	0.07	0.35	0.14	0.09	0.55	1.54	1.50	1.08	0.39	0.90	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	
M-Max 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.41	0.25	0.11	0.00	0.00	0.00	0.00	1.03	
M-Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.11	0.23	0.31	0.83	0.69	0.83	0.37	0.45	0.49	0.34	0.00	0.00	0.03	1.48	2.34	
M-Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.23	0.35	0.83	0.69	0.83	0.37	0.45	0.49	0.34	0.00	0.00	0.03	1.48	2.34	
M-Max 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.23	0.35	0.83	0.69	0.83	0.37	0.45	0.49	0.34	0.00	0.00	0.03	1.48	2.34	
M-Max 2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.81	0.43	0.27	0.11	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.19	
M-Max 2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.55	0.26	0.12	0.08	0.03	0.00	0.00	0.00	0.00	0.19	
M-Max 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	
M-Max 3.5G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	
M-Play	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	
M-Note	1.78	2.66	2.11	1.52	1.33	0.22	0.11	0.11	0.26	0.37	0.45	0.91	0.66	0.38	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	
M-Note	1.78	2.66	2.11	1.52	1.33	0.22	0.11	0.11	0.26	0.37	0.45	0.91	0.66	0.38	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	
M-Note 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.37	0.15	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.80	0.01	
M-Note 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.84	0.64	0.38	0.05	0.00	0.00	0.00	0.00	0.00	0.00	1.13	0.07	
M-Note Pro	0.00	1.11	0.54	0.37	0.17	0.02	0.02	0.01	0.01	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	2.02	0.23	0.02	0.01	
M-Note 3.5G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
M-Play	0.05	0.05	0.00	0.00	0.00	0.00	0.72	0.90	0.72	0.41	0.11	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	5.71	0.11	1.63	1.26	0.03
Redmi 1S	0.80	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.31	0.87	0.02	0.00	0.00
Redmi 2	5.34	9.61	8.96	7.68	2.86	0.61	0.32	0.20	0.08	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.99	3.80	0.16	0.04
Redmi 3	0.00	0.00	0.00	0.00	1.43	3.04	3.04	1.04	0.47	0.14	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Redmi 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.05	4.93	9.25	11.14	5.05	2.14	0.46	0.19	0.07	0.14	0.13	0.00	0.00	3.05	30.37	2.86
Redmi 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	2.32	3.01	1.70	0.99	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.50	7.75	1.12	0.00
Redmi 4 Prime	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redmi 4A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56	3.73	3.70	5.00	1.67	0.47	0.20	0.08	0.03	0.04	0.03	0.00	0.00	2.56	14.10	0.78
Redmi 4X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	3.22	3.12	1.68	0.68	0.17	0.08	0.03	0.10	0.10	0.00	0.00	0.00	0.00	8.50	0.96
Redmi 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.44	12.45	14.28	7.66	1.34	0.41	0.26	0.00	0.00	4.44	39.73	
Redmi 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	2.40	1.19	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.00
Redmi 5 Plus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.52	4.51	4.49	2.08	0.56	0.06	0.06	0.00	0.00	1.52	11.64	0.00
Redmi 5A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.73	5.55	5.86	0.47	0.66	0.22	0.33	0.00	0.00	2.73	16.15	0.00
Redmi 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	6.76	8.42	1.26	0.96	0.00	0.00	0.00	0.00	17.13	
Redmi 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.30	2.36	1.42	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00
Redmi 6 Pro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.62	1.74	1.40	1.07	0.00	0.00	0.00	0.00	3.33	
Redmi 6A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	2.75	5.75	4.43	3.01	0.00	0.00	0.00	0.00	8.89	
Redmi 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00																

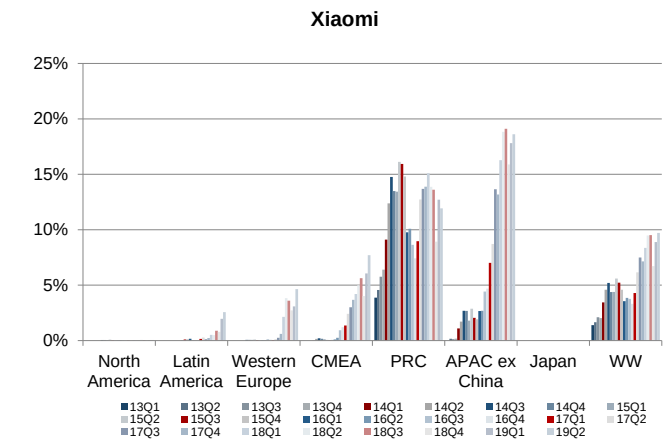
Source: IDC, Credit Suisse

Figure 66: Xiaomi: Smartphone shipments by region

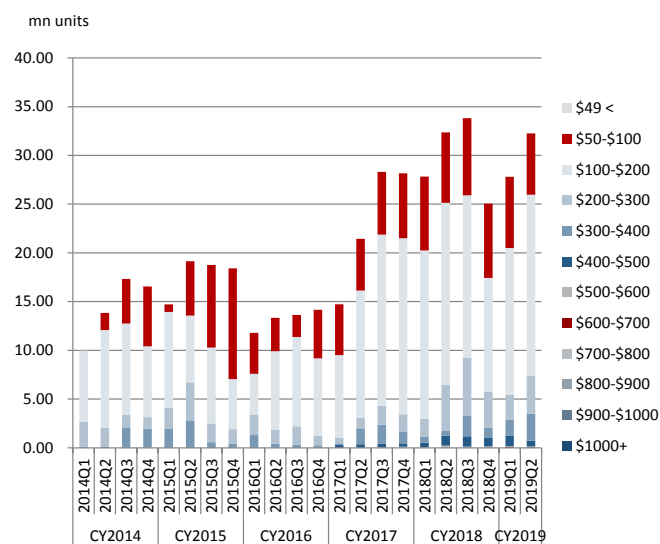


Source: IDC, Credit Suisse

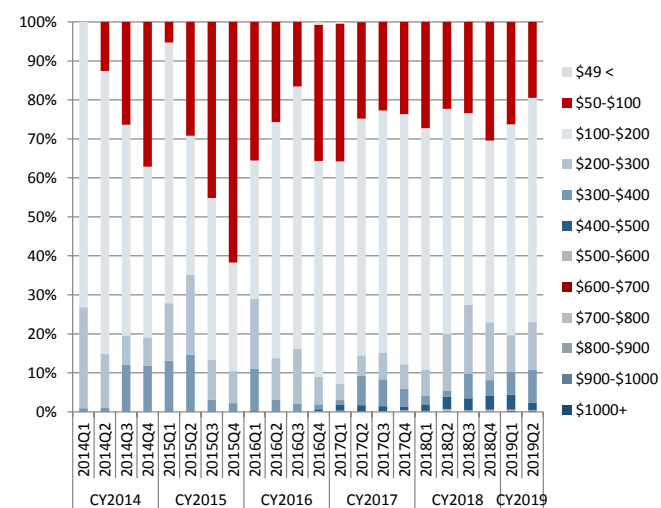
Figure 67: Xiaomi: Smartphone market share by region



Source: IDC, Credit Suisse

Figure 68: Xiaomi: Smartphone shipments by price band

Source: IDC, Credit Suisse

Figure 69: Xiaomi: Smartphone shipment mix by price band

Source: IDC, Credit Suisse

Figure 70: Xiaomi: Smartphone specs (Jan–Jun 2018 models)

	Redmi Note 5 (Redmi 5 Plus)	Redmi Note 5 Pro	Redmi Note 5 Pro	Mi Mix 2s	Redmi Note 5 AI Dual Camera	Black Shark	Mi A2 (Mi 6X)	Redmi S2	Mi 8	Mi 8 SE	Mi 8 Explorer
Announce	Feb 2018	Feb 2018	Feb 2018	Mar 2018	Mar 2018	April 2018	April 2018	May 2018	May 2018	May 2018	May 2018
Release	Feb 2018	Feb 2018	Feb 2018	April 2018	Mar 2018	April 2018	April 2018	May 2018	June 2018	June 2018	July 2018
Height (mm)	158.5	158.6	158.6	150.9	158.6	161.6	158.7	160.7	154.9	147.3	154.9
Width (mm)	75.5	75.4	75.4	74.9	75.4	75.4	75.4	77.3	74.8	73.1	74.8
Thickness (mm)	8.1	8.1	8.1	8.1	8.1	9.3	7.3	8.1	7.6	7.5	7.6
Weight (g)	180	181	181	191	181	190	168	170	175	164	177
Display size (inch)	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	6.21	5.88	6.21
Display resolution (px)	1080 x 2160	1080 x 2160	1080 x 2160	1080 x 2160	1080 x 2160	1080 x 2160	1080 x 2160	720 x 1440	1080 x 2248	1080 x 2244	1080 x 2248
Display (ppi)	403	403	403	403	403	403	403	269	402	423	402
Display	IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	IPS LCD	LTPS IPS LCD	IPS LCD	Super AMOLED	Super AMOLED	Super AMOLED
Camera (main)	12MP	Dual 12MP+5MP	Dual 12MP+5MP	Dual 12MP+12MP	Dual 12MP+5MP	Dual 12MP+20MP	Dual 12MP+20MP	Dual 12MP+5MP	Dual 12MP+12MP	Dual 12MP+5MP	Dual 12MP+12MP
f factor	2.2	2.2/2.0	2.2/2.0	1.8/2.4	1.9/2.0	1.8	1.8	2.2	1.8/2.4	1.9/2.0	1.8/2.4
CIS Size	NA	NA	NA	1/2.55", 1/2.9"	NA	NA	2.9/2.8	1.25	2.55/3.4	NA	2.55/3.4
CIS Pitch (um)	1.25	1.25/1.12	1.25/1.12	1.4/1.0	1.4/1.25	1.25/1.0	1.25/1.0	N	1.4/1.0	1.4/1.12	1.4/1.0
OIS	N	N	N	Y	N	N	N	N	Y	N	Y
Dual lens	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Camera (front)	5MP	20MP	20MP	5MP	13 MP	20MP	20 MP	16 MP	20 MP	20 MP	20 MP
Wifi	Wi-Fi 802.11 a/b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, WiFi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot
Bluetooth	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0
CPU clock	Octa-core 2.0 GHz Cortex-A53	Octa-core 1.8 GHz Kryo 260	Octa-core 1.8 GHz Kryo 260	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.8 GHz Kryo 385 Silver)	Octa-core 1.8 GHz Kryo 260	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.8 GHz Kryo 385 Silver)	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 385 Silver)	Octa-core 2.0 GHz Cortex-A53	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.8 GHz Kryo 385 Silver)	Octa-core (2x2.2 GHz Cortex-A75 & 6x1.7 GHz Cortex-A55)	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.8 GHz Kryo 385 Silver)
CPU Core	MSM8953	SDM636	SDM636	SDM845	SDM636	SDM845	SDM660	MSM8953	SDM845	SDM710	SDM845
GPU Core	Adreno 506	Adreno 509	Adreno 509	Adreno 630	Adreno 509	Adreno 630	Adreno 512	Adreno 506	Adreno 630	Adreno 616	Adreno 630
NAND	32/64GB	64GB	64 GB	64/128/256GB	32/64GB	64/128 GB	64/128GB	32/64GB	64/128/256GB	64 GB	128GB
Card slot	microSD, up to 128 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	N	microSD, up to 256 GB (uses SIM 2 slot)	N	N	microSD, up to 256 GB (dedicated slot)	N	N	N
DRAM	3/4GB	4/6GB	4/6 GB	6/8GB	3/4/6GB	6/8GB	4/6GB	3/4GB	6GB	4/6GB	8GB
Battery capacity	4000mAh	4000mAh	4000mAh	3400mAh	4000mAh	4000mAh	3010mAh	3080mAh	3400mAh	3120mAh	3000mAh
USB Connector	microUSB v2.0	microUSB v2.0	microUSB v2.0	2.0, Type-C 1.0 reversible connector	microUSB v2.0	2.0, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector	microUSB v2.0	Type-C 1.0 reversible connector	Type-C 1.0 reversible connector	Type-C 1.0 reversible connector

Source: Company data, Credit Suisse

Figure 71: Xiaomi: Smartphone specs (Jul–Dec 2018 models)

	Redmi 6A	Redmi 6	Mi Max 3	Mi A2 Lite (Redmi 6 Pro)	Mi A2 (Mi 6X)	Pocophone F1	Mi 8 Lite (Mi 8 Youth, Mi 8X)	Mi 8 Pro	Redmi Note 6 Pro	Black Shark Helo	Mi Mix 3	Mi Play
Announce	June 2018	June 2018	July 2018	July 2018	July 2018	Aug 2018	Sep 2018	Sep 2018	Sep 2018	Oct 2018	Oct 2018	Dec 2018
Release	June 2018	June 2018	July 2018	July 2018	July 2018	Aug 2018	Sep 2018	Sep 2018	Oct 2018	Nov 2018	Nov 2018	Dec 2018
Height (mm)	147.5	147.5	176.2	149.3	158.7	155.5	156.4	154.9	157.9	160	157.9	147.8
Width (mm)	71.5	71.5	87.4	71.7	75.4	75.3	75.8	74.8	76.4	75.2	74.7	71.9
Thickness (mm)	8.3	8.3	8.0	8.8	7.3	8.8	7.5	7.6	8.3	8.7	8.5	7.8
Weight (g)	145	146	221	178	166	180	169	177	182	190	218	150
Display size (inch)	5.45	5.45	6.9	5.84	5.99	6.18	6.26	6.21	6.26	6.01	6.39	5.84
Display resolution (px)	720 x 1440	720 x 1440	1080 x 2160	1080 x 2280	1080 x 2160	1080 x 2246	1080 x 2280	1080 x 2248	1080 x 2280	1080 x 2160	1080 x 2340	1080 x 2280
Display (ppi)	295	295	350	432	403	403	403	402	403	402	403	432
Display	IPS LCD	IPS LCD	IPS LCD	IPS LCD	LTPS IPS LCD	IPS LCD	IPS LCD	Super AMOLED	IPS LCD	AMOLED	Super AMOLED	IPS LCD
Camera (main)	13 MP	Dual 12MP+5MP	Dual 12MP+5MP	Dual 12MP+5MP	Dual 12MP+20MP	Dual 12MP+5MP	Dual 12MP+5MP	Dual 12MP+12MP	Dual 12MP+5MP	Dual 12MP+20MP	Dual 12MP+12MP	12MP
f factor	2.2	2.2/2.2	1.9	2.2/2.2	1.8/1.8	1.9/2.0	1.9/2.0	1.8/2.4	1.9/2.2	1.8/1.8	1.8	2.2
CIS Size	NA	NA	NA	NA	2.9/2.8	2.55	2.55/5	2.55/3.4	2.55	1.25/1.0	2.55/3.4	NA
CIS Pitch (um)	NA	1.25/1.12	1.4	1.25/1.12	1.25/1.0	1.4/1.12	1.4/1.12	1.4/1.0	1.4/1.12	NA	1.4/1.0	1.25
OIS	N	N	N	N	N	N	N	Y	N	N	Y	N
Dual lens	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Camera (front)	5 MP	5 MP	8 MP	5 MP	20 MP	20 MP	24MP	20 MP	Dual 20MP+2MP	20 MP	Dual 24MP+2MP	8 MP
Wifi	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot
Bluetooth	Bluetooth v4.2	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v4.2	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2
CPU clock	Quad-core 2.0 GHz Cortex-A53	Octa-core 2.0 GHz Cortex-A53	Octa-core 1.8 GHz Kryo 260	Octa-core 2.0 GHz Cortex-A53	Octa-core (4x2.8 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.8 GHz Kryo 385 Silver)	Octa-core (4x2.8 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.8 GHz Kryo 385 Silver)	Octa-core 1.8 GHz Kryo 260	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.8 GHz Kryo 385 Silver)	Octa-core (4x2.8 GHz Kryo 385 Gold & 4x1.7 GHz Kryo 385 Silver)	Octa-core (4x2.3 GHz Cortex-A53 & 4x1.8 GHz Cortex-A53)
CPU Core	Helio A22	MT6762 Helio P22	SDM636	MSM8953 Snapdragon 625	SDM660 Snapdragon 660	SDM845	SDM660 Snapdragon 660 (14 nm)	SDM845 Snapdragon 845 (10 nm)	SDM636 Snapdragon 636 (14 nm)	SDM845 Snapdragon 845 (10 nm)	SDM845 Snapdragon 845 (10 nm)	Mediatek MT6765 Helio P35 (12nm)
GPU Core	PowerVR GE-class	PowerVR GE8320	Adreno 509	Adreno 506	Adreno 512	Adreno 630	Adreno 512	Adreno 630	Adreno 509	Adreno 630	Adreno 630	PowerVR GE8320
NAND	16GB	32/64GB	64/128 GB	32/64 GB	32/64/128 GB	64/128/256 GB	64/128 GB	128 GB	32/64 GB	128/256 GB	128/256 GB	64 GB
Card slot	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (dedicated slot)	N	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 256 GB (uses SIM 2 slot)	N	microSD, up to 256 GB (uses SIM 2 slot)	N	N	microSD, up to 256 GB (uses SIM 2 slot)
DRAM	2GB	3/4GB	4/6 GB	3/4 GB	4/6 GB	6/8 GB	4/6 GB	6/8 GB	3/4/6 GB	6/8/10 GB	6/8/10 GB	4 GB
Battery capacity	3000mAh	3000mAh	5500mAh	4000mAh	3000mAh	4000mAh	3350mAh	3000mAh	4000mAh	4000mAh	3200mAh	3000mAh
USB Connector	microUSB 2.0	microUSB 2.0, USB On-The-Go	Type-C 1.0 reversible connector	microUSB 2.0	2.0, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector, USB On-The-Go	Type-C 1.0 reversible connector	Type-C 1.0 reversible connector	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector	Type-C 1.0 reversible connector	microUSB 2.0, USB On-The-Go

Source: Company data, Credit Suisse

Figure 72: Xiaomi: Smartphone specs (Jan–Jun 2019 models)

	Redmi Note 7	Redmi Go	Mi 9	Mi 9 SE	Mi 9 Explorer	Mi Mix 3 5G	Redmi Note 7 Pro	Redmi 7	Black Shark 2	Redmi Y3	Redmi Note 7S	Redmi 7A	Redmi K20 Pro	Redmi K20	Mi 9T
Announce	Jan 2019	Jan 2019	Feb 2019	Feb 2019	Feb 2019	Feb 2019	Feb 2019	Mar 2019	Mar 2019	April 2019	May 2019	May 2019	May 2019	May 2019	June 2019
Release	Jan 2019	Feb 2019	Mar 2019	Mar 2019	Mar 2019	May 2019	Mar 2019	Mar 2019	Mar 2019	April 2019	May 2019	June 2019	June 2019	June 2019	June 2019
Height (mm)	159.2	140.4	157.5	147.5	157.5	157.9	159.2	158.7	163.6	158.7	159.2	146.3	156.7	156.7	156.7
Width (mm)	75.2	70.1	74.7	70.5	74.7	74.7	75.2	75.6	75	75.6	75.2	70.4	74.3	74.3	74.3
Thickness (mm)	8.1	8.4	7.6	7.5	7.6	9.4	8.1	8.5	8.8	8.5	8.1	9.6	8.8	8.8	8.8
Weight (g)	186	137	173	155	173	NA	186	180	205	180	186	165	191	191	191
Display size (inches)	6.3	5	6.39	5.97	6.39	6.39	6.3	6.26	6.39	6.26	6.3	5.45	6.3	6.39	6.39
Display resolution (pixels)	1080 x 2340	720 x 1280	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2340	720 x 1520	1080 x 2340	720 x 1520	1080 x 2340	720 x 1440	1080 x 2340	1080 x 2340	1080 x 2340
Display (ppi)	409	294	403	432	403	403	409	269	403	269	409	295	403	403	403
Display	IPS LCD	IPS LCD	Super AMOLED	Super AMOLED	Super AMOLED	Super AMOLED	IPS LCD	IPS LCD	AMOLED	IPS LCD	IPS LCD	IPS LCD	Super AMOLED	AMOLED	AMOLED
Camera (main)	Dual 64MP+48MP	8 MP	Triple 48MP+16MP+12MP	Triple 48MP+13MP+8MP	Triple 48MP+16MP+12MP	Dual 12MP+12MP	Dual 48MP+5MP	Dual 12MP+2MP	Dual 48MP+12MP	Dual 12MP+2MP	Dual 48MP+5MP	13MP	Triple 48MP+8MP+13MP	Triple 48MP+8MP+13MP	Triple 48MP+8MP+13MP
f factor	1.8/2.4	2	1.8/2.2/2.2	1.8/2.4/2.4	1.8/2.2/2.2	1.8	1.8/2.4	2.2	1.8/1.2	2.2	1.8/2.2	2.2	1.8/2.4/2.4	1.8/2.4/2.4	1.8/2.4/2.4
CIS Size	NA	NA	2/3.3/3.6	2	2/3.3/3.6	2.55/3.4	2	NA	2	NA	2	1.12	2/3/4	2/3/4	2/3/4
CIS Pitch (µm)	0.8	1.12	0.8/1.0/1.0	0.8/1.12/1.12	0.8/1.0/1.0	1.4/1.0	0.8	1.25	0.8/1.0	1.25	0.8	N	0.8/1.12	0.8/1.12	0.8/1.12
OIS	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
Dual lens	Y	N	Y (Triple)	Y (Triple)	Y (Triple)	Y	Y	Y	Y	Y	Y	N	Y (Triple)	Y (Triple)	Y (Triple)
Camera (front)	13 MP	5 MP	20 MP	20 MP	20 MP	Pop-up 24MP+2MP	13 MP	8 MP	20 MP	32 MP	13 MP	5 MP	Motorized pop-up 20 MP	Motorized pop-up 20 MP	Motorized pop-up 20 MP
Wifi	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot
Bluetooth	Bluetooth v5.0	Bluetooth v4.1	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v5.0	Bluetooth v4.2, A2DP, LE	Bluetooth v5.0, A2DP, aptX HD, LE	Bluetooth v5.0, A2DP, aptX HD, LE	Bluetooth v5.0, A2DP, LE	Bluetooth v4.2, A2DP, LE	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, LE, aptX HD
CPU clock	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Quad-core 1.4 GHz Cortex-A53	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core 2.3 GHz	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (2x2.0 GHz Kryo 460 Gold & 6x1.7 GHz Kryo 460 Silver)	Octa-core (4x1.8 GHz Kryo 250 Gold & 4x1.8 GHz Kryo 250 Silver)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.41 GHz Kryo 485 & 4x1.78 GHz Kryo 485)	Octa-core (4x1.8 GHz Kryo 250 Gold & 4x1.8 GHz Kryo 250 Silver)	Octa-core (4x2.2 GHz Kryo 260 & 4x1.8 GHz Kryo 260)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.45 GHz Kryo 260)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (2x2.2 GHz Kryo 470 Gold & 6x1.8 GHz Kryo 470 Silver)	Octa-core (2x2.2 GHz Kryo 470 Gold & 6x1.8 GHz Kryo 470 Silver)
CPU Core	Qualcomm SDM660 Snapdragon 660 (14 nm)	Qualcomm MSM8917 Snapdragon 425 (28 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM712 Snapdragon 712 (10 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM675 Snapdragon 675 (11 nm)	Qualcomm SDM632 Snapdragon 632 (14 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM632 Snapdragon 632 (14 nm)	Qualcomm SDM660 Snapdragon 660 (14 nm)	Qualcomm SDM439 Snapdragon 439 (12 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM730 Snapdragon 730 (8 nm)	Qualcomm SDM730 Snapdragon 730 (8 nm)
GPU Core	Adreno 512	Adreno 308	Adreno 640	Adreno 616	Adreno 640	Adreno 640	Adreno 612	Adreno 506	Adreno 640	Adreno 506	Adreno 512	Adreno 505	Adreno 640	Adreno 618	Adreno 618
NAND	32/64 GB	8 GB	64/128 GB	64/128 GB	256 GB	64/128 GB	64/128 GB	32/64 GB	128/256 GB	32/64 GB	32/64 GB	16/32 GB	64/128/256 GB	64/128/256 GB	64/128 GB
Card slot	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 128 GB (dedicated slot)	N	N	N	N	microSD, up to 256 GB (uses SIM 2 slot)	microSD, up to 512 GB (dedicated slot)	N	microSD, up to 1 TB (dedicated slot)	microSD, up to 256 GB (uses shared SIM slot)	microSD, up to 256 GB (dedicated slot)	N	N	N
DRAM	3/4/6 GB	1 GB	6/8 GB	6 GB	12 GB	6 GB	4/6 GB	2/3/4 GB	6/8/12 GB	3/4 GB	3/4 GB	2/3 GB	6/8 GB	6/8 GB	6 GB
Battery capacity	4000mAh	3000mAh	3300mAh	3070mAh	3300mAh	3800mAh	4000mAh	4000mAh	4000mAh	4000mAh	4000mAh	4000mAh	4000mAh	4000mAh	4000mAh
USB Connector	2.0, Type-C 1.0 reversible connector	microUSB 2.0	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector	microUSB 2.0, USB On-The-Go	2.0, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector	microUSB 2.0	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector, USB On-The-Go

Source: Company data, Credit Suisse estimates

Figure 73: Xiaomi: Smartphone specs (Jul 2019 and later models)

	Mi 9T Pro	Mi CC9	Mi CC9e	Redmi 7A	Mi A3	Black Shark 2 Pro	Redmi Note8 Pro
Announce	Aug 2019	July 2019	July 2019	May 2019	July 2019	July 2019	Aug 2019
Release	Aug 2019	July 2019	July 2019	June 2019	July 2019	Exp. Sep 2019	Sep 2019
Height (mm)	156.7	156.8	153.5	146.3	153.5	163.6	161.3
Width (mm)	74.3	74.5	71.9	70.4	71.9	75	76.4
Thickness (mm)	8.8	8.7	8.5	9.6	8.5	8.8	8.8
Weight (g)	191	179	173.8	165	173.8	205	199
Display size (inches)	6.39	6.39	6.01	5.45	6.01	6.39	6.53
Display resolution (pixels)	1080 x 2340	1080 x 2340	720 x 1560	720 x 1440	720 x 1560	1080 x 2340	1080 x 2340
Display (ppi)	403	403	286	295	286	403	395
Display	Super AMOLED	Super AMOLED	Super AMOLED	IPS LCD	Super AMOLED	AMOLED	IPS LCD
Camera (main)	Triple 48MP+8MP+13MP	Triple 48MP+8MP+2MP	Triple 48MP+8MP+2MP	Single 13MP (China) or 12MP (India)	Triple 48MP+8MP+2MP	Dual 48MP+12MP	Quad 64MP+8MP+2MP+2MP
f factor	1.8/2.4/2.4	1.8	1.8/2.4	2.2	1.8/2.4	1.8/2.2	1.8/2.2/2.4/2.4
CIS Size	2/3/4	1/2/1900	2.0/2.2	2.9	2/2.2	1/2/1900	1.7/4/5/5
CIS Pitch (um)	0.8/1.12	0.8	0.8/1.12	1.12 (China), 1.25 (India)	0.8/1.12	0.8/1.0	0.8/1.12/1.75/1.75
OIS	N	N	N	N	N	N	N
Dual lens	Y (Triple)	Y (Triple)	Y (Triple)	N	Y (Triple)	Y	Y (Quad)
Camera (front)	Motorized pop-up 20 MP	32 MP	32 MP	5 MP	32 MP	20 MP	20 MP
Wifi	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot
Bluetooth	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v4.2, A2DP, LE	Bluetooth v5.0, A2DP, LE, aptX HD	Bluetooth v5.0, A2DP, aptX HD, LE	Bluetooth v5.0, A2DP, LE
CPU clock	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485)	Octa-core (2x2.2 GHz Kryo 360 Gold & 6x1.7 GHz Kryo 360 Silver)	Octa-core (4x2.0 GHz Kryo 260 Gold & 4x1.8 GHz Kryo 260 Silver)	Octa-core (2x2.0 GHz Cortex-A53 & 6x1.45 GHz Cortex-A53)	Octa-core (4x2.0 GHz Kryo 260 Gold & 4x1.8 GHz Kryo 260 Silver)	Octa-core (1x2.96 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485)	Octa-core (2x Cortex-A76 & 6x Cortex-A55)
CPU Core	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM710 Snapdragon 710 (10 nm)	Qualcomm SDM665 Snapdragon 665 (11 nm)	Qualcomm SDM439 Snapdragon 439 (12 nm)	Qualcomm SDM665 Snapdragon 665 (11 nm)	Qualcomm SDM855 Snapdragon 855+ (7 nm)	Mediatek Helio G90T (12nm)
GPU Core	Adreno 640	Adreno 616	Adreno 610	Adreno 505	Adreno 610	Adreno 640 (700 MHz)	Mali-G76MC4
NAND	64/128 GB	64/128/256 GB	64/128 GB	16/32 GB	64/128 GB	128/256 GB	64/128 GB
Card slot	N	microSD, up to 256 GB (uses shared SIM slot)	microSD, up to 256 GB (uses shared SIM slot)	microSD, up to 256 GB (dedicated slot)	microSD, up to 256 GB (uses shared SIM slot)	N	microSD, up to 256 GB (uses shared SIM slot)
DRAM	6 GB	6/8 GB	4/6 GB	2/3 GB	4/6 GB	8/12 GB	6/8 GB
Battery capacity	4000mAh	4030 mAh	4030 mAh	4000 mAh	4030 mAh	4000 mAh	4500 mAh
USB Connector	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector	microUSB 2.0	2.0, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector

Source: Company data, Credit Suisse

Figure 74: Xiaomi: Prices for core smartphone models

Xiaomi	Mi Series	Release Date	Memory	Front camera	Rear camera	Price	Note
	Mi 4	Aug 2014	3 GB/16 GB	8MP	13MP	1999RMB	
		Aug 2014	3 GB/64 GB	8MP	13MP	1999RMB	
	Mi 5	Feb 2016	3 GB/32 GB	4MP	16MP	1999RMB	
		Feb 2016	3 GB/64 GB	4MP	16MP	2299RMB	
	Mi 6	Apr 2017	4GB/64GB	8MP	12MP+12MP	2499RMB	
		Apr 2017	4GB/128GB	8MP	12MP+12MP	2899RMB	
Mi 6 Ceramic		Apr 2017	4GB/64GB	8MP	12MP+12MP	2999RMB	
		June 2018	6GB/64GB	20MP	12MP+12MP	2699RMB	
Mi 8		June 2018	6GB/128GB	20MP	12MP+12MP	2999RMB	
		June 2018	6GB/256GB	20MP	12MP+12MP	3299RMB	
Mi 8 SE		June 2018	4GB/64GB	20MP	12MP+5MP	1799RMB	
		June 2018	6GB/64GB	20MP	12MP+5MP	1999RMB	
Mi 8		July 2018	8GB/128GB	20MP	12MP+5MP	3699RMB	Explorer Edition
		July 2018	4GB/64GB	20MP	12MP+20MP	1599RMB	
Mi 6X		July 2018	6GB/64GB	20MP	12MP+20MP	1799RMB	
		July 2018	6GB/128GB	20MP	12MP+20MP	1999RMB	
		Sep 2018	4GB/64GB	24MP	12MP+5MP	1399RMB	
Mi 8 Lite		Sep 2018	6GB/64GB	24MP	12MP+5MP	1699RMB	
		Sep 2018	6GB/128GB	24MP	12MP+5MP	1999RMB	
Mi 8 Pro		Sep 2018	6GB/128GB	20MP	12MP+12MP	3199RMB	
		Sep 2018	8GB/128GB	20MP	12MP+12MP	3599RMB	
Mi Play		Dec 2018	4GB/64GB	8MP	12MP	1099RMB	
Mi 9		Feb 2019	6GB/128GB	20MP	48MP+16MP+12MP	2999RMB	
		Feb 2019	8GB/128GB	20MP	48MP+16MP+12MP	3299RMB	
Mi 9 SE		Feb 2019	6GB/64GB	20MP	48MP+13MP+8MP	1999RMB	
		Feb 2019	6GB/128GB	20MP	48MP+13MP+8MP	2599RMB	

Mi Mix Series	Release Date	Memory	Front camera	Rear camera	Price	Note
Mi Mix	Oct 2016	4GB/128GB	5MP	16MP	3499RMB	
	Oct 2016	6GB/256GB	5MP	16MP	3999RMB	
Mi Mix 2	Sep 2017	6GB/64GB	5MP	12MP	3299RMB	
	Sep 2017	6GB/128GB	5MP	12MP	3599RMB	
	Sep 2017	6GB/256GB	5MP	12MP	3999RMB	
	Sep 2017	8GB/256GB	5MP	12MP	4699RMB	
Mi Mix 2s	April 2018	6GB/64GB	5MP	12MP+12MP	3299RMB	
	April 2018	8GB/128GB	5MP	12MP+12MP	3599RMB	
	April 2018	8GB/256GB	5MP	12MP+12MP	3999RMB	
Mi Mix 3	Nov 2018	6GB/128GB	24MP+2MP	12MP+12MP	3299RMB	
	Nov 2018	8GB/28GB	24MP+2MP	12MP+12MP	3599RMB	
	Nov 2018	8GB/256GB	24MP+2MP	12MP+12MP	3999RMB	
	Nov 2018	10GB/256GB	24MP+2MP	12MP+12MP	4999RMB	
Mi Mix 3 5G	Feb 2019	8GB/64GB	24MP+2MP	12MP+12MP	599.00	cf. 4550RMB

Source: Company data, Credit Suisse

Figure 75: Global shipments for emerging market smartphone makers

Major Chinese, Indian, Emerging total		CY2015				CY2016				CY2017				CY2018				CY2019		CY2020		
mm units		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	1Q	2Q	3Q	4Q	YoY
Major Chinese, Indian, Emerging total																						
Major Chinese total		121.38	146.18	150.10	163.14	138.49	155.17	173.63	197.73	153.00	169.19	189.05	181.89	153.66	183.33	190.33	188.24	167.74	185.36	165.03	183.71	665.0
Huawei		112.15	133.11	136.37	149.19	128.06	142.99	162.92	191.12	146.76	161.23	182.04	175.49	149.34	179.84	184.65	182.87	165.63	183.71	625.1	655.5	696.7
Xiaomi		17.39	29.60	27.31	32.75	28.11	32.17	33.68	45.39	34.55	36.46	39.13	42.06	39.33	54.23	53.96	60.50	59.09	58.71	139.3	154.2	206.0
Lenovo		7.31	9.55	11.42	14.40	19.72	22.97	31.36	31.56	25.85	27.99	27.31	24.58	29.72	29.98	29.34	29.34	29.53	29.53	99.4	111.7	111.7
vivo		6.39	9.10	10.47	10.27	14.65	16.48	21.44	24.69	18.78	21.15	24.18	23.51	18.69	27.05	29.55	28.55	23.18	28.35	77.3	87.6	101.1
Xiaomi		14.71	19.15	18.76	18.41	11.80	13.34	13.63	14.27	14.80	21.44	28.30	28.17	27.84	32.35	33.83	25.05	27.81	32.26	53.0	92.7	119.1
Lenovo		18.75	16.21	18.80	20.19	10.87	11.12	13.99	15.03	11.53	11.19	15.34	12.27	9.16	10.26	10.97	10.37	9.77	9.54	51.0	50.3	40.8
ZTE		8.81	11.43	11.62	13.08	10.27	8.46	10.73	14.12	7.58	8.09	8.26	8.35	6.25	1.22	1.41	1.63	1.19	1.82	43.6	32.3	10.5
Coolpad		8.95	8.09	5.85	5.86	4.85	4.85	4.38	4.38	2.76	1.34	1.01	0.96	0.96	0.80	1.01	0.96	0.80	0.91	18.0	7.4	3.7
Gionee		2.69	2.88	3.62	3.56	5.71	7.99	8.80	10.18	7.15	6.14	6.17	6.03	0.82	0.27	0.06	0.19	0.12	0.10	32.7	25.8	1.3
TCL		8.73	9.74	9.82	10.78	7.92	7.01	8.70	9.25	5.16	4.67	4.01	5.32	3.15	3.41	4.49	6.25	3.87	4.59	20.3	19.2	13.0
LeEco		0.00	0.53	1.31	2.85	3.89	6.41	6.21	3.75	1.97	0.12	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.9	2.1	0.0
Hisense		1.79	1.70	1.38	1.32	1.24	1.29	1.54	1.29	1.62	1.59	1.29	1.59	1.62	1.59	1.29	1.59	1.62	1.59	5.9	7.1	4.8
K-Touch		1.47	1.29	0.81	0.70	0.91	0.45	0.46	0.33	0.27	0.31	0.30	0.26	0.19	0.15	0.15	0.14	0.07	0.08	2.2	1.1	0.6
Meizu		4.59	4.58	7.06	4.59	1.25	4.20	6.00	8.42	6.54	5.86	5.89	3.26	1.46	1.22	1.11	1.71	0.76	0.61	18.9	21.5	5.5
Bird																						

Source: IDC, Credit Suisse

5G-related trends

Our view based on market survey

5G chipset production could top 500mn units in 2020

The most striking finding in our September survey was the fact that the production schedules provided to foundries have output of 5G chipsets increasing from 46mn units in 2019 to over 500mn in 2020.

Some caution is in order here, however, since all of the major chipset makers other than Mediatek plan to make nothing but 5G-compatible chipsets from 2H 2019 forward. This means that new-model 4G phones coming in 2020 will have to use 5G chipsets and that chipset production volume therefore does not necessarily equate with 5G smartphone volume.

In terms of chipset design, AP+5G modem looks set to remain the primary configuration in the premium segment in 2019-2020, with SoCs coming from 2021. In lower-end segments where costs are an issue, the expectation is that SoCs incorporating 5G modems will launch from late 2019 through 1H 2020 including the Kirin 720, SDM7250, and Exynos 9630.

HiSilicon has meanwhile directed foundries to halve production of 4G chipsets in 4Q 2019 in an indication that chipset makers are adjusting inventories of 4G chipsets in tandem with the 5G ramp.

Trends at HiSilicon

HiSilicon targets production of 23mn 5G chipsets in 2019, including 5mn for the Balong 5000, 17mn for the Kirin 990 (4G and 5G combined) used in the Mate 30 and other premium models, and 1mn for the Kirin 820 for midrange and high-end phones. Plans for 2020 have output at 15mn units for the Balong 5000, 50mn for the Kirin 990, and 100mn for the Kirin 820. Some suppliers expect 5G compatibility across all of Huawei's P Series, Mate Series, Honor Series, and Nova Series phones for launch in the Chinese market in 2020. Some think Huawei could produce 100mn 5G compatible phones for the Chinese market in 2020 premised on a total smartphone market there of 400mn units and a 50% share for Huawei with half coming from 5G.

Trends at Qualcomm

Qualcomm targets production of 19mn 5G modems in 2019, including 4mn for the premium segment X50 (+SDM855), 11mn for the X55 (+SDM865) toward year's end in preparation for 2020-model phones, and 4mn for the SDM7250 SoC for midrange and high-end phones. It plans an increase to 240mn units in 2020, including 60mn for the X55 (+SDM865), 90mn for the X55 (+Apple A14/13), and 90mn for the SDM7250. Some of our sources expect the SDM7250 to be launched in two versions: a sub-6GHz and a sub-6GHz+mmWave. There is also a view that the midrange SDM6250 scheduled to launch in 4Q 2020 could be brought forward to 1H. SDM6250 for mid-end segment is scheduled to launch in 3Q 2020.

Trends at Apple

Qualcomm's schedule has it producing 90mn units of its X55 modem for Apple in 2020, but there is also a view that the A13's compatibility with the X55 paired with the iPhone's comparatively long product cycle could see Apple introduce 5G compatibility while 2019-model phones are still in play. We also heard talk of all 2020-model iPhones being 5G compatible or alternatively of some being LTE.

In terms of RF design, however, migration to sub-6GHz would appear comparatively easy since iPhones have had 4x4 MIMO compatibility since the XS and XS Max and have also incorporated PAMiD with 3.5GHz compatibility for models sold in Japan (however,

mmWave compatibility and the 2xTX MIMO compatibility at n41 and n77 sought by China Mobile and China Telecom could require a design change).

In addition, US and Japanese carriers are calling for n257 (28GHz) mmWave compatibility for 2020-model phones.

Samsung LSI Exynos

Samsung recently announced its new Exynos 9630 (8nm) as the world's first 5G chipset, for shipment to Chinese smartphone makers and others from late 2019. The Exynos 9630 is set for use in Samsung phones as well as Chinese phones from Lenovo, Xiaomi, and Vivo, but Samsung LSI's comparatively weak support capability means that Oppo and certain other smartphone makers have been refused supply.

In the premium segment, the Galaxy S11 looks likely to be equipped with an Exynos 9830 (6nm) processor and Exynos 5123 modem, in contrast to the Galaxy Note10's (7nm) Exynos 9825/5100 pairing.

MediaTek

MediaTek apparently plans to start shipping M70-based SoCs from late Jan–Mar CY20 or during Apr–Jun CY20 and launch volume production of mid-end SoCs from Jul–Sep CY20. For the full CY, it plans to produce 45mn units. Additionally, it is apparently designing two versions of M70-based SoCs with low-end and high-end RF specs, respectively.

Figure 80: 5G chipset production plan

5G SOC, BB+AP production forecast				2019	2020	
AP/BB/SOC	Product name	Process	Foundry	mn units	mn units	Customer
Hisilicon	Balong 5000(+Kirin 980/985/710)	7nm Pro	TSMC	5	15	Huawei
Hisilicon	Kirin 990	7nm EUV	TSMC	17	50	Huawei
Hisilicon	Kirin 820	7nm EUV	TSMC	1	100	Huawei
Qualcomm	X50(+SDM855)	8nm	Samsung	4	0	Mainly China, Samsung, LG
Qualcomm	X55(+SDM865)	7nm Pro	TSMC	11	60	Mainly China, Samsung, LG
Qualcomm	X55(+Apple A13/14)	AP5nm/7nm Pro+BB7nm Pro	TSMC	0	90	Apple
Qualcomm	SDM7250	7nm EUV	Samsung	4	90	Mainly China, Samsung, LG, others
Qualcomm	SDM6250 (3Q20 MP)	8nm?7nm?	Samsung	NA	NA	Mainly China, Samsung, LG, others
Samsung LSI	Exynos 9630	8nm	Samsung	3	50	Samsung, Lenovo, Xiaomi, vivo
Samsung LSI	5G Modem + AP	7nm EUV/5nmEUV	Samsung	0	15	Samsung Flagship
Mediatek	M70 SoC (1Q-2Q20), Midend SoC (3Q20)	7nm EUV	TSMC	1	45	Mainly China
Total				46	515	
Hisilicon				23	165	
Qualcomm				19	240	
Samsung LSI				3	65	
Mediatek				1	45	
				Samsung	11	155
				TSMC	35	360

Source: Credit Suisse estimates

RMB1,500 5G smartphones by 2H 2020

Chinese mobile carriers' key demands for 5G smartphones are as follows.

All new 5G phones to be SA-compatible from 2020

China Mobile is expected to launch commercial 5G service in October 2019. Only non-standalone (NSA) service will be available in 2019, but standalone (SA) is expected to be added from January 2020. Regarding new phones, however, only SA-compatible models will be eligible for carrier certification beginning January 2020 (NSA phones will continue to be sold).

TX MIMO at n41 and n78

Regarding RF front-end modules, all three Chinese mobile carriers are requiring 4xRX MIMO, and China Mobile and China Telecom are additionally calling for 2xTX MIMO

compatibility for the SA mode: China Mobile at n41 (2.5GHz) and China Telecom at n78 (3.7GHz).

Chinese smartphones will thus use n41(2.5GHz), n77(3.5GHz), and n79 (4.5 GHz) for 5G, suggesting a strong possibility of their incorporating two PAMIF and two diversity modules to enable 2x4 MIMO compatibility in a positive development for RF FEM makers.

5G compatibility in RMB1,000–2,000 phones by end-2020

China Mobile is calling for 5G compatibility in phones priced at RMB5,000 (\$700) and above in 2019, RMB3,000 (\$400) and above in mid-2020, and RMB1,000–2,000 (\$140–280) in late 2020.

Carriers offer subsidies to their device supply chains, but their limited framework has Chinese smartphone makers looking to accelerate their launch of 5G models in order to get a share of the pie. However, we currently have no direct details of 5G handset subsidies.

As of 2Q 2019, phones priced at \$700 and above accounted for 9% of the total Chinese smartphone market, with 26% priced at \$400 and up, 45% at \$275 and up, and around 80% at \$150 and up.

The more-bullish forecasts have Chinese 5G smartphone production at 200mn units in 2020, but we think this is difficult but not unrealistic assuming a total Chinese smartphone market of 400mn units split evenly between 1H and 2H and with 5G accounting for 25% (50mn units) in 1H and 80% (160mn) in 2H.

Chinese carriers apparently expect their current 850mn LTE subscribers to transition to 5G over 2019–22.

Figure 81: China smartphone shipment ratio by price band

Price Band	2016Q1	2016Q2	2016Q3	2016Q4	2017Q1	2017Q2	2017Q3	2017Q4	2018Q1	2018Q2	2018Q3	2018Q4	2019Q1	2019Q2
1000+	0%	0%	0%	0%	0%	0%	0%	6%	6%	3%	3%	3%	1%	1%
\$900-\$1000	1%	0%	0%	1%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%
\$800-\$900	5%	1%	1%	3%	3%	2%	1%	2%	1%	1%	1%	6%	1%	1%
\$700-\$800	0%	4%	2%	4%	3%	3%	3%	2%	2%	1%	1%	1%	4%	7%
\$600-\$700	5%	3%	4%	2%	3%	3%	3%	2%	2%	3%	1%	3%	4%	4%
\$500-\$600	2%	2%	1%	2%	3%	3%	3%	3%	3%	4%	3%	4%	5%	6%
\$400-\$500	2%	3%	3%	4%	14%	10%	8%	7%	10%	16%	10%	8%	10%	7%
\$300-\$400	21%	18%	22%	18%	12%	19%	24%	21%	13%	9%	18%	14%	14%	16%
\$200-\$300	14%	17%	20%	21%	21%	17%	16%	21%	25%	25%	21%	17%	14%	17%
\$100-\$200	32%	34%	30%	23%	24%	29%	33%	28%	31%	31%	36%	39%	43%	39%
\$50-\$100	14%	17%	14%	19%	15%	12%	8%	7%	6%	5%	6%	5%	3%	3%
\$0-\$50	3%	2%	3%	2%	2%	2%	1%	1%	0%	0%	0%	0%	0%	0%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: IDC, Credit Suisse

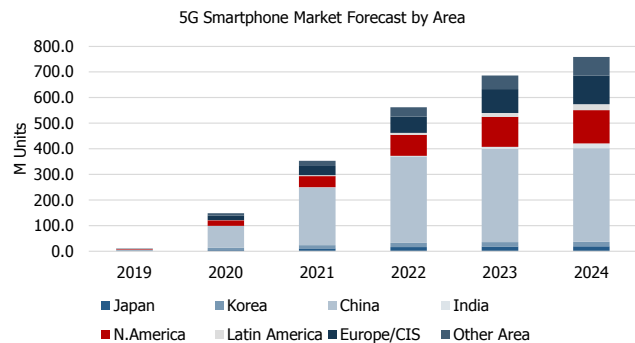
Outlook for 5G smartphone market

Our June survey indicated production of 120–150mn 5G smartphones in 2020, and this was consistent with a corresponding estimate of 158mn units by our Asia team cited in our 28 August [report](#) on 5G business opportunities for Japan's electronic component sector and also with an estimate of 149mn units by research firm Techno Systems Research (TSR) in May 2019.

However, we now see scope for 250–300mn units in 2020 in view of Chinese carriers' proactive stance on 5G, Huawei's aggressive 5G rollout, and Apple's plans. Specifically, we think Huawei could produce 100mn units, Apple 90mn (including all 5G-compatible devices), Samsung 40mn, and others 40–50mn.

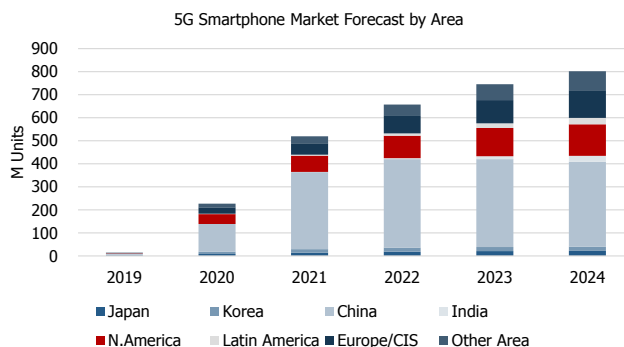
TSR likewise raised its shipment forecasts for 5G smartphones at the end of August to 14mn units for 2019 (previously 11mn), 227mn for 2020 (149mn), and 520mn for 2021 (353mn).

Figure 82: 5G smartphone market forecasts by region (as of May 2019)



Source: Credit Suisse based on TSR estimates

Figure 83: 5G smartphone market forecasts by region (as of end of August 2019)



Source: Credit Suisse based on TSR estimates

Figure 84: 5G and foldable smartphones

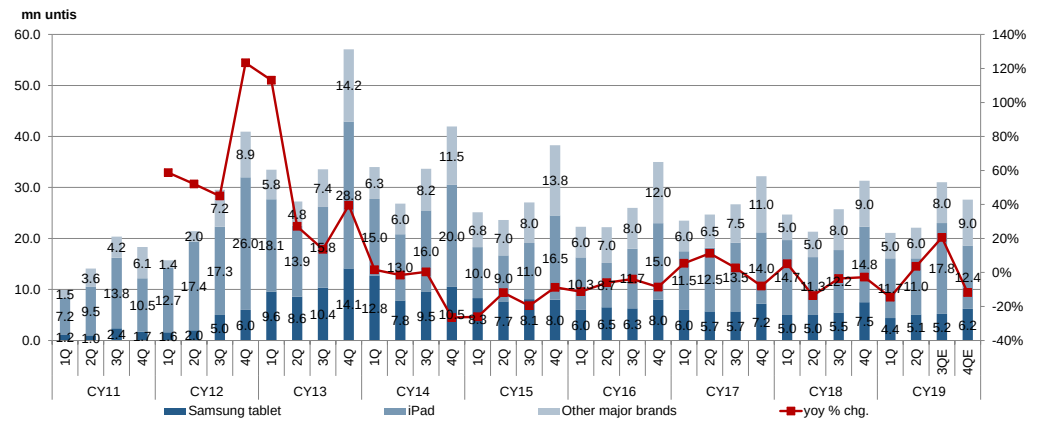
	5G	Foldable	Foldable + 5G	5G	5G	5G	5G	5G	5G	5G	5G	5G	5G
	Galaxy S10 5G	Galaxy Fold	Mate X	V50 ThinQ 5G	Mi Mix3 5G	Axon 10 Pro 5G	Reno 5G	Mate 20 X (5G)	7 Pro 5G	Galaxy Note10 5G	Galaxy Note10+ 5G	iQOO Pro 5G	Galaxy A80 5G
Vendor	Samsung	Samsung	Huawei	LG	Xiaomi	ZTE	Oppeo	Huawei	One Plus	Samsung	Samsung	Vivo	Samsung
Announce	Feb 2019	Feb 2019	Feb 2019	Feb 2019	Feb 2019	Feb 2019	April 2019	May 2019	May 2019	Aug 2019	Aug 2019	Aug 2019	Sep 2019
Release	April 2019	Exp. 2Q 2019	Exp. Nov 2019	May 2019	May 2019	May 2019	May 2019	July 2019	June 2019	Aug 2019	Aug 2019	Exp.Sept 2019	Sep 2019
Height (mm)	162.6	-	161.3	159.2	157.9	159.2	162	174.6	162.6	151	162.3	158.8	164.8
Width (mm)	77.1	-	78.3 (Folded), 146.2 (Unfolded)	76.1	74.7	73.4	77.2	85.4	75.9	71.8	77.2	75.7	76.4
Thickness (mm)	7.9	-	11 (Folded), 5.4 (Unfolded)	8.3	9.4	7.9	9.3	8.2	8.8	7.9	7.9	9.3	8.4
Weight (g)	198	-	295	183	N/A	N/A	215	232	206	168	198	217	206
Display size (inch)	6.7	7.3 (main display), 4.6 (cover display)	8	6.4	6.39	6.47	6.6	7.2	6.67	6.3	6.8	6.41	6.7
Display resolution (px)	1440 x 3040	1536 x 2152	2200 x 2480	1440 x 3120	1080 x 2340	1080 x 2340	1080 x 2340	1080 x 2244	1440 x 3120	1080 x 2280	1440 x 3040	1080 x 2340	1080 x 2400
Display (ppi)	502	414	414	537	403	398	390	346	515	401	498	402	393
Display	Dynamic AMOLED	Dynamic AMOLd (main display), Super AMOLED (cover display)	AMOLED	P-OLED	Super AMOLED	AMOLED	AMOLED	OLED	Fluid AMOLED	Dynamic AMOLED	Dynamic AMOLED	Super AMOLED	Super AMOLED
Camera (main)	Triple 12MP+12MP+16MP	Triple 12MP+12MP+16MP	Quad 40MP+16MP+8MP+TOF camera	Triple 12MP+12MP+16MP	Dual 12MP+12MP	Triple 48MP+20MP+8MP	Triple 48MP+Periscope 13MP+8MP	Triple 40MP+20MP+8MP	Triple 48MP+8MP+16MP	Quad 12MP+12MP+16MP	Quad 12MP+12MP+16MP+TOF 3D VEGA camera	Triple 48MP+13MP+2MP	Triple 48MP+8MP+5MP
f factor	1.5-2.4/2.4/2.2	1.5-2.4/2.4/2.2	1.8/2.2/2.4	1.5/2.4/1.9	1.80	1.80	1.7/3.0/2.2	1.8/2.2/2.4	1.6/2.2/2.4	1.5/2.1/2.2	1.5/2.1/2.2	1.8/2.2/2.4	2.0/2.2/2.2
CIS size	2.55/3.6	2.55/3.6	1.70	2.6/3.1	2.55/3.4	2	2	1.7/2.7/4	2	2.55/3.6	2.55/3.6	2	2
CIS Pitch (um)	1.4/1.0	1.4/1.0	N	1.4/1.0/1.0	1.4/1.0	0.8	0.8	N	0.8	1.4/1.0/1.0	1.4/1.0/1.0	0.8	0.8/1.12
OIS(Y/N)	Y (wide/telephoto camera)	Y (wide/telephoto camera)	N	Y (standard/telephoto camera)	Y (wide camera)	Y (standard/telephoto camera)	Y (Dual)	Y (telephoto camera)	Y (Dual)	Y (Dual)	Y (Dual)	N	N
Dual Camera (Y/N)	Y (Triple)	Y (Triple)	Y (Quad)	Y (Triple)	Y (Dual)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Triple)	Y (Quad)	Y (Triple)	Y (Triple)
Camera (front)	10MP+TOF camera	10MP+8MP (main display), 10MP (cover display)	N	8MP+5MP	24MP+2MP (Both mechanical pop-up)	20 MP	Motorized pop-up 16 MP	24 MP	Motorized pop-up 16 MP	10 MP	10 MP	12 MP	32MP
Wifi	Wi-Fi 802.11 a/b/g/n/ac/ax, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, DLNA, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, DLNA, hotspot	Wi-Fi 802.11 a/b/g/n/ac/ax, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac/ax, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot	Wi-Fi 802.11 a/b/g/n/ac, dual-band, Wi-Fi Direct, hotspot
Bluetooth	5.0, A2DP, LE, aptX	5.0, A2DP, LE, aptX HD	5.0, A2DP, LE, aptX HD	5.0, A2DP, LE, aptX HD	5.0, A2DP, aptX HD, LE	5.0, A2DP, LE	5.0, A2DP, EDR, LE, aptX HD	5.0, A2DP, aptX HD, LE	5.0, A2DP, LE, aptX	5.0, A2DP, LE, aptX	5.0, A2DP, LE, aptX	5.0, A2DP, LE, aptX	5.0, A2DP, LE
5G Band	N41, N71, N260, N261	N/A	N41, N77, N78, N79	N260, N261	N78	N78	N78	N/A	N/A	N/A	N/A	N/A	N/A
CPU clock	Octa-core (2x2.73 GHz Mongoose M4 & 2x2.31 GHz Cortex-A75 & 4x1.95 GHz Cortex-A55) - EMEA Octa-core (1x2.84 GHz Kryo 485 & 3x2.41 GHz Kryo 485 & 4x1.78 GHz Kryo 485) - USA/LATAM, China	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.92 GHz Cortex-A76 & 4x1.8 GHz Cortex-A55)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.8 GHz Kryo 485)	Octa-core (2x2.6 GHz Cortex-A76 & 2x1.92 GHz Cortex-A76 & 4x1.8 GHz Cortex-A55)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.80 GHz Kryo 485)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485) - USA/China	Octa-core (2x2.73 GHz Mongoose M4 & 2x2.4 GHz Cortex-A75 & 4x1.9 GHz Cortex-A55) - EMEA/LATAM, Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485) - USA/China	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485)	Octa-core (1x2.84 GHz Kryo 485 & 3x2.42 GHz Kryo 485 & 4x1.78 GHz Kryo 485)
CPU	Exynos 9820 Octa (8 nm) - EMEA Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/LATAM, China	Qualcomm SDM855 Snapdragon 855 (7 nm)	HiSilcon Kirin 980 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm)	HiSilcon Kirin 980 (7 nm)	Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/China	Qualcomm SDM855 Snapdragon 855 (7 nm) - USA/China	Qualcomm SDM855 Snapdragon 855 (7 nm)
GPU Core	Mali-G76 MP12 - EMEA Adreno 640 - USA/LATAM, China	Adreno 640	Mali-G76 MP10	Adreno 640	Adreno 640	Adreno 640	Adreno 640	Adreno 640	Mali-G76 MP10	Adreno 640	Mali-G76 MP12 - EMEA/LATAM Adreno 640 - USA/China	Adreno 640 (700 MHz)	Adreno 640
NAND	256 GB	512 GB	512 GB	128 GB	64/128 GB	128 GB	256 GB	128 GB	128/256 GB	256 GB	256/512 GB	128/256 GB	128 GB
Card slot	N	N	NM (Nano Memory), up to 256GB (uses SIM 2)	microSD, up to 512 GB (dedicated slot)	N	microSD, up to 512 GB	microSD, up to 256 GB (uses shared SIM slot)	NM (Nano Memory), up to 256GB (uses shared SIM slot)	N	N	microSD, up to 1 TB (dedicated slot)	N	microSD, up to 512 GB (6GB model only)
DRAM	8 GB	12 GB	8 GB	6 GB	6 GB	6 GB	8 GB	6 GB	6/8/12 GB	12 GB	12 GB	8/12 GB	6/8 GB
Battery capacity	4500mAh	4380mAh	4500mAh	4000mAh	3800mAh	4000mAh	4065 mAh	4200 mAh	4000 mAh	3500 mAh	4300 mAh	4500 mAh	4500 mAh
USB Connector	3.1, Type-C 1.0 reversible connector	3.1, Type-C 1.0 reversible connector	3.1, Type-C 1.0 reversible connector	3.1, Type-C 1.0 reversible connector	Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector	Type-C 1.0 reversible connector, USB On-The-Go	3.1, Type-C 1.0 reversible connector, USB On-The-Go	3.1, Type-C 1.0 reversible connector	3.1, Type-C 1.0 reversible connector	3.1, Type-C 1.0 reversible connector	2.0, Type-C 1.0 reversible connector, USB On-The-Go	2.0, Type-C 1.0 reversible connector

Source: Company data, Credit Suisse

Others

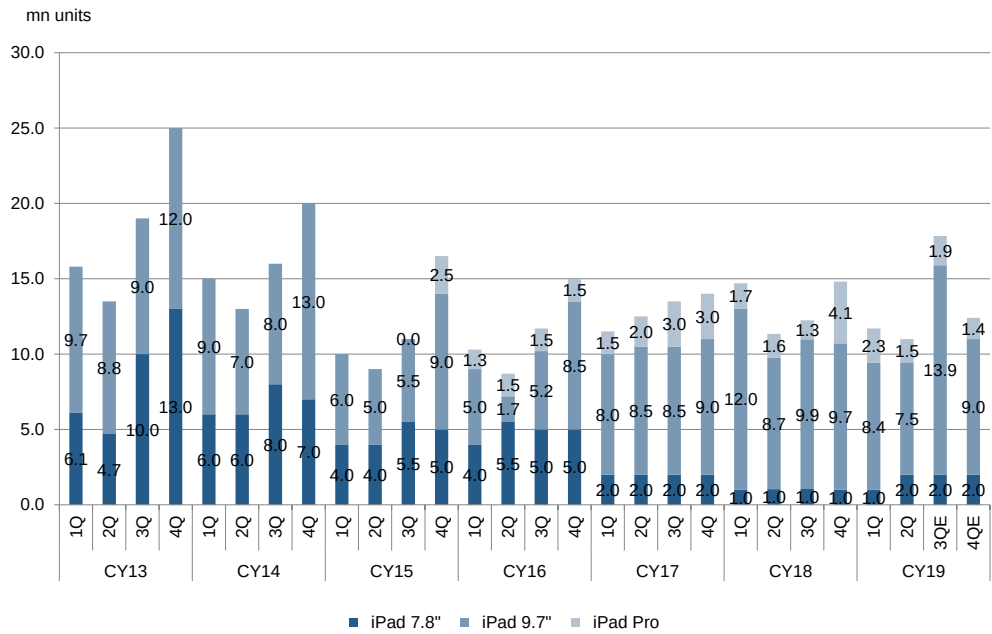
- Tablet output by the seven major brands, which totaled 102mn units in 2018, was projected at 99mn units for 2019 (-3% YoY) in our March survey, 101mn (-2%) in our June survey, and 102mn (-1%) in our current survey.
- iPad output, which amounted to 53mn units (+3% YoY) in 2018, was projected at 54mn (+2%) for 2019 in our June survey, and 53mn (flat) in our current survey. In 2018, quarterly output was 15mn units (+5% QoQ, +28% YoY) in Jan-Mar, 11mn (-23%, -9%) in Apr-Jun, 12mn (+8%, -9%) in Jul-Sep, and 15mn (+21%, +6%) in Oct-Dec. In our June survey, 2019 production volume was projected to total 12mn units (-19%, -18%) in Jan-Mar, 13mn (+10%, +17%) in Apr-Jun, 16mn (+24%, +34%) in Jul-Sep, and 13mn (-22%, -13%) in Oct-Dec. As of our current survey, the forecast is for 12mn in Jan-Mar (-21%, -20%), 11mn in Apr-Jun (-6%, -3%), 18mn units in Jul-Sep (+62%, +46%), and 12mn units in Oct-Dec (-30%, -16%).
- There were no notable PC-related updates. Expedited production ahead of US tariffs on China, and the resulting rush to procure parts early appear to have lifted Apr-Jun and Jul-Sep numbers, creating concerns about a possible pullback in Jan-Mar 2020 onward.
- Chinese server makers and data centers, as well as Alibaba, Tencent and others looks set to adopt new chips including Kunpeng 920 (HiSilicon's ARM-based server CPU) and Ascend 920 (Huawei's AI processor). This should drive sharp growth in demand for 2.5D substrates in high-multilayer applications.
- As of March, respondents expected the tightness of Intel's supply to ease around May-Jun, but they now look for this to occur from Oct-Dec. Flip-chip package makers have recently seen increased orders for flip-chip packages for the Ice Lake CPU (PC version).
- We also heard about sharp output growth at IoT module makers SunSea and Quectel, particularly in modules for narrowband IoT (NB-IoT) applications. This appears driven by a government-led effort to introduce smart gas meters and fire alarms. There seems to be a high risk of double-ordering for certain components, but this likely reflects tight supply of temperature compensated crystal oscillators (TCXO) and tuning-fork crystal oscillators. Japanese LCD makers are now making concerted efforts to raise prices and thereby improve margins. Their refusal to accept low-priced orders is exacerbating the tight supply.
- Nintendo Switch output is expected to reach 18-20mn units in CY19 and 20-22mn in FY19. Output for the prior model is estimated at 1.5-1.6mn units for Apr-Jun, 5.0-5.1mn for Jul-Sep, and 3.5-3.6mn for Oct-Dec, while output for the new Switch Lite, which started in March, is estimated at 1.7-1.8mn for Apr-Jun, more than 4.5mn units in Jun-Sep, and less than 3.5mn units for Oct-Dec.
- Apple apparently seems to plan output of 70-75mn AirPods and 20-25mn Apple Watches.

Figure 85: Tablet PC production volume forecasts by major brand maker

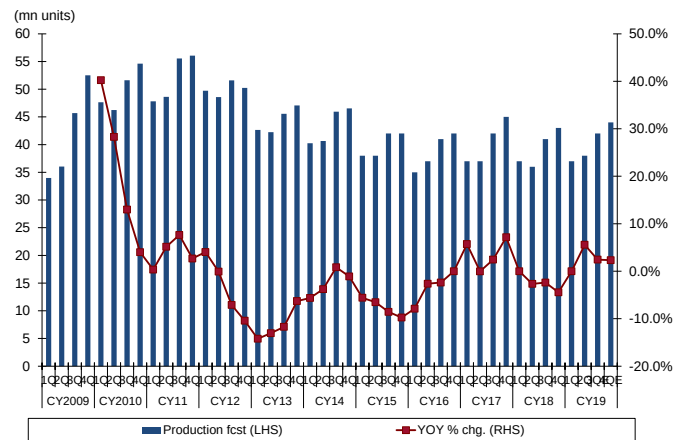


Source: Credit Suisse estimates

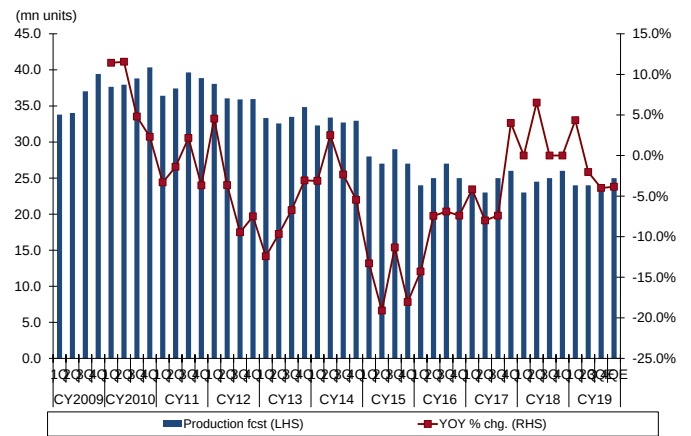
Figure 86: iPad production volume forecasts by form factor



Source: Credit Suisse estimates

Figure 87: Notebook PC ODM production volume

Source: Credit Suisse estimates

Figure 88: Motherboard production volume

Source: Credit Suisse estimates

Appendix

Figure 89: Smartphone shipment volume ranking top 10 (Shipment volume, market share)

Ranking	14Q1			14Q2			14Q3			14Q4		
	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S
1	Samsung	88.5	30.7%	Samsung	74.9	24.8%	Samsung	79.6	23.9%	Samsung	74.5	19.7%
2	Apple	43.7	15.1%	Apple	35.2	11.7%	Apple	39.3	11.8%	Apple	74.2	19.6%
3	Lenovo	18.9	6.6%	Lenovo	24.3	8.0%	Lenovo	25.7	7.7%	Lenovo	24.7	6.5%
4	Huawei	13.5	4.7%	Huawei	20.2	6.7%	Xiaomi	17.3	5.2%	Huawei	23.6	6.3%
5	LGE	12.3	4.3%	LGE	14.5	4.8%	LGE	16.8	5.1%	Xiaomi	16.5	4.4%
6	Coolpad	10.4	3.6%	Xiaomi	13.8	4.6%	Huawei	16.5	4.9%	LGE	15.6	4.1%
7	Xiaomi	10.0	3.5%	Coolpad	11.9	3.9%	ZTE	11.0	3.3%	TCL-Alcatel	13.6	3.6%
8	Sony	8.8	3.0%	ZTE	10.0	3.3%	Microsoft	10.9	3.3%	ZTE	11.9	3.2%
9	ZTE	8.2	2.8%	Microsoft	9.8	3.3%	Sony	9.9	3.0%	Sony	11.7	3.1%
10	Microsoft	8.0	2.8%	Sony	9.4	3.1%	OPPO	9.5	2.8%	Microsoft	9.7	2.6%

Ranking	15Q1			15Q2			15Q3			15Q4		
	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S
1	Samsung	82.1	24.5%	Samsung	72.8	21.3%	Samsung	83.6	23.3%	Samsung	81.7	20.4%
2	Apple	61.2	18.3%	Apple	47.5	13.9%	Apple	48.0	13.4%	Apple	74.8	18.7%
3	Lenovo	18.7	5.6%	Huawei	29.6	8.6%	Huawei	27.3	7.6%	Huawei	32.7	8.2%
4	Huawei	17.4	5.2%	Xiaomi	19.1	5.6%	Lenovo	18.8	5.2%	Lenovo	20.2	5.0%
5	LGE	15.4	4.6%	Lenovo	16.2	4.7%	Xiaomi	18.8	5.2%	Xiaomi	18.4	4.6%
6	Xiaomi	14.7	4.4%	LGE	14.1	4.1%	LGE	14.9	4.1%	LGE	15.3	3.8%
7	ZTE	8.9	2.7%	ZTE	11.4	3.3%	ZTE	11.6	3.2%	OPPO	14.4	3.6%
8	Coolpad	8.8	2.6%	TCL-Alcatel	9.7	2.8%	OPPO	11.4	3.2%	ZTE	13.1	3.3%
9	Others	8.7	2.6%	OPPO	9.6	2.8%	vivo	10.5	2.9%	vivo	12.1	3.0%
10	Microsoft	8.5	2.5%	vivo	9.1	2.7%	Others	9.8	2.7%	TCL-Alcatel	10.8	2.7%

Ranking	16Q1			16Q2			16Q3			16Q4		
	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S
1	Samsung	79.2	23.9%	Samsung	78.6	22.7%	Samsung	76.1	21.0%	Apple	78.3	18.2%
2	Apple	51.2	15.4%	Apple	40.4	11.7%	Apple	45.5	12.6%	Samsung	77.5	18.0%
3	Huawei	28.1	8.5%	Huawei	32.2	9.3%	Huawei	33.7	9.3%	Huawei	45.4	10.6%
4	OPPO	19.7	5.9%	OPPO	22.7	6.6%	OPPO	25.8	7.1%	OPPO	31.6	7.3%
5	vivo	14.6	4.4%	vivo	16.5	4.8%	vivo	21.4	5.9%	vivo	24.7	5.7%
6	LGE	13.4	4.0%	LG Electronics	13.9	4.0%	Lenovo	14.0	3.9%	Lenovo	15.0	3.5%
7	ZTE	11.8	3.6%	Xiaomi	13.3	3.9%	Xiaomi	13.6	3.8%	LG Electronics	14.4	3.3%
8	Lenovo	10.9	3.3%	Lenovo	11.1	3.2%	LG Electronics	13.5	3.7%	Xiaomi	14.3	3.3%
9	Xiaomi	10.3	3.1%	Others	10.1	2.9%	ZTE	10.7	3.0%	ZTE	14.1	3.3%
10	Others	7.9	2.4%	ZTE	8.5	2.4%	Others	9.7	2.7%	Others	10.4	2.4%

Ranking	17Q1			17Q2			17Q3			17Q4		
	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S
1	Samsung	80.1	23.2%	Samsung	79.8	22.9%	Samsung	83.3	22.1%	Apple	77.3	19.6%
2	Apple	50.8	14.7%	Apple	41.0	11.8%	Apple	46.7	12.4%	Samsung	74.5	18.9%
3	Huawei	34.5	10.0%	Huawei	38.5	11.0%	Huawei	39.1	10.4%	Huawei	42.1	10.7%
4	OPPO	25.8	7.5%	OPPO	28.0	8.0%	OPPO	30.6	8.1%	Xiaomi	28.2	7.1%
5	vivo	18.8	5.4%	Xiaomi	21.4	6.2%	Xiaomi	28.3	7.5%	OPPO	27.3	6.9%
6	LG Electronics	14.8	4.3%	vivo	21.1	6.1%	vivo	24.2	6.4%	vivo	23.5	6.0%
7	Xiaomi	14.8	4.3%	LG Electronics	13.3	3.8%	Lenovo	15.3	4.1%	LG Electronics	13.9	3.5%
8	Lenovo	11.5	3.3%	Lenovo	11.2	3.2%	LG Electronics	13.7	3.6%	Lenovo	12.3	3.1%
9	Others	8.1	2.4%	Others	10.0	2.9%	Others	10.0	2.6%	Others	10.0	2.5%
10	ZTE	7.6	2.2%	ZTE	8.1	2.3%	Transsion	8.3	2.2%	ZTE	8.4	2.1%

Ranking	18Q1			18Q2			18Q3			18Q4		
	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S	Company	mn units	M/S
1	Samsung	78.2	23.5%	Samsung	71.5	21.0%	Samsung	72.2	20.3%	Samsung	70.3	18.8%
2	Apple	52.2	15.7%	Huawei	54.2	15.9%	Huawei	52.0	14.6%	Apple	68.4	18.3%
3	Huawei	39.3	11.8%	Apple	41.3	12.1%	Apple	46.9	13.2%	Huawei	60.5	16.2%
4	Xiaomi	27.8	8.4%	Xiaomi	32.4	9.5%	Xiaomi	33.8	9.5%	OPPO	29.3	7.9%
5	OPPO	24.6	7.4%	OPPO	29.4	8.6%	OPPO	30.0	8.4%	vivo	25.8	6.9%
6	vivo	18.7	5.6%	vivo	27.1	7.9%	vivo	29.5	8.3%	Xiaomi	25.0	6.7%
7	LG Electronics	11.2	3.4%	Lenovo	10.3	3.0%	Lenovo	11.0	3.1%	Lenovo	10.4	2.8%
8	Others	9.2	2.8%	Transsion	10.1	3.0%	LG Electronics	10.5	3.0%	Transsion	10.0	2.7%
9	Lenovo	9.2	2.8%	LG Electronics	9.7	2.8%	Transsion	10.1	2.9%	LG Electronics	8.1	2.2%
10	Transsion	8.4	2.5%	Others	8.2	2.4%	Others	8.3	2.3%	Others	7.4	2.0%

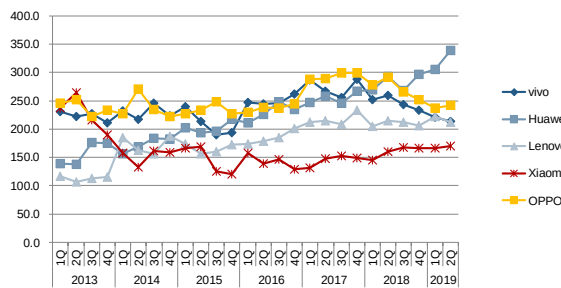
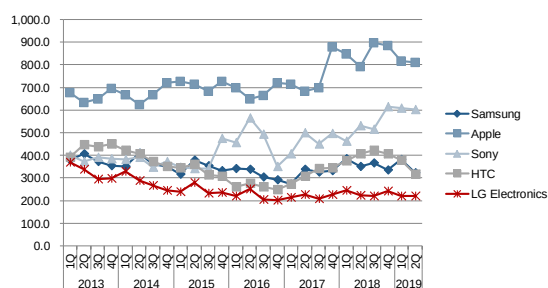
Ranking	19Q1			19Q2		
	Company	mn units	M/S	Company	mn units	M/S
1	Samsung	71.9	23.0%	Samsung	76.2	22.9%
2	Huawei	59.1	18.9%	Huawei	58.7	17.7%
3	Apple	36.8	11.8%	Apple	33.8	10.2%
4	Xiaomi	27.8	8.9%	Xiaomi	32.3	9.7%
5	vivo	23.2	7.4%	OPPO	29.5	8.9%
6	OPPO	23.1	7.4%	vivo	28.4	8.5%
7	Lenovo	9.8	3.1%	Transsion	9.7	2.9%
8	Transsion	8.5	2.7%	Lenovo	9.5	2.9%
9	LG Electronics	8.0	2.5%	LG Electronics	7.5	2.2%
10	Others	5.9	1.9%	Others	6.0	1.8%

Source: IDC, Credit Suisse

Figure 95: Smartphone ASP trend by brand (global)

Smartphone market: ASP trend (W/W ASP)

Sum of ASP	2013				2014				2015				2016				2017				2018				2019	
Vendor	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q
Apple	677.2	634.0	650.1	696.3	667.6	623.2	669.0	720.8	728.2	713.2	684.4	727.5	698.9	648.3	664.8	719.6	713.0	684.8	699.6	879.9	848.0	791.3	898.8	883.9	815.9	811.8
ASUS	579.9	607.1	517.0	493.2	368.8	166.2	156.7	164.6	157.6	179.1	199.7	183.4	177.4	165.1	181.3	210.3	206.0	220.0	223.2	249.7	252.9	244.6	223.6	223.8	221.2	223.9
Coolpad	101.1	115.4	105.5	114.4	104.7	98.8	87.7	103.1	101.5	94.0	102.2	99.0	88.0	94.7	108.4	109.7	109.6	98.0	103.5	124.8	160.6	129.2	125.1	107.6	88.2	120.7
Gionee	164.3	177.0	202.4	208.8	201.3	219.1	198.5	181.2	167.3	165.7	177.2	168.1	192.9	151.4	158.5	160.3	188.6	187.5	203.1	204.8	209.1	197.5	165.0	114.5	81.3	77.3
HTC	390.7	445.9	438.1	450.3	420.9	405.5	372.5	349.7	345.3	359.5	313.3	308.9	262.4	276.1	259.6	248.8	273.2	307.8	340.8	344.5	374.4	406.6	422.7	408.1	378.7	317.0
Huawei	138.9	137.6	176.2	175.2	156.9	169.3	183.7	182.7	202.3	194.1	196.4	217.6	211.4	226.3	247.6	234.6	247.0	258.3	245.7	266.8	269.6	293.2	267.7	296.4	305.6	339.3
Lenovo	117.3	107.4	112.6	115.2	184.5	162.2	156.4	188.0	174.1	157.0	159.6	173.1	174.2	178.8	185.3	201.1	211.9	215.0	208.5	233.5	205.0	214.7	212.0	205.7	222.7	211.6
LG Electronics	369.2	337.3	293.9	296.9	329.4	290.4	268.0	244.3	238.7	280.4	233.5	235.5	220.7	252.1	203.8	201.2	213.9	225.8	207.7	226.7	246.2	224.8	220.3	242.5	220.0	221.0
Meizu	344.8	303.1	263.9	293.1	298.3	268.4	207.8	267.7	199.9	160.0	152.2	147.5	131.0	137.7	147.2	150.8	160.0	151.6	160.8	143.9	153.7	183.6	198.4	235.3	227.6	234.6
Micromax	109.3	117.2	90.8	103.4	79.0	104.0	93.8	89.6	93.1	85.8	80.2	75.5	79.1	75.4	66.7	67.5	71.8	72.4	76.3	63.5	71.0	62.1	46.0	50.2	102.8	91.1
OPPO	245.9	252.4	221.9	233.4	226.8	270.3	234.5	222.3	227.4	233.0	247.9	227.0	229.4	237.8	236.5	244.6	288.0	289.4	298.6	299.2	278.4	291.5	264.9	251.3	236.8	241.7
Samsung	378.0	408.0	374.3	355.7	352.5	410.2	360.9	350.4	317.1	378.3	353.2	331.0	341.0	337.9	303.2	293.0	272.0	340.0	326.8	334.0	386.8	351.5	367.8	334.1	381.6	323.3
Sony	401.3	372.2	391.0	384.8	381.9	392.5	349.4	372.6	349.5	341.4	342.1	473.9	456.9	565.9	494.2	351.0	405.5	500.3	451.4	498.1	462.3	531.1	516.5	613.7	607.4	603.2
TCL	143.1	127.1	138.0	128.2	118.4	116.7	110.9	111.8	101.2	107.4	113.5	114.8	106.1	108.9	105.7	100.6	103.7	107.4	127.5	128.4	119.9	119.4	121.3	127.4	134.5	121.0
vivo	231.2	222.3	226.6	211.4	231.9	217.1	245.2	223.6	239.8	213.3	189.7	194.0	246.9	244.1	245.5	261.6	287.2	267.3	255.3	288.4	251.3	259.7	243.4	233.8	220.8	213.4
Xiaomi	236.9	264.9	216.0	190.2	158.1	132.2	161.4	159.4	166.1	168.8	125.9	120.8	157.3	138.5	146.9	129.2	131.2	148.1	152.5	149.2	144.9	159.8	168.0	165.8	166.8	170.1
ZTE	134.0	120.2	119.6	127.9	124.9	127.5	121.1	130.1	124.1	126.4	120.6	119.1	107.1	106.6	107.8	106.6	115.0	102.9	90.2	89.7	103.3	106.3	88.5	98.3	92.1	97.7
ASP	352.3	333.4	317.1	336.8	314.0	292.2	279.8	319.8	309.6	290.0	275.9	308.5	293.7	267.2	266.4	301.6	291.7	291.6	292.0	369.7	352.3	321.9	334.5	367.8	330.6	313.7

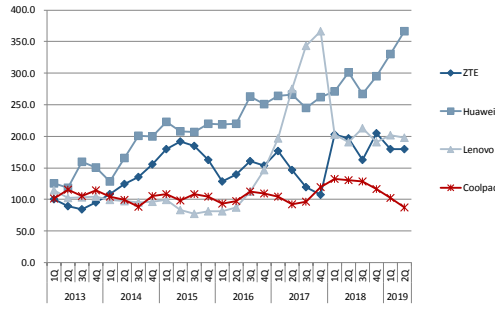
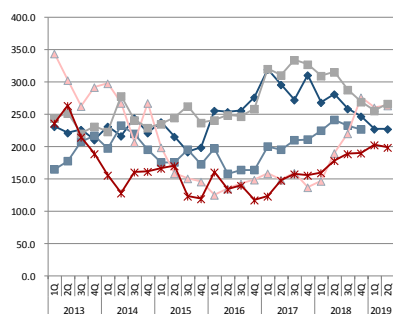


Source: IDC, Credit Suisse

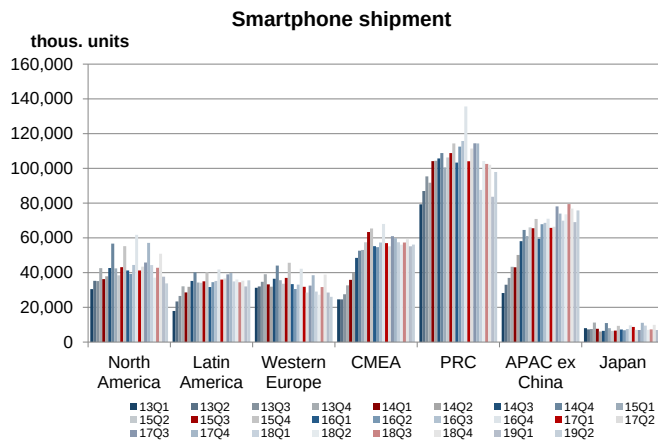
Figure 96: Smartphone ASP trend by brand (China)

China Smartphone market: ASP trend for Chinese local suppliers (US\$)

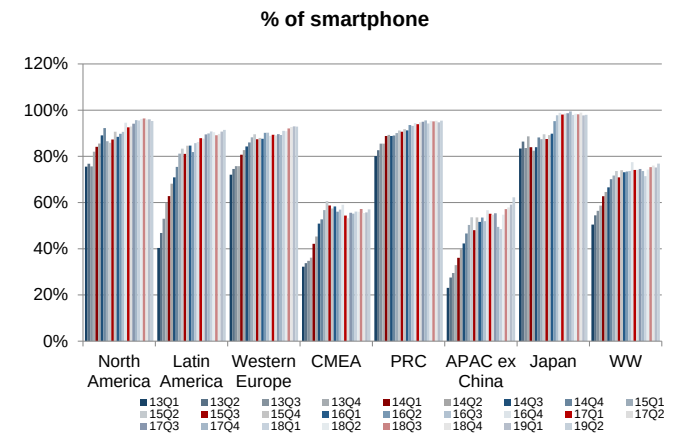
Sum of ASP	2013				2014				2015				2016				2017				2018				2019	
Vendor	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q
vivo	231.2	222.3	226.6	211.4	231.9	217.0	244.8	222.3	239.0	216.3	192.1	199.7	256.1	253.9	256.2	276.6	319.7	296.8	273.0	310.9	268.9	281.3	259.2	247.7	227.8	227.3
Gionee	165.3	177.6	208.5	217.3	196.9	232.3	220.3	195.2	176.1	175.4	195.4	172.9	197.7	158.3	163.6	163.8	200.5	195.3	210.1	211.3	224.3	241.8	232.6	226.8		
Meizu	344.2	302.9	263.5	292.1	297.9	268.4	207.5	267.5	199.0	159.1	151.5	146.5	125.6	135.9	143.1	148.8	159.0	149.0	160.4	137.4	146.9	190.3	220.8	277.2	261.0	264.4
OPPO	244.1	252.3	221.0	231.5	221.5	279.2	241.4	229.9	235.8	245.1	262.7	237.4	241.0	246.3	247.7	259.1	321.2	311.0	334.7	328.1	310.0	315.8	388.1	270.4	256.1	266.7
Xiaomi	236.9	263.9	215.1	189.7	156.2	128.7	161.5	162.5	166.6	170.5	124.0	119.4	161.2	134.3	140.4	118.3	124.2	148.0	157.8	156.1	160.2	179.0	189.1	199.8	202.7	199.3
Lenovo	114.4	102.7	103.1	104.6	99.4	97.3	95.6	96.1	99.3	83.4	77.2	81.6	80.8	87.0	112.7	146.9	196.6	275.6	343.8	367.0	202.5	190.8	213.1	190.3	201.5	198.3
Coolpad	101.0	115.4	105.5	114.1	104.7	99.0	88.6	104.9	108.6	98.5	108.7	104.5	93.1	97.2	112.9	109.6	104.6	92.8	96.7	119.5	132.8	130.4	128.4	116.2	102.6	87.2
Huawei	125.5	118.0	159.2	150.8	128.9	166.0	201.0	199.5	223.1	207.8	207.2	219.6	218.4	220.1	262.6	250.8	264.5	265.6	245.1	261.8	271.4	300.9	267.1	294.7	330.1	366.1
ZTE	100.4	89.0	84.8	95.0	108.9	124.2	135.1	155.7	180.0	191.4	184.2	162.3	128.6	139.7	160.8	153.9	176.4	146.9	119.8	106.9	203.3	196.9	162.1	204.8	179.8	180.0
ASP	214.8	191.6	200.3	221.7	223.8	194.7	202.7	252.9	276.9	251.7	244.6	267.8	270.8	237.0	245.4	273.6	294.6	277.4	286.1	342.5	332.1	314.1	301.7	331.5	306.7	319.0



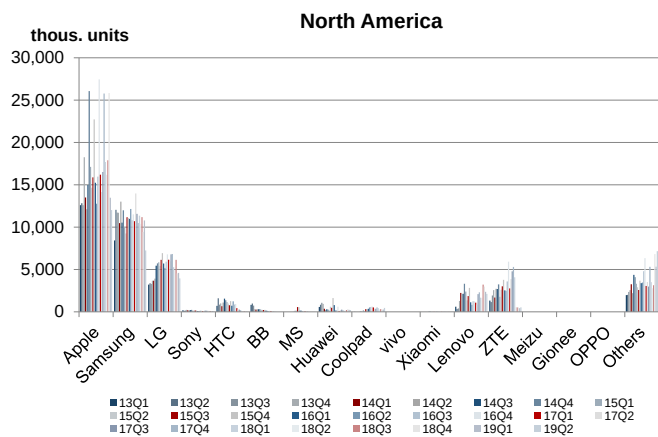
Source: IDC, Credit Suisse

Figure 97: Smartphone shipment volume by region

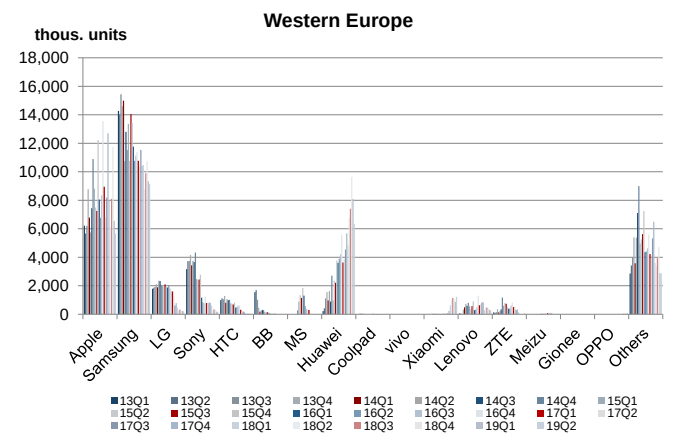
Source: IDC, Credit Suisse

Figure 98: Smartphone shipment market share

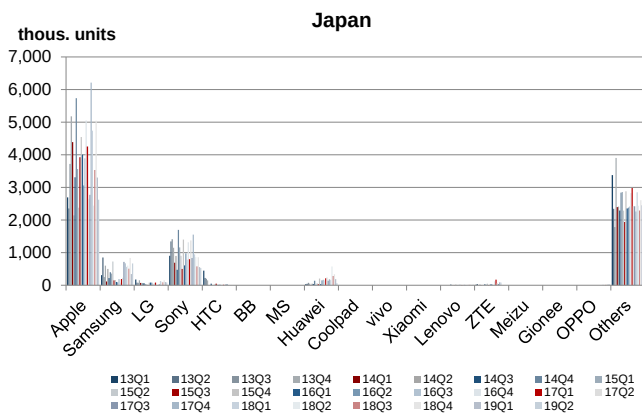
Source: IDC, Company data

Figure 99: Smartphone shipment volume by brand (North America)

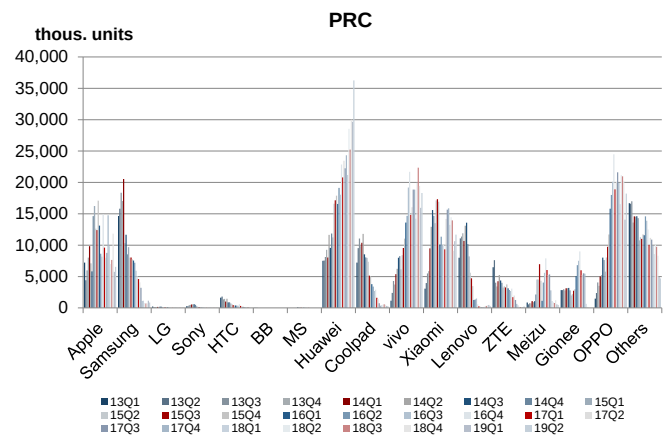
Source: IDC, Credit Suisse

Figure 100: Smartphone shipment volume by brand (Western Europe)

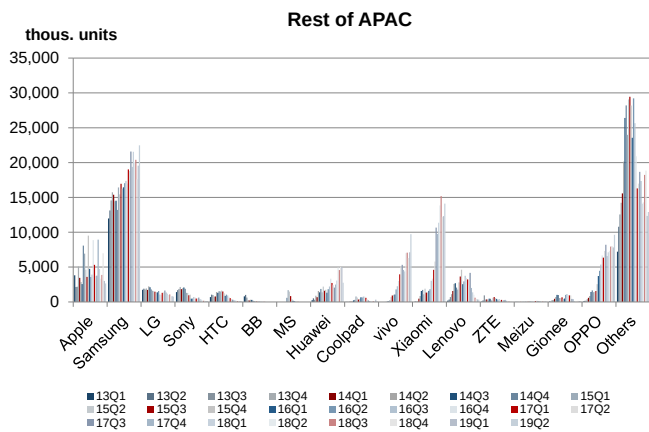
Source: IDC, Company data

Figure 101: Smartphone shipment volume by brand (Japan)

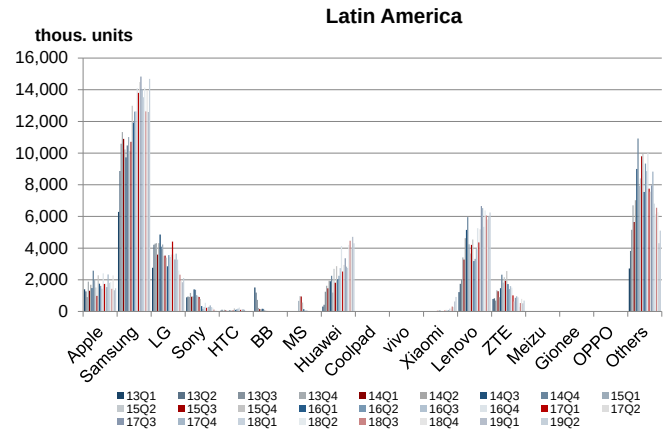
Source: IDC, Credit Suisse

Figure 102: Smartphone shipment volume by brand (PRC)

Source: IDC, Company data

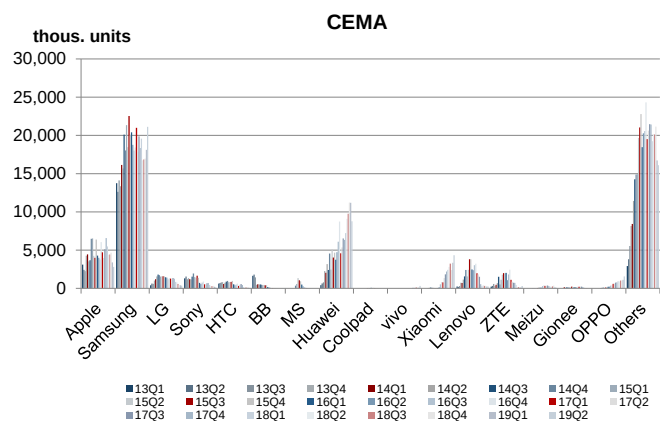
Figure 103: Smartphone shipment volume by brand (Rest of APAC)

Source: IDC, Credit Suisse

Figure 104: Smartphone shipment volume by brand (Latin America)

Source: IDC, Company data

Figure 105: Smartphone shipment volume by brand (CEMA)



Source: IDC, Company data

Companies Mentioned (Price as of 11-Sep-2019)

Advantest (6857.T, ¥4,430, UNDERPERFORM[V], TP ¥1,860)
Alibaba Group Holding Limited (BABA.N, \$176.09)
Anritsu (6754.T, ¥1,918, OUTPERFORM, TP ¥2,120)
Apple Inc (AAPL.OQ, \$223.59)
BOE Technology Group Co. Ltd (000725.SZ, Rmb4.05)
China Mobile Limited (0941.HK, HK\$67.3)
China Telecom (0728.HK, HK\$3.72)
Google (Unlisted)
HiSilicon (Unlisted)
Huawei (Unlisted)
Intel Corp. (INTC.OQ, \$52.79)
Lenovo Group Ltd (0992.HK, HK\$5.31)
MediaTek Inc. (2454.TW, NT\$374.5)
Murata Manufacturing (6981.T, ¥4,977, OUTPERFORM, TP ¥5,500)
Nintendo (7974.T, ¥41,100)
Nitto Denko (6988.T, ¥5,410)
Oppo (Unlisted)
QUALCOMM Inc. (QCOM.OQ, \$79.9)
ROHM (6963.T, ¥8,380, OUTPERFORM, TP ¥10,500)
Samsung Electronics (005930.KS, W47,150)
Samsung LSI (Unlisted)
Sony (6758.T, ¥6,451, OUTPERFORM, TP ¥8,500)
Sunsea AIoT (002313.SZ, Rmb20.88)
Taiwan Semiconductor Manufacturing (2330.TW, NT\$263.0)
Taiyo Yuden (6976.T, ¥2,326, OUTPERFORM[V], TP ¥3,200)
Tencent Holdings (0700.HK, HK\$346.0)
Vivo (Unlisted)
WINGTECH (600745.SS, Rmb71.4)
Xiaomi Corporation (1810.HK, HK\$9.27)
Yageo (2327.TW, NT\$230.0)

Disclosure Appendix

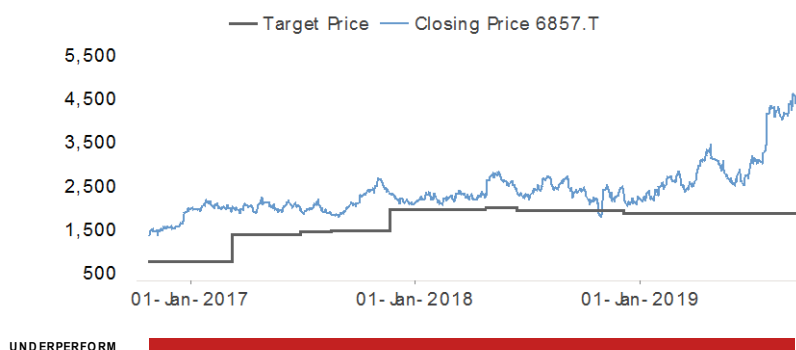
Analyst Certification

Akinori Kanemoto, Hideyuki Maekawa, Mika Nishimura, Yoshiyasu Takemura and Sayaka Shimonishi each certify, with respect to the companies or securities that the individual analyzes, that (1) the views expressed in this report accurately reflect his or her personal views about all of the subject companies and securities 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 in this report.

3-Year Price and Rating History for Advantest (6857.T)

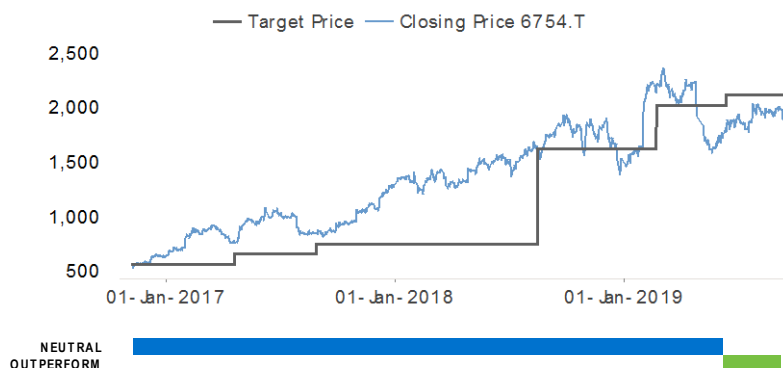
6857.T	Closing Price	Target Price	
Date	(¥)	(¥)	Rating
26-Oct-16	1,374	765	U
10-Mar-17	2,012	1,390	
29-Jun-17	1,964	1,440	
18-Aug-17	1,840	1,470	
20-Nov-17	2,335	1,960	
25-Apr-18	2,249	2,010	
14-Jun-18	2,424	1,930	
05-Dec-18	2,300	1,860	

* Asterisk signifies initiation or assumption of coverage.

**3-Year Price and Rating History for Anritsu (6754.T)**

6754.T	Closing Price	Target Price	
Date	(¥)	(¥)	Rating
09-Nov-16	531	565	N
20-Apr-17	765	660	
28-Aug-17	852	750	
15-Aug-18	1,619	1,620	
21-Feb-19	2,142	2,020	
12-Jun-19	1,781	2,120	O

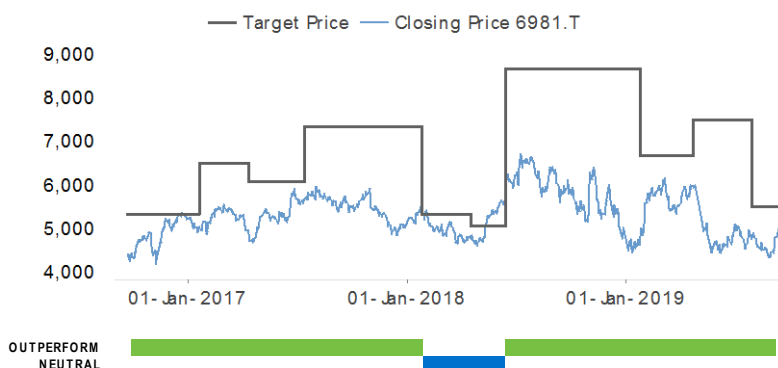
* Asterisk signifies initiation or assumption of coverage.



3-Year Price and Rating History for Murata Manufacturing (6981.T)

6981.T	Closing Price	Target Price	
Date	(¥)	(¥)	Rating
23-Sep-16	4,400	5,333	O
20-Jan-17	5,032	6,500	
13-Apr-17	4,790	6,067	
14-Jul-17	5,667	7,333	
26-Jan-18	5,305	5,333	N
17-Apr-18	4,777	5,067	
14-Jun-18	5,683	8,667	O
24-Jan-19	4,702	6,667	
22-Apr-19	5,971	7,500	
30-Jul-19	4,848	5,500	

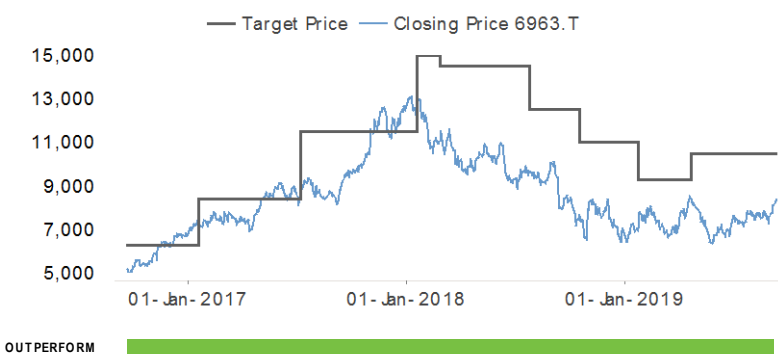
* Asterisk signifies initiation or assumption of coverage.



3-Year Price and Rating History for ROHM (6963.T)

6963.T	Closing Price	Target Price	
Date	(¥)	(¥)	Rating
21-Sep-16	5,180	6,300	O
18-Jan-17	7,230	8,400	
07-Jul-17	8,470	11,500	
19-Jan-18	12,800	15,000	
26-Feb-18	11,100	14,500	
26-Jul-18	9,630	12,500	
18-Oct-18	7,510	11,000	
24-Jan-19	7,340	9,300	
22-Apr-19	8,410	10,500	

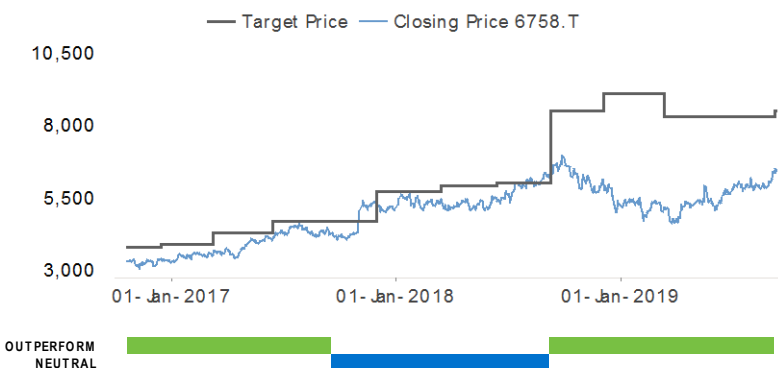
* Asterisk signifies initiation or assumption of coverage.



3-Year Price and Rating History for Sony (6758.T)

6758.T	Closing Price	Target Price	
Date	(¥)	(¥)	Rating
21-Oct-16	3,321	3,800	O
15-Dec-16	3,373	3,900	
10-Mar-17	3,661	4,300	
14-Jun-17	4,060	4,700	
19-Sep-17	4,294	4,700	N
30-Nov-17	5,201	5,700	
15-Mar-18	5,446	5,900	
14-Jun-18	5,387	6,000	
10-Sep-18	6,245	8,500	O
05-Dec-18	5,935	9,100	
13-Mar-19	5,166	8,300	
09-Sep-19	6,496	8,500	

* Asterisk signifies initiation or assumption of coverage.



3-Year Price and Rating History for Taiyo Yuden (6976.T)

6976.T	Closing Price	Target Price	
Date	(¥)	(¥)	Rating
25-Oct-16	1,098	1,000	N
14-Jul-17	1,800	2,300	O
26-Jan-18	1,820	2,150	
26-Feb-18	1,839	2,130	
14-Jun-18	2,573	4,000	
24-Jan-19	1,650	3,000	
22-Apr-19	2,665	3,500	
30-Jul-19	2,204	3,200	

* Asterisk signifies initiation or assumption of coverage.



As of December 10, 2012 Analysts' stock rating are defined as follows:

Outperform (O) : The stock's total return is expected to outperform the relevant benchmark* over the next 12 months.

Neutral (N) : The stock's total return is expected to be in line with the relevant benchmark* over the next 12 months.

Underperform (U) : The stock's total return is expected to underperform the relevant benchmark* over the next 12 months.

*Relevant benchmark by region: As of 10th December 2012, Japanese ratings are based on a stock's total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. As of 2nd October 2012, U.S. and Canadian as well as European ratings are based on a stock's total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. For Latin American and Asia stocks (excluding Japan and Australia), ratings are based on a stock's total return relative to the average total return of the relevant country or regional benchmark (India - S&P BSE Sensex Index); prior to 2nd October 2012 U.S. and Canadian ratings were based on (1) a stock's absolute total return potential to its current share price and (2) the relative attractiveness of a stock's total return potential within an analyst's coverage universe. For Australian and New Zealand stocks, the expected total return (ETR) calculation includes 12-month rolling dividend yield. An Outperform rating is assigned where an ETR is greater than or equal to 7.5%; Underperform where an ETR less than or equal to 5%. A Neutral may be assigned where the ETR is between -5% and 15%. The overlapping rating range allows analysts to assign a rating that puts ETR in the context of associated risks. Prior to 18 May 2015, ETR ranges for Outperform and Underperform ratings did not overlap with Neutral thresholds between 15% and 7.5%, which was in operation from 7 July 2011.

Restricted (R) : In certain circumstances, Credit Suisse policy and/or applicable law and regulations preclude certain types of communications, including an investment recommendation, during the course of Credit Suisse's engagement in an investment banking transaction and in certain other circumstances.

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Not Covered (NC) : Credit Suisse Equity Research does not provide ongoing coverage of the company or offer an investment rating or investment view on the equity security of the company or related products.

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Analysts' sector weightings are distinct from analysts' stock ratings and are based on the analyst's expectations for the fundamentals and/or valuation of the sector* relative to the group's historic fundamentals and/or valuation:

Overweight : The analyst's expectation for the sector's fundamentals and/or valuation is favorable over the next 12 months.

Market Weight : The analyst's expectation for the sector's fundamentals and/or valuation is neutral over the next 12 months.

Underweight : The analyst's expectation for the sector's fundamentals and/or valuation is cautious over the next 12 months.

*An analyst's coverage sector consists of all companies covered by the analyst within the relevant sector. An analyst may cover multiple sectors.

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Global Ratings Distribution

Rating	Versus universe (%)	Of which banking clients (%)
Outperform/Buy*	47%	(33% banking clients)
Neutral/Hold*	39%	(27% banking clients)
Underperform/Sell*	12%	(22% banking clients)
Restricted	2%	

*For purposes of the NYSE and FINRA ratings distribution disclosure requirements, our stock ratings of Outperform, Neutral, and Underperform most closely correspond to Buy, Hold, and Sell, respectively; however, the meanings are not the same, as our stock ratings are determined on a relative basis. (Please refer to definitions above.) An investor's decision to buy or sell a security should be based on investment objectives, current holdings, and other individual factors.

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The analyst(s) responsible for preparing this research report received compensation that is based upon various factors including Credit Suisse's total revenues, a portion of which are generated by Credit Suisse's investment banking activities

Target Price and Rating

Valuation Methodology and Risks: (12 months) for Advantest (6857.T)

Method: We base our ¥1,860 target price on a P/B of 1.6x and FY3/20E BPS of ¥1,163. We derive the multiple using the stock's average TOPIX-relative P/B since the Verigy acquisition in April 2012. We discount this by a 0.5 standard deviation in view of delays in DRAM tester investment and an expected sharp decline in FY3/20 profits and multiply the resulting 1.4x by the current TOPIX P/B of 1.13x (as of December 2018). We expect FY3/20 profits to be short of initial guidance for FY3/19 and see downside risk for the shares as this comes into view. Our UNDERPERFORM rating is based on a comparison of the company's potential total return versus our coverage universe.

Risk: Risks to our ¥1,860 target price and UNDERPERFORM rating for Advantest include (1) an increase in tester demand driven by the start of mass production by Chinese memory makers and/or early mass production of LP DDR5; (2) increased demand for AP/HPC logic testers.

Target Price and Rating

Valuation Methodology and Risks: (12 months) for Anritsu (6754.T)

Method: Our ¥2,120 target price is based on a fair P/E of 24.5x our FY3/21 EPS estimate of ¥86.24. Our 24.5x target P/E is based on the stock's 2.0x TOPIX-relative P/E during the early stages of the LTE ramp up and the current TOPIX P/E of 12.31x. We previously based our target price on a fair P/E of 24.0x and our average FY3/20–21E EPS of ¥84.01, based on our view that share price formation would likely be driven by a mix of expectations regarding 5G commercialization and the reality of current earnings. We now have better visibility on expected growth in R&D tester demand and think we are moving into a cycle of rising expectations for growth in 5G smartphone production volumes. We accordingly update our valuation base year to FY3/21. We expect an upturn in R&D tester demand from chip makers in FY3/20 and smartphone maker tester demand in FY3/21 to drive Anritsu's earnings.

Risk: Risks to our ¥2,120 target price and OUTPERFORM rating for Anritsu include slower commercialization of 5G services in China, a rise in R&D spending due to an increase in development projects, and a downturn in momentum for LTE.

Target Price and Rating

Valuation Methodology and Risks: (12 months) for Murata Manufacturing (6981.T)

Method: We base our ¥5,500 target price for Murata on a zero-growth ROIC model ($EV/IC = ROIC/WACC$) and our FY3/21 estimates. We assume a 7.7% risk premium, 0.0% risk-free rate, 7.4% WACC, 11.4% ROIC, and 1.00 beta. Our target price reflects strong growth centered on high-margin MLCCs and RF devices and the potential of automotive MLCCs. We rate the shares OUTPERFORM based on projected total return over the next 12 months compared with the rest of our coverage universe.

Risk: Downside risks to our ¥5,500 target price and OUTPERFORM rating include deterioration in supply-demand and falling prices for MLCCs, lower-than-expected North American and Chinese smartphone production, and worsening profits from MetroCirc and batteries.

Target Price and Rating

Valuation Methodology and Risks: (12 months) for ROHM (6963.T)

Method: We calculate our ¥10,500 target price for Rohm using our zero-growth ROC model ($EV/IC = ROC/WACC$) for FY3/21 (beta 1.05, RFR 0.0%, ERP 7.7%, WACC 8.09% and ROC 6.12%). We are upbeat on Rohm's potential for medium-term growth centering on automotive applications. Our OUTPERFORM rating is based on a comparison of the 12-month projected total returns for the company's shares and our coverage universe.

Risk: Risks for our ¥10,500 target price and OUTPERFORM rating for Rohm include adjustments in automotive/industrial equipment, a stronger yen, and weaker Japanese OEM auto output.

Target Price and Rating

Valuation Methodology and Risks: (12 months) for Sony (6758.T)

Method: Our ¥8,500 target price for Sony is based on a sum-of-the-parts (SOTP) valuation using EV/EBITDAs for FY3/20 estimates using competitors' average multiples as of Sep 2019 (G&NS: 11X, Blended Hardware: 5X, Semiconductors: 9X, Movie: 8x, Music: 15X, Others: 10X). We believe the potential for consolidated profit growth as company-specific factors overcome deterioration in the external business

environment. Our OUTPERFORM rating is based on a comparison of the company's 12-month potential total return versus our coverage universe.

Risk: Downside risks to our ¥8,500 target price and OUTPERFORM rating for Sony include losses narrowing at a slower pace in the smartphone business, weaker-than-expected sales of game software, and the yen depreciating against the dollar and euro.

Target Price and Rating

Valuation Methodology and Risks: (12 months) for Taiyo Yuden (6976.T)

Method: Our target price of ¥3,200 for Taiyo Yuden is based on a FY3/21 zero-growth ROIC model (EV/IC=ROIC/WACC, ERP 7.7%, RFR 0.0%, WACC 8.7%, ROC 11.3%, beta 1.3). We forecast higher margins owing to increased volumes and product mix improvement. Our OUTPERFORM rating reflects our outlook for total returns (12-month basis) relative to our coverage universe.

Risk: Downside risks to our ¥3,200 target price and OUTPERFORM rating for Taiyo Yuden include a deterioration in the MLCC supply-demand balance, lower prices, and production volumes at the major North American smartphone maker and at Chinese smartphone makers coming in below expectations.

Please refer to the firm's disclosure website at <https://rave.credit-suisse.com/disclosures/view/selectArchive> for the definitions of abbreviations typically used in the target price method and risk sections.

See the Companies Mentioned section for full company names

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