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The Sources of China's Innovativeness

Why China's "Unstoppable" Innovation Powerhouse Might Falter



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Western governments appear to fear that China is an innovation powerhouse on an almost unstoppable path to dominating future technologies. This is quite a turnaround. Only a few years ago, Western policies were crafted on the assumption that China was a copycat incapable of innovation. A focus on Intellectual Property theft as the Chinese "sin" that drove China's technological development led many in the West to miss what I have identified as the "Five Virtues" that have made China the innovation powerhouse it is today. China's future success is not inevitable, however, but dependent on a delicate policy ecosystem.

- China's formula for success comprises "Five Virtues": (a) a skillful modulation of protectionism in a large market; (b) attracting knowledge into the country; (c) liaison with Western actors; (d) party-state guidance instead of control; and (e) domestic competition with Chinese characteristics.
 - All these virtues are being challenged by domestic policies and deteriorating international conditions. China will remain innovative but the extent of its success is not foretold. The West still has some leverage.
 - An effective Western policy response requires a proper understanding of the diverse risks inherent in China's innovation power in different technologies. Geopolitics, global markets and technological characteristics will all need to be considered.
 - The European Union, including Germany, must invest not only in reducing dependencies on China, but also in its strengths to remain technologically indispensable to China.
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Against most expectations, the People's Republic of China (PRC) has developed into an innovation powerhouse.¹ Recent Australian research found that China leads in 37 of 44 critical technologies, as measured by international research output.² The latest Cyber Power Index prepared by the Belfer Center ranks China second, falling short only of the cyber capabilities of the United States.³ The World Intellectual Property Organization's Global Innovation Index paints a slightly different picture: China is placed 11th, but still ahead of several industrialized economies including France.⁴ These and other similar studies might be unable to grasp the full complexity and degree of China's technological advance. While only approximations, however, all these reports paint a clear picture: the PRC is highly innovative.

China's emergence as a technological power presents the European Union (EU) with a reality it did not anticipate. At least five distinct features of Western innovation ecosystems that stand in sharp contrast to China were widely assumed to be a guarantee of Western technology leadership. First, open markets in the West contrast with Chinese protectionism, enabling the free flow of information, knowledge and technology which facilitates innovation. Second, democracies provide freedom that is crucial for creativity. China's oppressive authoritarianism, by contrast, primarily rewards loyalty while inventiveness is considered secondary. Third, innovation is prized and comes with effective protection of intellectual property (IP) rights and legal certainty as a result of the West's rule of law. China is widely regarded as a culture of copycats with a legal system deeply intertwined with the party-state. Fourth, the PRC's state planning is contrasted with the entrepreneurial individualism of Europe and the US, which has driven many innovative companies. Fifth and finally, the risk-based allocation of resources is believed to create efficient technology ecosystems.

In contrast, China's dysfunctional allocation of resources is the result of a lack of functioning capital markets and of Chinese party-state control over the banking sector. In short, for decades, European policymakers ascribed Western digital prowess to the beneficial combination of liberal democracy and free market capitalism.

As a non-democratic, non-free-market state, China was believed to be unable to emulate this success. As recently as 2014, journals such as the *Harvard Business Review* could get away with publishing articles on "Why China Can't Innovate."⁵ Granted, numerous studies discussed China's growing power based on the PRC's economic might.⁶ However, the predominant perspective characterized Chinese actors as extractors of economic wealth by mimicking and refining Western technology without innovative breakthroughs.

This interpretation has turned out to be completely false. Today's China is deeply embedded in global technology development and production, as well as shaping the norms and standards that govern disruptive technologies.⁷ This success goes far beyond catching up with the West. The fundamental "sin" driving the PRC's growth model – the theft of IP – cannot account for why China has overtaken the West in a number of emerging and foundational technologies. If IP theft alone had been the sole characteristic of the China model, the PRC would have run out of steam as China gained technological leadership. Arguably, however, many governments and observers seem to perceive China to be on an inevitable path to becoming the dominant innovation power in the world.

As IP theft alone fails to explain this development, we need ideas and concepts that can account for China's technological competence and innovativeness. This may be difficult, as it removes the centrality of

1 Graham Allison et al., *The Great Tech Rivalry: China vs the US* (Cambridge, MA: Belfer Center for Science and International Relations, 2021): https://www.belfercenter.org/sites/default/files/GreatTechRivalry_ChinavsUS_211207.pdf (accessed October 22, 2023).

2 Jamie Gaida et al., *ASPI's Critical Technology Tracker: The Global Race for Future Power* (Canberra: ASPI, 2023): https://ad-aspi.s3.ap-southeast-2.amazonaws.com/2023-03/ASPIs%20Critical%20Technology%20Tracker_0.pdf?VersionId=ndm5v4DRMfplVuu.x69Bi_VUdMVLp07jw (accessed October 22, 2023).

3 Julia Voo et al., *National Cyber Power Index 2022* (Cambridge, MA: Harvard Kennedy School, 2022): <https://www.belfercenter.org/publication/national-cyber-power-index-2022> (accessed October 23, 2023).

4 Soumitra Dutta et al., *Global Innovation Index 2022: What is the Future of Innovation-driven Growth?* (Geneva: World Intellectual Property Organization, 2022): <https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2022-en-main-report-global-innovation-index-2022-15th-edition.pdf> (accessed October 23, 2023).

5 Regina M. Abrami et al., "Why China Can't Innovate," *Harvard Business Review*, March 2014: <https://hbr.org/2014/03/why-china-cant-innovate> (accessed September 18, 2021).

6 See e.g. James F. Hoge, "A Global Power Shift in the Making: Is the United States Ready?," *Foreign Affairs* 83, no. 4 (2004), pp. 2–7; Joshua Cooper Ramo, *The Beijing Consensus: Notes on the New Physics of Chinese Power* (London: Foreign Policy Centre, 2004); Robert S. Ross and Zhu Feng, *China's Ascent: Power, Security and the Future of International Politics* (Ithaca: Cornell University Press, 2008).

7 Tim Rühlig, Transatlantic Tech De-risking from China: The Case of Technical Standard-setting. Testimony before the US-China Economic Security Review Commission. Hearing on "Europe, the United States and Relations with China: Convergence or Divergence?"; Panel II: Technology, Standards/Data, and Trade. Washington, DC, 15 June 2023: https://www.uscc.gov/sites/default/files/2023-06/Tim_Ruhlig_Testimony.pdf (accessed October 22, 2023).

a Western narrative that is at the core of the self-perceptions of states and societies. However, while almost nobody denies China's innovativeness, it remains a mystery to many observers how the PRC could develop such creativity despite the seemingly unfavorable conditions provided by its political and economic system.

An understanding of the reasons behind Chinese innovativeness would not only be of analytical value, but also help to test the underlying assumption that China is unstoppable and will inevitably become the world's prime innovation powerhouse despite its current economic challenges. It may be these concerns that are fostering drastic policies to restrict if not freeze advances in China's technological capabilities. However, such policies ignore China's indigenous innovation capabilities. Withholding cutting-edge technology by means of export controls and reduced research collaboration assumes that all that is needed to stop China is to cut it off from Western IP. This paper explains why this perspective is oversimplified by discussing three questions:

- How did China become innovative?
- Will China remain innovative?
- How should the West react to China's innovativeness?

The paper addresses these three questions and argues for a more nuanced approach. IP theft may indeed be an underlying factor in China's innovativeness. However, it was only in combination with the Five Virtues that the PRC was able to become an innovation powerhouse. China is not on an inevitable path to success but its future innovativeness depends on a mix of domestic policy choices and developments in the international environment in which it operates. The West is not a helpless bystander but simply ending technology cooperation will not achieve its aims because this narrows the focus to IP theft and neglects China's Five Virtues. Western policies will only be effective if they overcome long-held beliefs in simplified assumptions and consider transnational technological ecosystems from three angles: geopolitics, global markets and the technology itself.

UNDERSTANDING PRAGMATISM WITH CHINESE CHARACTERISTICS: HOW DID CHINA BECOME INNOVATIVE?

摸着石头过河

Crossing the river by touching the stones

– Chen Yun

There is no doubt that China's innovativeness has profited from technology mimicry. IP theft by means of espionage or reverse engineering has contributed to China's technological development. US officials have estimated that China steals intellectual property worth \$250 to \$600 billion from the United States on an annual basis.⁸ The wide range of this estimate illustrates how difficult attributions of espionage are. IP theft was certainly the underlying "sin" in the PRC's technological development. However, to understand why China's innovation has not faded and has overtaken the West in some respects, one must go beyond IP theft to understand the conditions that made China an innovation powerhouse. Five features were particularly decisive. Emulating the Chinese Communist Party's (CCP) practice of capturing key concepts in combinations of a number and a noun (e.g., Three Represents of Jiang Zemin, and the Four Comprehensives, Two Establishes and Two Safeguards introduced by Xi Jinping), I refer to these features as China's Five Virtues. It is these that made the PRC innovative.

Virtue 1:

Porous Protectionism of a Huge Market

When outside observers learn about how porous the Great Firewall that shields China's internet from "unwanted" content is, they often wonder why this is the case. In fact, it is not Chinese incompetence but a skillful scaling of protectionism. Over the past two decades, China has been assiduously leveraging the scale of its market and its degree of protectionism. The potential of the PRC's domestic market of 1.4 billion people – and a middle class of roughly 400 million in 2017, depending on the precise definition of middle class –⁹ has proved enormously attractive to foreign companies, including the technology giants. The attractiveness of the sheer size of the Chinese

8 Yukon Huang, "China's Record of Intellectual Property Rights is Getting Better and Better," *Foreign Policy*, October 2019: <https://foreignpolicy.com/2019/10/16/china-intellectual-property-theft-progress> (accessed October 23, 2023).

9 Arendse Huld and Giulia Interesse, "China's Middle Class: Growth, Policy, and Consumption", Beijing, China Briefing, May 24, 2013: <https://www.china-briefing.com/news/china-middle-class-growth-policy-and-consumption> (accessed October 23, 2023).

market trumped the PRC's scaling of protectionism. In other words, imagination of how market potential could be exploited has overshadowed the unfavorable market conditions that technology companies have faced in the PRC.

As important as the scale of the Chinese market has been, the scaling of protectionism, that is, the partial protection of Chinese markets for foundational and emerging technologies, allowed the PRC to absorb new trends from the West while protecting infant Chinese technology firms. By speaking of "semi-protectionism," Matt Sheehan rightly highlights the prominent example of the Great Firewall in such scaling activities.¹⁰ The Great Firewall shields China's internet and has been put in place as an instrument of censorship and information control. However, the Great Firewall also serves a commercial function by selectively protecting China's internet companies from foreign competition. While the internet is not freely accessible, the Great Firewall is easy to circumvent by means of virtual private networks (VPNs). In other words, the Great Firewall is porous enough to allow innovation in without opening up the Chinese internet sector.

In 2016, an official in the Ministry of State Security (MSS) explained to me what he dubbed the "90/10 rule." Roughly 90 percent of Chinese internet users have a VPN and know how to circumvent the Great Firewall, but only around 10 percent regularly use VPNs. The MSS official made clear that this ratio was not the result of a sophisticated master plan but is widely considered ideal for the country. This has allowed the CCP to largely control the flow of information and created favorable conditions for indigenous digital service providers; but it has not cut tech companies off from ideas and knowledge developed in the West.¹¹

To further China's adaptive capabilities, the PRC is using its long tradition of vague regulatory texts that can be interpreted differently in accordance with the respective circumstances in divergent technologies,

in varying localities and at different times. For example, a local party official from Shanghai told me in 2016 that the local government had adapted its interpretation of various regulations in some districts of the metropolis due to the technological advances of previous years. In the same interview, he admitted that Shanghai was not ready to implement a specific regulation in the same way as the southern Chinese city of Shenzhen because the local companies affected were not as technologically mature as those in Shenzhen.¹²

In short, the First Virtue that made China innovative is its ability to utilize the size of its market, scale its semi-protectionism and remain flexible in adapting the regulatory environment to variations in market conditions across the country.

Virtue 2:

Attracting Technology and Knowledge to China

The Second Virtue has been China's ability to attract knowledge and technology transfers by various means. As income and living conditions in the PRC improved, Chinese scientists who had previously enjoyed training in the West and then continuing to work abroad in innovative companies in Europe, the United States or elsewhere became more likely to return to China. This accelerated return of Chinese scientists was not just the result of China's increased attractiveness, however, but also of the numerous talent programs that incentivized the relocation of researchers to the PRC.¹³ The most prominent of these programs is the Thousand Talents program and its youth equivalent, the Young Thousand Talents program. These programs are administered by the CCP United Front Work Department's Western Returned Scholars Association. By offering honorary titles, well-paid jobs, visa privileges and substantial resources for academic research, these efforts reportedly attracted 7,000 scholars to participate in the period 2008–2018.¹⁴ A recent evaluation of the Young Thousand Talents program confirmed significant successes, but a failure to attract the highest caliber academics.¹⁵ Although

10 Matt Sheehan, "The Chinese Way of Innovation," *Foreign Affairs*, April 2022: <https://www.foreignaffairs.com/articles/china/2022-04-21/chinese-way-innovation> (accessed October 23, 2023).

11 Anonymous author interview with an official of the Ministry of State Security, Beijing, June 2016.

12 Anonymous author interview with a local party-state official, Shanghai, October 2016.

13 Emily Weinstein, Chinese Talent Program Tracker, Washington DC: Center for Security and Emerging Technology: <https://chinatalenttracker.cset.tech> (accessed October 23, 2023).

14 Heping Jia, "What is China's Thousand Talents plan?," *Naturejobs Career Guide China*, 2018, p. S8: <https://www.nature.com/articles/d41586-018-00538-z.pdf> (accessed October 22, 2023).

15 Dongbo Shi et al., "Has China's Young Thousand Talents Program been Successful in Recruiting and Nurturing Top-caliber Scientists?," *Science* 379, no. 6627 (2023), pp. 62–65: <https://www.science.org/doi/10.1126/science.abq1218> (accessed October 22, 2023).

other analyses have been more skeptical of China's success,¹⁶ Western security agencies have warned of significant outflows of knowledge that have strengthened China's military capabilities.¹⁷

The knowledge that such highly skilled people took back to China cannot be overestimated. It is not limited to specific expertise on any given technology. At least as important is the experience of having worked in innovation ecosystems in the West. As a leading engineer working for a Chinese technology giant put it in connection with the southern Chinese innovation hub of Shenzhen: "This city would not be the same without all the returnees from Silicon Valley. But we are not in the US; Shenzhen has adapted the experience we gained to China's circumstances. Shenzhen is changing China, but China is shaping Shenzhen."¹⁸

A second means for gathering technology and knowledge has been forced technology transfers to China. The PRC has exploited the attractiveness of its market potential. Eager to gain access to the Chinese market, foreign technology firms have agreed to China's requirements for technology transfer. Joint Venture (JV) requirements are a typical example of barriers to entry that facilitated Chinese technological advances.¹⁹ Another important tool is foreign investment law. In sectors such as automotive and value-added telecommunications services, foreign investment has required a JV, which gives a Chinese peer competitor access to the respective technology. Such JV requirements and ownership restrictions vary across technologies and sectors but are widespread.²⁰ Western actors might complain about such practices, but they knew what they were getting into – even if they apparently underestimated its effectiveness.

Third and finally, China has become an integral part of the global supply chains that incentivized Western actors to collaborate with China. Observers have long underestimated the skills base that China rapidly

developed as a manufacturer of electronic goods designed or developed elsewhere. For at least the past decade, China has been an integral and irreplaceable part of the global digital ecosystem with considerable competitive advantages of its own. This obliges technology developers to share at least as much knowledge as required to allow manufacturers to produce the respective technologies. This can be highly complex and demanding, and mean unintended but unavoidable transfers of knowledge.

In short, the Second Virtue that made China innovative involves a range of more or less legitimate means of attracting technology and knowledge into China from the West, as well as the recruitment of talent, the use of conditions on market access and unintentional technology transfer linked to globalized value chains.

Virtue 3:

Liaison With Private Tech and Research in the West

China might prefer indigenous innovation but the PRC has never been self-sufficient; it relies on deep ties with private sector actors and research institutions in the West. This Third Virtue contributing to China's innovativeness has three dimensions.

First, it is China's political goal to become as self-reliant as possible by replacing foreign manufactured technologies with domestic sources. However, many Chinese tech giants have continued to import Western-made cutting-edge technology, knowing only too well of its superior quality. Ironically, this became particularly apparent to observers when Western sanctions constrained Chinese technology firms. Chinese end-customer industries such as Oppo, Vivo and Xiaomi are increasingly turning to domestic suppliers because they are either denied access to Western technology or fear the widening of sanctions. Between 2019 and 2022, the global chipset market share of Chinese semiconductor manufacturer UNISOC more than tripled from less than 3 percent to more than 10 percent.²¹

16 Yojana Sharma, "China's effort to recruit top academic talent faces hurdles", *Chronicle of Higher Education*, 28 May 2013: <https://www.chronicle.com/article/chinas-effort-to-recruit-top-academic-talent-faces-hurdles> (accessed October 22, 2023).

17 Federal Bureau of Investigation, "The China Threat. Chinese Talent Plans Encourage Trade Secret Theft, Economic Espionage", Washington, DC: <https://www.fbi.gov/investigate/counterintelligence/the-china-threat/chinese-talent-plans> (accessed October 23, 2023).

18 Anonymous author interview with a representative of a Chinese technology company, Shenzhen, October 2019.

19 Ross Buckley and Weihuan Zhou, "Navigating Adroitly: China's Interaction With the Global Trade, Investment and Financial Regimes," *East Asia Law Review* 9, no. 1 (2013), pp. 1–40.

20 Jyh-an Lee, "Forced Technology Transfer in the Case of China", *Journal of Science Technology Law* 26, no. 2 (2020), pp. 324–352

21 Jan-Peter Kleinhans et al., *Running on Ice: China's Chipmakers in a Post-October 7 World* (Washington DC: Rhodium Group, 2023): <https://rhg.com/research/running-on-ice> (accessed October 23, 2023).

Another Chinese semiconductor manufacturer, SMIC, made headlines when it provided its 7nm logic chipset²² to the sanctioned tech giant, Huawei.²³ Observers were alarmed because Western export controls had implicitly sought to freeze Chinese semiconductor capabilities at 14nm logic. In contrast to mainstream perceptions, this development was not a sign of dysfunctional sanctions. Huawei no longer has access to a superior chipset it had been using for a long time and now only has access to 7nm logic that is produced exclusively using deep-ultraviolet (DUV) equipment. Cutting-edge 7nm logic relies not only on DUV equipment but also extreme-ultraviolet (EUV) nodes, which are sanctioned. Chinese wafer production based on DUV is more complex, more expensive and slower, and has lower yields and higher defect rates. Before the sanctions, Huawei would never have chosen such inferior semiconductors. Now, it has no choice as it is cut off from its previous suppliers. Huawei's preference was not in line with political priorities. Instead, a private sector technology company simply chose to import foreign technology because of its commercial and performance gains. In short, collaboration between private sector technology firms, although against political guidance, has been beneficial to China's technological development.

Second, China has tried to compensate for its own technological weaknesses by means of targeted acquisitions of knowhow. Mergers and acquisitions have been important to compensate for lack of Chinese innovation capabilities, especially in the period 2014–2019.²⁴ Strikingly, this trend took off in the years following the announcement of the “Made in China 2025” plan, an attempt by the central government to boost Chinese technology capabilities. Even more noteworthy is that China is increasingly focusing on high-tech and strategic sectors such as manufacturing, as well as information and communication technologies. In the period 2016–2018, these two sectors accounted for almost half of all Chinese investments in Europe. Ten years before, the share of investments in these two sectors was well below 10 percent.²⁵

Third, Chinese firms and research institutions have developed deep and long-term collaborations with Western universities. Western research institutions profit from access to data and funding while their Chinese counterparts are embedded in Western innovation ecosystems. A well-known instrument for supporting such collaboration is the China Scholarship Council (CSC).

All in all, the import of foreign technology, mergers and acquisitions, and research collaborations with the West have helped China liaise more deeply with Western actors, improving its own abilities to innovate.

Virtue 4:

The Guiding Role of the Party-State

Although widely thought to hamper innovation, the role of the party-state should be considered the Fourth Virtue that has made China innovative. It is certainly true that central planning is an obstacle to creativity and thereby to innovation. However, while China continues to issue Five-Year Plans (FYPs), these are more than just relics of the country's past as a planned economy under Mao Zedong. Planning has substantially changed and today the party-state makes the best of it to promote innovation. The PRC's FYPs begin five-year cycles of planning and execution. A FYP no longer comprehensively prescribes economic activity from primary products to production and pricing. Instead, its function is to signal central party-state priorities to a broad set of actors, including private sector but mostly party-state actors at the subnational levels and state-owned commercial entities.²⁶ Subnational and sectoral plans substantiate and reinforce these general priorities by economic sector and region. Even these plans, however, while more concrete than the overall plan, are still vague enough to leave plenty of room for interpretation over their precise execution. Local party-state officials feel encouraged to allow experimentation in fields such as the technology priorities identified in the FYP – not least because targeted

22 The performance of chips generally increases the smaller they are; 7nm logic chips are a specific type of semiconductor, used for example in smartphones, that is quite small but not of the latest generation.

23 Yuchen Li, “US-China tech war: Is Huawei's new chip a threat?” *DW*, September 25, 2023: <https://www.dw.com/en/us-china-tech-war-is-huaweis-new-chip-a-threat/a-66915954> (accessed October 23, 2023).

24 Agatha Kratz et al., *Chinese FDI in Europe: 2022 Update* (Washington, DC: Rhodium Group, 2023): <https://rhg.com/research/chinese-fdi-in-europe-2022-update> (accessed October 23, 2023).

25 Michaela Rancan et al., *China: Challenges and Prospects from an Industrial and Innovation Powerhouse*. (Brussels: European Commission, 2019): <https://op.europa.eu/en/publication-detail/-/publication/c89434b2-88cd-11e9-9369-01aa75ed71a1/language-en> (accessed October 23, 2023), p. 34.

26 Sebastian Heilmann, *Red Swan: How Unorthodox Policymaking Facilitated China's Rise* (New York: Columbia University Press, 2018).

deregulation favors innovation in specific technology fields. Hence, central party-state planning in the 21st century is primarily a political signaling exercise to the subnational levels.

Such signaling is of particular importance for the allocation of financial resources. China's financial sector is state-dominated. State ownership and the market share of China's Big Five banks have decreased over time but it is not private sector financial institutions that have taken on the share, but a set of different types of banks that are mostly controlled by local government.²⁷ In the absence of functioning capital markets, China continues to strongly rely on bank credit. Thus, lending by the state-controlled financial sector is of the utmost importance in the PRC. Accordingly, the signals in an FYP unleash enormous financial resources in support of the central leadership's policy priorities. In an interview, a bank manager told me in 2016 that "we always want the loans handed out to [state-owned enterprises] SOEs to be performing. But when I receive guidance from the local party officials, I am not responsible. It is not my problem. The respective party official will be held accountable politically. Economically, the bank and we as bank managers have no problem either way."²⁸

This illustrates how party-state guidance and liabilities are linked in the Chinese political economy. This has two implications for the PRC's innovativeness. First, FYPs can socialize the risk of investments in speculative innovation that could be the next big discovery if this discovery lies within the broad array of policy priorities identified in an FYP. Without the party-state indirectly socializing the liability, financial institutions would be unlikely to invest as much as they do in future potential. Second, and following on from this, many of these investments default as they turn out to be less commercial than hoped. Hence, China cannot compete on efficiency but only on scale. In other words, many investments turn out to be unprofitable and not innovative but, if done at scale, some investments will turn out to be excellent investments. This is not sustainable in a free market economy, but supports innovation in a state capitalist system like China's.

In the area of infrastructure, for example, innovation can benefit from high-performing wireless infrastructure. In the rollout of the latest generation, so-called 5G, the West and China have chosen fundamentally different strategies. In the West, public 5G is provided by commercial mobile operators that have largely chosen "non-standalone 5G" as the most commercial option. In essence, non-standalone 5G is an updated version of 4G/LTE that offers higher download and upload speeds for mobile phone subscribers but does not require a new Core Network for the wireless network. In contrast, China's state-owned mobile operators have chosen to rollout standalone 5G, which requires more than just updates and a new Core Network. Standalone 5G offers no advantages over non-standalone 5G for mobile phone subscribers. However, the lower latency and the higher number of devices that can be connected to standalone 5G open up the possibility of new uses from machine-to-machine communication to self-driving cars. How fast these use cases will be implemented through public 5G networks remains to be seen. At the moment, they are being tried out in shielded private areas, such as factories or seaports, relying on separate private 5G networks. However, what this case demonstrates is that China has socialized risk to provide public infrastructure that offers the best conditions for innovation. Whether this will turn out to be worth the investment remains to be seen.²⁹

In short, China's party-state has abandoned its comprehensive planning function but political signaling has unleashed local experimentation by means of deregulation and, most importantly, funding. This socialization of risk has led China to compete not on efficiency, but on scale. The provision of infrastructure promotes innovation.

Virtue 5: **Internal Market Competition with Chinese Characteristics**

The Fifth Virtue that has made China innovative is fierce competition within the PRC, even if it does not take the same shape as competition in the West. Fundamentally, the driving force behind China's digital technology advance has been privately owned

27 Tim Rühlig, *China's Foreign Policy Contradictions* (New York: Oxford University Press, 2022), chapter 5.

28 *Ibid.*, p. 143.

29 Tim Rühlig and Liesbet van der Perre, "In Political and Technological Harmony or Disharmony? How Europe and China Advance Towards 6G," in *Europe's Strategic Technology Autonomy from China: Assessing Foundational and Emerging Technologies*, ed. Tim Rühlig (Berlin: Digital Power China, 2023), pp. 41–57: https://timruehlig.eu/ctf/assets/x93kiko5rt7l/2kCX6lXU6CWjDPBkjaPnmF/eacc44fd42b9086dd898fdef7bc12965/DPC_-2023_-final.pdf (accessed October 23, 2023).

companies founded by private sector entrepreneurs. Of China's five biggest software companies – Huawei, JD.com, China Mobile, Alibaba, and Tencent – only China Mobile is a state-owned firm. The other four companies were all founded by private entrepreneurs – Tencent with the support of US venture capital. State capture is certainly essential for corporate success in the PRC.³⁰ None of these firms would have flourished without significant support from the party-state. However, the entrepreneurial decisions of their founders have been most important to the success of these companies. China's "red entrepreneurs" may have to maintain good relations with the party-state, but they are still entrepreneurs who compete with their peers for market share.³¹ Europeans tend to discuss the role of US corporations and their distinct self-interest in a critical way. Nobody in Europe doubts that US Big Tech and the US government are two separate actors with different though at times overlapping interests. China is not a monolithic actor either, however, and the public-private divide in the PRC deserves greater attention. While there is a considerable degree of proximity between Chinese corporations and the party-state, recent regulatory measures targeting China's privately dominated platform economy have confirmed yet again that the interests of Chinese corporations deviate from the interests of the CCP.

Competition in China is not solely bound up with private entrepreneurs. Competition exists within the party-state complex too. Different segments of the party-state's political economy compete not just over influence but also over revenue. Within government, security bodies have separate interests to the military or to the technological bureaucracy. Moreover, as a local party-state official put it in 2016, "party officials are often closely cooperating with the local economy. We all want our local companies to flourish – not just because it creates jobs and prosperity for the people, but also because it improves our own track record. In order to get promoted, we need to outcompete our colleagues from other cities. [...] In China], commercial competition is closely intertwined with competition between local party-state officials." China's party-state involvement does not hinder competition; in fact, it is an integral part of it.

This culture of competition meets a society that is thirsting for innovation. For example, while WeChat Pay, China's most popular mobile payment application, has a market penetration of 84 percent, Apple Pay is used by only 24 percent of US internet users. WeChat Pay handles as many transactions every day as Apply Pay does in a month, even though both mobile payment systems were launched at roughly the same time in 2014–15. In describing Chinese consumers as "hyper-adoptive" and "hyper-adaptive," Zak Dychtwald provides a plausible explanation for the Chinese population's willingness to adopt technology innovations: "To understand what's powering the global rise of Chinese companies, we need to recognize that China now has at its disposal a resource that no other country has: a vast population that has lived through unprecedented amounts of change and, consequently, has developed an astonishing propensity for adopting and adapting to innovations, at a speed and scale that is unmatched elsewhere on earth."³² In fact, China's per capita GDP has grown more than 30-fold since 1990. In comparison, among the top 40 global economies, Poland ranks second in per capita GDP growth, at roughly nine times bigger than it was in 1990.

In short, China's Fifth Virtue is its distinct form of competition, which involves the Chinese party-state. This competitive culture meets a thirst for innovation and willingness to adapt and adopt more quickly than most if not all other societies around the world.

In summary, China's innovativeness is not merely the result of mimicry. IP theft is a "sin" that China has profited from. However, the Five Virtues – scaling of protectionism and the market, attracting technology and knowledge to China, liaison with private technology and research, a guiding not controlling role of the party-state, and competition with Chinese characteristics – have made the PRC the innovation powerhouse it is today. China's innovativeness is not the result of a masterplan. China has shown the courage to accept failure. A pragmatic method of trial and error, and a willingness to compete on scale rather than efficiency have been decisive. Just as Chen Yun, a long-time companion of the CCP's economic reformist Deng Xiaoping, suggested, China has been carefully "crossing the river by touching the stones."

30 Curtis J. Milhaupt and Zheng Wentong, "Beyond Ownership: State Capitalism and the Chinese firm," *Georgetown Law Journal* 103, no.3 (2015), pp. 665–722.

31 Kellee S. Tsai, "China: Economic Liberalization, Adaptive Informal Institutions, and Party-State Resilience," eds Stephan Leibfried et al., *Oxford Handbook of Transformations of the State* (Oxford: Oxford University Press, 2015), pp. 654–70.

32 Zak Dychtwald, "China's new Innovation Advantage," *Harvard Business Review*, May–June 2021: <https://hbr.org/2021/05/chinas-new-innovation-advantage>.

THE COLOR OF THE CAT MATTERS AFTER ALL: WILL CHINA STAY INNOVATIVE?

不管黑猫白猫，捉到老鼠就是好猫

No matter if it is a white cat or a black cat, as long as it can catch mice, it is a good cat

— Deng Xiaoping

The Five Virtues have made China innovative but each faces its own challenges. Five Obstacles, one for each of the Five Virtues, put the sustainability of China's evolution to an innovation powerhouse at risk. Analyzing these obstacles helps to evaluate the PRC's prospects for remaining innovative. Will the PRC's authoritarian political system ultimately stall China's development? Is China doomed to fail? Or has the PRC found a "magic formula" from among the Five Virtues? Is the country now on an inevitable path to success?

Obstacle 1: Growing Protectionism

China's huge market is still characterized by semi-protectionism. In recent years, however, several domestic policies have restricted the cross-border flow of information and knowledge. In 2018, China's Ministry of Industry and Information Technology announced VPN services that circumvent the Great Firewall would in the future require governmental approval. This made most of the widely used VPN services illegal.³³ Several VPN services have since been closed, suspended or had to pay high penalties for violating China's Cybersecurity Law.³⁴

China has also gradually tightened its regulations on cross-border data transfer in recent years. In line with the Cybersecurity Law, the Data Security Law,

the Personal Information Protection Law and several related regulations, such as the 2022 Measures for Security Assessment of Cross-border Data Transfer,³⁵ companies must now apply for a security assessment by the Cyber Administration of China before data can be transferred abroad. Many of these rules are vague, not least the classification scheme for data types that require different levels of scrutiny.³⁶ These new data regulations and tougher requirements on VPNs are only two examples of tightening party-state control of the semi-protected market.

The First Virtue is being called into question not only by domestic policies, but also by international attempts to diversify away from the PRC. The United States and the European Union, among others, have announced their intention to reduce their dependency on the Chinese market in order to "de-risk."³⁷ If such announcements are followed through with serious efforts to establish new sources of supply (e.g., by means of free trade agreements), the attractiveness of the Chinese market could suffer. International firms could find themselves operating in alternative markets that are less regulated and more predictable than the Chinese one.

In short, growing protectionism at home and Western attempts to open up alternative markets could be considered the First Obstacle, which challenges the First Virtue.

Obstacle 2: Market Entry Barriers

Just as China has tightened control over its semi-protected market, the PRC has also complicated market access for foreign companies to China. More generally, the securitization of economic affairs in China is the Second Obstacle to Chinese innovativeness and challenges China's Second Virtue. For example, a revised version of the Counterespionage Law of 2023 drastically expands the law's definition of espionage.³⁸ An ambiguous definition of national security secrets could end up penalizing traditional

33 Josh Ye, "China Tightens Great Firewall by Declaring Unauthorised VPN Services Illegal," *South China Morning Post*, 23 January 2017: <https://www.scmp.com/news/china/policies-politics/article/2064587/chinas-move-clean-vpns-and-strengthen-great-firewall> (accessed October 22, 2023).

34 Alexander Chipman Koty, "Why HR Should Care About VPN Use in China," *China Briefing*, 21 June 2018: <https://www.china-briefing.com/news/vpn-china-hr-due-diligence> (accessed October 22, 2023).

35 Rogier Creemers et al., "Translation: Outbound Data Transfer Security Assessment Measures," Stanford: DigiChina, Draft for Comment, October 2021: <https://digichina.stanford.edu/work/translation-outbound-data-transfer-security-assessment-measures-draft-for-comment-oct-2021> (accessed October 23, 2023).

36 Qian Tong and Wang Xintong, "China Tightens Controls on Cross-border Data Transfers," *Nikkei Asia*, 16 June 2023: <https://asia.nikkei.com/Spotlight/Caixin/China-tightens-controls-on-cross-border-data-transfers> (accessed October 23, 2023).

37 European Commission, Speech by President von der Leyen on EU-China relations, Brussels, March 30, 2023: https://ec.europa.eu/commission/presscorner/detail/%20en/speech_23_2063 (accessed October 23, 2023).

38 China Law Translate, Counterespionage Law of the PRC (2023 edition), Yale: China Law Translate: <https://www.chinalawtranslate.com/en/counter-espionage-law-2023> (accessed October 23, 2023).

business activities. The data required for traditional equity research to assess risk could easily be considered of national interest and its handling could be criminalized. This could have enormous chilling effects that reduce any cross-border cooperation that requires significant amounts of data, including economic and technological exchange.

In parallel with such increased barriers to market entry, the attractiveness of the Chinese market has significantly decreased. The days when the PRC grew by double digit numbers are over. China has reached a level of development that makes further productivity growth difficult to achieve. The PRC is undergoing a structural economic transformation and economists expect growth rates to drop from around 5 percent in 2021–25 to 3.6 percent between 2026 and 2030 and 2.4 percent in the period 2030–2035.³⁹ While this may still be well above the growth expectations of most developed economies, such growth falls short of China's growth rates since the turn of the millennium, which according to World Bank data ranged from 6 percent in 2019 to 14.2 percent in 2007 (with an exceptional low of 2.2 percent in 2020 at the height of the Covid-19 pandemic).

It is not only domestic developments that are having a potentially negative effect on the attractiveness of the Chinese market and its implications for innovation. Western political leaders are limiting export and investment guarantees. Germany's new China Strategy, for example, confirms the "general ceiling for investment guarantees of three billion euro per company and country."⁴⁰ This sends a signal to companies that the risks associated with doing business with China will no longer be socialized. Ironically, what is currently being discussed as de-risking is in effect the end of European taxpayers bearing liability, and thereby de-risking Chinese business for European companies.

In sum, growing market access requirements and the securitization of the economic system in China, as well as limitations on exports and investment guarantees for Western companies pose a Second Obstacle that potentially undermines the effectiveness of the Second Virtue outlined above.

Obstacle 3: Hostile Environment

Economic and technological dependencies are increasingly being perceived as potential threats. "Weaponized interdependence" has superseded the traditional interpretation that mutual dependency is a stabilizing force in international affairs.⁴¹ Several Chinese policies reflect this securitization trend. Of particular importance to the growing isolation of China could be the introduction of the PRC's Intelligence Law of 2017, article 7 of which requires all Chinese entities to cooperate with the PRC's security services if requested.⁴² This has raised suspicion and concern in the West. For example, trusted relations of research cooperation have been called into question because Chinese cooperation partners would be required by law to disclose information to the Chinese security agencies on request. In 2023, such concerns were further fueled when China's Ministry of State Security publicly called on all Chinese citizens to engage in counterespionage activities.⁴³

However, it is not only Chinese policies that have contributed to an increasingly hostile environment. Western countries, including the EU and its member states, have enacted laws and regulations that impede liaison between European and Chinese actors. For example, the EU and some of its member states have adopted screening mechanisms to control foreign direct investment (FDI).⁴⁴ While these instruments were designed to be actor-agnostic, Chinese investments were clearly the main target.

39 Alicia Garcia-Herrero, "Can Chinese Growth Defy Gravity?" Bruegel, 20 June 2023: <https://www.bruegel.org/policy-brief/can-chinese-growth-defy-gravity> (accessed October 22, 2023).

40 Federal Republic of Germany, Federal Foreign Office, Strategy on China of the Government of the Federal Republic of Germany, 20 June 2023, p. 38: <https://www.auswaertiges-amt.de/blob/2608580/49d50fccc479304c3da2e2079c55e106/china-strategie-en-data.pdf> (accessed October 23, 2023).

41 Henry Farrell and Abraham L. Newman, "Weaponized Interdependence: How Global Economic Networks Shape State Coercion," *International Security* 44, no.1 (2019), pp. 42–79.

42 China National People's Congress (NPC), 中华人民共和国国家情报法. [National Intelligence Law of the People's Republic of China], Beijing: NPC, 2017: http://www.npc.gov.cn/zgrdw/npc/xinwen/2017-06/27/content_2024529.htm (accessed October 23, 2023).

43 Ryan Woo, "China Wants to Mobilise Entire Nation in Counter-espionage," Reuters, August 2, 2023: <https://www.reuters.com/world/china/china-wants-mobilise-entire-nation-counter-espionage-2023-08-01> (accessed October 22, 2023).

44 Official Journal of the European Union, Regulation (EU) 2019/452 of the European Parliament and of the Council of 19 March 2019 Establishing a Framework for the Screening of Foreign Direct Investments into the Union, March 21, 2019: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R0452&qid=1696287250158> (accessed October 22, 2023).

Another example is export controls. In October 2022, the US adopted a comprehensive and complex set of export controls that requires licensing of the export of semiconductor equipment.⁴⁵ In June 2023, the Netherlands issued complementary regulations that control the export of lithography machinery essential for the production of semiconductors.⁴⁶ While the US and the Netherlands justify their export regimes with reference to dual-use export controls, it cannot be denied that they stall Chinese semiconductor capacity at 7nm logic. While it is certainly the case that these export controls will stimulate the indigenous production of chips within the PRC, lack of access to chipset below 7nm logic restricts the PRC's chances of developing generative Artificial Intelligence. While China's trailing edge semiconductor production is likely to flourish, innovation based on cutting-edge semiconductors is likely to be hindered if not completely choked off.⁴⁷

A final example is the growing concern over research security or knowledge security in Western countries. Both voluntary and mandatory instruments to limit research collaboration are being discussed in both the US and the EU member states, for fear of technology transfer and espionage.⁴⁸

All in all, the Third Obstacle involves amended Chinese intelligence rules, as well as a number of defensive instruments enacted by Western countries such as FDI screening and export controls. These instruments challenge the Third Virtueliaison with tech and research actors from abroad.

Obstacle 4: **Centralization of Control in Times of Crisis**

While China is still far from the days of the planned economy under Mao Zedong, there are visible centralization trends. Most prominently, a new Central Commission for Science and Technology was announced in March 2023 under the Central Committee of the CCP to be led by paramount leader Xi Jinping.⁴⁹ This is a clear sign that Xi Jinping aims

to tighten control over science and technology policy throughout China. Such a tightening of control comes at a time of economic crisis. A looming bursting of the real estate bubble has put China's financial sector under enormous stress. As a result, state-owned banks are likely to lend out fewer resources. Hence, the guiding function of the party-state – unleashing enormous resources for innovation – is coming under pressure from centralized control and fewer resources in the system.

At the same time, the West is placing the preferential treatment provided to Chinese actors under increasing scrutiny, not least through the development by the EU of a number of defensive policy tools, such as the anti-dumping and anti-subsidy instruments. Neither instrument is entirely new but recent amendments have made them more effective. In short, the Fourth Virtue – the benefits of the Chinese party-state's guidance – faces the obstacle of centralized domestic control and sharper instruments by Western countries to counter preferential treatment and unfair competition practices.

Obstacle 5: **Injecting Insecurity**

The Fifth and final Obstacle is growing insecurity in China, in both the technology sector and more broadly in society. This all began with what has been called the "rectification" of private sector companies in the technology sector, most prominently Alibaba and the company's founder, Jack Ma, but also Tencent and Didi. These and other companies have been subject to various investigations that were widely interpreted as a clampdown on private sector companies that had become too influential from the perspective of the CCP leadership. Regardless of whether this interpretation is correct, the rectification of the platform economy has injected uncertainty into the sector and could discourage entrepreneurs from taking risks. CCP leaders are now seeking to reassure private tech entrepreneurs and have signaled that the rectification has come to an end. Whether such reassurances

45 US Department of Commerce, Bureau of Business and Security, "Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)," Press release, October 7, 2022: <https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file> (accessed October 22, 2023).

46 Government of the Netherlands, "Government Publishes Additional Export Measures for Advanced Semiconductor Manufacturing Equipment," The Hague, June 30, 2023: <https://www.government.nl/latest/news/2023/06/30/government-publishes-additional-export-measures-for-advanced-semiconductor-manufacturing-equipment> (accessed October 22, 2023).

47 Jan-Peter Kleinhans and John Lee, *China Semiconductor Observatory Baseline Report, 2022* (Berlin: Stiftung Neue Verantwortung, 2022): https://www.stiftung-nv.de/sites/default/files/cso_baseline_report_2022.pdf (accessed October 23, 2023).

48 Ingrid d'Hooghe, *How National Governments and Research Institutions Safeguard Knowledge Development in Science and Technology* (The Hague: Leiden Asia Centre, 2022): <https://leidenasiacentre.nl/wp-content/uploads/2022/11/How-National-Governments-and-Research-Institutions-Safeguard-Knowledge-Development-in-Science-and-Technology.pdf> (accessed October 22, 2023).

49 Charles Mok, "The Party Rules: China's New Central Science and Technology Commission," *The Diplomat*, 23 August 2023: <https://thediplomat.com/2023/08/the-party-rules-chinas-new-central-science-and-technology-commission> (accessed October 22, 2023).

will eliminate the sense of insecurity among China's private sector entrepreneurs remains to be seen.⁵⁰

More broadly, there is anecdotal evidence to suggest that a sense of insecurity is growing in both the party-state and wider society. In 2019, a local party cadre told me in an interview that "the anti-corruption campaign is certainly necessary for the survival of the party and to preserve our credibility. But it has also created an atmosphere of suspicion and fear. None of us wants to stick out anymore. We are all following the central party line. [...] I am concerned this will have negative effects on our society."⁵¹ More broadly, China's zero-Covid policy, as well as its abrupt end, might have injected a sense of insecurity into wider society, including the tech sector.⁵²

All these sources of insecurity could undermine the Fifth Virtue that has made China innovative, as it rests on risk-taking and the confidence of not only China's entrepreneurs, but also its consumers. While the West has little influence on domestic conditions, a potential strengthening of the competitiveness of the European Single Market could help create an innovation-friendly alternative to the Chinese market for multinational technology firms.

All Five Obstacles require deeper examination to properly evaluate their impact on the Five Virtues that have made China an innovation powerhouse. Generally speaking, the Five Virtues continue to facilitate Chinese innovation and China is certainly not doomed to fail. However, new obstacles could endanger the degree to which the Five Virtues can achieve their potential to facilitate future innovation. The Five Virtues are not natural law, but the subject of policy choices and embedded in an international environment that can be made more or less conducive. For some of the Obstacles, domestic policies will be more decisive (Obstacles 1, 4 and 5), while international policies and the resulting environment are key for the others (Obstacles 2 and 3). Both domestic and international factors play a role in all the Obstacles. Only time will tell the extent to which changing conditions will negatively affect China's capacity to innovate. Observers should not underestimate China's ability to adapt.

For the time being, China watchers and policymakers in Europe will need to examine the "shades of grey" in

different innovation ecosystems instead of predicting complete failure or total success. Deng Xiaoping's pragmatism, perhaps best captured in his "cat quotation" cited above, has done a great deal for China. Under President Xi Jinping, however, it is not certain how much leeway will continue to be given to the Five Virtues. In other words, the color of the cat matters after all. How dogmatic China's future approach turns out to be will largely determine the country's future innovativeness.

RECTIFYING FALSE ASSUMPTIONS: HOW THE WEST SHOULD REACT TO CHINA'S INNOVATIVENESS

实事求是

Seek truth from facts

— Book of Han

Recognition of China's innovativeness has triggered a strong reaction in the West. Many Western governments appear to be concerned that China cannot be stopped. Ironically, their policies are still rooted in a long-held myth that China's economic success is primarily if not exclusively the result of IP theft and technological mimicry. Accordingly, Western governments have put in place investment and export control instruments that seek to cut the PRC off from Western knowledge. This perspective misses the point that beyond the Chinese "sin" of IP theft, the country's innovativeness has been fostered by Five Virtues. Only if this is acknowledged can we understand why China is neither doomed to fail nor on an inevitable path to success. China's approach to innovation does not just work as a catch-up model, as has been widely assumed. As China takes on technological leadership, it will not necessarily run out of steam. Nonetheless, China's Five Virtues do face Five Obstacles arising from both domestic and international policy. (The Five Virtues and Obstacles are summarized in Table) Neither future success nor future failure will be structural, but a matter of policy choice.

Western governments have rightly noticed that they have trusted too much in market efficiency and too

50 Rogier Creemes, "The Great Rectification: A New Paradigm for China's Online Platform Economy," SSRN, 10 January 2023: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4320952#;:text=Rogier%20Creemes,-Leiden%20University%20%2D%20Leiden&text=The%20rectification%20pursued%20six%20discrete,supporting%20the%20technology%20development%20area (accessed October 22, 2023).

51 Anonymous author interview with a local party-state official, Beijing, November 2019.

52 Anonymous author interview with a representative of a Chinese technology firm, Berlin, September 2023.

Table – Summary of the Five Virtues and Five Obstacles

Chinese Virtues	Mechanisms underlying the Chinese Virtues	Obstacles to the Chinese Virtues	Mechanisms underlying the Obstacles
First Virtue: Scaling of protectionism and market	Utilizing market size Scaling; (semi-) protectionism Flexibly adapting regulation	First Obstacle: Growing protectionism	Domestic: tightened VPN regulations; cross-border data transfer regulations International: diversification/de-risking agenda
Second Virtue: Attracting technology and knowledge to China	Attracting talent Forcing technology transfer Gaining knowledge due to globalized value chains	Second Obstacle: Market entry barriers	Domestic: revised counterespionage law, slowing growth International: limitations to export and investment guarantees
Third Virtue: Liaising with private tech firms and research in the West	Importing foreign technology Investing in foreign tech firms Collaborating with research institutions	Third Obstacle: Hostile environment	Domestic: securitization, intelligence law, call for counterespionage activity International: investment screening, export controls, research security instruments
Fourth Virtue: Guiding not controlling role of the party-state	Signaling priorities through FYPs Socializing risk of investment in future technology Providing infrastructure	Fourth Obstacle: Centralization of control in times of crisis	Domestic: Central Commission for Science and Technology; fewer resources International: anti-dumping instrument; anti-subsidy instrument
Fifth Virtue: Competition with Chinese characteristics	Competitive "red entrepreneurs" Competitive party cadres Competition for innovation-savvy consumers	Fifth Obstacle: Injecting insecurity	Domestic: rectification of the (private) platform economy; societal insecurity (zero-Covid, anti-corruption) International: increasing competitiveness of other markets

Source: Authors own illustration

little in industrial policy. Europe and the US are critically revisiting previous assumptions about the weakness of mixed economies and adapting their policies. For too long, the development and production of innovation was largely seen as an issue for private companies. State authorities may have provided funding for basic research, but the secret of Silicon Valley was always considered the absence of political interference. This has changed. China's success and the fear that dependencies come with

enormous risks have led Western governments to take action to promote their own technological capabilities and to restrict those of the PRC. Will this mix of an active industrial policy and material and non-material export controls work?

The answer is, yet again, a nuanced one. Undoubtedly, China's technological strength and our dependencies create real risks. To address them properly, however, at least four different risks need to be differentiated:

- **Risks to global supply chain resilience:** The global value chains of many, if not all, emerging and foundational technologies are characterized by a transnational division of labor. No region is in control of all the production steps and its supplier markets. Thus, Western governments should carefully analyze global supply chains, and identify bottlenecks and whether they can be circumvented, and how diversification could increase the resilience of global supply chains in order to reduce second- and third-order negative impacts on European industries in case of supply disruptions.
- **Risks to national security:** Not reducing strategic dependency or losing strategic capacity might have (in)direct negative impacts on European member states' national security. Disruptive technologies can be used in various ways for military and intelligence purposes. Backdoors in critical digital infrastructure are a widely discussed phenomenon. However, potential national security risks from dependency on drones, surveillance cameras or AI chips from Chinese vendors have not yet attracted the same attention.
- **Risks to values and sustainability:** Strategic dependency or technology cooperation can also conflict with the normative agendas of states. Like implementation of export restrictions to protect human rights, strategic dependence can also be scrutinized according to the human rights violations that such technology would enable. Similarly, sustainability is of growing concern, and emerging and foundational technologies play an increasingly important role. While both Europe and China emphasize its importance, the priority attributed and approaches to sustainability vary.
- **Risks to competitiveness:** Europe might invest in strategic capacities or try to reduce strategic dependencies to be able to compete internationally in the long term if a certain technology or market is deemed highly important in the future. It may or may not be popular to say, but the prosperity of our economies will, to a significant extent, depend on the ability to remain competitive in light of what the EU has termed the "twin transition" – the transformation of our societies to digital and carbon neutral ones.

A recent report by the Digital Power China (DPC) research consortium demonstrated that risk profiles

vary significantly across different emerging and foundational technologies.⁵³ Whether risks to supply chain resilience, national security, values or competitiveness are a priority varies depending on the specific technology. This means that a smart policy response to China's innovativeness should be implemented in three steps.

First, Western governments should acknowledge that risk profiles vary depending on the technology and that our own technological development relies on the PRC's innovation to varying degrees. Risks need to be assessed from three angles: geopolitical realities, global markets and dependencies, and the technology itself.

Second, as China's innovativeness is not a given but depends on the Five Virtues and the Five Obstacles outlined above, Western governments should consider their own policy options without neglecting the domestic factors in China that will shape the PRC's innovation power. This means acknowledging that China is not a copycat and we rely on Chinese innovation, but without ignoring that we still have a degree of leverage. All Five Obstacles involve a dimension dependent on Western policy choices, but all Five Obstacles are also influenced by Chinese policy decisions.

Third, Western governments should carefully craft a policy that combines reducing strategic dependencies where necessary with the aim of remaining technologically indispensable to China. In light of the intensifying US-China technological rivalry, Europe needs to ensure that our companies continue to play an indispensable role in global supply chains in the long term. Technological indispensability maintains leverage that should be used only after careful consideration. Once China is cut off from a certain technology, the PRC might suffer but the leverage is gone and China will adapt to the new realities.

In short, an effective policy of living with China's innovation power needs to overcome the illusion that the PRC's technological development rests purely on mimicking and copying. We have to seek truth from facts, as the ancient Book of Han reminds us. Twenty years ago, cutting China off from Western technology might have stalled its development. Today, we need to consider China's inherent strengths without neglecting its dependencies on us that still give us some

53 Tim Rühlig (ed.), *Europe's Strategic Technology Autonomy From China: Assessing Foundational and Emerging Technologies* (Berlin: Digital Power China, 2023): https://timruhlig.eu/ctf/assets/x93kiko5rt7l/2kCX6lXU6CWjDPBkjaPnmF/eacc44fd42b9086dd898fdef7bc12965/DPC_-2023_-final.pdf (accessed October 23, 2023).

leverage. How China became innovative is substantially different from the Western approach to innovation. We have learned that there is more than one path to innovativeness. However, while we should not dismiss China's successes as purely the result of fraud and acknowledge its complexity, we also need to understand that our policy responses should not mimic China. Our political and economic systems are different. The real task is to let the strengths of our own democracies and free market economies shine again.



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