

Testimony of

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Good afternoon Chairman Rubio, Ranking Member Cardin and members of the Committee; thank you for inviting me to share the views of the Information Technology and Innovation Foundation (ITIF) on the issue of unfair Chinese trade and technology policies and practices and what the federal government should do in response.

The Information Technology and Innovation Foundation is a non-partisan think tank whose mission is to formulate and promote public policies to advance technological innovation and productivity internationally, in Washington, and in the states. Recognizing the vital role of technology in ensuring prosperity, ITIF focuses on innovation, productivity, and digital economy issues. ITF has long focused on the issue of not only how unfair foreign policies and practices, particularly Chinese, negatively impact the U.S. economy, but why and how the federal government should establish a robust national competitiveness and innovation policy. I very much appreciate the opportunity to comment on these issues today.

In my testimony I first discuss the importance for a new framework for how to think about the economic challenge from China and the key points in this regard raised in the recent report from Chairman Rubio – “Made in China 2025 and the Future of American Industry”. Second, I discuss the nature of China economic challenge from “Made in China, 2025.” Finally, discuss components for more robust trade, innovation and competitiveness strategies, including components to help small businesses.

The Importance of a New Doctrine for Responding to the Economic Challenge From China

Before discussing some of the major issues vis-à-vis China’s “Made in China, 2025” program, I would like to first comment on a number of major points made in Chairman Rubio’s report. The report makes a number of critical points that are all too often ignored or misunderstood. The development of widespread clarity and agreement on these points is the single most important task facing the Washington economic and trade policy making community today.

First, the report highlights the need for a wake-up call when it comes to understanding the nature and extent of the economic threat from China. Until recently, the Washington trade and economic policy establishment largely turned a blind eye to the China challenge, perversely arguing either that China’s unfair trade and economic practices helped the U.S. economy by keeping prices low or that the effects were inconsequential.¹ Even after China has gained global market share in a number of extremely complex, advanced technology industries like jet aircraft, high-speed rail, solar panels, personal computers, supercomputers, telecommunications equipment, and internet services, many still dismiss China’s capabilities and assume China will be incapable of even partial success meeting their aggressive MIC25 goals. While mastery of some particularly complex technologies like semiconductor logic circuits remains a challenge for China, Chinese companies have made significant progress in an array of other technologies, including in some kinds of semiconductors (e.g., chips for internet-of-things devices). Moreover, the fact that nations like Japan in the 1960s and 70s and Taiwan and South Korea in the 1980s and 90s could rapidly progress to become advanced technology economies suggests that there is nothing inherently keeping a nation like China from making similar progress, especially given the massive amount of government support for the effort.²

Second, the report rightly notes that globalization can be harmful not just to some U.S. workers, but to the U.S. economy overall if it is based on unfair, predatory trade practices. Yet, the Washington trade and economics community persists in advancing a narrative that while trade may hurt some workers, regions, firms or industries, overall it is a net positive for the U.S. economy as a whole. Many even argue that one-sided free trade, where America obeys the rules and our competitors do not, is still welfare maximizing. This is wrong. To be sure, two-sided free trade – like trade between Mexico, Canada and the United States – is welfare maximizing for the United States, but trade with nations like China, whose entire trading system is based on “innovation mercantilism,” reduces U.S. economic welfare. Foreign mercantilist trade practices, especially those designed to challenge America’s core competitive advantage in higher-wage, innovation based industries harm not just a few “losers” from trade, but the entire U.S. economy. Thus, as the Rubio report rightly calls for, it is time to move “beyond the false choices poised about economic growth and trade.” For too long, the Washington trade community established set up a Manichean choice: one was either for free trade or protectionism. In fact, one can and should be for free trade and against foreign protectionism.

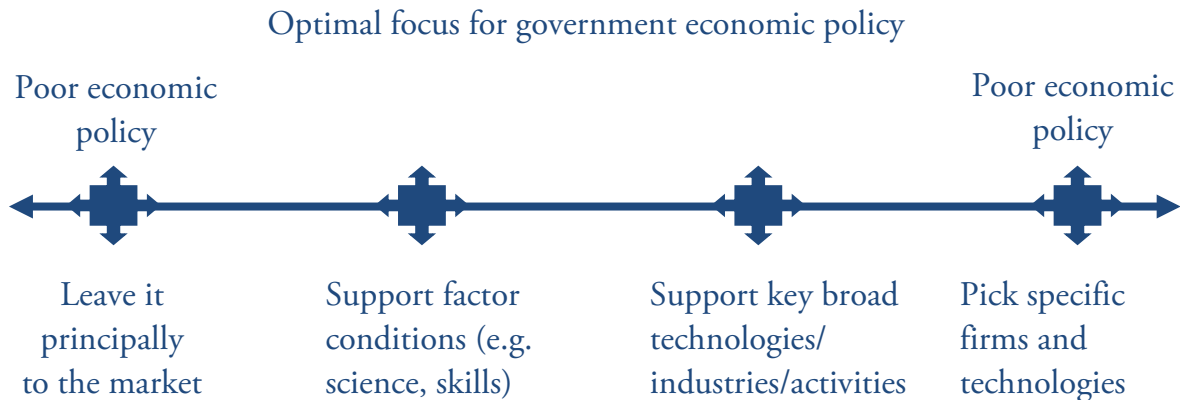
Third, the report rightly notes that it is a mistake to posit only two choices: laissez faire, free-market capitalism vs heavy-handed “industrial policy”. This choice was always a false one, but never more so than now. For U.S. governments (local, state or federal) to help companies in the United States, particularly in advanced industries, compete globally, especially against China, does not necessarily imply, as some on the right claim “inappropriate industrial policy” or as some on the left would claim wasteful “corporate welfare”. The reality, as every U.S. governor knows, regardless of political party affiliation, is that jurisdictions are now in intense competition for advanced industries, and that governments have to play a supportive role or risk losing those industries and the good jobs that come with them. Therefore prioritization of the high-wage industries of the 21st century, as the report calls for, is not some kind of statist, misallocation of resources, but rather needs to be a core component of 21st century statecraft, one that the Washington economic policy community sorely needs to improve its understanding of and capabilities for.

Because this point of the appropriate role for government is so poorly understood and even actively opposed by many in the economic policy community, it’s worth elucidating it. Notwithstanding the efforts of rigid free-market economists to blur the differences between smart industrial policy and heavy-handed, distorting industrial policies, there are real differences. To illustrate this, it is useful to envision a continuum of government-market engagement, increasing from left to right in four steps: from (1) a “laissez-faire, leave it to the market” approach; to (2) “supporting factor conditions for innovation;” to (3) “supporting key broad technologies/industries”; to (4) “picking specific technologies/firms” (for example, supporting ABC Widget company as a national champion and picking XYZ kind of battery technology, rather than storage technology generally) (see figure 1). Only the last type of actions qualify as inappropriate “industrial policy.” As the Rubio report points out there is a range of activities between these two poles that governments can and should take to spur innovation and competitiveness.

Finally, the report rightly notes that the choice should not be between working to roll back Chinese innovation mercantilism and spurring more innovation and productivity at home. Some who resist taking firm steps against Chinese policies and practices argue that only the latter is needed. Others who eschew a stronger federal rule in spurring competitiveness, including support for the public investment that must

accompany that policy, argue that getting touch with China is enough. The reality is that the federal government will not restore the promise of the American dream if it does just one or the other. It must do both: roll back Chinese innovation mercantilism and put in place a robust national innovation and competitiveness policy.

Figure 1: Continuum of Government Market Engagement



The Challenge From “Made in China 2025”

Today the United States leads in the fifth industrial revolution (information technology) and hopes to lead in the sixth (artificial intelligence, robotics, biotechnology, etc.), but a major threat to our leadership is from China’s unfair and harmful trade and technology policies. China is seeking global technology dominance in an array of advanced technology industries through an unprecedented array of predatory economic and trade policies and practices. The world has never seen a country like China before, with its organized and strategic system of authoritarian state capitalism and massive scale. It is not a market economy where private sector firms largely dictate their own strategy and actions. It is not a country governed by the rule of law. It is not a country constrained by global norms of acceptable economic and trade behavior. It is a country where the government is concerned with one and only one economic goal: winning in advanced technology industries by any means possible.

As ITIF has documented across a series of reports—including “False Promises: The Yawning Gap Between China’s WTO Commitments and Practices,” “Enough is Enough: Confronting Chinese Innovation Mercantilism,” and “Stopping China’s Mercantilism: A Doctrine of Constructive, Alliance-Backed Confrontation”—China has deployed a vast panoply of innovation mercantilist practices that seek to unfairly advantage Chinese advanced-industry producers over foreign competitors.³ These practices have included forced technology transfer and forced local production as a condition of market access; theft of foreign intellectual property (IP); curtailment and even outright denial of access to Chinese markets in certain sectors; manipulation of technology standards; special benefits for state-owned enterprises; capricious cases to force foreign companies to license technology at a discount; government subsidies of Chinese companies, and government-subsidized acquisitions of foreign enterprises. U.S. and foreign enterprises across virtually every

advanced technology sector—from aerospace and biotechnology to information and communications technology (ICT) products, Internet, clean energy, and digital media—have been harmed by China’s aggressive use of these types of innovation mercantilist policies and will continue to be harmed if China cannot be pressured to roll back its egregious predatory practices.

In the last few years, though, the focus of China’s efforts has shifted. In 2015, Chinese President Xi Jinping unabashedly trumpeted a goal of making China the “master of its own technologies.”⁴ China’s arrival at that point resulted from the evolution of Chinese economic policy over the past two decades. Up to the mid-2000s, China’s economic development strategy sought principally to induce foreign multinationals to shift relatively low- and moderate-value production to China.⁵ It used an array of unfair tactics, including currency manipulation, massive subsidies, and limits on imports. As ITIF and others such as MIT’s David Autor have shown, the cost the United States millions of manufacturing jobs.⁶ However, that strategy changed in 2006 as China moved to a “China Inc.” development model of indigenous innovation which focused on helping Chinese firms, especially those in advanced, innovation-based industries, often at the expense of foreign firms. Marking the shift was a seminal document called the “National Medium- and Long-term Program for Science and Technology Development (2006-2020),” which called on China to master 402 core technologies, everything from intelligent automobiles to integrated circuits and high-performance computers.

In recent years President Xi has doubled down on this approach, through new promulgations such as the “13th Five-Year Plan for Science and Technology,” the “13th Five-Year Plan for National Informatization,” “The National Cybersecurity Strategy,” and of course, the “Made in China 2025 Strategy.” As the Mercator Institute for China Studies in Germany writes, “Made in China 2025 in its current form [means that] China’s leadership systematically intervenes in domestic markets so as to benefit and facilitate the economic dominance of Chinese enterprises and to disadvantage foreign competitors.”⁷ For instance, with regard to ICT-enabled manufacturing the strategy calls for 80 percent domestic market share of high-end computer numeric controlled machines by 2025; 70 percent for robots and robot core components; 60 percent for big data; 60 percent for IT for smart manufacturing; and 50 percent for industrial software.⁸

Unfair Policies and Practices Underpin “Made in China 2025”

At the heart of China’s strategy is foreign technology acquisition. The Chinese leadership knows that if it just relies on market forces few if any foreign technology leaders will provide them with the technology Chinese firms need. And domestic Chinese firms, while making progress, lag behind the global technology leaders. As a result, China has deployed a panoply of tools to unfairly obtain needed foreign technology. Once it obtains technology it relies on an array of tools, including protected markets and massive subsidies, to scale up and gain global market share.

Intellectual Property Theft: Intellectual property theft is an important tool in the Chinese arsenal. China has deployed industrial spies to obtain foreign secrets. As the *New York Times* documented, a leading Chinese computer chip maker allegedly paid employees of a Taiwanese chip company working with the U.S. company Micron to steal valuable chip designs.⁹

Another vector is cyber theft. Seven percent of U.S. firms operating in China listed cyber theft as a problem, a number that presumably would be higher if every firm that had faced an intrusion was aware of it.¹⁰ The *IP Commission Report on the Theft of U.S. Intellectual Property* found that China accounted for nearly 80 percent of all IP thefts from U.S.-headquartered organizations in 2013, amounting to an estimated \$300 billion in lost business annually.¹¹ An updated 2017 Commission report put the figure at \$600 billion.¹² Then NSA Director Keith Alexander has called Chinese IP theft, “the greatest transfer of wealth in history.”¹³ Even though President Xi made “commitments” to end Chinese cyber-theft, there is little evidence that the Chinese have followed through on this promise. As the China the National Counterintelligence and Security Center stated in its “2018 Foreign Economic Espionage in Cyberspace” report:

China has expansive efforts in place to acquire U.S. technology to include sensitive trade secrets and proprietary information. It continues to use cyber espionage to support its strategic development goals—science and technology advancement, military modernization, and economic policy objectives. China's cyberspace operations are part of a complex, multipronged technology development strategy that uses licit and illicit methods to achieve its goals.¹⁴

Meanwhile, China still has one of the highest rates of unlicensed software usage in the world, with 74 percent of the software in use unlicensed and the market value of unlicensed software usage exceeding \$8.7 billion in 2013.¹⁵ 240,000 Internet cafés in China rely on illegal copies of entertainment software.¹⁶ Chinese firms even produce and sell technology to allow consumers around the world to circumvent encryption protection so they can pirate video games.

Another vector for purloined intellectual property is to trick companies in the United States into thinking that a Chinese firm wants to invest in them. A seemingly independent Chinese investment fund will approach a small to mid-sized U.S. technology company and indicate a willingness to invest needed capital in the company. But before the Chinese company can do this, they must do due diligence and they send in employees, who turn out to work for a state-owned Chinese company, to obtain key information about the company, including trade secrets. The firm never hears back from the investment company again.

Another path is through exchange visits and student enrollments in U.S. universities. At least at one time, it was common for Chinese exchange visitors to the United States to use opportunities to visit factories and other facilities to engage in industrial espionage, including measuring equipment, taking photos and writing detailed technical notes to bring back to China. And as Daniel Golden writes in *Spy Schools* there have been cases where Chinese graduate students enrolled in U.S. universities use their access to valuable scientific and engineering information to bring that back and provide it to Chinese companies.¹⁷

Chinese trade secret theft also represents an increasing challenge. A prime example is Boston-based American Superconductor (AMSC), which provides software, design, and hardware solutions for wind manufacturers and energy providers. American Superconductor's top customer, the Chinese-based wind turbine manufacturer Sinovel Wind Group, faced criminal and civil actions for paying an AMSC employee to steal proprietary power-converter and control-system software, which it then used illegally in its wind turbines to meet electricity grid standards.¹⁸ The employee, an engineer at one of AMSC's subsidiary's, was recently

found guilty of industrial espionage in Austria. In another telling case, the global agriculture firm Monsanto decided to open production and research facilities for advanced corn technology in China and proceeded to develop experimental fields growing genetically enhanced corn. It wasn't long before the advanced corn was systematically stolen, clearly an effort by the Chinese government to gain access to the IP embedded in Monsanto's corn.¹⁹

Weak IP Enforcement: Weak enforcement of IP law is another vector. Chinese firms can often copy and reengineer foreign technologies with impunity (what they call introducing, digesting, absorbing and re-innovating), even those technologies protected by patents. As a *MIT Sloan Management Review* article, "Protecting Intellectual Property in China," noted, "Intellectual property protection is the No. 1 challenge for multinational corporations operating in China."²⁰ According to the U.S. International Trade Commission, in 2009, U.S. IP-intensive enterprises conducting business in China reported losses of approximately \$48.2 billion in sales, royalties, or license fees due to Chinese IPR infringement.²¹ In 2018, according to the American Chamber of Commerce in China, one-quarter of surveyed U.S. companies cited "Insufficient protection offered by text of IP-related laws and regulations," while 24 percent cited, "Difficulty prosecuting IP infringements in court or via administrative measures" as significant challenges.²²

China also favors domestic over foreign patent applicants when it comes to strategic industries. As the 2016 report "Technology Protectionism and the Patent System: Strategic Technologies in China," finds, "Foreign applications in technology fields that are of strategic importance to China (as defined by being listed on the MLP) are 4 to 7 percentage points less likely to be approved than local applications, all else equal."²³ As it notes, "Given the importance of industrial policy in China and the country's strong focus on indigenous innovation and intellectual property, the empirical results provide a case of technology protectionism by means of the patent system."²⁴

State-Backed Purchases of U.S. Technology Companies: An increasingly important way for Chinese firms to gain access to needed technology is to simply buy up U.S. technology companies or invest in high-tech startups. Indeed, until recently, a not-insignificant share of Chinese foreign direct investment into the United States was in technology industries. According to Select USA, the top four industrial categories in terms of numbers of Chinese FDI projects from 2003 to 2015 were electronics, industrial machinery, software and information technology services, and communications.²⁵ The Rhodium Group reports that over the last 16 years there has been roughly \$18 billion of Chinese FDI into ICT and electronics industries deals, with most of that in just the last few years. Of the \$4.9 billion invested in electronics, \$4.2 billion was invested in 2016, with 99.99 percent of that going to buy U.S. firms.²⁶ Of the \$14.2 billion invested in ICT, 74 percent was made from 2014 to 2016, with more than 95 percent going to acquisitions.²⁷ These numbers would have been considerably larger if the federal government had not informally or formally blocked some deals through the Committee on Foreign Investment in the United States (CFIUS). Fortunately, Chinese inward FDI has dramatically fallen in the last two years as it became clear that the U.S. government would take a harder look at their attempts to buy U.S. technology. And of course, the recent enactment of the Foreign Investment Risk Review Modernization Act (FIRRMA) will hopefully help even more going forward.

The role of Chinese government money in U.S. deals is underreported in part because of the opaque nature of this support. As Wang and Wang note, many Chinese firms lack transparency, making it difficult for host countries to know enough about the investing firm.²⁸ This was evident for example in the attempted purchase of German semiconductor equipment firm Aixtron by a Chinese investor where there were “a web of relations among the customer, the buyer, and the Chinese state.”²⁹ Moreover, the Chinese government channels funds to supposedly private investment bodies, making it look as if these deals are commercial.

The main purpose of most Chinese technology companies buying U.S. technology companies is not to make a profit, but to take U.S. technology to upgrade their own technology capabilities. The Rhodium Group notes that in the aviation sector, “The dominant player is aviation conglomerate AVIC, which is looking to the US market to upgrade its technology and other capabilities.”³⁰ Likewise, in the electronics and electrical equipment sector, “Chinese investors are drawn to the US electronics and electrical equipment sector for building their brands, expanding their sales and distribution channels, and upgrading their innovative capacity and technology portfolios.”³¹ Investments in pharmaceuticals and biotechnology are “often driven by upgrading technology (such as Wuxi’s acquisition of AppTec, a laboratory services firm).”³² As one study of Chinese FDI estimated, 30 percent of the private firm deals and 46 percent of the SOE deals are motivated by technology acquisition.³³ The authors go on to state that Chinese acquisition of overseas firms “has become the most widely used methods [of investing overseas] for Chinese firms, largely because it provides rapid access to proprietary technology.”³⁴

China has also ramped up its efforts to buy into early-stage U.S. technology start-ups. A recent report from DOD’s Defense Innovation Unit Experimental (DIUx) finds that “Chinese participation in venture-backed startups is at a record level of 10-16% of all [U.S.] venture deals (2015-2017) and has grown quite rapidly in the past seven years.”³⁵ And some of this investment comes from venture firms that are backed by Chinese governments (federal or provincial). For example, the Zhongguancun Development Group, a state-owned enterprise headquartered in Beijing has set up “Danhua capital” to promote the strategy of “Zhongguancun capital going global and bringing in overseas advanced technology and talents.”³⁶ Likewise, Shenzen Capital Group, a purportedly private venture capital firm that has invested in at least one advanced U.S. technology company,³⁷ has actually received about 80 percent of its invested capital from the Chinese government,³⁸ and its investments are focused, not surprisingly, to match the central governments key targeted industries. The firm even boasts a chart that compares the technology allocation of its investments and how it compares to the governments priorities.³⁹

FDI acquisition is not the only path to U.S. technology capabilities. For example, China is investing in U.S. research universities to gain access to their research, often with U.S. state government-backing. For example, Maryland is committing nearly \$600,000 over three years to build up the Maryland International Incubator, in a bid to attract high-tech companies from China and elsewhere to collaborate with University of Maryland researchers. Of the 18 companies in the incubator, nine are from China, with most of these being biotech companies.⁴⁰ In addition, Chinese firms have become investors in early stage U.S. technology companies. These include the venture capital arms of Chinese Internet companies such as Alibaba or Tencent. The idea is to invest in start-ups and use that as a way to bring technology and knowledge back to China. Indeed, at least a few Silicon Valley experts report that they are seeing a significant uptick in Chinese venture investment in

Silicon Valley. In just the first three months of 2018, Chinese-based venture-capital funds invested \$1.4 billion into U.S. biotechnology companies.⁴¹ This trend could very well increase in coming years as China sees that its traditional acquisition route becomes more difficult. We see this pattern in other nations as well. 40 percent of venture capital in Israel in 2015 reportedly came from China.⁴²

Forced Technology Transfer: Dwarfing these tools is forced technology transfer. Although China's World Trade Organization (WTO) accession agreement contains rules constraining it from tying foreign direct investment or market access to requirements to transfer technology to the country,⁴³ China routinely requires firms to transfer technology in exchange for being granted the ability to invest, operate, or sell in China.⁴⁴ As Harvard Business School professors Thomas Hout and Pankaj Ghemawat document in "China vs the World: Whose Technology Is It?," Chinese technology transfer requirements as a condition of market access have affected scores of companies in industries as diverse as aviation, automotive, chemicals, renewable energy, and high-speed rail.⁴⁵ To be sure, because such conditions usually contravene China's WTO commitments, officials are careful not to put such requirements in writing, usually resorting to oral communications to pressure foreign firms to transfer technology.⁴⁶ In 2012, 23 percent of the value of all foreign direct investment projects were joint ventures.⁴⁷ And the U.S.-China Business Council's "2014 China Business Environment Survey" reports that 62 percent of companies had concerns about transferring technology to China, while 20 percent reported that they had been requested to transfer technology to China within the past three years.⁴⁸

Forced technology transfer is not new. A 1987 Congressional Office of Technology Assessment report states, "Although most U.S. firms approach the China market with the intent to sell products, many find they must include technology transfer if they wish to gain access to the China market."⁴⁹ But what is new are two things. First, there are more foreign companies seeking to get in the Chinese market, such that the scale of forced technology transfer is much larger than it was two decades ago. In 2015 for example, 6,000 new international joint ventures, amounting to \$27.8 billion of FDI inflows, were established in China.⁵⁰

Second, the sophistication and value of the technology the Chinese government is now demanding is significantly higher than in decades past when U.S. companies could afford to give their Chinese "partners" older generations of technology, confident that the U.S. firms could innovate faster. Now for many foreign advanced industry companies, doing business in China requires transferring ever-more valuable technology to Chinese joint venture partners. In 2013, 35 percent of U.S. business respondents in China said that tech transfer requirements were a concern, and 42 percent in advanced technology industries voiced this concern.⁵¹ Fifty-six percent of survey respondents who gave a response thought that tech transfer requirements were increasing.⁵² And as USTR points out in its 301 report on China, it is likely that these numbers are under-reported.⁵³

The Chinese government has employed the weapon of forced technology transfer to gain technological know-how in a variety of industries. A well-known case in point concerns high-speed rail. Over the past 15 years China built the largest high-speed rail network in the world. That massive purchase of rolling stock, signal systems, and related equipment was something no foreign rail producer could afford to ignore. As such, the Chinese government had enormous leverage to pressure foreign producers to give the Chinese state-owned

enterprise competitors key technology and IP. The Chinese term for this is “exchanging market for technology.”⁵⁴ As Chen and Haynes document, in 2004 the State Council of China adopted a new railway development strategy that shifted from just subsidizing domestic producers in order to help them improve their technology to one where they “introduce advanced technology through joint design and manufacturing, [with an ultimate objective to] to build a Chinese brand.”⁵⁵ After that the state Ministry of Railways (MOR) launched three tenders for foreign high-speed electric trains and in each one MOR stipulated that foreign companies had to collaborate with domestic partners in the competition and had to transfer key technologies to achieve localization.¹⁶ The tender included two key conditions: to win, the bidder had to transfer technology to China and the final products had to be marketed under the Chinese state-owned enterprise rail car brand. This was all in support of the government’s “Action Plan for the Independent Innovation of Chinese High-Speed Trains.” As a result, multiple foreign train companies were pressured to transfer valuable technology to the Chinese companies (now principally one company due to the central government forcing the two main companies to merge into a powerful national champion, Chinese Railway Construction Corporation, now the largest rail producer in the world.) As Chen and Haynes write, “The result is a new HSR [high speed rail] industry in China has emerged which now serves the new vast HSR network and looks externally to export its new skill in HSR production and its new cutting-edge activity in HSR innovations.” Not only are CRCC and related Chinese companies virtually guaranteed all Chinese rail projects, but CRCC is now aggressively exporting trains and train systems containing advanced foreign technology to other nations, backed with generous export subsidies from the central government. For example, the China Export-Import Bank (a state agency) announced in 2017 the equivalent of \$30 billion in financing assistance for CRCC exports.⁵⁶ (Surprisingly, the U.S. Department of Commerce International Trade Administration, in its document promoting U.S. rail export opportunities to China, makes no mention of the fact that the lion’s share of these opportunities come with forced technology transfer requirements.⁵⁷)

The Chinese have employed different tactics to the same end in the biopharmaceutical industry, where various policies enable Chinese firms to get access to U.S. technology. For example, the relatively short six-year term for data exclusivity, coupled with the lack of a formal definition of a “new chemical entity,” means the Chinese government can pressure U.S. firms to turn over important data to Chinese generic drug firms. Similarly, the Chinese government requires that any drugs sold in China must go through Chinese clinical trials, even if they are approved in the United States. This extends the time for sales before a company can sell a drug by as much as 8 years, meaning that the company has only 12 years left of patent-protected sales in China before a Chinese generic company can copy the drug. Moreover, in China, unlike the United States and Europe, there is no extension of marketing exclusivity at the back end to take into account long clinical trial delays. Moreover, China also issues compulsory licenses for the intellectual property for particular drugs.⁵⁸ Finally, it presses foreign biopharmaceutical companies to form joint ventures if they want their drugs more easily put on the government list of drugs to qualify for reimbursement.⁵⁹

We also see this in cloud computing. China requires companies running cloud-computing operations to be locally controlled. This means that if a company like Amazon Web Services or Microsoft wants to serve the rapidly growing Chinese market it must partner with a Chinese company and sell their services under the Chinese company brand. And as part of this partnership the expectation is that the foreign cloud provider will provide the Chinese firm with technology and know-how.⁶⁰ Chinese cloud providers, like Aliyun, the cloud

services unit of Alibaba, is able to establish its own data centers in the United States without any similar requirements.

Subsidies: Once Chinese firms gain access to needed foreign technology, the next step of the Chinese strategy is to ensure that they have the capital needed to scale up. This involves direct and indirect subsidies and also designing markets protected from foreign competition so the Chinese firms can accumulate capital. Once firms have the technology, competencies and scale to go global, the government often subsidizes global market expansion, such as through the China Export-Import Bank (an entity the World Bank has funded) and China's Export and Credit Insurance Corporation (Sinosure).⁶¹ Moreover, by leading to global overcapacity and selling below cost, China uses that overcapacity as a cudgel to disrupt the economics of innovation-based industries (i.e., subsidized competition prevents foreign competitors from earning reasonable profits from one generation of innovation to reinvest in future generations of innovation) and thus weaken foreign competitors, enabling Chinese firms to gain even more global market share.

The Chinese government also works to limit foreign competition for its budding national champions. For example, in the high-end equipment manufacturing sector, China maintains a program that conditions the receipt of a subsidy on an enterprise's use of at least 60 percent Chinese-made components when producing intelligent manufacturing equipment.⁶² And despite the fact that China "clarified and underscored ... that it agreed that enterprises are free to base technology transfer decisions on business and market considerations" at a December 2014 meeting of the United States-China Joint Commission on Commerce and Trade (JCCT), USTR notes that China has "announced two measures relating to [local procurement of] information technology equipment used in the banking services sector and in providing Internet- or telecommunications-based services more generally."⁶³

China also lavishes Chinese firms that have obtained foreign technology with massive subsidies. As George and Usha Haley document in their book, *Subsidies to Chinese Industry: State Capitalism, Business Strategy, and Trade Policy*, China's game plan has long been to "aggressively subsidize targeted industries to dominate global markets." As they document, in the 2000s, China provided almost \$100 billion in subsidies to just three industries alone: \$33 billion for paper, \$28 billion for auto parts, and \$27 billion for steel.⁶⁴ China's share of global solar panel exports grew from just 5 percent in the mid-2000s to 67 percent today, with Chinese solar output turbocharged by at least \$42 billion of subsidies from 2010 to 2012 alone.⁶⁵ China now wants to replicate this strategy in other advanced-technology industries, such as semiconductors and electric batteries.⁶⁶ For instance, China's National Integrated Circuit (IC) Strategy calls for at least \$160 billion in subsidies to create a completely closed-loop semiconductor industry in China, including explicit plans to halve Chinese imports of U.S.-manufactured semiconductors by 2025 and eliminate them entirely by 2035. The "Made in China 2025 Strategy" is supported by some 800 state-guided funds to the tune of more than \$350 billion, including advanced-battery manufacturing, wide-body aircraft, and robotics.

Moreover, Chinese government-backed investment funds aim to control \$1.7 trillion, equal to one-third of the assets in the global private equity market.⁶⁷ Since the global financial crisis, the Chinese government has moved aggressively to stimulate capital investment that will strengthen its competitive position, both domestically and in global markets. First created in 2008, there are now more than 2,000

of these so-called “government guidance funds,” three-quarters of which have been established between 2015 and 2018. Having raised \$530 billion so far, the funds already represent a massive vehicle for Chinese governments to subsidize Chinese tech companies and acquire foreign tech companies under the guise of venture capital. And the goal is for them to more than triple in size: The funds have been tasked with leveraging \$1.7 trillion, which is 33 percent of the \$5.2 trillion that private equity firms now control globally.

What is at Stake?

Given China’s Made in China 2025 plan, it is no exaggeration to suggest that, without aggressive action, the United States may face a world within two decades where U.S. jobs in industries as diverse as semiconductors, computers, biopharmaceuticals, aerospace, Internet, digital media, and automobiles are significantly reduced due to Chinese policies unabashedly targeting domestic and global market share in those industries.

It is important to understand that the challenge to America’s leadership in technology-based industries is much different than the process of losing more commodity-based, low-skilled industries to China in the 2000s. If, for example, the value of the dollar was to fall significantly related to the yuan (and other currencies), it is possible that America could regain at least some of the production lost to China in industries like textiles and apparel, furniture, metal parts, and other similar low- and medium-value added products. Companies could simply buy machines, set up factories, and restart production domestically in a cost-effective way. But if America’s technology companies were severely weakened or even put out business, no currency decline could bring them back because competitiveness in technology industries is based less on cost and more on a complex array of competencies at the firm- and ecosystem-level. For example, a firm cannot simply buy some semiconductor equipment and start producing chips. To do that would require not just machines but deep and complex tacit knowledge embedded in the firm in workers (from the shop floor to scientists to managers) coupled with an innovation ecosystem (universities training the right talent, a network of suppliers, etc.). Once those capabilities are lost, they are essentially gone, and are very difficult to resurrect absent massive government intervention.

There is an additional reason why losing advanced technology industries is problematic. Most technology-based industries have high barriers to entry. In contrast to the t-shirt industry where entry largely requires just capital to buy sewing machines, entry into innovation-based industries requires both physical and intellectual capital. In an industry like semiconductors, for example, firms spend hundreds of millions, if not billions, of dollars developing technical capabilities to enable production. Producing the first chip of a particular generation is incredibly expensive because of the amount of R&D involved. Producing the second chip is much cheaper because only the material and labor costs are involved. In this sense, fixed costs are extremely high, but marginal costs are low. In these innovation-based industries losing market share to unfairly competing firms supported by their innovation mercantilist governments means two things. First, sales fall. This is true because global sales are largely fixed (there is only so much demand for semiconductors, jet airplanes, and other similar advanced products), and if a mercantilist-supported competitor gains market share, the market-based competitor loses share. Second, because profits decline more than sales, it is now more difficult for the market-based innovator to reinvest revenues in the next generation of products or

services, meaning that the mercantilist-supported entrant has an advantage in the next generation of products. This can lead to a death spiral whereby the market-based leader can lose complete market share.

A loss of advanced technology industries has two major negative impacts on the U.S. economy. The first is on prosperity, as the average wage in these industries is approximately 75 percent higher than average U.S. wages.⁶⁸ The second is on national security and the defense industrial base. U.S. defense superiority is based in large part on technological superiority. Our service men and women go into any conflict with the advantage of fielding technologically superior weapons systems. But maintaining that advantage depends on the U.S. economy maintaining global technological superiority, not just in defense-specific technologies but in a wide array of dual-use technologies. To the extent the United States continues to lose technological capabilities to China, U.S. technological advantage in defense over China will diminish, if not evaporate, as U.S. capabilities whither and Chinese ones strengthen. It is certainly a highly risky proposition to assume that the United States can continue its weapons systems superiority over the Chinese if: 1) the Chinese continue to advance, largely through unfair, predatory practices at the pace they are; and 2) the United States loses a moderate to significant share of its advanced technology innovation and production capabilities. As ITIF wrote in 2014, “The United States defense system is still the most innovative in the world, but that leadership is not assured and is in danger of failing. This decline is not only impacting defense innovation and capabilities, but also overall commercial innovation and U.S. competitiveness.”⁶⁹

What the U.S. Government Should Do

To respond to the challenge from MIC25, the federal government needs to do two main things: 1) more aggressively work to constrain and roll back the unfair parts of MIC25 and other Chinese government policies; and 2) institute stronger domestic policies to help firms in advanced industries increase output (and jobs) in the United States.

Roll Back Chinese Innovation Mercantilism

There are an array of policies that can be instituted that can limit the harm from Chinese policies on the U.S. economy and also exert pressure on the Chinese government to roll back its unfair policies. While I list several here, the most important is for the Washington policy community to work to identify and implement what an array of possible policy actions in an array of areas (e.g. financial regulation, trade law, intellectual property law, criminal enforcement, customs enforcement, etc.).

One step Congress can take is to instruct USTR to bring a WTO case against China over its ongoing failure to publish thousands of trade-related final measures, including subsidies, in a single official journal as it's required to do under WTO rules. One reason it's been difficult to bring subsidy cases against China at the WTO is that China fails to properly publish its subsidies. Getting the WTO to enforce China's publication requirements would make it possible to bring additional WTO cases for subsidy or other violations, such as forced IP or technology transfer.

The United States also needs a new regime to contest China's strict technology-licensing laws. Under Chinese contract law and technology import-export regulations (or TIER), a foreign licensor into China is obligated to offer an indemnity against third-party infringement to the Chinese licensee.⁷⁰ In other words, a foreign

licensor licensing into China has to provide insurance that practicing the licensed technology does not infringe any IP held by a third party. But, under TIER, this legal obligation only attaches to “technology import contracts.” That is, this obligation only attaches to a foreigner licensing technologies into China; the Chinese licensor has no such obligation. This discriminates against foreign licensors. The foreign licensor is legally bound to offer something that the Chinese licensee is not, making it difficult for small companies, companies which may experience high litigation risks in China’s litigious environment, and companies engaged in collaborative research and development (such as cross-licensing, open-source licensing, and charitable activities) to arrive at mutually beneficial licensing agreements. TIER makes it almost impossible for small companies, such as start-ups, to license their breakthrough technologies in China, because no start-ups (due to their limited resources) would be able to conduct the complex analysis required by China’s high-litigation environment and industrial policies that limit the value of foreign IP in order to offer insurance against third-party infringement disputes. While large multinational companies could avoid this issue by licensing technology (e.g., through their China-based subsidiaries), start-up companies cannot do so because they typically do not have subsidiaries in China. Consequently, the impact of the mandatory indemnification requirement on small- and medium-sized companies, and especially start-ups, is particularly acute.

Another provision in TIER mandates that in technology-import contracts, improvements belong to the party making the improvements, which typically is the Chinese licensee. Thus, foreign licensors, including U.S. firms, cannot negotiate to own any improvements or to share the improvements with Chinese licensees, even if both licensing parties desire for the improvements to be shared or owned by the foreign licensors. Moreover, TIER prohibits any technology-import contracts to “unreasonably restrict the export channels” of the Chinese licensee, thereby impeding the ability of the two licensing parties to allocate markets as they see mutually beneficial. Put simply, U.S. companies are obligated under TIER to let Chinese firms own the improvements and cannot freely negotiate with Chinese entities.

To address this discrimination, Congress should enact a regime whereby if Chinese entities seek licenses in the United States, then the Chinese enterprise must license on the same terms by which foreigners are required to license into China. Such legislation would specifically require the Chinese licensor to offer an indemnity against infringement by the U.S. licensee and to stipulate that the U.S. licensees are entitled to own the improvements they make and receive a reasonable market allocation under the licenses. Another possible approach would be for Congress to pass legislation requiring that the U.S. company whose original technology was improved by the Chinese entity receives an automatic exclusive license to use that improved technology [in the United States], such that the full potential of the original technology owned by the U.S. companies is not encumbered by improvements owned by the Chinese entity. Although technology-licensing law is usually a matter of state contract law, the legislation would be enacted pursuant to Congress’s power to legislate international commerce.

Congress should strengthen FBI-university partnerships to limit inappropriate IP transfer. The FBI should engage in a stronger partnership with U.S. research universities to help them better understand how to take steps to better identify students here for the purpose of intellectual property transfer and how to limit such access. The point is not to just limit access and transfer of sensitive military technology subject to deemed export controls, but also advanced technology that can help China compete with the United States. At the

same time, Congress should support FBI efforts to beef up and better target commercial counterintelligence resources to better help enterprises in the United States stop Chinese commercial espionage.⁷¹

Congress should work to establish stronger authorities to prohibit Chinese firms that are stealing IP from accessing the U.S. banking and financial system. For example, it should empower the Treasury Department to deny Chinese-headquartered enterprises access to listing on U.S. stock exchanges if they fail to provide financial statements in line with generally accepted accounting principles.

Congress should pass legislation that allows firms to ask the Department of Justice for an exemption to coordinate actions regarding technology transfer and investment to other nations. One of the key levers China has is that it's a monopsonist: its market is so large it can essentially compel foreign companies to hand over technology in order to sell their products in China. But if companies in a similar industry can agree that none of them will transfer technology to China in order to gain market access, then the Chinese government will have less leverage over them. The same would be true if companies agreed that they would not invest in China until China improved its IP protections. Such an amendment to antitrust law would be similar to the 1984 Cooperative R&D Act, which allowed firms to apply to form pre-competitive R&D consortia.

Congress should also stand up a new arm of DOJ's antitrust division focused on foreign government-enabled and led antitrust violations. Currently, DOJ can bring actions against foreign firms if they are found to be acting in an anticompetitive manner. DOJ needs to not only be able to but be willing to bring actions against foreign firms if their actions are helped by their state in a way that leads to anticompetitive results. In the case of China, its subsidies, forced technology transfer, IP theft, and other unfair actions give Chinese firms unfair advantages that distort markets in an anticompetitive manner. DOJ should be able to investigate cases and if they found a violation, bring those to an administrative law judge who would adjudicate the case and the damages the U.S. government could impose on the Chinese companies that benefited from the anti-competitive Chinese government policies or practices. The challenge will be that not all Chinese companies likely to have cases brought against them are involved in the U.S. market. But some are, and for the ones that aren't such a ruling would effectively preclude them from entering the U.S. market.

Take Stronger Actions to Support U.S. Advanced Industry Competitiveness

While policies and actions to roll back Chinese mercantilist actions are critical, the United States also needs to do much more to boost U.S. competitiveness at home. Congress should take efforts to limit Chinese efforts to manipulate its currency for competitive advantage, as it has done over the last year to suppress the price effects from the Trump administration tariffs on Chinese imports. Congress also need send clear signals to the Treasury Department that the official policy of the U.S. government should not be to maintain a strong dollar (meaning any value of the dollar stronger than what is needed to run balanced trade). A strong dollar hurts American workers, especially in traded sectors, by increasing the pressure on companies in the United States to keep wages low as a way to stay competitive. Rather the policy should be to work to lower the value of the dollar until U.S. trade is in balance, and then after that to let market forces determine currency levels.

But a more fairly valued dollar is not enough. Congress needs to consider policies to help U.S. companies boost productivity. As such, America needs its own "Invented and Made in America 2029" program where

the federal government identifies the technologies most important to America's national and economic security and allocates at least an additional \$25 billion annually to support their development.⁷² As part of this a key area is to work to improve U.S. manufacturing productivity growth, which in the last decade has been anemic, averaging about one-third of the growth rates of the prior two decades. Lagging productivity growth makes it harder to companies, especially in traded sectors to boost employee compensation. There are host of steps Congress can take to help firms, especially manufacturers boost productivity, including significantly boosting funding of NIST's Manufacturing Extension Partnership program, expanding the number of and funding duration of the Manufacturing USA Institutes, boosting funding for NSF's National Robotics Initiative, and establishing a program to fund community colleges to establish robotic test bed and training facilities that small manufacturers and workers could access.

There are other actions to consider, many of which ITIF has detailed in its report "The Competitive Edge: A Policymaker's Guide to Developing a National Strategy."⁷³ These include expanding lending authorities for the Export-Import Bank,⁷⁴ increased efforts to develop STEM talent, and spurring more technology transfer from universities and federal labs.⁷⁵ Moreover, the federal government should work to establish a deeper North American supply chain, which would provide U.S. companies with an alternative to the Chinese supply chain. Approving the USMCA trade agreement would facilitate that.

Finally, the recent tax reform bill allowed first year expensing of machinery and equipment helped spur more investment including presumably in robots, but it is due to expire at the end of 2022. And in 2022 companies will have to deduct R&D expenditures over five years. Congress should make expensing for capital investment and R&D expenditures permanent, while at the same time increase the Alternative Simplified Credit rate from 14 percent to at least 25 percent.⁷⁶ (At least 26 nations now field a more generous R&D tax incentive).

The Challenge to Small Business and Policy Responses

More robust small business growth and new firm formation, especially in trade sectors, will be critical to restoring robust and vibrant economic growth. For the purpose of thinking about competition from MIC25 there are three kinds of small businesses: 1) suppliers to globally traded original equipment makers (OEMs); 2) companies that themselves sell directly in global markets; and 3) domestic serving, consumer-facing companies (e.g. dry cleaners, barbers, grocery stores, etc.). Unfair competition from China hurts all three kinds, but the biggest impact is on the first two. As large companies close or contract domestic facilities, either because of Chinese competition or because they have moved production to China, most of the supplier contracts move to China. At the same time, why start a small manufacturing company if you know you will face robust and subsidized competitors from China or face a risk of having your IP stolen? Overall, there is less incentive to start a new manufacturing firm when many big U.S. customers are now overseas, or when you know you will face a big, subsidized foreign competitor, which is why efforts to roll back Chinese innovation mercantilism need to be a key part of any small business agenda.

But there are also a host of steps Congress could take to help new and small business, particularly in globally traded sectors. One step would be to encourage the Small Business Administration (SBA) to focus more resources on firms in traded sectors, like agriculture, manufacturing, and software, content and internet services. Currently the SBA treats all industries alike in its funding priorities, but industries serving local

markets (e.g., liquor stores) play little role in supporting local or national economic competitiveness, and by and large providing funding to them simply shifts activity from one firm to another. Neither of these things is true for firms in industries that are globally traded, yet only 7.5 percent of loans under the SBA's primary program for assisting small businesses (7A loan program) go to manufacturers. Congress should require the SBA to develop a plan to significantly increase the share of support going to traded-sector firms.⁷⁷

Congress should also establish a 401(k)-like deferred-investment program that would give small and mid-sized manufacturers greater resources to bootstrap themselves by allowing them to make tax-deferred investments through manufacturing reinvestment accounts. The funds would be available for tax-free withdrawal if used for R&D, workforce training, or capital equipment investments. Connecticut has already put such a program in place.⁷⁸

Congress should also consider removing obstacles to the tax code to limit the growth of technology startups. Current law prevents passive investors from taking advantage of net operating losses or research tax credits of the companies in which they invest. This makes sense for tax shelters that are never meant to be profitable. But it makes it even harder for small research companies to find investors. Congress should create an exception for companies that devote over half of their expenses to research and development and that have fewer than 250 employees and less than \$150 million in assets. Investors could only use that portion of the losses or credit that was devoted to qualifying research activity.⁷⁹ In addition, firms can normally carry past operating losses forward in order to deduct them from future income, thereby lowering their taxes. Under Section 382 of the tax code, firms lose this ability when they undergo a change in ownership. Since small research-intensive startup firms often engage in successive financing rounds before achieving success, this provision makes it hard for them to ever recover their past losses and artificially inflates their historical income for tax purposes. Congress should exempt that portion of net operating losses that are generated by small firms that conduct qualifying research and development activities.⁸⁰

Congress should introduce an Open Commercialization Infrastructure Act. One way to increase the use of America's national R&D infrastructure would be to pass an "Open Commercialization Infrastructure Act" that permits private use of bonded facilities—including universities, federal labs, and public libraries—for certain activities related to entrepreneurial education and training as well as for economic development and job creation. This would be useful because buildings that are financed through tax-exempt bonds currently are not permitted to develop private programming. For example, a small business trying to develop a commercial product would be restricted from taking advantage of a 3-D printer in a makerspace at a bonded facility such as a public library. This and many other kinds of private activities that benefit entrepreneurs—such as business incubators, accelerators, and training programs—are important for broader economic development. Congress should ensure more infrastructure is available for such purposes.⁸¹

The current federal system for funding research also pays too little attention to commercializing technology and is still based on the linear model that assumes basic research gets easily translated into commercial activity. To address this, the administration should work with Congress to establish an automatic set-aside program that allocates a modest percentage of federal research budgets to technology-commercialization activities. For instance, Congress could allocate 0.15 percent of agency research budgets to fund university,

federal laboratory, and state government technology-commercialization and innovation efforts. The funds could be used to provide: 1) “commercialization capacity-building grants” to institutions of higher education pursuing specific initiatives to improve their capacity to commercialize faculty research, and 2) “commercialization-accelerator grants” to support institutions of higher education pursuing initiatives that allow faculty to directly commercialize research in an effort to accelerate research breakthroughs.⁸²

Congress should allow a greater share of SBIR and STTR grant awards to be used for commercialization activities. SBIR’s impact could be much greater if some facets of the program were geared significantly more toward commercialization. Awardees currently are prohibited from using grant money to fund critical commercialization activities that would enable them to raise their profiles and accomplish certain key milestones so they can build prototypes of new products or services, acquire commercial customers, attract private capital, or accelerate market entry. These activities cover the gamut from intellectual-property development and prosecution to marketing and staff recruitment. To fill these gaps, SBIR awardees should be permitted to expend at least 5 percent of their SBIR funds on commercialization-oriented activities. For instance, in the last Congress, the Support Startup Business Act (S. 2149), co-sponsored by Sens. Chis Coons (D-DE) and Cory Gardner (R-CO), would allow program awardees to allocate up to \$50,000 of their awards for commercialization-related activities, including services such as market validation, IP protection, market research, and business model development.⁸³

Finally, Congress should create an “Innovation Voucher” program operated by NIST. As in almost a dozen other countries, these vouchers can spur innovation and stimulate knowledge transfer by allowing small and mid-sized enterprises to “buy” expertise from universities, national labs, and research institutions to conduct studies, analyze the innovation potential of new technologies, etc. A promising example has been the Small Business Voucher Pilot program in the Energy Department’s Office of Energy Efficiency and Renewable Energy (EERE), which has provided vouchers to 114 small business across 31 states, disbursing more than \$22 million since 2015. For example, the Oak Ridge National Laboratory (ORNL) collaborated to launch “RevV,” a \$2.5 million manufacturing innovation program that offers vouchers for manufacturers in Tennessee to access the world-class researchers and facilities at ORNL. The administration should work with Congress to extend such vouchers across the entire federal lab system under the auspices of NIST by authorizing \$50 million that would be state-matched.⁸⁴

CONCLUSION

In summary, taking firm and strategic action against Chinese predatory, mercantilist practices, while at the same time establishing and implementing a robust national innovation and competitiveness strategy are critically needed if we are to assure future U.S. advanced industry competitiveness. Whether or not such actions can be successful is an open question. But one thing is clear: not taking action will make it much easier for the Chinese government to achieve their goal of dominating advanced technology industries.

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