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BRIEFING MEMO

China, 5G, and Dominance of the Global "Infosphere"

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Modern consumer society has rapidly evolved from domination by "things" to domination by information. Once upon a time, for example, a car was an object for personal transportation in which anything more than basic information about speed and fuel level came from and through the driver. Now, the automobile itself provides and processes information with which drivers interact at a much richer level. Back-up cameras, blind spot and lane drift warning lights, hands-free wireless telephony, and GPS have transformed the driving experience fundamentally, even ahead of the truly revolutionary era of self-driving cars. A large and growing fraction of the world's day-to-day life of individuals, objects, and institutions will be indelibly stored with an electronic "footprint." The intelligence value of this information from a national security perspective exclusively accessed through a modern communications system dominated by China – 5G – is immense and profoundly threatening.

The new dominance of information is simultaneously bewildering and promising. Moreover, as rapid as the pace of development has been over the past decade, it will soon quicken—with broad implications for almost every aspect of human life. An important aspect of this shift has been the convergence of rapidly developing and mutually reinforcing technologies into an infosphere that will incorporate almost all information-based communications and data services in the global information infrastructure.

Not coincidentally, an integrated infosphere meets aspirations held by the People's Republic of China to dominate and control the global information infrastructure. Beijing's investments in 5G reflect an understanding that this technology is the gateway to control the world's information infrastructure and growing realm of 5G-dependent technologies. A Chinese-dominated infosphere is, in fact, the "digital road" component of its Belt-and-Road-Infrastructure (BRI). While U.S. policymakers have yet to fully grasp the implications of this emerging infosphere, the components below reflect the enabling dimensions that support China's effort to dominate the global information infrastructure.

The Coming 5G Tech Revolution

The emergence of 5th generation (5G) mobile communications technology is far more significant than most people understand. To think of it as one step up from 4G—as 4G was from 3G and so on back to its introduction in the 1980s—fails to do justice to the technological leap involved. 5G technology will enable a worldwide transition to mobile telecommunication with nearly instantaneous transfer of data. Forecasters estimate that by 2025, three-quarters of the world's population (6 billion people) will be interacting with data an average of once every 18 seconds. These interactions will take place through ubiquitously distributed 5G capabilities embedded in everyday appliances through the "Internet of Things" (IoT), as well as with the data business that governments provide and often control.[1]

The establishment of a global 5G network is the critical enabler of the global infosphere—the means of coupling other mutually reinforcing services.

BeiDou: China's Competitor to GPS

China will complete deployment of its global BeiDou ("Big Dipper") precision navigation and timing system in 2020. This 40+ satellite constellation competitor to the U.S. Global Positioning System (GPS) is a crucial element of China's "digital road." Its precise geotemporal (time and spatial location) information will provide nearly continuous information on individuals, objects, and transactions. When linked to a 5G telecommunications system, the BeiDou system will enable cell phone users to be monitored, stored, tracked, and evaluated remotely by the Chinese government.

The Beidou system will provide the People's Republic of China with access to cell phone geolocation and temporal subscriber information on Chinese 5G networks. Furthermore, China's facial recognition software embedded in mobile telephones exploits 200 million traffic cameras and other imaging devices to track individuals. This capability has been demonstrated in China's efforts to rigidly control and suppress the ethnic identity of non-Han Muslim and Tibetan minorities.[2] The system is now being propagated to China's BRI partner nations. The beneficiary of its largest BRI project, Pakistan, has also become the first international user of the BeiDou system.

The Potential Vulnerabilities of Large-Scale 5G Data

Perhaps the most difficult aspect of the infosphere to grasp is the sheer scale of data that feeds it. Ninety percent of the data produced in the entirety of human history has been procured in the past 24 months, and the data tsunami is just beginning. Every day, 2.5 quintillion bytes (2.5 quintillion is 2.5×10^{18}) of data are produced, and much more will come as 5G technologies enable nearly universal connection of objects and devices via the internet. The vast data harvest enabled by China's dominance of 5G mobile communications will contribute to China's ability to dominate the science of artificial intelligence and related disciplines of machine learning, deep learning, and other dimensions of the data sciences. Extremely large data sets are needed to "train" the algorithms that produce the AI results. The more data, the more accurate will be the results.

This stupefying quantity of information defies traditional methods of data reduction and analysis. But insight can be extracted using modern data analytic techniques, including

artificial intelligence and machine learning. The interwoven technologies of the infosphere contribute to this relentless data flow, in turn providing insights into its users both *en bloc* and individually.

The process by which everyday transactions produce and deliver data in overwhelming volume is just beginning. By 2030, the commercial and industrial IoT may incorporate 125 billion or more devices sending data through the global 5G network. This data will be stored and processed in global digital data clouds for exploitation by individuals, commercial entities, and governments.[3]

Underserved Financial Markets and China's Growing Financial Services Sector

China's vast internet user population, approximately 800 million people, offers a formidable market for financial services technologies.[4] In particular, ubiquitous access to the internet through mobile devices has driven the creation of an extensive financial technologies infrastructure covering a wide range of financial services including payments, financing, savings and investment, online insurance, and cloud computing.

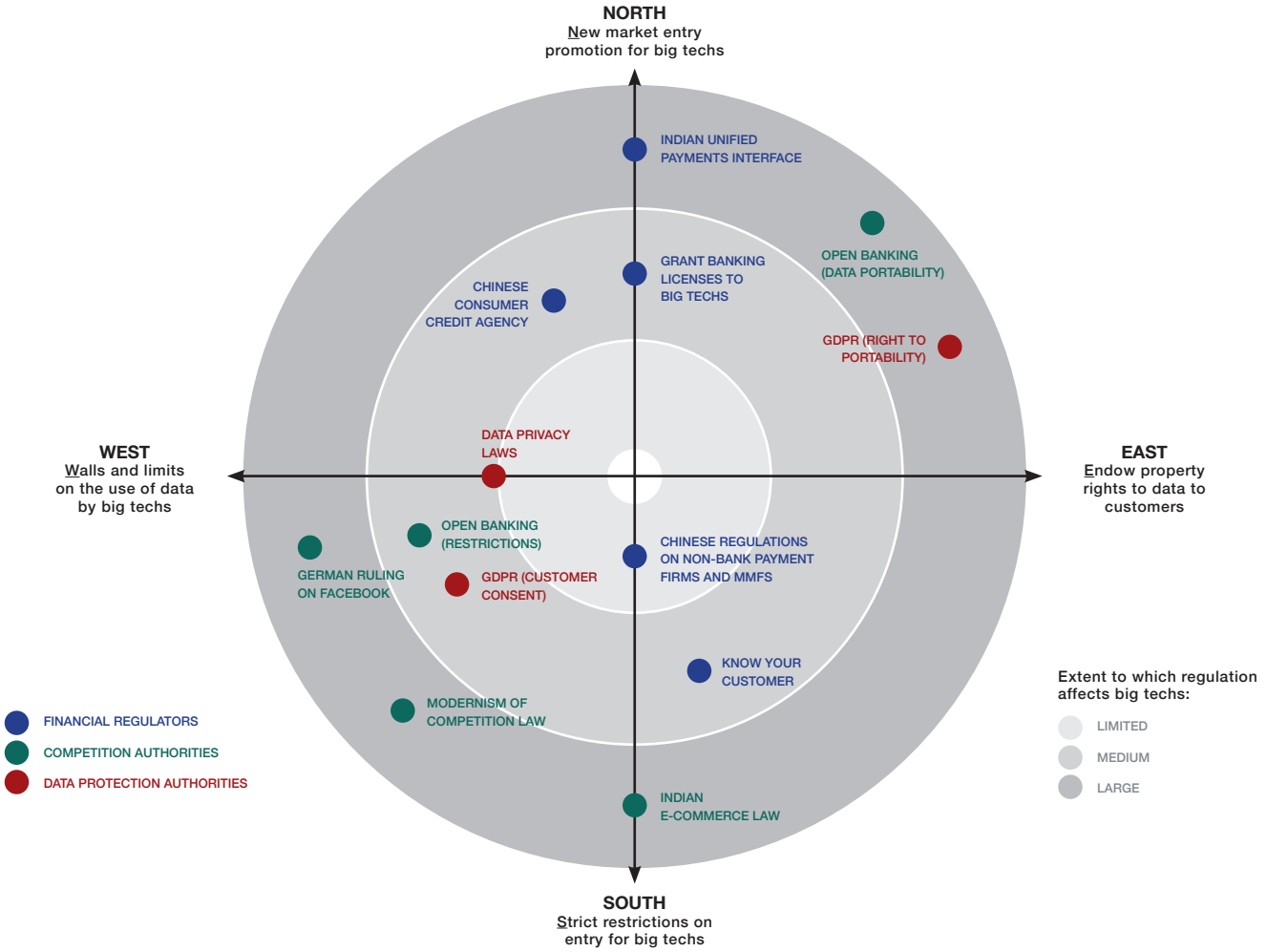
China is positioned to overtake the U.S. as the world's largest insurance market—a form of financial service that is readily propagated by modern telecommunications technology, particularly 5G.[5] Meanwhile, the broad-based availability of financial services in developing countries would be a massive transformation.

The provision of financial services is an increasing focus of technology firms as well. Their underlying technologies are well-suited to financial services but are significantly affected by the regulatory environment in which the services are offered. In Europe, and to an increasing degree in the U.S., financial technology (or "fintech") firms are likely to face an increasingly demanding regulatory environment.[6]

Figure 1 represents a "regulatory compass" for big techs in finance, summarizing how the market is shaped by regulatory practices. The regions with limited or medium-intensity regulation of financial services—especially in the developing world—are well aligned with China's financial services market offerings.[7]

The growth, diversity, and global reach of these technologies will be enhanced as China modernizes its infosphere, seeking global dominance based on its early fielding of 5G networks. The creation of this parallel payments system supports China's long-term aspiration to reduce the international role of the dollar (though the prospects for doing so in the near future appear remote).[8]

Figure 1. A Regulatory Compass for Big Techs in Finance



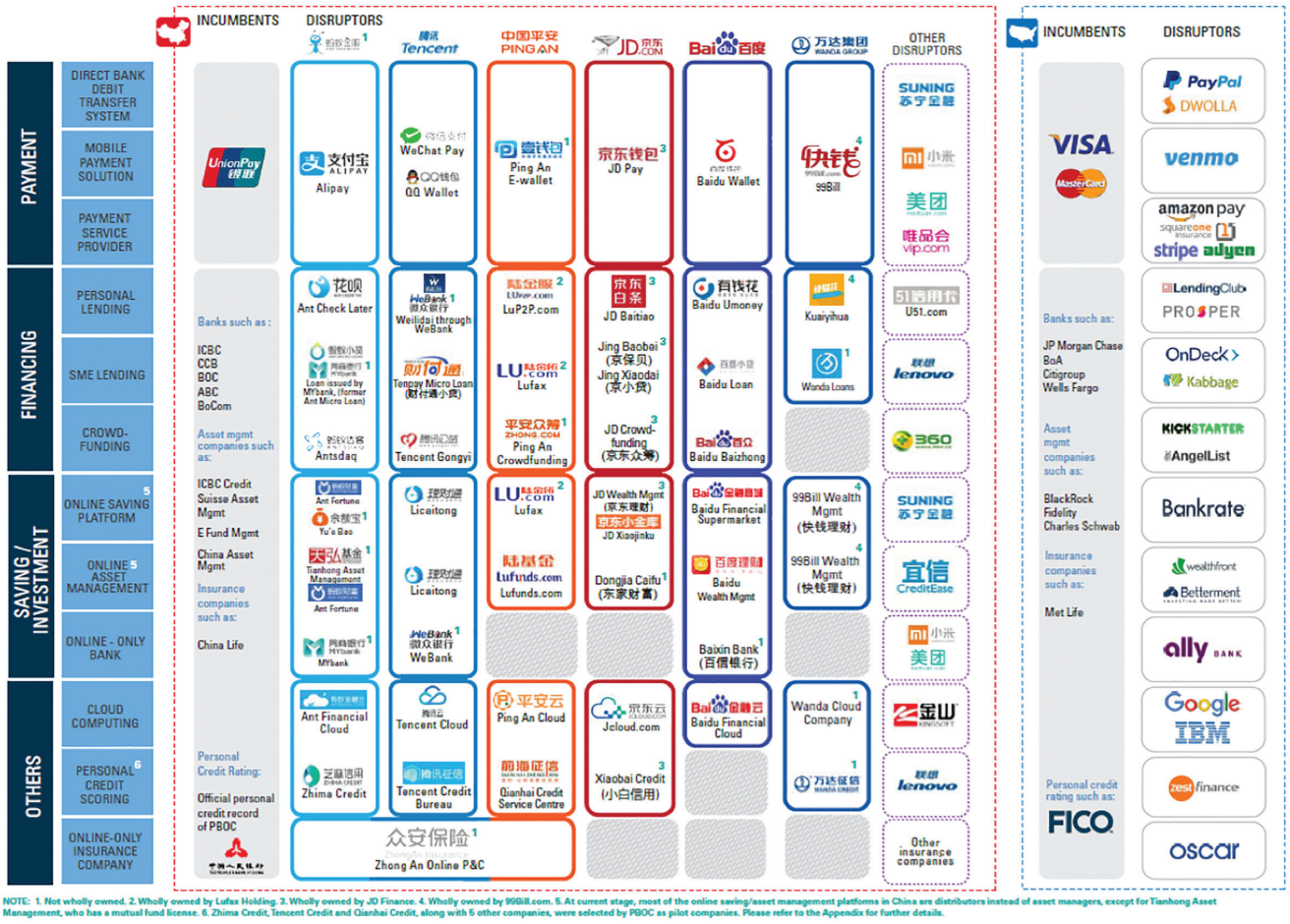
Each dot refers to a public policy affecting big techs to some degree. The placement of a policy on the compass reflects the choice of a policymaker (financial regulator, competition authority or data protection authority) in terms of: (i) promoting/restricting big tech' entry into the finance (north-south axis); or (ii) endowing customers with data property rights/restricting big techs' use of customer data (east-west axis).

Source: Annual Economic Report 2019, Bank for International Settlements, https://www.bis.org/publ/arpdf/ar2019e.htm

Nevertheless, the propagation of China's cashless payments at scale on an international basis is likely to be successful in many markets in developing nations with immature financial services infrastructures. These underserved markets can create a platform for significant Chinese presence in countries across Africa, Asia, and the Western Hemisphere—especially the countries where China has other commercial, diplomatic, and security interests. The "retail" character of China's payments system also facilitates the harvesting of data on individual transactions, which can provide China with detailed information about the patterns of life of individuals. In turn, this data can contribute to China's efforts to influence local governments, private sector institutions, and individuals.

China aspires to extend the financial technology it is developing in the China market into a global financial technology "ecosystem", as illustrated in Figure 2. This ecosystem consists of a multitude of financial services including payments, financing, savings and investment, insurance tied together through its 5G communications system.

Figure 2. China's Financial Technology Ecosystem



NOTE: 1. Not wholly owned. 2. Wholly owned by Lufax Holding. 3. Wholly owned by JD Finance. 4. Wholly owned by 99Bill.com. 5. At current stage, most of the online saving/asset management platforms in China are distributors instead of asset managers, except for Tianhong Asset Management, who has a mutual fund license. 6. Zhima Credit, Tencent Credit and Qianhai Credit, along with 5 other companies, were selected by PBOC as pilot companies. Please refer to the Appendix for further details.

Source: Goldman Sachs Group, Inc., The Rise of China FinTech, Equity Research: The Future of Finance, August 2017, page 6

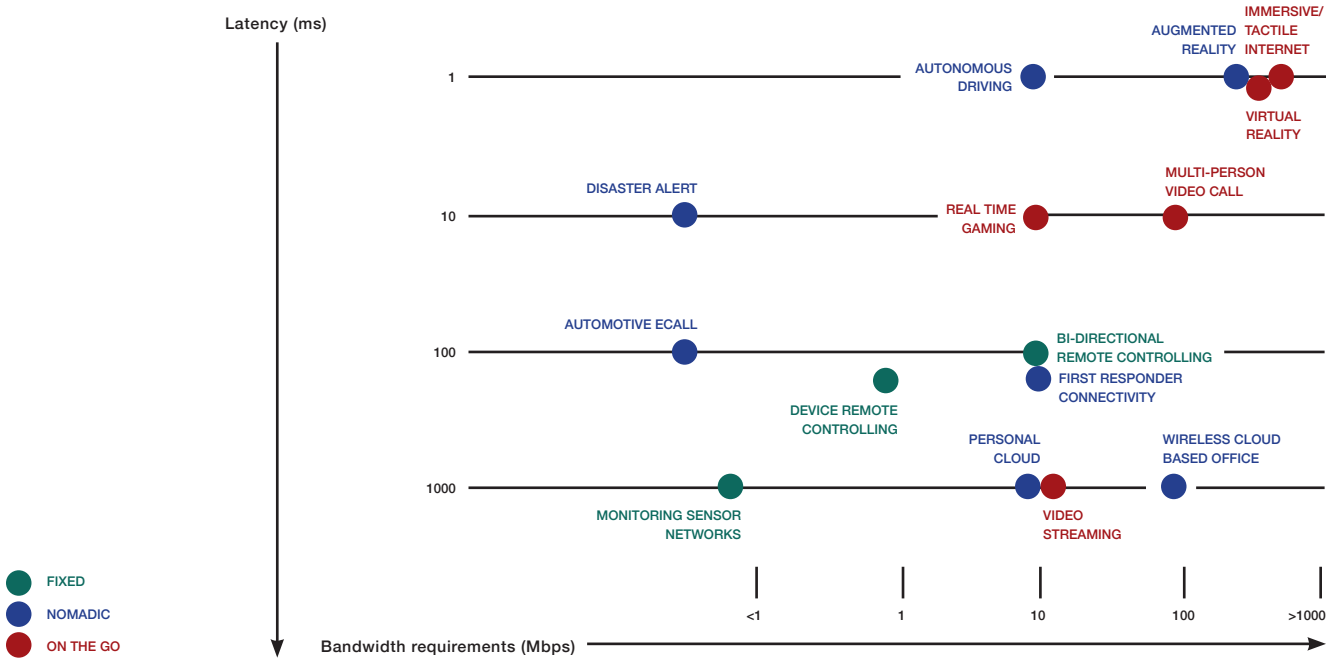
Dominance of the infosphere through propagation of 5G technology based largely on Chinese technical standards facilitates China's ability to create a parallel international payments system. China's mobile payments system eliminates the need for cash through a two-dimensional QR (Quick Response) barcode linked to a "digital wallet." The process also enables the harvesting of a vast trove of geotemporally tagged individual financial transactions—information that can then be aggregated with other data collected on specific individuals.

This transactional information is one of the important enablers of China's social credit system.[9] For example, in areas where non-Han Chinese citizens live (Tibet and the Uighur regions of Western China), a deficient social credit score prevents millions from buying tickets for public transportation.[10]

The Technologies of Autonomy

The extension of network connectivity between users and billions of devices in the next several years through the IoT will incorporate the ability to use and control devices remotely as well as enable their autonomous operation.[11] 5G's capacity to transmit information extremely rapidly will advance related technologies of autonomy such as artificial intelligence (as illustrated in Figure 3 below).

Figure 3. Implications for Zero Lag in Data Exchange with 5G Telecommunication Services



Source: Nic Fildes, "Huawei Spat Comes as China Races Ahead in 5G," Financial Times, December 12, 2018, https://www.ft.com/content/0531458a-fd6c-11e8-ac00-57a2a826423e

The data rates characteristic of 4G provide insufficient bandwidth for instantaneous (i.e. low-latency) data transfer to permit autonomous operation of systems such as cars and aircraft. 5G will provide near-zero lag-time in the completion of data exchanges, making the operation of autonomous systems feasible. China's aspirations to control the global ("virtual") information infrastructure complements its $1.7 trillion investment in the global physical infrastructure. If China is able to dominate the next generation of telecommunications services through its propagation of 5G, it will underpin its BRI aims to become the world's leading economic and military power by 2049, the 100th anniversary of the founding of the PRC.

Concluding Observations on China's "Infosphere"

The highly integrated character of China's information infrastructure is an important component of its wider commercial and national security objectives.[12] The intelligence role of China's 5G technology is a matter of great concern to U.S. and allied governments.

Of particular note, in 2014, the UK established the Huawei Cyber Security Evaluation Centre (HCSEC) Oversight Board to analyze and report annually on China's ability to use Huawei 5G infrastructure to monitor the content of UK telecommunications traffic. The HCSEC's 2019 conclusion was unchanged from its negative 2018 assessment about the UK's vulnerability. It is unlikely that any Chinese entity, public or private, including Huawei, could avoid compliance with China's 2017 National Intelligence Law, which compels individuals and institutions to collaborate with China's intelligence organizations when requested.[13]

China's emerging efforts to gain control of the global infosphere by linking it to a global Chinese 5G network are likely to continue. Recent U.S. legislative initiatives that attempt to develop competitive offerings to China's infrastructure efforts, including 5G, remain embryonic and untested.[14] The United States is late to the game, and the time to catch up is short.

[1] Rana Foroohar, "The 5G Race is Not Won Yet," *Financial Times,* April 24, 2019, https://www.ft.com/content/339c74d8-61ff-11e9-b285-3acd5d43599e.

[2] Paul Mozur, "Being Tracked While Reporting in China, Where 'There Are No Whys,'" *New York Times,* April 16, 2019, https://www.nytimes.com/2019/04/16/insider/china-xinjiang-reporting-surveillance-uighur.html. Louise Lucas and Emily Feng, "Inside China's Surveillance State", Financial Times, July 20, 2019; https://www.ft.com/content/2182eebe-8a17-11e8-bf9e-8771d5404543.

[3] Louis Columbus, "2018 Roundup of Internet of Things Forecasts and Market Estimates," *Forbes,* December 13, 2018, https://www.forbes.com/sites/louiscolumbus/2018/12/13/2018-roundup-of-internet-of-things-forecasts-and-market-estimates/#b6b731f7d838. https://www.ft.com/content/2182eebe-8a17-11e8-bf9e-8771d5404543.

[4] Wei Wang and David Dollar, "What's Happening with China's Fintech Industry?," *Brookings Institution,* February 8, 2018, https://www.brookings.edu/blog/order-from-chaos/2018/02/08/whats-happening-with-chinas-fintech-industry/.

[5] "China to overtake US as world's biggest insurance market," *China Daily,* July 7, 2019, http://www.chinadaily.com.cn/a/201907/07/WS5d219ff7a3105895c2e7c138.html.

[6] Bank for International Settlements, "Big Tech Opportunities in Finance: Opportunities and Risks," June 23, 2019, https://www.bis.org/publ/arpdf/ar2019e3.htm.

[7] Isabella Kaminska, "A pound of flesh for your Libra inclusion," *Financial Times,* June 19, 2019, https://ftalphaville.ft.com/2019/06/24/1561376706000/A-pound-of-flesh-for-your-Libra-inclusion-/.

[8] Colby Smith, "China's Currency Will Not Replace the Dollar," *Financial Times,* September 19, 2018, https://ftalphaville.ft.com/2018/09/19/1537329600000/China-s-currency-will-not-replace-the-US-dollar/.

[9] Joe Kainz et al, "China's 'Social Credit System' Explained," *South China Morning Post,* February 21, 2019, https://www.scmp.com/video/china/2186173/chinas-social-credit-system-explained.

[10] Lily Kuo, "China bans 23m from buying travel tickets as part of 'social credit' system," *The Guardian,* March 1, 2019, https://www.theguardian.com/world/2019/mar/01/china-bans-23m-discredited-citizens-from-buying-travel-tickets-social-credit-system. China's Social Credit Score process is also being extended to foreign and domestic businesses as well; Bloomberg News, "China's Social Credit Tool to Monitor Companies Sparks Alarm", August 28, 2019; https://www.bloomberg.com/news/articles/2019-08-28/china-s-social-credit-for-companies-sparks-alarm-eucham-warns.

[11] John Chen et al, China's Internet of Things, *US China Economic and Security Commission,* October 2018; https://www.uscc.gov/sites/default/files/Research/SOSi_China%27s%20Internet%20of%20Things.pdf.

[12] In its 5th annual report, the UK's Huawei Centre Cyber Security Oversight Board concluded that "HCSEC's work has continued to identify concerning issues in Huawei's approach to software development bringing significantly increased risk to UK operators, which requires ongoing management and mitigation." Report to the National Security Adviser of the United Kingdom, *Huawei Cyber Security Evaluation Centre Oversight Board Annual Report 2019,* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790270/HCSEC_OversightBoardReport-2019.pdf.

[13] In particular, Article 7 states: "Any organization or citizen shall support, assist and cooperate with the state intelligence work in accordance with the law, and keep the secrets of the national intelligence work known to the public. The State protects individuals and organizations that support, assist and cooperate with national intelligence work." National Intelligence Law of the People's Republic (2017), http://www.npc.gov.cn/npc/xinwen/2017-06/27/content_2024529.htm.

[14] The creation of the International Development Finance Corporation under the BUILD Act, which expands the scope of OPIC's Political Risk Insurance capabilities with support from the Agency for International Development (AID), seeks to enable US investors to compete with China in countries where the political risk of such investment is high. See: https://www.opic.gov/build-act/overview. The Asia Reassurance Initiative Act (ARIA), also approved in December 2018, aims to provide $1.5 billion in related support to US entities competing with China's BRI. Ankit Panda, "What the ARIA Will and Will Not Do for the US in Asia," *The Diplomat,* January 19, 2019, https://thediplomat.com/2019/01/what-aria-will-and-wont-do-for-the-us-in-asia/. The U.S. government effort to block the sale of the Ukrainian aircraft engine firm Motor Sich to China may become the first use of the authorities in the BUILD Act. Brett Forrest, "US Aims to Block Chinese Acquisition of Ukrainian Aerospace Company," *Wall Street Journal,* August 23, 2019; https://www.wsj.com/articles/u-s-aims-to-block-chinese-acquisition-of-ukrainian-aerospace-company-11566594485.

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