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Resiliency and Competitiveness”

The United States, China, and the Contest for the Fourth Industrial Revolution

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## Introduction

Chairman Sullivan, Ranking Member Markey, distinguished members of the Committee, thank you very much for the opportunity to testify at today’s hearing on the China challenge and efforts to build U.S. resiliency and competitiveness. As requested, I will be focusing my remarks on three subjects. First, I will discuss Beijing’s challenge to U.S. global technology leadership and its ambitions to dominate what it often refers to as the “Fourth Industrial Revolution.” Second, I will discuss some of the challenges the United States faces in reshoring or diversifying supply chains presently based in China as well as in sustaining its technology leadership. Finally, I will offer recommendations for U.S. policy focusing on a few broad categories of effort: (1) information gathering; (2) government coordination; (3) immigration and basic science; (4) reforms of corporate and financial incentives; and (5) coordination with likeminded stakeholders. It is hoped that these policies might build long-term U.S. resilience and competitiveness as we enter what some call a “superpower marathon” with China.<sup>2</sup>

## I. China’s Challenge to U.S. Global Technology Leadership

It is increasingly clear to most observers that China is pursuing a robust, state-backed effort to displace the United States from global technology leadership. This effort is not driven entirely by commercial considerations but geopolitical ones as well. Beijing believes that the competition over technology is about more than whose companies will dominate particular markets. It is also about which country will be best positioned to lead the world.

China’s leaders have often seen technology and economic exchange through a political lens, particularly as a way to create or avoid dependency, strengthen China’s “comprehensive power,” and build order. This perspective appears to be rooted in the Party’s Leninist and mercantilist traditions as well as in its nationalist history. China’s “century of humiliation,” which stretches from the Opium Wars to the founding of the People’s Republic of China in 1949, is seen as a product of the country’s failure to achieve “wealth and power” [富强] relative to the industrialized West and Japan.<sup>3</sup> Accordingly, technological advancement has long been seen as a means to achieving “wealth and power,” whether during China’s pursuit of strategic weapons during Mao

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<sup>1</sup> This testimony draws from the author’s forthcoming book. See Rush Doshi, *The Long Game: China’s Grand Strategy to Displace American Order* (Oxford: Oxford University Press, 2021).

<sup>2</sup> Michael Brown, Eric Chewning, and Pavneet Singh, “Preparing the United States for the Superpower Marathon with China,” The Brookings Institution, April 2020, [https://www.brookings.edu/wp-content/uploads/2020/04/FP\\_20200427\\_superpower\\_marathon\\_brown\\_chewning\\_singh.pdf](https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_superpower_marathon_brown_chewning_singh.pdf)

<sup>3</sup> Orville Schell and John Delury, *Wealth and Power: China’s Long March to the Twenty-First Century* (New York: Random House, 2013).

Zedong's leadership or its push to achieve what his successor Deng Xiaoping labeled as the "fourth modernization" of science and technology progress – both of which were self-consciously styled as efforts to boost China's power. Now, as China perceives a new period of technological change, the Chinese Communist Party's writings suggest geopolitics is again at the forefront.

### *China's Ambitions - Seizing the Fourth Industrial Revolution*

The Chinese Communist Party believes that the world has entered a period of "great changes unseen in a century." At the core of these changes is a shift in the balance of power between the United States and China, and one key driver of that change is the onset of a new round of technological innovation which Xi Jinping and others have sometimes referred to as the "Fourth Industrial Revolution" [第四次工业革命].

Although the idea of a "Fourth Industrial Revolution" initially emerged from the World Economic Forum in 2015, the concept has been embraced by the Chinese Communist Party. As Xi Jinping argued in a 2018 speech: "From the mechanization of the first industrial revolution in the 18th century, to the electrification of the second industrial revolution in the 19th century, to the informationization of the third industrial revolution in the 20th century," each round of "disruptive technological innovation" has shaped history.<sup>4</sup>

China's leaders believe the next decade will largely determine who leads the next industrial revolution. "The next ten years will be a key decade," Xi argued, "a new round of technological revolution and industrial change – artificial intelligence, big data, quantum information, and biotechnology – are gathering strength." They would bring "earth-shaking changes" while offering an "important opportunity to promote leapfrog development," allowing China to bypass legacy systems and overtake competitors.<sup>5</sup>

China's leaders have long employed the phrase "catch up and surpass" [赶超] to describe their technological ambitions, with the United States and West seen as the critical benchmark. But revolutionary technological changes, in the eyes of some Chinese commentators, now make this lofty goal actually achievable.<sup>6</sup> The Fourth Industrial revolution could create the kind of "great divergence" that accompanied past industrial revolutions, where some countries and early adopters leapt ahead of rival competitors with historical implications for global politics. And while Party officials are generally guarded in describing China's ambitions in this fashion, many commentaries and think tank pieces seem to suggest that surpassing the United States in high technology would end its era of global leadership, and presumably, usher in one of Chinese leadership.

A wide range of Chinese commentators all agree that technology is increasingly at the center of U.S.-China competition. "In the next decade...the competition for the fourth industrial revolution will begin between China and the United States," writes Jin Canrong, a well-known international

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<sup>4</sup> "What is the Fourth Industrial Revolution? Xi Jinping described the blueprint like this! [第四次工业革命什么样？习近平这样描绘蓝图！]." *Qiushi* [求是网], July 27, 2018. [http://www.qstheory.cn/zhuanqu/2018-07/27/c\\_1123186013.htm](http://www.qstheory.cn/zhuanqu/2018-07/27/c_1123186013.htm).

<sup>5</sup> "Xi Jinping: Follow the trend of the times and achieve common development [习近平：顺应时代潮流 实现共同发展]." *People's Daily* [人民日报], July 26, 2018. <http://cpc.people.com.cn/n1/2018/0726/c64094-30170246.html>.

<sup>6</sup> Julian Baird Gewirtz, "China's Long March to Technological Supremacy," *Foreign Affairs*, August 27, 2019, <https://www.foreignaffairs.com/articles/china/2019-08-27/chinas-long-march-technological-supremacy>.

relations professor and a dean at Renmin University.<sup>7</sup> “Scientific and technological capabilities have become an important indicator of a country's comprehensive strength, and it has also become the main battlefield for great power competition,” argues Zhu Feng, another well-known scholar and professor at Nanjing University.<sup>8</sup> And countless other prominent scholars express similar sentiments.

A typical discourse on the geopolitical stakes of technology competition comes from an authoritative and apparently pseudonymous commentary posted on the website of the Central Party School journal *Study Times* [学习时报] roughly two months after Xi's 2018 address on the Fourth Industrial Revolution.<sup>9</sup> “Britain seized the opportunity of the first industrial revolution” which provided it an empire; afterwards, when the second industrial revolution arrived, “the United States seized the dominant power of advanced productivity from Great Britain and jumped into position as the world's number one industrial power, laying a solid foundation for establishing global hegemony.” Then, “the third industrial revolution originated in the United States,” and the United States seized it and boosted its “comprehensive strength,” providing the foundation for American hegemony. China now sees an opportunity to wield what it believes is a superior system to follow in the footsteps of Britain and the United States, seize a new industrial revolution, and become the world's leading state.

### *China's Advantages – What China Thinks it Does Better than the United States*

China believes it is well-positioned to outcompete the United States in the competition for the Fourth Industrial Revolution and that it has four main advantages: (1) heavy investment in R&D; (2) superior institutions and industrial policies supporting China's ambitions; (3) manufacturing prowess and centrality to global supply chains; and (4) a more robust operation to set the global technology standards that could determine the future of key industries.

First, China has learned from U.S. history in crafting its own approach to basic science research. Beijing recognizes, as the United States once did, that such research cannot be supported entirely by the market and the private sector and instead must be supported by the public. China's investments have been enormous. The National Science Foundation estimates that China's total R&D spending is roughly equivalent to U.S. spending even though China's economy is smaller.<sup>10</sup> By some estimates, China's government-funded R&D also already exceeds U.S. federal R&D spending. And in the technologies central to the Fourth Industrial Revolution, the differences are significant. China spends roughly \$2.5 billion annually, a modest sum that is nonetheless estimated to be more than ten times what the U.S. spends in a sector with critical economic and

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<sup>7</sup> Jin Canrong [金灿荣]. “Jin Canrong: The Fourth Industrial Revolution is mainly a competition between the U.S. and China, and China has a greater chance of winning [金灿荣：第四次工业革命主要是中美之间的竞争，且中国胜算更大].” *Guancha* [观察者网], July 29, 2019. [https://www.guancha.cn/JinCanRong/2019\\_07\\_29\\_511347\\_s.shtml](https://www.guancha.cn/JinCanRong/2019_07_29_511347_s.shtml).

<sup>8</sup> Zhu Feng [朱锋]. “A Summary of Recent Academic Research on ‘Great Changes Unseen in a Century’ [近期学界关于“百年未有之大变局”研究综述].” *People's Forum, Academic Frontier* [人民论坛·学术前沿], no. 7 (2019).

<sup>9</sup> Li Jie [李杰]. “Deeply understand and grasp the world's “great changes unseen in a century” [深刻理解把握世界“百年未有之大变局”].” *Qiushi* [求是网], September 3, 2018. [http://www.qstheory.cn/llwx/2018-09/03/c\\_1123369881.htm](http://www.qstheory.cn/llwx/2018-09/03/c_1123369881.htm).

<sup>10</sup> Beethika Khan, Carol Robbins, and Abigail Okrent, *The State of U.S. Science and Engineering 2020* (Washington, DC: National Science Foundation, 2020), <https://nces.nsf.gov/pubs/nsb20201/global-r-d>.

strategic potential.<sup>11</sup> In addition to that annual spending, Beijing also plans to spend some \$10 billion to build the National Laboratory for Quantum Information Sciences.<sup>12</sup> Similarly, in artificial intelligence, China spends at least as much as the United States and likely more, according to estimates from Georgetown’s Center for Security and Emerging Technology.<sup>13</sup>

Second, China believes its institutions are better designed to mobilize the state, society, and market to wield industrial policy to achieve the country’s technological ambitions. For example, the *Study Times* commentary cited previously noted that institutions are key to seizing technological leadership, which in turn buttresses hegemonic ambitions – this is why, it argued, Britain replaced Spain, the United States replaced Britain, and why China might supplant the United States. The commentary followed countless similar commentaries in China arguing that the polarized U.S. political system was underperforming relative to China’s system.<sup>14</sup> As a result, it argued, “the emergence of a new round of scientific and technological revolution and industrial transformation is conducive to China’s institutional advantages and to achieving ‘overtaking by curve,’” a reference to sprinting ahead as a competitor slows down or mishandles a turn around a racetrack.

How do these supposed institutional advantages manifest themselves in practical terms? China’s leaders have been explicit about the superiority of their industrial policy programs which are intended to help China seize the commanding heights of the Fourth Industrial Revolution.<sup>15</sup> For example, in the aftermath of COVID-19, China’s National People’s Congress approved a plan to spend \$1.4 trillion in five to six years to build fifth generation wireless networks, install cameras and sensors to create smart cities, and integrate this network with industry to accelerate progress in smart manufacturing. Earlier this year, China had about 200,000 5G towers in use; by the end of the year, it will have more than half a million with an ultimate goal of 5 million.<sup>16</sup>

In addition, China has released more than 100 science and technology plans, including detailed plans for leadership in AI by 2030 and in standard-setting by 2035.<sup>17</sup> It has several special purpose

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<sup>11</sup> Arthur Herman, “The Quantum Computing Threat to American Security,” *Wall Street Journal*, November 10, 2019, <https://www.wsj.com/articles/the-quantum-computing-threat-to-american-security-11573411715>.

<sup>12</sup> Neel V. Patel, “China is beating the US when it comes to quantum security,” *MIT Technology Review*, December 12, 2019, <https://www.technologyreview.com/2019/12/12/131600/china-is-beating-the-us-when-it-comes-to-quantum-security/#:~:text=Prisco%20says%20the%20China%20is,although%20this%20number%20is%20disputed>.

<sup>13</sup> Ashwin Acharya and Zachary Arnold, *Chinese Public AI R&D Spending: Provisional Findings* (Washington, DC: Center for Security and Emerging Technology, 2019), <https://cset.georgetown.edu/wp-content/uploads/Chinese-Public-AI-RD-Spending-Provisional-Findings-1.pdf>.

<sup>14</sup> These sources are discussed in greater detail in Rush Doshi, *The Long Game: China’s Grand Strategy to Displace American Order* (Oxford: Oxford University Press, 2021). For a typical example, see Zhang Yunling [张蕴岭], Yang Guangbin [杨光斌], Wei Ling [魏玲], Zhu Feng [朱锋], Jin Canrong [金灿荣], and Xie Tao [谢韬]. “How to recognize and understand the great changes in a century [如何认识和理解百年大变局].” Charhar Institute [察哈尔学会], March 28, 2019. <http://www.charhar.org.cn/newsinfo.aspx?newsid=14706>.

<sup>15</sup> “Li Keqiang: The Internet + Double Innovation + Made in China 2025 Will Give Birth to a ‘New Industrial Revolution’ [李克强：互联网+双创+中国制造2025催生一场“新工业革命”].” Xinhua [新华网], October 15, 2015. [http://www.xinhuanet.com/politics/2015-10/15/c\\_1116825589.htm](http://www.xinhuanet.com/politics/2015-10/15/c_1116825589.htm).

<sup>16</sup> Anjani Trivedi, “China Is Winning the Trillion-Dollar 5G War,” *Washington Post*, July 12, 2020, [https://www.washingtonpost.com/business/china-is-winning-the-trillion-dollar-5g-war/2020/07/12/876cb2f6-c493-11ea-a825-8722004e4150\\_story.html](https://www.washingtonpost.com/business/china-is-winning-the-trillion-dollar-5g-war/2020/07/12/876cb2f6-c493-11ea-a825-8722004e4150_story.html).

<sup>17</sup> Tai Ming Cheung et al., *Planning for Innovation: Understanding China’s Plans for Technological, Energy, Industrial, and Defense Development* (Washington, DC: U.S.-China Economic and Security Review Commission,

funds allocating tens of billions towards specific research areas. And it has developed its flagship industrial policy initiative, Made in China 2025, which targets ten high-tech industries: information technology; smart manufacturing; aerospace; maritime engineering; advanced rail; electric vehicles; electrical equipment; new materials; biomedicine; and agricultural machinery and equipment. Made in China 2025 seeks to indigenize these key technologies, gain favorable positions in global supply chains, win market share within China, and ultimately capture global market share from foreign markets. To do so, it wields the full power of the state and the market power of the Chinese economy to elevate local champions over their high-tech foreign competitors globally, with specific quotas set in each industry for China's anticipated share.<sup>18</sup> The initiative relies on technology transfer, market access restrictions, state-backed foreign acquisitions, and subsidies. While Beijing has formally deemphasized it in its official discourses following backlash from the United States and Europe, the core of the initiative remains very much alive.

Third, Chinese sources suggest an understanding even though the United States may have superior innovation capabilities relative to China, in many industries, that advantage matters little without manufacturing capabilities and will almost certainly evaporate unless they return. Chinese scholars see the country's centrality to global manufacturing and supply chains as an enormous strategic advantage; in contrast, they argue that the United States has allowed "the hollowing out of its industrial base" which means it cannot convert its innovations into products without China's factories. This dependence on China's manufacturing capability – when combined with China's large numbers of engineers, its penchant for reverse-engineering, and robust state support – gives it long-term advantages in the competition with the United States.<sup>19</sup> As the researcher Dan Wang notes, "China remains unmatched as a manufacturing site given its numbers of skilled workers, deep supplier networks and the government's credible public support for manufacturers and provision of reliable infrastructure."<sup>20</sup> Even amid the pandemic, companies like Tesla are deeply invested in China while others like Honeywell have announced new investments in Wuhan, China.

Fourth, China is increasingly focused on setting standards in technical bodies relative to the United States. China's objectives include promoting its industries, earning lucrative royalties when its patents are used, and embedding its values and governance approaches in the architecture of technology. This year, China released its China Standard 2035 Plan as part of an effort to advance its standards globally. Even before this plan was announced, however, China had already grown influential in key bodies like the Third Generation Partnership Project (3GPP) and the International Telecommunication Union (ITU) and in some cases sought to shift standard-setting discussions to bodies where its influence was greater. Chinese firms are expected to gain enormous royalties from having succeeded in the competition over 5G standards. Moreover, with respect to governance, Chinese companies like ZTE have proposed standards for

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2016),

<https://www.uscc.gov/sites/default/files/Research/Planning%20for%20Innovation%20-%20Understanding%20China's%20Plans%20for%20Tech%20Energy%20Industrial%20and%20Defense%20Development072816.pdf>.

<sup>18</sup> *Made in China 2025: Global Ambitions Built on Local Protections* (Washington, DC: United States Chamber of Commerce, 2017), [https://www.uschamber.com/sites/default/files/final\\_made\\_in\\_china\\_2025\\_report\\_full.pdf](https://www.uschamber.com/sites/default/files/final_made_in_china_2025_report_full.pdf).

<sup>19</sup> Jin. "Jin Canrong: The Fourth Industrial Revolution is mainly a competition between the U.S. and China, and China has a greater chance of winning [金灿荣：第四次工业革命主要是中美之间的竞争，且中国胜算更大]."

<sup>20</sup> "Can the U.S. End control of the Global Supply Chain," *Bloomberg*, June 9, 2020, <https://www.bloombergquint.com/global-economics/why-the-u-s-can-t-easily-break-china-s-grip-on-supply-chains>

street light architecture that would allow video monitoring capabilities to be built in; for facial recognition that would require specific and extraneous demographic and biometric data to be stored; and for a new internet architecture that would advantage monitoring, censorship, and control.<sup>21</sup> Beijing’s success in these bodies is in part a product of its successful investments in next-generation technologies like 5G but also the more “hands-on” approach the Party appears to take relative to the more industry-led and “hands-off” approach that the United States takes. Although many standard-setting bodies are primarily comprised of companies that are supposed to vote based on their own interests, at least in China’s cases, companies like Lenovo that initially voted to endorse approaches backed by U.S. companies were criticized by nationalists for doing so and pressured to instead endorse approaches backed by major Chinese companies like Huawei. As Lenovo’s leadership team noted in an apologetic message posted online, “We all unanimously believe that Chinese companies should unite and should not allow outsiders to play them against each other.”<sup>22</sup> If China’s efforts continue to be successful, Beijing may be able to lock-in its approaches and extend its lead in certain key global technologies to the detriment of universal values and U.S. interests.

## II. Challenges to U.S. Reshoring, Diversification, and Technology Competition

Despite a growing consensus across the political spectrum that the erosion of U.S. manufacturing and technology leadership has weakened U.S. resilience, competitiveness, and security, efforts to reverse these trends face a wide range of challenges.

### *Challenges to Reshoring Industry and Diversifying from China*

Several advanced economies are launching efforts to “reshore” manufacturing currently in China or to diversify supply chains to markets outside China. Taiwan was one of the first to do so, and in pursuit of what it called a “non-red supply chain,” it began mounting a robust effort to lure Taiwanese manufacturers currently in China back to Taiwan.<sup>23</sup> Others have followed suit. Japan has subsidized exit from China for eighty-seven companies, expending \$2 billion on efforts to bring production back to Japan or to diversify it into Southeast Asia.<sup>24</sup> Similar discussions are underway in the EU as well, with top officials discussing the possibility of reshoring or diversification of some critical industries.<sup>25</sup> And of course, the United States is also considering a variety of instruments to promote reshoring and supply chain diversification, including through

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<sup>21</sup> Lindsay Gorman, “The U.S. Needs to Get in the Standards Game—With Like-Minded Democracies,” *Lawfare*, April 2, 2020, <https://www.lawfareblog.com/us-needs-get-standards-game%E2%80%94minded-democracies>.

<sup>22</sup> “Take action and fight to the death to win Lenovo's honor defense war! [行动起来，誓死打赢联想荣誉保卫战！]” WeChat Post, May 16, 2018, <https://mp.weixin.qq.com/s/JDlmQbGFkxu-D2jsqNz3w>.

<sup>23</sup> Matthew Fulco, “Is Taiwan Winning the U.S.-China Trade War?,” *Taiwan Business Topics - AmCham Taipei*, August 16, 2019, <https://topics.amcham.com.tw/2019/08/taiwan-winning-trade-war/>.

<sup>24</sup> Simon Denyer, “Japan helps 87 companies to break from China after pandemic exposed overreliance,” *Washington Post*, July 21, 2020, [https://www.washingtonpost.com/world/asia\\_pacific/japan-helps-87-companies-to-exit-china-after-pandemic-exposed-overreliance/2020/07/21/4889abd2-cb2f-11ea-99b0-8426e26d203b\\_story.html](https://www.washingtonpost.com/world/asia_pacific/japan-helps-87-companies-to-exit-china-after-pandemic-exposed-overreliance/2020/07/21/4889abd2-cb2f-11ea-99b0-8426e26d203b_story.html).

<sup>25</sup> “Introductory statement by Commissioner Phil Hogan at Informal meeting of EU Trade Ministers,” European Commission, April 16, 2020, [https://ec.europa.eu/commission/commissioners/2019-2024/hogan/announcements/introductory-statement-commissioner-phil-hogan-informal-meeting-eu-trade-ministers\\_en](https://ec.europa.eu/commission/commissioners/2019-2024/hogan/announcements/introductory-statement-commissioner-phil-hogan-informal-meeting-eu-trade-ministers_en).

low-interest loans, corporate tax cuts, a dedicated fund, and proposals to pay 100% of a company's reshoring expenses.<sup>26</sup>

These efforts are meeting with mixed success. While some manufacturing has left China for Vietnam, Bangladesh, India, Mexico, and Taiwan, among others, many companies are unwilling or unable to relocate. The European Chamber of Commerce in China found that only about 11% of its members were considering relocation out of China; similarly, the President of AmCham China noted that the majority of the group's members are not planning on exiting China.<sup>27</sup> For these firms, the rationale goes beyond cost alone. As the Paulson Institute scholar Damien Ma argues, it is hard for Americans to quit Amazon because it is the "everything store," and it is hard for manufacturers to quit China because it is the "make everything country."<sup>28</sup> Surveys of American and Chinese businesses demonstrate that most are not presently thinking of shifting out of China because their access to a diverse range of suppliers in China is an enormous advantage that offsets the value of reduced labor costs, subsidies, or tax credits. At the same time, China is working to counteract offshoring. General Secretary Xi Jinping has declared that protecting China's supply chains is one of the country's six national priorities in the wake of COVID-19.

### *Challenges to Retaining the U.S. Technology Base*

Even as some industries are reluctant to leave China, others have already exited or are considering exiting the U.S. market. For example, Intel announced that it would likely outsource most of its cutting-edge chip manufacturing given "process slips" it has encountered in manufacturing 7nm semiconductors - a decision that comes even as the U.S. government has made it clear that the semiconductor industry is a priority for U.S. reshoring and despite a new round of tax credits and subsidies meant to support it.<sup>29</sup> Some financial analysts have suggested that this is the right decision for Intel, and that it would be efficient for it to sell its plants and focus on design, and allow other companies focused on production alone to manufacture for Intel. But what is efficient would be seriously damaging for the U.S. industrial base and for an industry critical to U.S. security and competitiveness since the outsourcing of manufacturing by the country's largest chipmaker would allow whatever chipmaking knowledge exists in the United States to essentially atrophy, thereby making any future manufacturing in that industry significantly less likely for decades to come. Meanwhile, despite the difficulties and costs, China remains determined to acquire these same manufacturing capabilities because it recognizes efficiency is not the only

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<sup>26</sup> Jodi Xu Klein, "Is TSMC's Arizona project a US tech supply chain win? Or a cautionary tale?," *South China Morning Post*, June 10, 2020, <https://www.scmp.com/tech/innovation/article/3088489/tsmcs-arizona-project-us-tech-supply-chain-win-or-cautionary-tale>.

<sup>27</sup> Joe McDonald, "Companies prodded to rely less on China, but few respond," *Associated Press News*, June 29, 2020, <https://apnews.com/bc9f37e67745c046563234d1d2e3fe01> and "Supply Chain Challenges for US Companies in China," AmCham China, April 17, 2020, <https://www.amchamchina.org/about/press-center/amcham-statement/supply-chain-challenges-for-us-companies-in-china>.

<sup>28</sup> Damien Ma (@damienics), Twitter Post, June 30, 2020, 4:54 p.m., <https://twitter.com/damienics/status/1278114690871300101?s=20>.

<sup>29</sup> Ian King, "Intel Plunges as It Weighs Exit from Manufacturing Chips," *Bloomberg*, July 23, 2020, <https://www.bloomberg.com/news/articles/2020-07-24/intel-considers-what-was-once-heresy-not-manufacturing-chips>.

relevant value and has benefited directly from the ways in which manufacturing prowess has produced tacit knowledge and technical expertise that can seed a larger industrial ecosystem.

A critical reason that Intel is looking abroad is Taiwan and South Korea have made enormous investments in an ecosystem of physical and human capital within this industry and have some resilience - if one of their firms misjudge the next wave of semiconductors as Intel did, they may have more “cushion” because of that broader ecosystem that supports the industry. In contrast, the United States lacks a comparable ecosystem of specialized engineering capability, tacit knowledge, and professional networks in chip production. Its industry therefore has little resilience.<sup>30</sup> Onshoring chip manufacturing, in other words, is about more than the provision of capital – it requires a larger supporting ecosystem that can create that resilience. That kind of ecosystem will not be built overnight, it will in part have to be created with patience, and in some cases with better immigration policies, some careful experimentation with incentivizing localization, subsidies and credits where appropriate, and several other instruments.

### *Considerations for Competitiveness and Resilience*

The geoeconomic challenge China poses is so significant that the United States will need to explore instruments beyond simple tax credits and subsidies if it hopes to reshore or diversify its supply chains and sustain its position in the Fourth Industrial Revolution.

This kind of broad strategy is sometimes referred to as “industrial policy,” which is in turn often mistakenly seen as a narrow effort to pick winners and losers in an industry. The reality, however, is that many mundane government practices might qualify as “industrial policies” and are not designed to pick winners and losers. Indeed, if industrial policy is generally understood to be “government intervention in a specific sector which is designed to boost the growth prospects of that sector and to promote the development of the wider economy” - particularly in cases where the market is believed to be inadequate - then many practices might fall under the broad umbrella of so-called industrial policy.<sup>31</sup> In this sense, industrial policy is everywhere, and it includes policy instruments such as tax incentives, subsidies, trade agreements, regulation, investments in infrastructure, support for a skilled workforce, among countless others. What many effectively mean when they use the term “industrial policy” is a state strategy to boost competitiveness and resilience in a particular sector, a phraseology which is far less controversial but effectively similar in meaning.<sup>32</sup> The question is not whether the United States should pursue such a strategy - there has long been bipartisan consensus that it should - but how it can do so in a way that avoids waste and capture and that instead sustains resilience, competitiveness, security, and technological leadership relative to China.

First, with respect to reshoring and supply chain diversification, other states have adopted practices in this vein that might be instructive for U.S. policymakers. Despite efforts by a wide range of governments to reshore or diversify supply chains currently based in China, only Taiwan

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<sup>30</sup> David P. Goldman, “Intel is making a mockery of reshoring,” *Asia Times*, July 25, 2020, <https://asiatimes.com/2020/07/intel-is-making-a-mockery-of-reshoring/>.

<sup>31</sup> Uri Dadush, “Industrial Policy: A Guide for the Perplexed,” OCP Policy Center, January 2016 <https://carnegieendowment.org/files/OCPPC-PB-1605industrialpolicy.pdf>.

<sup>32</sup> Reda Cherif and Fuad Hasanov, “All the Way to the Top: Industrial Policy, Innovation, and Sustained Growth,” *IMF Blog*, November 13, 2019, <https://blogs.imf.org/2019/11/13/all-the-way-to-the-top-industrial-policy-innovation-and-sustained-growth/>.

has so far been particularly successful. Beginning in 2019, Taiwan pursued a “non-red supply chain” in key advanced industries including telecommunications, electronics, smart machinery, biomedicine, and green energy.<sup>33</sup> To lure manufacturers back from China, Taiwan used a wide range of policy instruments that went far beyond tax credits and subsidies, relying on measures like rent assistance, cheap finance, land acquisition, and simplified provisions on reinvestment, among others. The effort self-consciously addressed what Taiwan calls its “five shortages”: land, water, power, manpower, and talent to entice companies to return. Most critically, the initiative was housed in the “InvestTaiwan” office at the Ministry of Economic Affairs (MOEA), which the head of the office described as a “a one-stop shop to help manufacturers return home smoothly.”<sup>34</sup> Since its establishment in 2019, the office has succeeded in achieving \$33 billion worth of reshoring in terms of investment which has boosted Taiwan’s economic growth. The office’s success was no doubt partly boosted by U.S. tariffs, but it was also due to the ease with which one office could serve as a single point of contact for all firms thinking about leaving China and the willingness of that office to proactively work with businesses to address a wide range of concerns beyond questions of credits and subsidies.

Second, with respect to efforts to boost competitiveness and resilience in high-tech industries, a range of states have adopted “industrial policy” plans. China, as discussed, has its Made in China 2025 strategy and now a \$1.4 trillion digital infrastructure plan. For its part, Germany has Industry 4.0, the United Kingdom released an Industrial Strategy, and a wide range of other states are experimenting with similar efforts.

Over the last twenty years, had the United States government been more willing to experiment with these tools and techniques to promote its high-technology industries, it is possible – though by no means guaranteed – that the competitive landscape with China could have looked very different today. The kind of approach that helped restore the U.S. semiconductor industry in the 1980s with SEMATECH and helped catalyze the genomics industry in the same period with the Human Genome Project could potentially have been attempted in other industries. And at the very least, more robust efforts to save floundering high-tech industries could have also been consequential. Indeed, at various times over the last two decades, the United States intervened to save industries like finance, automotives, and insurance. Those efforts, however, did not generally extend to companies that were at the cutting edge of high technology. For example, the United States government did not intervene to save Motorola or Lucent, companies that today could have formed the foundation of an American 5G industry. Similarly, if the United States had mounted a more robust technology innovation policy to sustain semiconductor manufacturing, it is possible that the deterioration of that capability - and its potential loss of Intel outsources production - could have been avoided. Rather than lamenting what might have been, the past can be a useful guide to a more competitive future. Accordingly, it is worth noting that if Washington makes the right moves now, it is likely that the competitive landscape with China over the next two decades could be significantly and positively impacted.

For the United States then, as the experience with Intel demonstrates, the core question will be how Washington can reverse the loss of expertise and experience in key industries and, in a few specific cases, attract foreign companies to come to the United States and build reservoirs of tacit knowledge that could form the foundation for future manufacturing resilience. These efforts will

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<sup>33</sup> Fulco, “Is Taiwan Winning the U.S.-China Trade War?”

<sup>34</sup> Fulco, “Is Taiwan Winning the U.S.-China Trade War?”

likely require a wide range of policy instruments to boost U.S. manufacturing or incentivize others to manufacture in the United States. These might include subsidies, tax breaks, investments in education and training, use of government procurement policies to encourage local production, state-mandated production (e.g., under the Defense Production Act), carefully structured trade agreements that advantage domestic manufacturing, and export controls.<sup>35</sup> In the past, particularly given the allure of the U.S. market, similar efforts have helped attract Japanese auto manufacturers to the United States, with companies like Toyota producing 70% of the cars they sell to Americans at their U.S. factories. By going beyond simple subsidies and tax credits, the United States could build a broader ecosystem that will sustain and attract advanced industries.

Some of the policies critical to this effort are explored below.

### III. Recommendations for U.S. Policy

#### 1. Information Gathering for Economic Strategy

- **The U.S. Congress should consider creating an entity that can audit the U.S. supply chain and craft robust reporting requirements on supply chains for industry.** China has demonstrated a willingness to use its nodal position in modern supply chains as leverage against other countries. If the United States has a less sophisticated understanding of global supply chains than China, it will not be well-positioned to resist or help allies resist these efforts. Moreover, as the recent pandemic has shown, the federal government often has little idea until it is too late just how dependent certain critical industries (like the pharmaceutical sector, or PPE manufacturing) are on imports from China and other countries. Accordingly, the United States needs reliable information on supply chains within and across industries. Efforts already undertaken to audit supply chains in critical minerals and in medical supplies should be expanded into a wide range of critical and high-tech industries, institutionalized in a federal government entity, and bolstered through mandatory reporting requirements for industries.<sup>36</sup> This entity could conceivably be staffed or supported by other economic statistics-producing agencies, including the U.S. Census Bureau, the Department of Commerce's Bureau of Economic Analysis, or the International Trade Commission, among others.
- **The U.S. Census Bureau should restart and expand its Current Industrial Reports program:** These reports which were produced annually produced rich and detailed information on U.S. industries and created teams of individuals with deep, institutionalized knowledge on each industry. That information will be essential for crafting and implementing strategies to boost U.S. resilience and competitiveness,

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<sup>35</sup> Geoffrey Gertz, "How to Deglobalize," *Foreign Policy*, July 24, 2020, <https://foreignpolicy.com/2020/07/24/how-to-deglobalize/>

<sup>36</sup> Geoffrey Gertz, "How to Deglobalize," *Foreign Policy*, July 24, 2020, <https://foreignpolicy.com/2020/07/24/how-to-deglobalize/> and Nedal T. Nassar et al., "Evaluating the mineral commodity supply risk of the U.S. manufacturing sector," *Science Advances* 6, no. 8 (2020), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7035000/>. Also see the text for the Coronavirus Aid, Relief, and Economic Security (CARES) Act on the National Academies of Sciences, Engineering, and Medicine website: <https://www.nationalacademies.org/ocga/public-laws/coronavirus-aid-relief-and-economic-security-cares-act>.

reshoring, supply chain security, reversing deindustrialization, and competing with China.<sup>37</sup>

- **The U.S. government should undertake supply chain stress tests of companies in critical industries.** The proliferation of just-in-time manufacturing and lean production has reduced inventory in supply chains, leaving little "slack" in the system when confronted with foreign economic coercion, natural disasters, or other supply chain shocks. Just as the United States and European Union mandated stress tests for banks after the financial crisis, supply chain stress tests would involve efforts to determine how long a particular node in the supply chain could function after a supply shock and how long it might take to recover normal functionality.<sup>38</sup>

## 2. Coordinating Economic Policy and Strategy

- **The U.S. Congress should consider mandating a quadrennial national strategy on competitiveness and resilience.** The United States government has published a series of annual strategy reports, including the Quadrennial Defense Review (now the National Defense Strategy), the Quadrennial Diplomacy and Development Review, the Quadrennial Energy Review, the Quadrennial National Health Security Review, and roughly a dozen strategic plans for various U.S. government departments, among other efforts. Vanderbilt Law Professor Ganesh Sitaram has proposed a similar effort for U.S. competitiveness. The document and the process of drafting it could help create sustained attention on U.S. economic and technological leadership, align various agencies, and force long-term thinking about domestic and international trends.<sup>39</sup>
- **The U.S. Congress should consider various models that could integrate the U.S. government's various economic agencies and ensure coordinated approaches to competitiveness and resilience:** When Taiwan sought to reshore supply chains based in China, the government created a "one-stop shop" within one of its ministries for that very purpose, thereby streamlining corporate engagement with Taiwan's government and ensuring timely and comprehensive and bespoke attention to various challenges each company faced. Other governments that pursue technology policies or industrial policies similarly integrate a wide range of economic agencies within mission-specific offices or even entire ministries. Similar approaches could be considered within the U.S. government. On the modest side, these approaches might involve offices comprised of economic officials from a variety of agencies with a specific and discrete task, such supply chain reshoring or diversification. As the Brookings Institution scholar

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<sup>37</sup> "Comprehensive List of the Commission's Recommendations," from *2019 Report to Congress of the U.S.-China Economic and Security Review Commission* (Washington, DC: U.S.-China Economic and Security Review Commission, 2019), <https://www.uscc.gov/sites/default/files/2019-11/2019%20Recommendations%20to%20Congress.pdf>, 538.

<sup>38</sup> David Simchi-Levi and Edith Simchi-Levi, "We Need a Stress Test for Critical Supply Chains," *Harvard Business Review*, April 28, 2020, <https://hbr-org.cdn.ampproject.org/c/s/hbr.org/amp/2020/04/we-need-a-stress-test-for-critical-supply-chains>. Also see Gertz, "How to Deglobalize."

<sup>39</sup> Ganesh Sitaraman, "On Agency Structure," *American Compass*, June 10, 2020, <https://americancompass.org/essays/on-agency-structure/>.

Geoffrey Gertz has noted, the United States Commercial Service assists firms with exports while other entities work to attract foreign investment.<sup>40</sup> Similar entities could presumably be created to focus on reshoring or diversification. On the expansive side, as some like Ganesh Sitaram suggest, this could involve a reorganization and streamlining of U.S. economic agencies to better implement “industrial policy” or national strategies for competitiveness and resilience, with strong protections to ensure accountability and prevent capture.<sup>41</sup>

### 3. *Boosting American Strengths in Immigration and R&D*

- **The U.S. Congress should facilitate high-skilled immigration to the United States:** American openness is an enormous strength that has long allowed the United States to attract the best foreign minds to bolster its science and technology capabilities. U.S. labs at the forefront of the Fourth Industrial Revolution largely depend on graduate students from a wide range of countries. For example, roughly 80% of graduate students in electrical engineering and computer science are foreign nationals.<sup>42</sup> Most prefer to stay in the United States following the completion of their degrees - with vast majorities staying a decade after graduation - though increasingly many are unable to do so.<sup>43</sup> Similarly, U.S. companies also rely on foreign talent to fill shortfalls in science and technology, though the total number of those visas has been capped since 2005 at 85,000, with only 20,000 reserved for those with graduate degrees.<sup>44</sup> Reforms are needed to ensure that the United States has access to the world’s best high-tech talent. Per a report by Georgetown’s Center for Security and Emerging Technology, the U.S. Congress should (1) raise the cap on H1-B visas; (2) automatically grant green cards (exempt from green card caps) to postgraduate degree holders, particularly in STEM; (3) emulate Canada’s dedicated post-graduation employment visa for international students; (4) create a visa program for entrepreneurial graduate students who wish to start companies after graduating; (5) codify the Optional Practical Training program in statute, among other policies.<sup>45</sup>

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<sup>40</sup> Geoffrey Gertz, “How to Deglobalize,” *Foreign Policy*, July 24, 2020, <https://foreignpolicy.com/2020/07/24/how-to-deglobalize/>

<sup>41</sup> Ganesh Sitaraman, “On Agency Structure,” *American Compass*, June 10, 2020, <https://americancompass.org/essays/on-agency-structure/>.

<sup>42</sup> “The Importance of International Students to American Science and Engineering,” National Foundation for American Policy, October 2017, <http://nfap.com/wp-content/uploads/2017/10/The-Importance-of-International-Students.NFAP-Policy-Brief.October-20171.pdf>.

<sup>43</sup> Boris Granovskiy and Jill H. Wilson, “Foreign STEM Students in the United States,” Congressional Research Service, November 1, 2019, <https://crsreports.congress.gov/product/pdf/IF/IF11347>. The report notes that, “According to the National Science Foundation’s 2017 survey of STEM doctorate recipients from U.S. IHEs, 72% of foreign doctorate recipients were still in the United States 10 years after receiving their degrees. This percentage varied by country of origin; for example, STEM graduates from China (90%) and India (83%) stayed at higher rates than European students (69%).”

<sup>44</sup> Ely Ratner et al., *Rising to the China Challenge: Renewing American Competitiveness in the Indo-Pacific* (Washington, DC: Center for a New American Security, 2020), <https://www.cnas.org/publications/reports/rising-to-the-china-challenge>.

<sup>45</sup> Remco Zwetsloot et al., *Keeping Top AI Talent in the United States: Findings and Policy Options for International Graduate Student Retention* (Washington, DC: Center for Security and Emerging Technology, 2019), <https://cset.georgetown.edu/wp-content/uploads/Keeping-Top-AI-Talent-in-the-United-States.pdf>, 29-35.

- The United States Congress should increase federal R&D spending by four-fold to keep pace with China, and it should ensure increases go beyond the life sciences.** Federal R&D spending has declined for decades. As a percentage of GDP, the U.S. federal government spends only .61% of GDP on R&D – the percentage is one of the lowest in seventy years, lower than ten other science powers, and lower even than pre-Sputnik funding. Moreover, half of federal R&D spending goes to life sciences alone.<sup>46</sup> While it is true that business has contributed significantly to U.S. R&D spending, particularly in applied research, basic research generally comes from the federal government and has historically formed the foundation for major breakthroughs – including radar, computing, and nuclear power.<sup>47</sup> One more recent example, as economist Jonathan Gruber notes, is the \$3 billion Congress spent beginning in the 1980s to map the human genome. That investment catalyzed the genomics industry, which employs 280,000 people in the United States and generates taxes of \$6 billion annually.<sup>48</sup> Meanwhile, as U.S. government research spending falls, China’s is growing rapidly and may well exceed 2.5% of GDP in coming years. For that reason, a doubling or tripling of federal research spending is in order, would allow us to keep pace with China, and would restore us to levels last seen in the 1960s.

#### 4. Reforms to Stimulate Long-Term Planning and Competition

- The U.S. Congress should consider anti-monopoly measures to build U.S. resilience in critical industries:** True resilience requires ensuring that the United States has several viable competitors in any given industry, particularly those essential to American health and security. At the innovation frontier, companies frequently make bets about the progress of future technology, some of which prove prescient and others of which prove mistaken. When only one state champion is left in a given industry, the price of making the wrong bet can be devastating for the wider economy and for the country’s technological leadership. In contrast, when there are multiple companies operating in a critical industry, the odds that one will make the right bet and sustain the country’s leadership in that industry are far greater. When market structure sometimes complicates efforts at ensuring competition, Congress can assist weaker competitors, a policy approach it has used in the past to ensure a competitive defense industrial base.<sup>49</sup> Then, as now, competition between leading firms in these essential industries is more likely to produce lower prices, higher quality products, industrial resilience, and greater innovation – advantaging the United States relative to outright mercantilist competitors with one leading state champion.

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<sup>46</sup> James Pethokoukis, “US federal research spending is at a 60-year low. Should we be concerned?,” American Enterprise Institute, May 11, 2020, <https://www.aei.org/economics/us-federal-research-spending-is-at-a-60-year-low-should-we-be-concerned/>.

<sup>47</sup> M. Anthony Mills and Mark P. Mills, “The Science Before the War,” *The New Atlantis* (Winter 2020), <https://www.thenewatlantis.com/publications/the-science-before-the-war>.

<sup>48</sup> James Pethokoukis, “Jonathan Gruber on jump-starting breakthrough science and reviving economic growth: A long-read Q&A,” American Enterprise Institute, June 3, 2019, <https://www.aei.org/economics/johnathan-gruber-on-jump-starting-breakthrough-science-and-reviving-economic-growth-a-long-read-qa/>.

<sup>49</sup> Matt Stoller, *Goliath: The 100-Year War Between Monopoly Power and Democracy* (New York: Simon & Schuster, 2019).

- The U.S. Congress should consider financial sector and tax policy reforms that reduce the short-termism of corporate America and encourage a focus on longer-term decision-making:** The shareholder revolution of the 1980s helped usher in a focus on returns on capital at the expense of longer-term planning. Most shares of stock are held for less than a year now compared to eight years in the 1950s; CEO tenure is now near a historic low of roughly five years; and the pressure to generate financial returns often disincentivizes manufacturing relative to other more lucrative business activities. Efforts to adjust the institutionalized “short-termism” of U.S. capital markets will be difficult and controversial, but some prominent executives like JPMorgan Chase CEO Jaimie Dimon and Berkshire Hathaway CEO Warren Buffet are publicly supportive. As Michael Brown, Eric Chewning, and Pavneet Singh note in an April report from the Brookings Institution, Congress could incentivize the creation of new benchmark metrics that include longer timeframes as well as tax policy that encourages holding equity positions for longer periods.<sup>50</sup>

## 5. *International Efforts with Like-Minded Stakeholders and in Key Institutions*

- The U.S. Congress should encourage greater basic science research collaboration between the United States and its key allies and partners, who together comprise two times more spending than China.** Basic science research is already an increasingly international endeavor, and U.S.-China scientific cooperation is increasingly common. But while the United States and China spend roughly equivalent amounts on R&D presently, the combined total spent by Japan, Germany, South Korea, India, France, and the UK exceeds the U.S. and China respectively. The U.S. Congress should relax some of the people-to-people impediments to greater allied and partner collaboration (e.g., visa policies) while also encouraging basic science research organizations to engage more with allies and partners. Greater diffusion across allied and partner channels could help sharpen the American technological edge, allowing the country to benefit from others. Moreover, formal partnerships could involve efforts to “set standards and values around sharing data, transparency, reproducibility and research integrity,” as Georgetown’s Center for Strategic and Emerging Technology argues.<sup>51</sup>
- Congress should support efforts to advance coordinated domestic and multilateral approaches to standard setting:** While many standard-setting bodies are comprised of companies rather than countries, China’s top-down effort to shape standards requires a response from the U.S. government. This is particularly urgent during times when standard-setting processes might be inaugurating new paradigms in critical industries, including telecommunications (e.g., 5G-RAN) and the internet of things, that could long shape the future. First, Congress could support establishment of interagency working groups on standards that could coordinate internally. For example,

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<sup>50</sup> Michael Brown, Eric Chewning, and Pavneet Singh, “Preparing the United States for the Superpower Marathon with China,” The Brookings Institution, April 2020, [https://www.brookings.edu/wp-content/uploads/2020/04/FP\\_20200427\\_superpower\\_marathon\\_brown\\_chewning\\_singh.pdf](https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_superpower_marathon_brown_chewning_singh.pdf)

<sup>51</sup> Alison Snyder, “Allies could shift U.S.-China scientific balance of power,” *Axios*, June 18, 2020, <https://www.axios.com/scientific-research-expenditures-america-china-743755fe-3e94-4cd3-92cf-ea9eb1268ec2.html>.

OSTP could establish an interagency working group on technology standards that brings together the departments of State, Commerce, Justice, and Defense as well as the U.S. intelligence community and NIST - and that also consults with U.S. industry.<sup>52</sup> Second, to build coalitions among different companies and countries, Congress could support the establishment of offices within the departments of Commerce and State to coordinate U.S. approaches with like-minded stakeholders.<sup>53</sup>

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<sup>52</sup> Ely Ratner et al., *Rising to the China Challenge: Renewing American Competitiveness in the Indo-Pacific* (Washington, DC: Center for a New American Security, 2020), <https://www.cnas.org/publications/reports/rising-to-the-china-challenge>.

<sup>53</sup> Lindsay Gorman, “The U.S. Needs to Get in the Standards Game—With Like-Minded Democracies,” *Lawfare*, April 2, 2020, <https://www.lawfareblog.com/us-needs-get-standards-game%E2%80%94minded-democracies>.