China 5G

Shifting Asia
Dear reader

Welcome to the latest edition of Shifting Asia.

The advent of 5G will likely be a watershed moment for many groundbreaking technologies. Promising vastly superior speeds, latency rates and capacity compared to today’s networks, 5G is set to catalyze the wider adoption of economy-changing technologies like artificial intelligence, driverless cars and smart cities.

In recognizing the technology’s disruptive potential and enablement of other major innovative fields, the development and deployment of 5G is a matter of national strategic priority for China’s government.

By November 2019, 5G services in China were offered in 50 cities, more than any other country. Beijing plans to expand coverage to over 330 cities in 2020 and to construct some 1.1 million 5G base stations. Official estimates put the costs of this massive rollout at USD 130bn to USD 218bn over the next five years (2020–2025) – by far the most amount worldwide. The capex involved is huge, yet the economics are compelling thanks to China’s massive scale and population.

The geopolitics of 5G remains the key risk, for hi-tech competition remains at the heart of the strategic rivalry between the US and China. The Trump administration’s efforts to thwart Huawei’s technological supremacy haven’t dented China’s rollout pace or its global leadership in 5G. Still, a substantial tightening of US content rules would risk delaying service expansion in China.

For us, investing in China 5G offers exposure to one of the biggest technological upgrades in recent times. In this paper, we identify the near-term investment opportunities as well as the thematic ideas that are likely to endure over the medium and long term.

We wish you a happy reading and look forward to any comments and feedback you may have.

Min Lan Tan
Head of APAC Investment Office
The China 5G opportunity

China is the world leader in 5G, and this sets the country up for a promising technological future. This also offers investors a unique opportunity to gain early exposure to a transformative innovation.

Biggest 5G spender worldwide

China’s telcos will spend at least USD 130bn on 5G over the next five years, representing almost a third of global capital expenditures on the technology.

5G infrastructure is cheap in China

Still, at USD 92 per person, China is spending much less per capita than its global peers. Costs to build and maintain 5G infrastructure in China are much less thanks to homegrown inventor Huawei, the sharing of 3.5GHz bands between telcos and the free licensing of 5G bandwidth.

Plans are cheap too

The average monthly price of a low-end 5G plan (30GB) in China is USD 18 (CNY 128), among the lowest worldwide. And over 20% of 5G-enabled smartphones in China are under USD 286 (CNY 2,000), also among the lowest globally. Such affordable rates should accelerate adoption.

Investment opportunities

Given the huge capex, disruption and economic value to be generated by 5G, as well as its role as a key enabler of smart city development in China, we see significant investment opportunities for investors.

Near term
- Chinese tower companies
- Smartphone supply chain

Medium term
- Cloud operators, data centers, cloud gaming, AI, AR and VR
- Disruptors in e-commerce, logistics, manufacturing and healthcare

Long term
- Autonomous driving
- Local semiconductor/tech firms
Sino-US tensions a key risk

A risk to the rollout of 5G in China is the White House’s ban on American companies selling parts to Huawei, which sources critical components from US suppliers. This will likely be a key focus in future negotiations.

5G a strategic priority

Nonetheless, there is no stopping 5G in China. The benefits to the public, businesses and the country’s strategic direction are too great. People and companies using 5G will enjoy faster speeds, increased capacity and lower latency. The jump in internet power will propel the advancement of industries from retail to transportation.

Autonomous vehicles in the driver’s seat

Autonomous driving stands to gain the most. China’s sizeable aging non-driving population and relatively smaller percentage of licensed drivers (compared to other developed countries) will fuel demand for autonomous vehicles, which 5G can enable to a far greater degree than 4G.

5G versus 4G

<table>
<thead>
<tr>
<th>4G</th>
<th>5G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency</td>
<td>10 ms</td>
</tr>
<tr>
<td>Peak date rates</td>
<td>1 Gbps</td>
</tr>
<tr>
<td>Available spectrum</td>
<td>3 GHz</td>
</tr>
<tr>
<td>Connection density</td>
<td>100,000 connections / Km²</td>
</tr>
</tbody>
</table>

Source: Qorvo, Bloomberg Intelligence, UBS
What makes China 5G special?
5G: a strategic priority for China
To China, 5G is not just any technology. It’s seen as a critical strategic component of the country’s future, both at home and abroad. One reason is because by championing its development, the country can dominate the global market for equipment. Indeed, the rollout of 5G will support a large domestic telecom equipment industry ranging from chips, networking equipment and smartphones, all of which have important overseas export markets. The significance of the technology, and China’s position of leadership in its development, caught the US administration’s attention in 2019. (See page 9 for a discussion on the impact US-China tensions may have on China’s 5G rollout.)

The Chinese government also views 5G as a key enabler of the digital economy. With its outsized manufacturing industry, China could greatly benefit from the advancement of automation and big data analysis – for which 5G enables through Internet of Things (IoT) applications. Through the government’s smart city network strategy, 5G is set to catalyze the progression of connected cars and digital healthcare – two key areas where Beijing seeks to become a global leader.

As a result, state planning and policy support have rallied behind China’s 5G rollout. Central to this push is its three national telecom carriers, two of which are state-owned enterprises (SOEs). Beijing’s ambition for China to lead the 5G industry resulted in the country’s rollout in mid-2019, joining the US, Korea and Japan as the first to do so. A major driving force for its rapid launch was to showcase its technology to overseas buyers, as those other three markets compete in 5G components and product supply. By November 2019, 5G services in China were offered in 50 cities, more than any other country. China plans to expand coverage to over 330 cities in 2020 through 1–1.1 million 5G base stations.

In its initial stage, China’s 5G usage models will likely be different than in most countries. For markets like the US and Australia, and potentially the UK and Russia, 5G will be used more as a fixed-broadband substitute. This is also likely to be the case for emerging markets, where it will be used mostly to improve the economics of the last mile. But in China, fixed-broadband penetration is high and it’s inexpensive. So initial 5G services will likely focus more on IoT applications in retail through smart home concepts, and in industry to boost automation through faster connectivity. Like in Korea, cloud gaming in China may develop quickly thanks to 5G.

Huge but cheap capex involved
Such a massive rollout will incur, according to a study released by the China Academy of Information and Communication Technology (a research institute under the Ministry of Industry and Information Technology (MIIT), USD 130bn to USD 218bn in capital expenditures over the next five years (2020–2025) – by far the greatest amount worldwide. Accounting for around 31% of global 5G capex during this period, this spending bonanza reflects China’s massive scale and population. Yet, when adjusting for population size, the total capex amounts to just USD 92 per person. This number is comparatively low versus developed economies, and is more aligned with forecast per capita capex in other emerging markets (see Fig. 1).

Fig. 1
Comparison of global 5G capex per capita
Capex (USD per capita)
One reason for China’s lower per capita capex is access to homegrown, low-cost 5G networking technology developed by Huawei. Tellingly, many countries seek China’s 5G technology due to the lack of low-cost alternatives. Another reason is that China’s two SOE carriers, China Telecom and China Unicom, both of which use 3.5GHz bands, will share their networks, incurring considerable cost savings. This arrangement likely wouldn’t receive regulatory approval in other countries due to anti-trust laws, but in China the move aims to narrow the gap in scale and resources between China Mobile and the two SOE carriers. Regulators in other Asian markets, such as Singapore and Malaysia, are also considering shared networks to ease the 5G capex burden of individual carriers. China plans to build a standalone 5G network (which would not rely on legacy 4G infrastructure), but given the high costs involved, it is initially rolling out non-standalone networks like most markets.

A third area of capex cost savings is the free licensing of 5G spectrums for carriers. In countries like Germany and Italy, 5G spectrum licensing costs account for almost half of their total projected 5G expenses over the next 10 years. Many markets, mainly European ones, deploy mid-band (2.4–4.2 MHz) and 700 MHz for 5G like China. They have seen average auction costs ranging from USD 0.12 to USD 1.23 on a MHz/population basis, with the highest prices fetched in Singapore and Taiwan (see the table for more details). In the US and Hong Kong, a shorter wavelength millimeter wave spectrum has been auctioned at a low cost or for free because the spectrum is unused. But 5G cannot completely rely on short wavelength spectrums due to the limited reach, and both markets have also auctioned mid-band spectrums at higher prices.

**Inexpensive plans and handsets**

China’s 5G tariff plans, we anticipate, will be among, if not, the world’s lowest. One reason is that the Chinese government has considerable influence on carrier tariffs, which require government approval. Low-end 5G tariff plans (30GB) for the three carriers start at CNY 128 (USD 18) at the moment, and are comparable or cheaper than existing monthly high-data 4G plans. China’s low-end 5G plans are currently the cheapest worldwide among major economies. But the higher-end plans (300GB) cost CNY 599 (USD 86) on average (1. SCMP, 1 November, 2019), which is more comparable to monthly plans in Korea (USD 84 for 250GB) and in the US (USD 70, but for only 15GB).

Handset affordability should also accelerate 5G adoption and lower plan prices in China as subscriptions grow. The scope and price range of 5G handset models in China will expand rapidly in 2020. Prices of CNY 5,000 (USD 700) and above are normal for many Chinese 5G models, and new low-end models are launching for as low as USD 300. According to the International Data Corporation (IDC), over 20% of the 5G handsets set for launch this year will be less than CNY 2,000 (USD 286). Most 5G models available in Korea and the US are more than USD 1,000, although device makers plan to introduce budget models for less than half this price in 2020. However, while carriers will likely discount 5G handsets to hasten 5G subscriber migration in markets like the US and Korea, Chinese carriers won’t need to do the same because low-end models are readily available.

---

**Comparison of global spectrum cost per capita**

<table>
<thead>
<tr>
<th>Country</th>
<th>Cost per capita (USD cents)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>123.95</td>
</tr>
<tr>
<td>Taiwan</td>
<td>69.88</td>
</tr>
<tr>
<td>Italy</td>
<td>41.58</td>
</tr>
<tr>
<td>Germany</td>
<td>22.29</td>
</tr>
<tr>
<td>Norway</td>
<td>20.54</td>
</tr>
<tr>
<td>Korea</td>
<td>16.17</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>11.70</td>
</tr>
<tr>
<td>Spain</td>
<td>5.19</td>
</tr>
<tr>
<td>Finland</td>
<td>4.01</td>
</tr>
<tr>
<td>US (mmWave)</td>
<td>0.88</td>
</tr>
<tr>
<td>Korea (mmWave)</td>
<td>0.43</td>
</tr>
<tr>
<td>Taiwan (mmWave)</td>
<td>0.14</td>
</tr>
<tr>
<td>Hong Kong (mmWave)</td>
<td>0</td>
</tr>
<tr>
<td>China</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Regulators, UBS as of February 2020
Implications of Sino-US tensions for China’s 5G rollout

Huawei affair: a catalyst for China’s 5G rollout

The White House’s ban on US companies selling critical tech components to Huawei, which claims a 70% share of the global 5G market, hasn’t had a visible impact yet on the company. In fact, the move spurred the Chinese government to accelerate 5G licensing and boost telco 5G spending in 2019. So, in a way, it served as a catalyst for a faster rollout.

Case in point, the 5G spectrum licenses were launched in mid-2019, much earlier than the original plan to start by the end of the year. This enabled Huawei to begin commercial activity for its 5G equipment sooner than anticipated, thereby accelerating the development of products like 5G smartphones. Chinese telco capex for the year beat expectations with nearly 150,000 towers built by the end of 2019; around 100,000 were planned to be erected. (These are preliminary numbers and may change in time.)
Further tightening of US content rules could delay rollout

It was assumed that by denying Huawei access to American-made semiconductor chips, the company would run out of stock within a few months. But it stockpiled US components prior to the ban, and since its enforcement, has gradually shifted to Japanese and Taiwanese component suppliers while still respecting US de minimis rules limiting US-originated technology or intellectual property (IP) in such components to 25%. The content calculation is particularly onerous given that some third-party semiconductor manufacturers use US-made photo lithography machines for integrated circuit manufacturing.

We believe that, as it stands, Huawei can mass produce its domestic 5G network needs independent of US suppliers. But if the White House further lowers the content rules to 10% or bans it outright – as has been threatened by the commerce department despite the Phase 1 trade deal – Huawei would need time to fill the gap, which could delay China’s 5G rollout.

5G smartphone development less of an issue

If the US ban on Huawei were to tighten further, rival domestic 5G smartphone makers like Xiaomi and Lenovo, which are not subject to the same ban, should be able to comfortably supply the domestic market. Huawei has replaced most US components used in its 5G smartphones with alternatives. The Mate 30 domestic 5G model handset and the Y9 Prime 2019 for Europe and India have no US components, according to a UBS study. And while the ban on Google software, particularly its Android operating system, was initially viewed as a potential obstacle for Huawei’s 5G handsets, Huawei developed its own proprietary Harmony/Hongmeng OS launched in 2019.

More problematic is the ban on using popular Google apps, like Gmail, Google Maps, YouTube, and Google Search, by denying Huawei the Google Mobile Services License. While these apps aren’t used much domestically, they could impact export sales of 5G handsets where bundled Google apps are considered standard. With exports making up around half of Huawei’s handset sales, the ban could result in a loss of export market for its handset business. However, this won’t affect 5G’s rollout or adoption in China.

Huawei to remain an important bargaining chip in negotiations

The US restrictions on Huawei will likely be used as a bargaining chip in future negotiations, much of which will focus on IP transfer and state subsidy issues. The timing for a proposed tightening of US content restrictions, around the same time as the US-China Phase 1 signing in January 2020, suggests an intent to kick-start Phase 2 negotiations given Beijing’s reluctance to re-start negotiations so soon. Separately, further US government pressure on allies to part ways with Huawei could damage the firm’s profitability and delay their 5G rollouts; but this won’t affect China’s. A move to a 10% de minimis content rule is possible – but not our base case – given it could backfire onto domestic US companies.

![Fig. 3](image-url) Other domestic smartphone brands could gain more market share from Huawei

Percentage of smartphone shipments to China as of 1H19

<table>
<thead>
<tr>
<th>Brand</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vivo</td>
<td>65%</td>
</tr>
<tr>
<td>Oppo</td>
<td>62%</td>
</tr>
<tr>
<td>Huawei</td>
<td>55%</td>
</tr>
<tr>
<td>Xiaomi</td>
<td>38%</td>
</tr>
<tr>
<td>Apple</td>
<td>19%</td>
</tr>
<tr>
<td>Samsung</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: Company data, Goldman Sachs, UBS

![Fig. 4](image-url) Huawei total revenue breakdown by region

2018, before US’s export ban

- Americas: 7%
- Asia Pacific: 11%
- EMEA: 28%
- China: 52%
- 2% Others

Source: Company data

---

1 Proprietary Tear Down analysis in association with Fomalhaut, 15 November, 2019
Interview with Leo Chiu
Chief technology partner of ClickVentures

Leo Chiu is a hands-on practitioner and tech savvy entrepreneur. He is currently the chief technology partner of ClickVentures, and a venture advisor at Spike Ventures (a venture fund for Stanford University alumni), focusing on blockchain, AI and big data related ventures. He graduated from Stanford University with a master’s degree in management science and technology (aka operations research & engineering economics), one of the specialized fields of the STEM discipline. He has initiated four big data/Al startups as the core contributor. At the same time, he also coaches youths and young adults in China’s Greater Bay Area on the topic of innovation-driven entrepreneurship via various mentorship programs and the mainstream media.

What is the potential impact of the proposed US export restriction on US content in third-party components sold to Huawei or to China to 10% from the current 25%?

If the export restriction on US content were to be lowered to 10%, it can be interpreted as a total cutoff of China tech companies importing any cutting-edge technologies from overseas. The stipulated 10% level is quite low and would affect China’s import of chips from practically all overseas producers. In fact, it would substantially affect the innovative development of core technologies in China and it may even delay the 5G development.

The US commerce department is drafting changes to the foreign direct product rule so that factories overseas will need licenses if they intend to use US semiconductor equipment to supply chips to Huawei, according to a Wall Street Journal report on 17 February. It implies a further restriction on US content from the originally discussed 10% level. Whether Chinese tech companies have access to US semiconductor manufacturing equipment will remain a crucial factor for China’s 5G development. However, cutting to 10% could backfire by hurting a number of US enterprises.

China has been very supportive of the localization of software and hardware industry segments through policy and financing support. How far are we from building a fully localized production pipeline in China? What measures have been launched by central and local governments to support the localization plan?

The US government’s intention to limit China’s use of its cutting edge technology dates back to 2012, when local media reported that the US was investigating ZTE’s sale of banned US equipment. In view of the escalating threat of export restrictions by the US, the Chinese government has been actively nurturing the localization of semiconductor technology. China still lacks the entire supply chain of chip-making technology. It may take at least 10 years for China to reach international standards for manufacturing cutting-edge chips. The US’s restrictions have forced China to increase its efforts in reducing its reliance on exports by developing and manufacturing locally. Ultimately, it is positive for the development of technology in China over the long term.

Central and provincial governments have been very supportive of the development of tech industries through grants and financing to entice the return of tech talents to China from overseas. Currently, the lower the city tier, the greater the financial support that is offered to tech companies or tech experts, in particular those having viable business proposals.

What are the key benefits that 5G technology can offer us in our daily life?

Among all the key potential applications of 5G technology, the broad public probably views autonomous driving as the killer application of 5G. The low latency and high capacity, empowered by 5G, can support massive volumes of communications and instant responses, which will be the holy grail of self-driving cars. Other key benefits would be 5G’s application in remote surgeries in the medical science field, and the application of virtual reality and augmented reality in the gaming and entertainment field.

Market practitioners predict that fully autonomous driving (level 5 vehicles) is about 5 to 10 years away. Is it a realistic projection?

The technology supporting the development of fully autonomous driving vehicles is already available. In fact, the key hurdle for the broad rollout of fully automated vehicles includes upgrading the urban infrastructure and developing a system that can manufacture vehicles at scale with cost-effective and interoperable software/hardware. The related insurance policies and regulatory changes are also crucial factors that will determine whether there will be a faster rollout of autonomous vehicles than currently expected by the market.
Chapter 2

How 5G empowers different industries
5G to empower autonomous driving and industrial IoT

**Autonomous driving – 5G’s key disruption**

The ultra-low latency of 5G is crucial for the development of autonomous driving (AD), as it can markedly improve safety and the user experience. Broadband connectivity largely determines the safety of AD, which relies on vehicle-to-cloud communication to detect vehicles that could be in blind spots. With the support of 5G, vehicles can communicate to cloud systems in real time — rather than on a lag. China’s sizeable aging non-driving population and relatively smaller percentage of licensed drivers (compared to other developed countries) provide a solid platform of demand growth for autonomous vehicles (AV). In fact, the country’s high road accident casualty rate (one of the highest in the world) has led people to embrace AVs as safer drivers than humans.

Outlined in its “Made in China 2025” plan, the central government seeks to reduce traffic accidents and related deaths through the use of intelligent and, eventually, fully autonomous vehicles. Beijing also hopes that by increasing the use of AVs, congestion and pollution would ease. In 2018, armed with central government backing, China became the first country to allow nationwide road tests for AVs. In recent auto shows, different manufacturers have been showcasing their concept cars.

How will 5G advance IIoT?

A profound change is taking place in the industrial world. The industrial IoT (IIoT), which is the integration of IoT applications in industrial-related processes, is bringing automation and connectivity throughout the value chain. Smart machines are connecting everything from manufacturing processes to transport networks with cloud systems, giving unprecedented control and transparency to businesses and customers. This should enhance value for the industrial economy, from product development, inventory, production and finally to aftermarket.

The industrial IoT is not automation in its traditional form; it is characterized by increased software content (focusing on AI), machine-to-machine and human-to-machine interactions, and edge computing. And 5G is at the heart of this trend as the technology enabler. Faster speeds produce faster interactions between different production interfaces, and lower latency allows a vast number of involved devices to “talk” with one another at the same time. This last point is particularly critical, as it is needed to make the production process the most autonomous possible both in confined and unconfined environments.

China the most important player in IIoT development

China’s central government aims to strengthen its global competitiveness by transforming from low-cost labor-intensive production to technology-driven manufacturing. The State Council revealed in November 2017 guidance for the country’s IIoT development, indicating that Beijing seeks to enhance China’s manufacturing sector through
Shifting Asia: China 5G – March 2020

Chapter 2 – How 5G empowers different industries

information technology. The goal is to upgrade the physical economy through digitalization, thus capturing a first-mover advantage to develop IIoT technology.

Having a well-established IIoT technology platform can drive the development of smart manufacturing, optimize resource allocation and capture new business opportunities. In the face of the threat from the US to clamp down on technology transfers, Beijing is keen to define its own IIoT standards and to develop the supply chain in order to help China achieve self-sufficiency in advanced technology applications. The local governments of major manufacturing hubs, such as Guangdong, Zhejiang and Jiangsu provinces, have followed the central government’s plan and laid out their local IIoT development strategies.

**Government policy and support to foster IIoT platform**

To bring about the desired transformation, China outlined in an industrial internet development action plan in 2018 that it will support 10 cross-sector IIoT platforms by 2020 as foundational infrastructure. Initially, policymakers planned to help around 300,000 companies adopt IIoT platforms in their R&D, manufacturing and business operations. The ultimate goal is to form a compatible cross-industrial and sector platform that shares common standards and resources.

As more companies adopt IIoT innovations, a closed IIoT ecosystem will likely emerge – one where companies continue to improve their operations based on the big data they generate in the operation process. The government is leading this effort, with standards covering protocols, testing criteria and frameworks for general demand. Fiscal and tax incentives are being offered to encourage enterprises to integrate cloud and IIoT solutions. Local governments, together with services providers, have offered discounts for industrial enterprises that use cloud services.

**Applications of IIoT**

The enormous number of factories in China offers a rich platform to develop IIoT technologies. With labor costs rising, the adoption of IIoT offers attractive cost-savings opportunities. Adoption is likely to start in asset-heavy industries with complex supply chains and/or high degrees of automation. By doing so, companies have a common interface to analyze, store, control and react to data generated during operations in real time. Inter-operations between IT and operating systems can lift production efficiency and ultimately optimize resource allocation.

Given that IIoT requires substantial investment in facilities, companies adopting IIoT have to be larger in scale in order to have the financial capability to endure the substantial capital outlay. So asset, equipment and efficiency management firms have been the first to adopt IIoT. The benefits – lower costs, greater quality control – will likely be seen across all industries that produce products, including healthcare & pharmaceuticals, automotive and manufacturing sectors. Apart from cloud service providers, we expect software vendors to benefit during the initial IIoT rollout in 2019–20. Gradually, the benefits should also accrue for total solution providers as SMEs increasingly adopt IIoT solutions.

---

**Comparative global manufacturing share in GDP**

*Fig. 7*

<table>
<thead>
<tr>
<th>Country</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>30</td>
</tr>
<tr>
<td>Korea</td>
<td>25</td>
</tr>
<tr>
<td>Thailand</td>
<td>20</td>
</tr>
<tr>
<td>Malaysia</td>
<td>15</td>
</tr>
<tr>
<td>Germany</td>
<td>10</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5</td>
</tr>
<tr>
<td>Philippines</td>
<td>5</td>
</tr>
<tr>
<td>Singapore</td>
<td>5</td>
</tr>
<tr>
<td>Austria</td>
<td>5</td>
</tr>
<tr>
<td>World</td>
<td>5</td>
</tr>
<tr>
<td>India</td>
<td>5</td>
</tr>
<tr>
<td>Euro area</td>
<td>5</td>
</tr>
<tr>
<td>Latin America</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>5</td>
</tr>
<tr>
<td>Brazil</td>
<td>5</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: World Bank
Chapter 2 – How 5G empowers different industries

IIoT leverages big data to strengthen industrial operations

Fig. 8

Disruption to online retail and entertainment

How will 5G help e-commerce businesses?
Thanks to faster speeds and the substantial improvement in latency, 5G should bring more shoppers to online platforms. The greater flexibility of 5G should also significantly improve the experience of personalized shopping, with the help of AI and virtual reality (VR). The mass-market adoption of these new applications will likely open up new markets for China’s e-commerce operators in lower-tier cities and rural districts.

With 4G, e-commerce penetration advanced rapidly into rural areas; sales from rural locations climbed 21% y/y in 1H19, outpacing the national growth rate by 3.2 percentage points. For people living in the countryside, online platforms make goods and services available that in the past wouldn’t be in their regions. So with 5G, markedly improved speeds should translate to even more online shopping, which in turn would boost operators’ topline growth.

VR to revolutionize the shopping experience
One way penetration will likely increase in the 5G era is through the greater adoption of VR. Thanks to the faster speeds offered, 5G will allow more companies – e-commerce giants as well as traditional retailers – to enhance their VR content and integrate the tech in their online platforms. With 5G speeds, virtual personal assistants/shoppers will give instant suggestions to customers. It will also allow e-commerce companies to collect and analyze a wealth of customer preference data, potentially resulting in more tailored and targeted marketing strategies. Comprehensive online marketplaces, empowered by 5G, could bridge the offline and online gap, presenting new omni-channel opportunities to retailers.

Apart from e-commerce retailing, 5G will likely be a boon for the online gaming and online entertainment industries as users say goodbye to download waits, buffering delays, service blackouts and capacity constraints. The proliferation of affordable smart home devices should also facilitate the shift of households to online shopping. The rise of these areas, in turn, will generate massive amounts of digit data, which can be used to provide better experiences and products.

5G to transform e-commerce supply chain
On the supply side, 5G will likely transform existing e-commerce supply chains. The increased speeds and connectivity of 5G could bring automated delivery networks into the mainstream, thus lowering labor costs in the long term because of the improvements in logistics efficiency. Certain e-commerce operators in China have been experimenting with drone delivery; JD.com has seven different types of drones that are capable of delivering packages across four Chinese provinces. Drones can potentially improve efficiency by flying along fixed routes from warehouses to various landing pads, from which local contractors then deliver these packages to the designated address. We expect to
see the increasing use of drones as part of logistics operations, given that 5G can connect many more devices at relatively low power compared to existing 4G LTE networks.

Aside from improving delivery logistics, 5G will also likely greatly disrupt inventory control and product monitoring. A big issue for retailers worldwide is the challenge in managing overstock, out-of-stock and/or returns. The unexpected logistics disruption driven by the COVID-19 outbreak serves as a good test of whether China’s e-commerce operators have adequate logistics capacity.

A major change in the 5G era will be the proliferation of IoT devices and applications, as the benefits of the cellular upgrade will make it easier for warehouses and supply chains to communicate about inventory levels. The result should be a reduction in business losses. For instance, 5G-enabled outdoor and indoor sensors can better monitor the entire supply chain and, therefore, provide e-commerce companies with details on the conditions of products when they arrive at a consumer’s doorstep. So overall, from the user experience to the warehouse, 5G has the potential to disrupt the entire e-commerce sector.

### Implications for handset and component suppliers

**Will 5G lift demand for new handsets?**

With the smartphone replacement cycle lengthening, the market is generally concerned about potential demand for 5G smartphones. This lengthening, in our view, is directly related to the declines in 4G mobile phone shipment growth, from 157% y/y in 2015 and 18% in 2016 to –11% in 2017, –15% in 2018 and –6% in 2019 (Jan–Nov). Lower smartphone shipments and a longer replacement cycle set a solid base of users who may be considering smartphone upgrades to 5G.

Attractive features and affordable prices should also spur 5G smartphone growth. These attributes, we believe, will be a crucial catalyst for 5G smartphone demand, despite the high penetration rate of smartphones currently. UBS Evidence Lab data indicates the general public is more interested in 5G than other new features. Ericsson reported that the general market sees value in 5G through alleviating urban network congestion, mobile VR and faster connectivity.
How would 5G adoption rates differ from 4G?

Using the historical data (from the MIIT) of the last 4G or 3G migration cycles as a reference, we should not expect a sudden surge in 5G handsets after the initial rollout. China started 4G services in the beginning of 2014, and the penetration rate reached 75% in 2018; the penetration rate in the first year was a mere 8%. Similarly, it took around five years for 3G to peak at a penetration of 38% from the initial rollout in 2009.

However, there are some major differences in the underlying circumstances which might lead to a different 5G adoption rate than in the previous cycles. One is China’s early lead in 5G; it was a relative latecomer with 4G. This means that people may take time to warm up to the technology. Goldman Sachs estimates China can reach full penetration of 5G in 8–10 years, i.e., by 2023–25, which is longer than the previous adoption cycle of around five years (see Fig. 3).

However, smartphone operators have been actively launching affordable 5G models, with the lowest ones at around CNY 2,000. Relatively cheap phones and more smartphones obtaining 3C certifications (China’s compulsory certificate mark) should drive demand for 5G smartphones. Over the longer term, demand could be affected by the challenges to build 5G beyond key urban areas and by the high cost of 5G infrastructure.
How manufacturers are boosting demand

We believe 5G smartphone volumes in 2020 will depend on the specification and pricing of new models. Due to the lack of a killer app in the market, users may not want to pay for the higher-end phones and may stick with mid-tier models. Given the substantial costs budgeted for core 5G components (particularly mobile processors), leading Chinese smartphone brands have downgraded model specifications to offer a mid-tier price model. For instance, a leading maker reduced its panel choice from OLED to LCD and camera pixels from 13MPx to 12MPx in its new 5G model, which marked as a downgrade from the last 4G model. Given Huawei now focuses more on the domestic market, and due to its higher vertical integration of the 5G component supply chain, it has managed to launch new 5G phones at an attractive CNY 2,000 price point. We therefore expect more Chinese smartphone makers to migrate to mid-tier models and to lower prices, in order to increase demand.

Potential drivers for components

The increasing popularity of 5G smartphones will likely generate substantial demand for mobile data storage. As 5G offers 10–100x faster speeds than 4G, it should generate significant mobile data growth and could increase cellular IoT connections by 3x or more over the next 3–4 years. This should therefore encourage demand for new and upgraded data centers. China’s public cloud hardware market, according to our estimates, should rebound in 2020 and grow by around 20% y/y over the medium term.

Among the key components, the 5G chipset is expected to enjoy substantial demand growth given the increasing demand for faster data transfers, the reliance on cloud technology and the sharp increase in base stations. The leading US and Taiwanese semiconductor companies plan to mass produce their 5G chips, which are key components of 5G smartphones and equipment supply chains. At this stage, it is still uncertain whether mid-tier to low-end phones will become mainstream. However, growing price competition among leading smartphone makers might shift demand for lenses toward the low-end segment to balance the price cost of including 5G-related components. The migration to the low-tier handset may hurt some camera lens suppliers.

Exponential growth in mobile data to support demand for 5G phones

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2019</th>
<th>2020*</th>
<th>2021*</th>
<th>2022*</th>
<th>2023*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile data</td>
<td>22</td>
<td>31</td>
<td>43</td>
<td>58</td>
<td>79</td>
<td>107</td>
</tr>
<tr>
<td>(exabytes/month)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellular IoT</td>
<td>1.0</td>
<td>1.3</td>
<td>1.7</td>
<td>2.2</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Connections (bn)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Estimates
Source: Ericsson, Bloomberg Intelligence, UBS

Fig.11

Related reports
> Tech disruption: 5G is not just a faster G
> Will 5G break the Chinese telco slump?
Chapter 3

Investing in China 5G
Key telecom operators and tower companies as key enablers

Telecom operators, being the key enablers of 5G ecosystems, have played a critical role in supporting China’s lead in rolling out 5G. China launched 5G services in early November 2019 and extended to around 50 cities by the end of the year. Beijing aims to broaden 5G coverage to over 330 cities in 2020. The broadening coverage of the 5G network is expected to trigger increased capex that will be front-end loaded. Based on the offered 5G tariff package by select telecom operators, telecom operators are unlikely to charge a substantial premium for 5G over 4G. In our earlier report of China’s telecom sector, we forecast the 5G rollout would result in an around 4% compound annual growth rate for the telecom operators over the coming three years (2020–22E).

China’s former head of the Ministry of Industry and Information Technology (MIIT), Li Yizhong, commented that China will invest up to CNY 1.5trn to deploy 6 million 5G base stations over the next seven years (by 2026E). He projected the peak construction cycle of 5G base stations to arrive in 2020–21. The amount pledged, which was more than the market expected, and the peak cycle commencing in 2020 should accelerate the deployment of 5G base stations in China.

Mobile devices and their supply chains

Smartphone and component makers are set to benefit from the rise in 5G subscriber growth. China is expected to account for over 75% of forecasted global smartphone demand in 2020. There is a strong pipeline of 5G smartphone models to be launched in China this year, in addition to the 30-plus launched in 2019. China’s component manufacturers account for over 60% of production for 5G smartphones. The coronavirus outbreak may soften valuations and earnings in the near term to account for the losses in discretionary spending (or smartphones). Android-based models may also suffer because of the licensing ban. But we don’t believe these risks will derail the medium- to long-term structural growth that we believe the 5G rollout offers China’s handset and component makers.

Local governments’ 5G plans in China

Fig. 12

Source: Media reports as of February 2020
Demand to rise for cloud computing and security software

According to the MIIT, China’s cloud market is projected to grow 32% on average over 2018–22, reaching CNY 290bn by 2022. The public cloud market is forecast to grow by an even faster 41% on average over the same period. Public cloud is estimated to reach a 60% share of China’s total cloud market by 2022. The substantial increase in download speeds from 5G (at least 20x faster than 4G LTE rates) should greatly boost demand for cloud computing, as should the likely rise in cloud gaming. The Infrastructure as a Service (IaaS) area, the most prevailing cloud system in China, is dominated by three leading players and still underpenetrated at the moment.

Local semiconductor/tech firms supported by localization

In response to the White House’s threats, China’s government has vowed to support the local semiconductor supply chain and software firms as part of a localization program. Chinese customers have also increasingly sourced from local suppliers to lower the potential disruption risk on supply chains, in response to the tensions. With financial backing from the government, we expect local players to increase their investment in R&D in order to close the gap with their US peers. This should, ultimately, help them gain market share over the long run from a low base at present.

Beneficiaries of the fast expanding IoT market

5G’s high connectivity and low latency should foster the proliferation of IoT. The possible applications are numerous, including in transportation, logistics, manufacturing, healthcare and other smart-city-related areas. The MIIT has set specific targets for coverage and the number of connections over the medium to long term. The number of connected devices in China might far exceed 2 billion by 2023, according to the MIIT. Enabling the IoT ecosystem should become a new revenue source for telecom operators and equipment providers.

E-commerce portals to deepen market penetration

With more AR/VR applications on the horizon, 3D video and mass-market adoption of 4K/8K TV should increase with 5G. This should allow established e-commerce portals to further deepen their penetration into China’s consumer market. These e-commerce companies are partnering with other offline retailers to provide more comprehensive service coverage for customers. This should also help e-commerce companies to expand into untapped categories, in particular the FMCG segment.

Investment guidance

We recommend investors to invest in a diversified list of enablers and disruptors that will benefit from the development of China’s 5G ecosystem. We expect select enablers, including Chinese tower companies and those in the smartphone supply chain, to see notable business growth from the early adoption of 5G in China. As adoption accelerates, we expect demand growth will appear among core 5G enablers like cloud service providers and data centers. Also, as IoT applications proliferate, 5G disruptors in the areas of online e-commerce, logistics, manufacturing and healthcare should gain market share from traditional operators. The underlying technologies empowering the disruption, including artificial intelligence, AR and VR, and cloud gaming operators, should benefit over the medium term. Local semiconductor/tech firms should also gain market share in the domestic market in light of strong government support. And we expect notable demand for autonomous driving, the killer application of 5G as the technology matures and related regulatory/insurance policies are implemented.
UBS Chief Investment Office’s ("CIO") investment views are prepared and published by the Global Wealth Management business of UBS Switzerland AG (regulated by FINMA in Switzerland) or its affiliates ("UBS"). The investment views have been prepared in accordance with legal requirements designed to promote the independence of investment research.

Generic investment research – Risk information:
This publication is for your information only and is not intended as an offer, or a solicitation of an offer, to buy or sell any investment or other specific product. The analysis contained herein does not constitute a personal recommendation or take into account the particular investment objectives, investment strategies, financial situation and needs of any specific recipient. It is based on numerous assumptions. Different assumptions could result in materially different results. Certain services and products are subject to legal restrictions and cannot be offered worldwide on an unrestricted basis and/or may not be eligible for sale to all investors. All information and opinions expressed in this document were obtained from sources believed to be reliable and in good faith, but no representation or warranty, express or implied, is made as to its accuracy or completeness (other than disclosures relating to UBS). All information and opinions as well as any forecasts, estimates and market prices indicated are current as of the date of this report, and are subject to change without notice. Opinions expressed herein may differ or be contrary to those expressed by other business areas or divisions of UBS as a result of using different assumptions and/or criteria.

In no circumstances may this document or any of the information (including any forecast, value, index or other calculated amount ("Values")) be used for any of the following purposes (i) valuation or accounting purposes; (ii) to determine the amounts due or payable, the price or the value of any financial instrument or financial contract; or (iii) to measure the performance of any financial instrument including, without limitation, for the purpose of tracking the return or performance of any Value or of defining the asset allocation of portfolio or of computing performance fees. By receiving this document and the information you will be deemed to represent and warrant to UBS that you will not use this document or otherwise rely on any of the information for any of the above purposes. UBS and any of its directors or employees may be entitled at any time to hold long or short positions in investment instruments referred to herein, carry out transactions involving relevant investment instruments in the capacity of principal or agent, or provide any other services or have officers, who serve as directors, either to/for the issuer, the investment instrument itself or to/for any company commercially or financially affiliated to such issuers. At any time, investment decisions (including whether to buy, sell or hold securities) made by UBS and its employees may differ from or be contrary to the opinions expressed in UBS research publications. Some investments may not be readily realizable since the market in the securities is illiquid and therefore valuing the investment and identifying the risk to which you are exposed may be difficult to quantify. UBS relies on information barriers to control the flow of information contained in one or more areas within UBS, into other areas, units, divisions or affiliates of UBS. Futures and options trading is not suitable for every investor as there is a substantial risk of loss, and losses in excess of an initial investment may occur. Past performance of an investment is no guarantee for its future performance. Additional information will be made available upon request. Some investments may be subject to sudden and large falls in value and on realization you may receive back less than you invested or may be required to pay more. Changes in foreign exchange rates may have an adverse effect on the price, value or income of an investment. The analyst(s) responsible for the preparation of this report may interact with trading desk personnel, sales personnel and other constituencies for the purpose of gathering, synthesizing and interpreting market information.

Tax treatment depends on the individual circumstances and may be subject to change in the future. UBS does not provide legal or tax advice and makes no representations as to the tax treatment of assets or the investment returns thereon both in general or with reference to specific client’s circumstances and needs. We are of necessity unable to take into account the particular investment objectives, financial situation and needs of our individual clients and we would recommend that you take financial and/or tax advice as to the implications (including tax) of investing in any of the products mentioned herein.

This material may not be reproduced or copies circulated without prior authority of UBS. Unless otherwise agreed in writing UBS expressly prohibits the distribution and transfer of this material to third parties for any reason. UBS accepts no liability whatsoever for any claims or lawsuits from third parties arising from the use or distribution of this material. This report is for distribution only under such circumstances as may be permitted by applicable law. For information on the ways in which CIO manages conflicts and maintains independence of its investment views and publication offering, and research and rating methodologies, please visit www.ubs.com/research. Additional information on the relevant authors of this publication and other CIO publication(s) referenced in this report; and copies of any past reports on this topic; are available upon request from your client advisor.

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

Distributed to US persons by UBS Financial Services Inc. or UBS Securities LLC, subsidiaries of UBS AG. UBS Switzerland AG, UBS Europe SE, UBS Bank, S.A., UBS Brasil Administradora de Valores Mobiliarios Ltda, UBS Asesores Mexico, S.A. de C.V., UBS Securities Japan Co., Ltd, UBS Wealth Management Israel Ltd and UBS Menkul Degerler AS are affiliates of UBS AG. UBS Financial Services Incorporated of Puerto Rico is a subsidiary of UBS Financial Services Inc. UBS Financial Services Inc. accepts responsibility for the content of a report prepared by a non-US affiliate when it distributes reports to US persons. All transactions by a US person in the securities mentioned in this report should be effected through a US-registered broker dealer affiliated with UBS, and not through a non-US affiliate. The contents of this report have not been and will not be approved by any securities or investment authority in the United States or elsewhere. UBS Financial Services Inc. is not acting as a municipal advisor to any municipal entity or obligated person within the meaning of Section 15B of the Securities Exchange Act (the “Municipal Advisor Rule”) and the opinions or views contained herein are not intended to be, and do not constitute, advice within the meaning of the Municipal Advisor Rule.
External Asset Managers / External Financial Consultants: In case this research or publication is provided to an External Asset Manager or an External Financial Consultant, UBS expressly prohibits that it is redistributed by the External Asset Manager or the External Financial Consultant and is made available to their clients and/or third parties.

Austria: This publication is not intended to constitute a public offer under Austrian law. It is distributed only for information purposes to clients of UBS Europe SE, Niederlassung Österreich, with place of business at Wächtergasse 1, A-1010 Wien. UBS Europe SE, Niederlassung Österreich is subject to the joint supervision of the European Central Bank (“ECB”), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Austrian Financial Market Authority (Finanzmarktaufsicht), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB, the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Austrian Financial Market Authority (Finanzmarktaufsicht), to which this publication has not been submitted for approval.

Brazil: This publication is not intended to constitute a public offer under Brazilian law or a research analysis report as per the definition contained under the Comissão de Valores Mobiliários (“CVM”) Instruction 598/2018. It is distributed only for information purposes to clients of UBS Brasil Administradora de Valores Mobiliários Ltda. and/or of UBS Consenso Investimentos Ltda, entities regulated by CVM.

Canada: In Canada, this publication is distributed to clients of UBS Wealth Management Canada by UBS Investment Management Canada Inc.

China: This report is prepared by UBS Switzerland AG or its offshore subsidiary or affiliate (collectively as “UBS Offshore”). UBS Offshore is an entity incorporated out of China and is not licensed, supervised or regulated in China to carry out banking or securities business. The recipient should not contact the analysts or UBS Offshore which produced this report for advice as they are not licensed to provide securities investment advice in China. UBS Investment Bank (including Research) has its own wholly independent research and views which at times may vary from the views of UBS Global Wealth Management. This report shall not be regarded as providing specific securities related information. The recipient should not use this document or otherwise rely on any of the information contained in this report in making investment decisions and UBS takes no responsibility in this regard.

Czech Republic: UBS is not a licensed bank in the Czech Republic and thus is not allowed to provide regulated banking or investment services in the Czech Republic. Please notify UBS if you do not wish to receive any further correspondence.

Denmark: This publication is not intended to constitute a public offer under Danish law. It is distributed only for information purposes to clients of UBS Europe SE, Denmark Branch, filial af UBS Europe SE, with place of business at Sankt Annæ Plads 13, 1250 Copenhagen, Denmark, registered with the Danish Commerce and Companies Agency, under No. 38 17 24 33. UBS Europe SE, Denmark Branch, filial af UBS Europe SE is subject to the joint supervision of the European Central Bank (“ECB”), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Danish Financial Supervisory Authority (Finanstilsynet), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. France: This publication is distributed by UBS (France) S.A., French “société anonyme” with share capital of € 132.975.556, 69, boulevard Haussmann F-75008 Paris, R.C.S. Paris B 421 255 670, to its clients and prospects. UBS (France) S.A. is a provider of investment services duly authorized according to the terms of the “Code Monétaire et Financier”, regulated by French banking and financial authorities as the “Autorité de Contrôle Prudentiel et de Résolution”. Germany: This publication is not intended to constitute a public offer under German law. It is distributed only for information purposes to clients of UBS Europe SE, Germany, with place of business at Bockenheimer Landstrasse 2-4, 60306 Frankfurt am Main. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the European Central Bank (“ECB”), and supervised by the ECB, the German Central Bank (Deutsche Bundesbank) and the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), to which this publication has not been submitted for approval.

Greece: UBS Switzerland AG and its affiliates (UBS) are not licensed as a bank or financial institution under Greek legislation and do not provide banking and financial services in Greece. Consequently, UBS provides such services from branches outside of Greece, only. This document may not be considered as a public offering made or to be made to residents of Greece.

Hong Kong: This publication is distributed to clients of UBS AG Hong Kong Branch by UBS AG Hong Kong Branch, a licensed bank under the Hong Kong Banking Ordinance and a registered institution under the Securities and Futures Ordinance. UBS AG Hong Kong Branch is incorporated in Switzerland with limited liability.

India: UBS Securities India Private Ltd. (Corporate Identity Number U67120MH1996PTC097299) 2/9, 2 North Avenue, Maker Maxity, Bandra Kurla Complex, Bandra (East), Mumbai (India) 400051. Phone: +912261556000. It provides brokerage services bearing SEBI Registration Number INZ000259830; merchant banking services bearing SEBI Registration Number: INM000010809 and Research Analyst services bearing SEBI Registration Number: INH000002204. UBS AG, its affiliates or subsidiaries may have received compensation for non-investment banking securities-related services and/or non-securities services from the subject Indian company/companies. Within the past 12 months, UBS AG, its affiliates or subsidiaries may have received compensation for non-investment banking securities-related services and/or non-securities services from the subject Indian company/companies. The subject company/ companies may have been a client/clients of UBS AG, its affiliates or subsidiaries during the 12 months preceding the date of distribution of the research report with respect to investment banking and/or non-investment banking securities-related services and/or non-securities services.

Indonesia, Malaysia, Philippines, Thailand: This material was provided to you as a result of a request received by UBS from you and/or persons entitled to make the request on your behalf. Should you have received the material erroneously, UBS asks that you kindly destroy/ delete it and inform UBS immediately. Any and all advice provided and/or trades executed by UBS pursuant to the material will only have been provided upon your specific request or executed upon your specific instructions, as the case may be, and may be deemed as such by UBS and you.

The material may not have been reviewed, approved, disapproved or endorsed by any financial or regulatory authority in your jurisdiction. The relevant investments will be subject to restrictions and obligations on transfer as set forth in the material, and by receiving the material you under take to comply fully with such restrictions and obligations. You should carefully study and ensure that you understand and exercise due care and discretion in considering your investment objective, risk appetite and personal circumstances against the risk of the investment. You are advised to seek independent professional advice in case of doubt.

Israel: UBS is a premier global financial firm offering wealth management, asset management and investment banking services from its headquarters in Switzerland and its operations in over 50 countries worldwide to individual, corporate and institutional investors. In Israel, UBS Switzerland AG is registered as Foreign Dealer in cooperation with UBS Wealth Management Israel Ltd., a wholly owned UBS subsidiary. UBS Wealth Management Israel Ltd. is a Portfolio Manager licensee which engages also in Investment Marketing and is regulated by the Israel Securities Authority. This publication is intended for information only and is not intended as an offer to buy or solicitation of an offer. Furthermore, this publication is not intended as an investment advice and/or investment marketing and is not replacing any investment advice and/or investment marketing provided by the relevant licensee which is adjusted to each person needs. The word “advice” and/or any of its derivatives shall be read and construed in conjunction with the definition of the term “investment marketing” as defined under the Israeli Regulation of Investment Advice, Investment Marketing and Portfolio Management Law, 1995.

Italy: This publication is not intended to constitute a public offer under Italian law. It is distributed only for information purposes to clients of UBS Europe SE, Succursale Italia, with place...
of business at Via del Vecchio Politecnico, 3-20121 Milano. UBS Europe SE, Succursale Italia is subject to the joint supervision of the European Central Bank (“ECB”), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Bank of Italy (Banca d’Italia) and the Italian Financial Markets Supervisory Authority (CONSOB - Commissione Nazionale per le Società e la Borsa), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. Jersey: UBS AG, Jersey Branch, is regulated and authorized by the Jersey Financial Services Commission for the conduct of banking, funds and investment business. Where services are provided from outside Jersey, they will not be covered by the Jersey regulatory regime. UBS AG, Jersey Branch is a branch of UBS AG a public company limited by shares, incorporated in Switzerland whose registered offices are at Aeschenvorstadt 1, CH-4051 Basel and Bahnhofstrasse 45, CH 8001 Zurich. UBS AG, Jersey Branch’s principal place business is 1, IFC Jersey, St Helier, Jersey, JE2 3BX. Luxembourg: This publication is not intended to constitute a public offer under Luxembourg law. It is distributed only for information purposes to clients of UBS Europe SE, Luxembourg Branch, with place of business at 33A, Avenue J. F. Kennedy, L-1855 Luxembourg. UBS Europe SE, Luxembourg Branch is subject to the joint supervision of the European Central Bank (“ECB”), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Luxembourg supervisory authority (Commission de Surveillance du Secteur Financier), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. Mexico: This information is distributed by UBS Asesores México, S.A. de C.V. (“UBS Asesores”), an affiliate of UBS Switzerland AG, incorporated as a non-independent investment advisor under the Securities Market Law due to the relation with a Foreign Bank. UBS Asesores is a regulated entity and it is subject to the supervision of the Mexican Banking and Securities Commission (“CNBV”), which exclusively regulates UBS Asesores regarding the rendering of portfolio management, as well as on securities investment advisory services, analysis and issuance of individual investment recommendations, so that the CNBV has no surveillance faculties nor may have over any other service provided by UBS Asesores. UBS Asesores is registered before CNBV under Registry number 30060. You are being provided with this UBS publication or material because you have indicated to UBS Asesores that you are a Sophisticated Qualified Investor located in Mexico. The compensation of the analyst(s) who prepared this report is determined exclusively by research management and senior management of any entity of UBS Group to which such analyst(s) render services. Nigeria: UBS Switzerland AG and its affiliates (UBS) are not licensed, supervised or regulated in Nigeria by the Central Bank of Nigeria or the Nigerian Securities and Exchange Commission and do not undertake banking or investment business activities in Nigeria. Portugal: UBS Switzerland AG is not licensed to conduct banking and financial activities in Portugal nor is UBS Switzerland AG supervised by the portuguese regulators (Bank of Portugal “Banco de Portugal” and Portuguese Securities Exchange Commission “Comissão do Mercado de Valores Mobiliários”). Singapore: This material was provided to you as a result of a request received by UBS from you and/or persons entitled to make the request on your behalf. Should you have received the material erroneously, UBS asks that you kindly destroy/delete it and inform UBS immediately. Clients of UBS AG Singapore branch are asked to please contact UBS AG Singapore branch, an exempt financial adviser under the Singapore Financial Advisers Act (Cap. 110) and a wholesale bank licensed under the Singapore Banking Act (Cap. 19) regulated by the Monetary Authority of Singapore, in respect of any matters arising from, or in connection with, the analysis or report. Spain: This publication is not intended to constitute a public offer under Spanish law. It is distributed only for information purposes to clients of UBS Europe SE, Sucursal en España, with place of business at Calle Maria de Molina 4, C.P. 28006, Madrid. UBS Europe SE, Sucursal en España is subject to the joint supervision of the European Central Bank (“ECB”), the German Central Bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Spanish supervisory authority (Banco de España), to which this publication has not been submitted for approval. Additionally it is authorized to provide investment services on securities and financial instruments, regarding which it is supervised by the Comisión Nacional del Mercado de Valores as well. UBS Europe SE, Sucursal en España is a branch of UBS Europe SE, a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. Sweden: This publication is not intended to constitute a public offer under Swedish law. It is distributed only for information purposes to clients of UBS Europe SE, Sweden Bankfilial, with place of business at Regeringsgatan 38, 11153 Stockholm, Sweden, registered with the Swedish Companies Registration Office under Reg. No 516406-1011. UBS Europe SE, Sweden Bankfilial is subject to the joint supervision of the European Central Bank (“ECB”), the German Central bank (Deutsche Bundesbank), the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), as well as of the Swedish supervisory authority (Finansinspektionen), to which this publication has not been submitted for approval. UBS Europe SE is a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the ECB. Taiwan: This material is provided by UBS AG, Taipei Branch in accordance with laws of Taiwan, in agreement with or at the request of clients/prospects. UAE: UBS is not licensed in the UAE by the Central Bank of UAE or by the Securities & Commodities Authority. The UBS AG Dubai Branch is licensed in the DIFC by the Dubai Financial Services Authority as an authorised firm. UK: This document is issued by UBS Wealth Management, a division of UBS AG which is authorised and regulated by the Financial Market Supervisory Authority in Switzerland. In the United Kingdom, UBS AG is authorised by the Prudential Regulation Authority and is subject to regulation by the Financial Conduct Authority and limited regulation by the Prudential Regulation Authority. Details about the extent of regulation by the Prudential Regulation Authority are available from us on request. A member of the London Stock Exchange. This publication is distributed to retail clients of UBS Wealth Management.
Shifting Asia

UBS CIO’s Shifting Asia thought leadership series takes on the major trends shaping Asian markets and how they could impact investors over the next 5–10 years.

Scan the QR code to access the collection or contact your client advisor.

Read the full series at ubs.com/cio