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From copycat to early bird: Taking stock of China's 5G ambitions

China has rapidly become a big player in 5G technology[1], thanks to the government's strategy and its support of high investment in Research and Development (R&D). This new technology is part of the Made in China 2025 initiative, through which the Chinese government targets self-sufficiency in high-end industries. China coordinated its approach to 5G and some successes are already visible. For example, 40% of global patents for current 5G network standards are from Chinese firms. Moreover, Chinese companies are set to benefit from 5G. Huawei is the global leader in network infrastructures; it currently holds 29% of the market. Furthermore, 5G is expected to trigger a cycle of mobile phone replacement, and three out of the five global mobile phone leaders are Chinese: Huawei, Xiaomi and Oppo. After having had to play catch-up in the 3G and 4G era, China has secured a strong position in the 5G race, but its ambitions face challenges. The country's successes were greatly supported by integrating global value chains. However, China still relies on imports, especially for high-end products, leaving the sector exposed to protectionist threats. This is visible in the trade war with the United States (US), which targets many electronic products. Moreover, the deployment of 5G networks by Chinese companies is perceived as a cybersecurity risk by many recipient countries. The US is banning Huawei equipment and pressing its allies to do the same, which could limit the growth of Chinese 5G in the future.

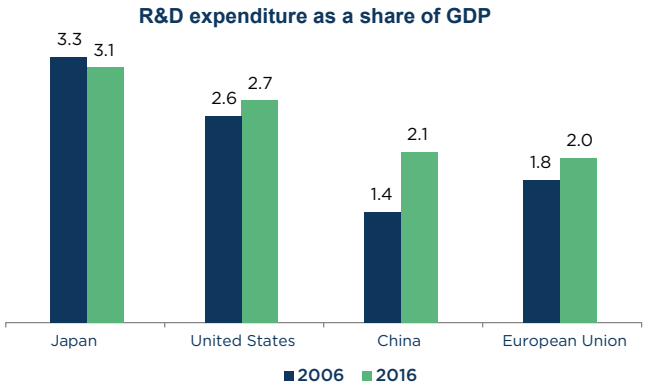
China holds a strong position in the global race to dominate 5G

After having had to play catch-up in the era of 3G and 4G, the authorities have put special emphasis on the development of 5G technology. China has rapidly become a big player in 5G, triggering much attention from both incumbents and policymakers. This rise has been facilitated by top-down support from the government, an issue that continues to cause friction among some of China's largest trade partners. The 13th Five Year Plan (2016-2020) states the ambition for China to launch 5G before 2020. This also fits into the Made in China 2025 initiative, through which the Chinese government aims to achieve self-sufficiency in high-end industries by 2025. It also targets global leadership in innovation by 2050[2]. The IMT-2020 5G promotion group was launched in 2014 by the Ministry of Industry and Information Technology (MIIT), the National Development and Reform Commission (NDRC), and the Ministry of Science and Technology (MOST). The group aims to bring together all players in the ecosystem to create synergies and improve cooperation. This has facilitated a unified strategy, enabling Chinese companies to build a strong position in the global 5G market. To this end, the government has also supported investment in the sector, notably by creating the National Integrated Circuit Industry Investment Fund in 2014. The goal is to have its home-grown chip industry expand from USD 65 billion in 2016 to USD 305 billion in 2030[3].

1 - 5G stands for fifth generation of wireless network. Compared to 4G, it will increase sharply the speed and weight of wireless data communications (increased bandwidth) and allow the connection of new devices (lower latency).
2 - Ernest and Young (2018). *China is poised to win the 5G race.*
3 - The Economist (2018). *Chips wars: China, America and silicon supremacy.*

In the context of a supportive policy framework, Chinese companies have been able to increase private sector R&D at a fast rate. In fact, private sector R&D as a share of GDP has increased quite dramatically, overtaking the European Union (EU) in 2016 **(Chart 1)**. The top-five Chinese companies with the biggest R&D investments are in the technology sector **(Table 1)**[4]. In the race to develop 5G networks, having access to government support can be an important competitive advantage, as large investments are needed to put in place the basic infrastructure required to build said networks. The return on investments can be a significant barrier to entry, as most proceeds are expected to be made from the products using 5G networks, rather than from the monetisation of the networks themselves.

CHART 1
Chinese investment in R&D is increasing fast



Sources: Word Bank, Unesco

TABLE 1
Main players in China's Information and Communications Technology (ICT) sector[7]

Company	Industry	Net sales (€bn)[8]	Net sales YOY	R&D intensity (%)	Number of employees (thousands)	Market cap (€bn)
HUAWEI	Technology Hardware & Equipment	77.3	16	15	180	N/A
CHINA TELECOM	Technology Hardware & Equipment	46.9	4	0.3	284	6.0
LENOVO	Technology Hardware & Equipment	37.8	5	3	54	5.1
ALIBABA	Software & Computer Services	32.0	58	9	66	366.6
TENCENT	Software & Computer Services	30.4	56	7	45	333.4
MIDEA GROUP	Home appliances	28.4	52	4	102	33.1
QINGDAO HAIER	Home appliances	20.2	34	3	77	11.0
TCL	Electronic & Electrical Equipment	14.1	7	4	75	4.1
ZTE	Technology Hardware & Equipment	13.9	7	13	75	10.5
BOE TECHNOLOGY GROUP	Electronic & Electrical Equipment	11.6	38	3	63	0.3
BAIDU	Software & Computer Services	10.9	20	15	39	52.0
NETEASE	Software & Computer Services	6.9	42	8	20	30.2
HIKVISION	Electronic & Electrical Equipment	5.3	31	8	26	29.9
CTRIP.COM	Software & Computer Services	3.4	39	31	37	22.5
FIBERHOME	Fixed Line Telecommunications	2.6	22	10	14	3.5

Operators based in the US, Japan and Korea are also competing with China to roll-out 5G networks. Chinese companies in the sector hold an advantage relative to their competitors, as many of these are directly- or indirectly-owned or controlled by the government[5]. Consequently, while the biggest US tech companies spend a lot of money on stock buybacks and dividends, Chinese counterparts have more leeway to reinvest profits into R&D and/or to purchase technology. For instance, between 2015 and 2017, the top-five US tech companies spent USD 228 billion on buybacks and dividends, against USD 10.7 billion for the top five in China[6].

The early bird gets the worm

China's coordinated approach to promoting 5G will help many Chinese companies to benefit from the country's first-mover advantage. The 3rd Generation Partnership Project (3GPP), which brings together the major global telecommunications associations, works as the international platform in charge of defining telecommunication standards. In December 2017, the 3GPP officially ratified the first release of non-standalone 5G (NSA 5G) standards[9]. It carries the list of essential patents (SEP) to be used when building the network infrastructure, from which firms owning the patents will then receive royalties. The Eurasia Group[10] estimates that Chinese companies, including Huawei, ZTE and Lenovo, hold 40% of chosen patents. Huawei has the most patents compared to any other company. This process is iterative, and official standards for standalone 5G (SA 5G) are yet to be fully defined. However, this already represents a leap forward from the spectator role that Chinese firms played during the same process for 4G.

China's first-mover advantage goes beyond its influence on patents. In late 2018, China Mobile began rolling out the most ambitious trial network of standalone (SA) 5G in five large Chinese cities[11]. According to a report by Ernest and Young, 40% of global 5G connections will come from China by 2025. Moreover, Huawei is currently the largest network infrastructure provider, ahead of Nokia (Finland), Ericsson (Sweden), ZTE (China) and Cisco (US). Huawei controls 29% of the global market, and offers equipment branded as both cheaper, and easier to deploy and maintain[12]. This means Huawei could hold comparative advantages in emerging markets. Case in point, 70% of 4G networks in Africa are Chinese-built[13]. This figure is 43% in Asia-Pacific and 34% in Latin America.

However, demand for ICT products has been weakened by saturation in key markets: in 2017, mobile phone penetration rates were 82% in China, only slightly behind the US at 84%. This has exerted downside pressure on the profitability of mobile phone manufacturers and network providers, with the former focusing on reducing inventories of old technology before they roll out new generation phones. The commercialisation of NSA 5G is planned for 2019 in some countries (Australia, China and South Korea). When this happens, it will trigger a replacement cycle for mobile phones. On top of being the leader in global network equipment, Huawei is the second largest mobile phone manufacturer behind Samsung, while other Chinese firms Xiaomi and Oppo are fourth and fifth respectively, behind Apple. In this regard, the China Academy of Information and Communications Technology (CAICT), a research institute under the MIIT, estimates that by 2025, the 5G market could account for 3.2% of Chinese GDP, representing USD 166 billion.

4 - European Commission (2018). *The EU Industrial R&D Investment Scoreboard.*
5 - Balding, C. and Clarke, D. (2018). *Who owns Huawei?. SSRN.*
6 - Financial Times (2018). *China is winning the global tech race.*
7 - European Commission (2018). *R&D ranking of the World's Top 2500 companies.*
8 - Fiscal year 2017/2018.
9 - Non-standalone (NSA) 5G networks are supported by existing 4G (or LTE) infrastructure. NSA 5G will increase data bandwidth, paving way for augmented reality or UltraHD videos. It will not deliver 5G's second promise that is ultra-reliable low latency communications, which will be used to develop of the internet of things (IOT).
10 - Eurasia Group (2018). *The Geopolitics of 5G. Eurasia Group White Paper.*
11 - Wireless Watch (2018). *China Mobile will be first to Standalone 5G NR, while US MNOs tussle.*
12 - Foreign Policy (2019). *The Improbable Rise of Huawei.*
13 - Foreign Policy (2019). *For Africa, Chinese-built internet is better than no internet at all.*

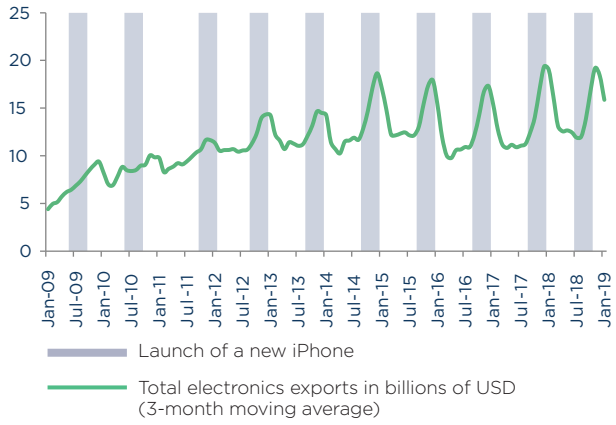
The advent of an ICT giant[14]

The ICT sector has become increasingly important for China's economy, representing approximately 10% of GDP, and it will constitute an important source of future growth. In fact, the new economy expanded at an average annual rate of 16% between 2007 and 2017 – twice as fast as real GDP, according to estimates by the Chinese Academy of Social Sciences (CASS). Moreover, high tech exports account for approximately 30% of total exports, with electronics alone representing 10% of total exports and increasing to 160 billion USD in 2018 from 80 billion USD in 2009. The growth of China's ICT sector was greatly supported by the country's integration in global value chains. According to a report by McKinsey[15], more than 50% of computers and 30-40% of embedded systems (found in automotive, machinery, industrial and medical electronic products) contain content designed and manufactured in China. The shift up global value chains has turned China into the largest consumer of semiconductors (45% of total), with the latter overtaking crude oil as China's top import in 2014 **(Chart 3)**.

These evolutions have had implications both domestically and abroad. For example, the distribution of China's outward foreign direct investment (ODI) has changed drastically as a result of China's quest to move up global ICT value chains. Previously, Chinese ODI focused on securing access to natural resources, such as oil and metals, in emerging markets. But the share of Chinese ODI targeting the primary sector dropped from 65% in the period from 2003 to 2005 to 26% from 2013 to 2015. The trend has increasingly favoured investments in technology in developed markets, such as Europe and North America. This has been possible because the sector features a large number of well-capitalised and supported global players. For instance, Tencent and Baidu have pursued a combined total of 243 acquisitions in 2018 alone. The strategy paid off and Chinese companies have moved up global value chains quite significantly. From being tagged as "copycat" nation, reproducing the products of foreign companies for the Chinese market, China worked to create its own innovation ecosystem. According to Trade in Value Added (TiVA) statistics by the OECD, the value added of Chinese electronics exports increased by more than 250% between 2005 and 2015. Moreover, the total domestic share of this value added increased from 64% to 76%.

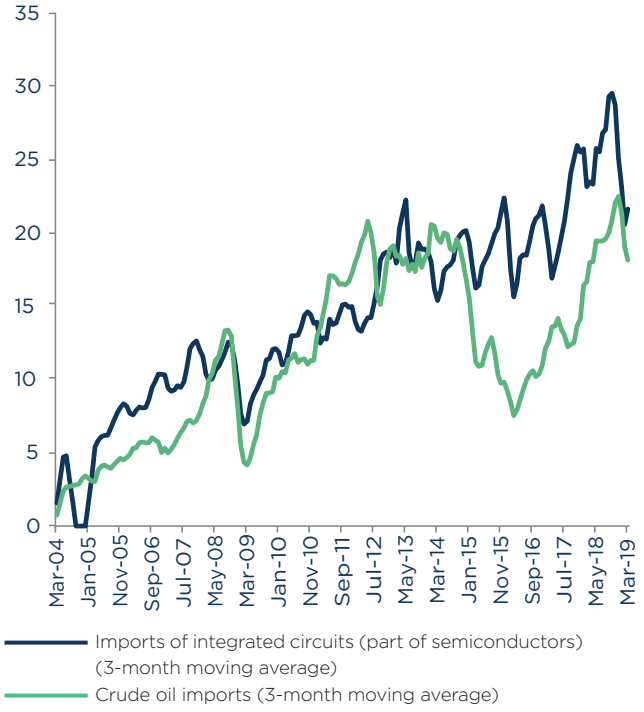
Despite their progress, Chinese companies remain dependent on high value added imports – such as semiconductors – from foreign providers, including Qualcomm, Intel, Nvidia and Samsung. Bridging the technological know-how gap is easier said than done. Currently, China's strengths are in assembly and packaging, but it will need to turn to design and manufacturing to achieve its more ambitious goals. There is a window of opportunity, as Moore's law[16] is becoming too expensive to follow and fewer semiconductors will be moving to technologies that are 20 nanometres and below. China already has companies designing semiconductors (or fabless). These include Spreadtrum Communications and HiSilicon Technologies, a Huawei subsidiary. However, the barriers to entry on the manufacturing front remain high. Building high end manufacturing plants (or foundries) requires billions of US dollars in investments, and foundries in more advanced markets, such as Taiwan, are still years ahead of China. In other words, China's ICT sector has emerged as a strong global player, but its 5G ambitions still face challenges.

CHART 2
New iPhone launches trigger cyclical patterns in Chinese electronic exports[17]



Source: Bloomberg

CHART 3
China's increased external reliance for semiconductors (USD billions)



Source: Bloomberg

The applications of 5G go beyond the disruptive implications of mobile phone replacement cycles for the ICT sector. Global spending on hardware, software and telecommunications is expected to grow by 4% on average between 2017 and 2022, reaching USD 6 trillion[18]. This is a good opportunity for Chinese companies developing supporting hardware and services. The country will also benefit from increased global sales from foreign brands that have relocated parts of their production process to China **(Chart 2)**. Moreover, SA 5G promises to unfold a new technology cycle by making data downloads 600 times faster than the current 4G speed, with increased reliability and lower latency. This new network should allow more devices to become connected and "smart". If China manages to capture an even larger proportion of value added in the ICT global value chain, the positive growth outlook for the sector should be confirmed **(see Insert)**.

14 - In Coface's methodology, the ICT sector includes: telecommunication goods and services, electronics, computer software and hardware.
15 - Mc Kinsey (2014). *Semiconductors in China: Brave new world or same old story?*
16 - Moore's law, enunciated in 1975, predicts that the capabilities of a semiconductor of a given size would double every two years.
17 - Electronic exports include mobile phones, LCD monitors, cameras, etc...
18 - International Data Corporation (2019). *ICT Spending Forecast.*

China's 5G ambitions face challenges

Protectionism under the US-China trade war

According to figures by the OECD, "computer, electronic and optical products" is the most globalised supply chain in East and Southeast Asia[19]. However, in spite of globalisation trends, the sector has been subject to protectionist threats in recent times. In particular, the US has adopted containment strategies that focus on weakening the position of Chinese competitors, and seek to diversify production away from China. In the unfolding trade war between the US and China, electronics are specifically targeted by tariffs: 51% of the USD 200 billion worth of Chinese imports subject to 25% tariffs are electronics, including 23.5% of mobile phones. US tariffs worsen the terms of trade of Chinese exports vis-à-vis their largest market. This incentivises US companies and consumers to diversify demand away from China.

Furthermore, as discussed in the Insert, Chinese companies have not yet managed to capture a proportion of high value added manufacturing, and are therefore still reliant on imports of key components. This leaves Chinese companies exposed to supply chain risks. For example, ZTE and Fujian Jinhua were forced to halt production following US sanctions in 2018. The move followed allegations that these companies violated Iranian sanctions. However, the timing of the decision coincided with the implementation of US President Donald Trump's tariffs, and the resolution of such dispute was touted as a success in President Trump's ongoing negotiations with China. More recently, Huawei's Chief Financial Officer Meng Wanzhou was arrested in Canada on allegations that she played a key role in securing contracts for Huawei in Iran, as well as facilitating Chinese investments in US tech firms via an opaque network of offshore subsidiaries. Chinese companies will continue to be exposed to risks surrounding these types of non-tariff measures. And in May 2019, the US announced it would ban Huawei and its affiliates from buying parts and components from US companies without US government approval. This could cause large disruptions in Huawei's supply chain considering that around 16% of its components came from US firms in 2018[20].

Cybersecurity risks

The deployment of 5G networks by Chinese companies is perceived as a security risk by many potential recipient countries. For example, a number of countries, led by the US, argue that using Huawei 5G network infrastructure poses a threat, as backdoors could grant the Chinese government access to sensitive data on foreign companies and consumers. The US has successfully pressed some of its allies to ban Huawei equipment as a result[21]. The argument feeds off a Chinese law that compels all Chinese citizens or firms to cooperate with national security agencies if required. Moreover, some questions have been raised regarding Huawei's ownership structure. Answering these demands of security and transparency guarantees is a major challenge for Huawei and all Chinese tech firms. But banning Chinese firms altogether reduces competitiveness in the sector, which makes it a costly decision that is bound to clash with private operators' interests. For instance, the European Commission estimated that it would cost EUR 500 billion to equip the EU with 5G infrastructure. Since the EU does not have home-grown leaders in this space, the Commission has only recommended that member states increase collaboration in topics related to cybersecurity[22]. Huawei opened a Cyber Security Transparency Centre in Brussels in 2019 to prove its support of policy efforts to oversee risks in the sector.

Technology has its limits

Although 5G is currently receiving a lot of attention given political considerations, not to mention anticipation of the future applications of the technology, it will take years before unified SA 5G networks are in place. The GSM Association forecasts that only 14% of all connections will be 5G-powered by 2025[23]. This is because there are limitations to technological capabilities. For example, 5G signal has a reach of only 10% of a 4G signal (500 feet), while the antennae are large (approximately the size of a refrigerator) and expensive. 5G phones are likely to be on the market in 2019, triggering a small replacement cycle for users who wish to benefit from the limited availability of 5G hotspots. However, there is a long way to go before 5G is the new telecommunication standard.

19 - OECD (2018). *The changing nature of international production.* TiVA Indicators.
20 - *Reuters (2019). Blacklist mess: Huawei $105 billion business at stake after U.S. broadside*
21 - So far, Australia and Japan have followed while the United Kingdom (UK), Canada, New Zealand and India have not reached a final decision. Thailand, South Korea or Saudi Arabia are allowing Huawei to develop their 5G networks.
22 - European Commission (2018). *Proposal for a regulation of the European Parliament and the Council establishing the Connecting Europe Facility and repealing regulations.* Impact Assessment.
23 - GSM Association (2018). *The Mobile Economy.*

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