SEMICONDUCTOR INDUSTRY ASSOCIATION

Semiconductor Industry Association

Written Comments to the United States Trade Representative Regarding the Initiation of a Section 301 Investigation into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation

Thursday, October 5, 2017

1. Summary

The Semiconductor Industry Association (SIA) appreciates the opportunity to submit written comments to the Office of the United States Trade Representative (USTR) regarding USTR's investigation under Section 301 of the Trade Act of 1974. SIA is the voice of the U.S. semiconductor industry, one of America's top export industries and a key driver of America's economic strength, national security, and global competitiveness. SIA seeks to strengthen U.S. leadership of semiconductor manufacturing, design, and research by working with Congress, the Administration, and other key industry stakeholders to encourage policies and regulations that fuel innovation, propel business, and drive international competition.

SIA recognizes USTR's concerns about Chinese government policies and practices that can pressure U.S. semiconductor companies to disclose or transfer their intellectual property to Chinese entities or develop IP in China. These are longstanding concerns, raised by many sectors, and which have remained despite a decade of dialogue. At the same time, China is a key market for U.S. semiconductor companies – the fastest-growing and single-largest market for finished U.S. semiconductors, totaling nearly 33% of global demand in 2016 for the U.S. industry – and continued access to this market on nondiscriminatory terms is critical for our industry's success.

We continue to believe that constructive solutions are still possible, since forced technology transfers as a result of secure-and-controllable policies and other intrusive government interventions serve neither Chinese nor U.S. long-term interests. Proactively promoting the alignment of China's efforts in the global semiconductor space in a way that embraces, not separates them from, internationally recognized rules and global best practices should be viewed as a top priority. Moreover, if China truly aspires to be a global innovator and part of the global semiconductor and technology value chains, it must ensure effective protection of intellectual property regardless of its origin, preserve market access on commercial terms, maintain vibrant semiconductor demand, and refrain from non-market-based government interventions. In order to achieve these goals, the U.S. and other governments and industries should work with China's leadership and companies on reforms to ensure that market-based principles consistent with China's international obligations are applied, that voluntary commercial cooperation within the global value chain is embraced, and that the sharing and transfer of IPR is based on commercial considerations, not government dictates.

This submission identifies and discusses the laws, policies, and practices of most concern to our industry. First, we discuss a broad overview of the importance of the U.S. semiconductor

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industry and its intellectual property to the U.S. economy. Second, we discuss the importance of the Chinese semiconductor market to the U.S. industry. This submission then briefly describes the broader context of Chinese industrial policy efforts as it relates to semiconductor technology, including the role of technology transfer in achieving Chinese goals. We then describe various specific measures we believe should be within the scope of the USTR investigation that: (i) require or induce the transfer of technologies and IP to Chinese entities; and (ii) interfere with the ability of U.S. companies to set market-based rates for their IP, and thus undermine control over their technology in China.

2. Importance of Semiconductor Innovation and Intellectual Property to the American Economy

Semiconductors are the building blocks upon which U.S. technological leadership rests. Semiconductors (sometimes referred to as integrated circuits, ICs, or chips) are the foundational enabling technology of modern electronics and play a key role in communications, computing, transportation, health care, energy, and many other sectors at the forefront of U.S. competitiveness.

- Semiconductors are among the top four U.S. exports, along with aircraft, refined oil, and automobiles.
- The U.S. semiconductor industry accounts for nearly 50 percent of global market share and is the clear leader in advanced semiconductor innovations.
- The U.S. semiconductor industry employs almost 250,000 U.S. workers directly and supports over one million additional indirect jobs throughout our economy.
- The U.S. semiconductor industry invests 18.5 percent of revenue annually in research and development (R&D), the second-highest rate of any U.S. industry in 2016.
- Of the 15 U.S. companies receiving the most patents in the U.S. in 2016, five were semiconductor companies.

Leadership in semiconductor research, design, and manufacturing also has a "multiplier effect" by driving innovation throughout other sectors of the economy, resulting in increased growth, jobs, and productivity.[1] Semiconductor technology is also fundamental to U.S. national security,[2] playing a pivotal role in U.S. non-commercial infrastructure.[3] Maintaining U.S. leadership in this sector requires a healthy and vibrant U.S. semiconductor industry – one that can continue to invest strongly in its own future and that partners effectively with government to address key challenges facing the nation. In the ongoing race to find the next new switch, develop new materials, and create new designs, the U.S. semiconductor industry must remain at the forefront of these discoveries to direct the next generation of technological progress and maintain its status as the global leader in semiconductor innovation.

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[1] Information Technology and U.S. Productivity Growth: Evidence From a Prototype Industry Production Account. Journal of Productivity Analysis, 36(2), 159-175. Jorgenson, D. W., Ho, M. S., & Samuels, J. D. (2011).

[2] In 2017, the President's Council of Advisors on Science & technology noted that: "*Cutting-edge semiconductor technology is also critical to defense systems and U.S. military strength, and the pervasiveness of semiconductors makes their integrity important to mitigating cybersecurity risk.*" Ensuring Long-Term U.S. Leadership in Semiconductors. Executive Office of the President President's Council of Advisors on Science and Technology, January 2017

[3] Semiconductor Technology and U.S. National Security. Col. Lawrence K. Harada, U.S. Army War College, Program Research Project (Apr. 21, 2010).

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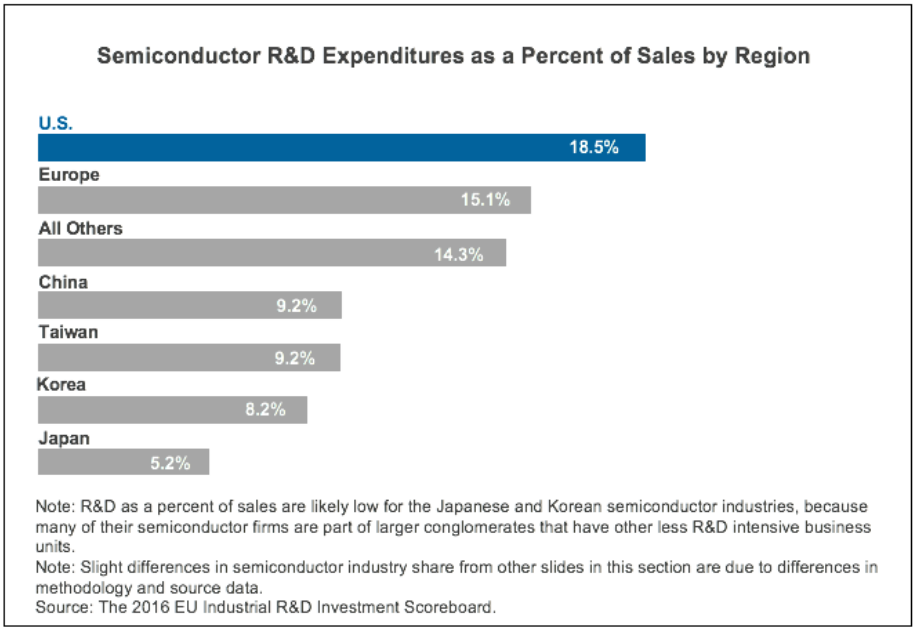
Along with creating new commercial technologies, protecting them in the marketplace is equally important for U.S. semiconductor firms. Indeed, IP is the lifeblood of the U.S. semiconductor industry, and its protection is critical for continued U.S. global leadership. U.S. semiconductor industry investments in technology R&D have reflected this priority, and remain consistently high. In 2016 alone, the U.S. semiconductor industry invested nearly $35 billion into R&D, and those investments have grown at a nearly 8.1% compound annual growth rate since 1996.

Annual semiconductor R&D expenses as a percent of sales have exceeded 10% over the past 20 years. This rate is unprecedented among major manufacturing sectors of the United States economy. The rapid pace of technological change in semiconductor technology requires constant advancement in semiconductor process technology and device capabilities. As a result, the rate of U.S. semiconductor industry R&D spending is now 18.5% as a percent of sales, second only to the U.S. pharmaceutical and biotechnology industry in 2016.

As a result of this significant commitment to investing in R&D, the United States enjoys worldwide leadership in semiconductor sales, nearing 50% of the global market. The direct relationship between U.S. industry leadership and R&D is quite clear when compared to other nations' semiconductor industries. As the chart below indicates, the United States semiconductor industry spends more on R&D as a percent of sales than any other country or region.



For an R&D-intensive industry such as the U.S. semiconductor industry to thrive, patents and other forms of intellectual property must be protected and relevant laws enforced. Only in such an environment can innovation continue. This is why one of SIA's top policy priorities is ensuring intellectual property protection, including in foreign markets such as China. Such protections are vital if China aspires to be a technology leader, since there is little incentive to innovate if new advances can be easily copied.

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3. Importance of China to the U.S. Semiconductor Industry

China is a key market for many of our semiconductor companies. Indeed, according to the World Semiconductor Trade Statistics (WSTS) organization, China is the fastest-growing and single-largest market for the U.S. semiconductor industry, totaling nearly 33% of sales worldwide in 2016. Continued access for U.S. semiconductor firms to the China market, while at the same time protecting our intellectual property and trade secrets, is vital to our overall competitiveness.

In addition, China is an integral part of, and deeply embedded in, the semiconductor and electronics industry global supply chain. In 2015, China exported nearly $600 billion in electronic goods that are powered by semiconductors, representing nearly a third of all Chinese exports. Many U.S. semiconductor firms have also made investments in the China market, including semiconductor design, fabrication, and assembly/test. These investments have allowed the U.S. semiconductor industry to partner with China's unique electronics industry supply chain, in particular the ability to foster closer business partnerships with the growing number of domestic Chinese original electronics manufacturers (OEMs).

Although China has made significant progress in complying with the rules-based trading system since WTO accession in 2001, SIA's member companies continue to face a number of Chinese policies and practices that significantly impair their competitiveness and market access.

4. Chinese Industrial Policy Context

While section five of our submission focuses on the specific regulatory issues or measures we suggest for inclusion within the scope of the 301 Investigation, it is useful to describe the broader context of Chinese industrial policy.

The Chinese government has in recent years placed a strong focus on the development of indigenous information communications technology (ICT) capabilities in order to bolster economic growth and protect national security. From President Xi Jinping's high-level committee on cybersecurity to ministerial-level directives, there is an organized effort by the state to use industrial policy to achieve the objective of "building a strong cyber country" based on indigenous technologies.[4] Promoting the development of domestic intellectual property is seen as essential to these efforts.

Indeed, Chinese President Xi Jinping, who chairs a special party committee on cybersecurity, has said, *"that for China to build a strong cyber country, [we] must have our own [Chinese] technology, and have technology that is up to scratch."*[5] President Xi Jinping has also called for the development of government plans, roadmaps, and timetables to accelerate innovation for deemed "core technologies." Providing further evidence that the Chinese objective is the import

[4] Chinese National Cyberspace Strategy. Translated by China Copyright & Media, December 27, 2016: https://chinacopyrightandmedia.wordpress.com/2016/12/27/national-cyberspace-security-strategy/

[5] Central Leading Group for Internet Security and Informatiziation Established. China Copyright & Media Translation, March 1, 2014. https://chinacopyrightandmedia.wordpress.com/2014/03/01/central-leading-group-for-internet-security-and-informatization-established/

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substitution of foreign technology, President Xi Jinping chaired a special, high-level Government meeting in 2016 on accelerating *"cyber information technology indigenous innovation*" and called for "*the implementation of a domestic product secure-and-controllable substitution plan"* to be developed by his Government.[6]

Answering this call, the Chinese government has promulgated a number of plans and policies that specifically aim to achieve the goals set forward by the leadership. For example:

- China's *13th Five-Year Plan for Social & Economic Development* released in 2015 calls for China to become an "innovation nation" by 2020, and an innovation leader by 2030.[7]
- Building upon this high-level goal, the Chinese State Council in August 2016 issued the *13th Five-Year Plan for Scientific and Technological Development,* which includes a detailed list and roadmap to develop key technologies such as "super computers and quantum communication."[8]
- The "*Made in China 2025 Plan"* published in 2015, calls for China to make specific and meaningful gains in core manufacturing technologies, with specific import substitution targets.[9]
- China's industrial policy ambitions have also more recently focused on emerging technologies, such as artificial intelligence and robotics. This includes the Chinese State Council *Artificial Intelligence Development Plan* released in July 2017 that, according to Reuters, called for China to become a world-wide leader in AI technology by 2025.[10]

A. Chinese Industrial Policy & Subsidies for Semiconductors

China has placed a specific initiative in motion to build and enhance its own homegrown semiconductor industry.[11] In June 2014, China released the *Promotion of a National IC Industry Development Guidelines,*[12] which call for the development of an entire semiconductor industry ecosystem within China, with the goal of becoming the global leader in all major segments of the industry by 2030. China's goals include development of domestic high-end server CPUs and memory devices.[13] These Guidelines are consistent with efforts underway in China to

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[6] Xi Jinping: Accelerate Cyber Information Technology Indigenous Innovation, Make All Efforts to Achieve the Goal of Constructing a Strong Cyber Power. Remarks by President Xi Jinping at the 36th Study Session of the Politburo of the Communist Party of China. Xinhua News, October 9, 2016: http://news.xinhuanet.com/politics/2016-10/09/c_1119682204.htm (Chinese) and http://news.xinhuanet.com/english/2016-10/10/c_135741436.htm (English).
[7] The 13th Five Year Plan. U.S. – China Economic & Security Review Commission. February 14, 2017: https://www.uscc.gov/sites/default/files/Research/The%2013th%20Five-Year%20Plan.pdf
[8] China to Boost Scientific and Technological Innovation. China Daily, August 8, 2016: http://english.gov.cn/policies/latest_releases/2016/08/08/content_281475412096102.htm
[9] Made in China 2025 Plan Unveiled to Boost Manufacturing. Xinhua English News, May 19, 2015. http://news.xinhuanet.com/english/2015-05/19/c_134252230.htm. According to Germany based research think-tank MERICS: *"Beijing initiated a master plan…aimed at turning the country into a production hub for high-tech products within the next few decades. According to the plan, the domestic market share of Chinese suppliers for "basic core components and important basic materials" is intended to increase to 70 per cent by 2025."* Made in China 2025: The Making of a High-Tech Superpower and Consequences for Industrial Countries. Mercator Institute for China Studies, December 2016. https://www.merics.org/en/merics-analysis/papers-on-china/made-in-china-2025/
[10] China Aims to Become World Leader in AI, Challenges U.S. Dominance. Reuters, July 20, 2017: https://www.reuters.com/article/us-china-ai/china-aims-to-become-world-leader-in-ai-challenges-u-s-dominance-idUSKBN1A5103
[11] China's Next Target, U.S. Microchip Hegemony. Wall Street Journal, July 27, 2017. Online, Available at: https://www.wsj.com/articles/chinas-next-target-u-s-microchip-hegemony-1501168303
[12] China Daily: China Announces Measures to Boost IC Industry. June 26, 2014. Online, available at: http://usa.chinadaily.com.cn/business/2014-06/25/content_17613997.htm
[13] President Xi Urges to Build National Big Data Center. China Daily, November 4, 2016 http://www.chinadaily.com.cn/m/innermongolia/2016-11/04/content_27272335.htm

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indigenize the broader ICT sector and establish so-called "secure and controllable" technologies. The Guidelines encourage the adoption of these technologies through a series of problematic regulations, technical measures, and standards under the Chinese cyber rules referenced in Section Five of this paper.

Key to China's IC promotion efforts are the central and local Chinese government and/or state-directed subsidies in the form of investment funds, credit lines, or grants designed to build or acquire a leading semiconductor industry, which can have market-distorting effects. To date, $21 billion has been raised by the National IC Fund,[14] and more than $80 billion has been raised by local government funds.[15] This top-down effort to develop an indigenous industry is already underway through government-funded and directed investment activity, specifically targeting companies and technologies at all levels of the semiconductor development and fabrication lifecycle. In addition, multiple Chinese government investments in "national champions" – each billions of dollars in scale – are being bolstered to rapidly expand domestic IC design capabilities and manufacturing capacity.[16]

B. The Role of Technology Transfer in Chinese Industrial Policy

Chinese government officials and policy documents emphasize the shortest path to development is through technology transfer and absorption.[17] Historical precedent and academic research also notes technology transfer is an important method for building advanced industries.[18] Indeed, Chinese President Xi Jinping has clearly indicated that tech transfer is a method encouraged for technology development: *"we must make clear which things can be imported but have to be secure and controllable, which things may be imported, digested and*

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[14] China-Backed Fund Plays Big Role in Country's Chip Push. Wall Street Journal July 31, 2017, Online Available at: https://www.wsj.com/articles/china-backed-fund-plays-big-role-in-countrys-chip-push-1501493401

[15] Beijing, Shanghai IC Sectors Prospering. Digitimes, September 25, 2017. https://www.digitimes.com/news/a20170920PD212.html?mod=0

[16] China to Dominate Fab Spending. EEtimes, June 16, 2016 https://www.eetimes.com/document.asp?doc_id=1329926

[17] "Strengthen Basic Research, Original Innovation, Integrated Innovation, and Inducement/Absorption & Re-Innovation." Essay by Bai Chunli, President, China Academy of Sciences. Guangming Daily, November 12, 2015. http://theory.people.com.cn/n/2015/1112/c40531-27806027.html and Xi Jinping Speech at the Work Conference for Cybersecurity & Informatiziation. April 19, 2016. Translation available at: https://chinacopyrightandmedia.wordpress.com/2016/04/19/speech-at-the-work-conference-for-cybersecurity-and-informatization/

[18] Technology transfer has played a key role in the "catch-up" strategies utilized by East-Asian economies in high-tech sectors such as electronics. Dr. Linsu Kim, in "Technology Transfer & Intellectual Property Rights: The Korea Experience" (UNCTAD, June 2003, PP2 https://www.iprsonline.org/resources/docs/Kim%20-%20ToT%20and%20IPRs%20-%20Blue%202.pdf) notes that: *"If successful, some of these industries may eventually accumulate sufficient indigenous technological capabilities to generate emerging technologies and challenge firms in advanced countries….(and that) Technology transfer from foreign firms in advanced countries can be a very important source of new knowledge for firms in developing countries."* Furthermore, Dr. Dieter Ernst in "Late Innovation Strategies in Asian Electronics Industries" (East-West Center, March 2004 https://www.eastwestcenter.org/system/tdf/private/ECONwp066.pdf?file=1) notes that: *"A defining characteristic of these 'late innovation strategies' is a heavy reliance on international knowledge sourcing from global industry leaders, for instance for critical component and process technologies."* Chinese scholars too have recognized the critical role of technology transfer from foreign sources in the success of their industrial development. Dr, Liu Xielin of the Graduate University Chinese Academy of Sciences in "Path-Following or Leapfrogging in Catching-Up: The Case of Chinese Telecommunication Equipment Industry" (Center for Innovation, Research, and Competence in the Learning Economy. Lund University, 2007 http://wp.circle.lu.se/upload/CIRCLE/workingpapers/200701_Liu.pdf) notes that: "*The accessibility of knowledge through government support, alliance with foreign companies or R&D work shapes the capabilities of Chinese companies to catch-up."* Chinese telecom equipment firms have indeed caught up: *"Huawei's 2016 carrier business revenue…is well ahead than Ericsson and Nokia, its main rivals in the telecom equipment space."* Huawei Reveals Carrier Biz Revenue for 2016, Beat Ericsson, Nokia. Telecomlead, March 31, 2017: http://www.telecomlead.com/telecom-equipment/huawei-reveals-carrier-biz-revenue-2016-beating-ericsson-75760

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absorbed for re-innovation, which things can be developed in collaboration with others, and for which things we must rely on our own strength and indigenous innovation."[19]

Chinese industrial policy for high-technology sectors such as ICT and semiconductors place a priority on actively encouraging and facilitating the transfer of critical IP needed to indigenize and augment these capabilities.[20] China deploys a number of methods to facilitate technology transfer, including mergers and acquisitions and government-encouraged tech sharing arrangements. Below is a more detailed explanation of each of these main tools:

- **Government Support for Targeted Mergers and Acquisitions.** After China's launch of the IC Guidelines in 2014 and the establishment of IC industry investments funds, China's national and local government-backed semiconductor funds have directly and indirectly supported overseas mergers and acquisitions (M&A) by domestic Chinese IC firms. Chinese Government officials have frequently cited M&A as a tool to rapidly gain access to key semiconductor technology and intellectual property.[21]

  According to analysis from the Rhodium Group, through early 2016 there had been more than 27 attempted, completed, and/or pending international M&A deals by Chinese-headquartered firms in the semiconductor industry (many of which received government financing), for a total investment worth more than $37 billion.[22] According to their analysis, more than half of these deals were financed or backed by Chinese government entities.[23]

- **Government Encouragement of Technology Sharing Business Arrangements.** According to China's WTO accession protocol, the PRC Government cannot mandate formal technology transfer requirements for foreign enterprises to engage in the research and development, manufacturing, or sale of semiconductors in China.[24] Notwithstanding their WTO obligations, Chinese Government officials and policy documents actively encourage such arrangements as a means for Chinese firms to acquire advanced technological capabilities.[25] It is important to note that not all commercial technology sharing or licensing arrangements with Chinese entities are tied to government incentives or policies, and many are purely market-based transactions. For the purposes of this section and these comments, we highlight only those government actions that distort market forces.

  There are several specific methods utilized by the Chinese Government to encourage certain transactional arrangements to acquire IP. First, Chinese government control of critical sectors of the economy such as telecoms, finance, insurance, transportation,

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[19] See footnote 17
[20] Government Plans to Build National Technology Transfer System. Chinese State Council, September 26, 2017: http://english.gov.cn/policies/latest_releases/2017/09/26/content_281475886854922.htm. Note that Technology transfer is not the only tool though China uses to foster its domestic industries, and should be viewed as one of many Chinese industrial policy tools that utilized by the State.
[21] China's Investments in the United States: Recent Trends and the Policy Agenda. The Rhodium Group Report Prepared for the U.S. China Economic & Security Review Commission. December 2016: https://www.uscc.gov/sites/default/files/Research/Chinese_Investment_in_the_United_States_Rhodium.pdf
[22] Ibid
[23] Ibid
[24] Protocol on the Accession of the People's Republic of China, WT/L/432, Part I, Section 7, para. 3 (23 Nov. 2001)
[25] Quid Pro Quo: Technology Capital Transfers for Market Access in China. Federal Reserve Bank of Minneapolis, 2014 Research Department Staff Report. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.699.1962&rep=rep1&type=pdf

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energy, and healthcare, allows the Government to act as a "gatekeeper" and influence the ICT procurements of these sectors to favor domestic produced products and services.[26] Second, as elaborated further in Section Five of this submission, Chinese cybersecurity rules and measures put tremendous pressure on foreign tech firms to find local partners to assist them in compliance with these rules.[27] Finally, and more relevant for semiconductor firms, a number of China's leading electronics companies are entirely state-owned or under significant state influence,[28] allowing the state to put both formal (e.g. the form of cybersecurity rules) and informal pressure on their technology suppliers to engage in collaborative technology sharing arrangements with domestic entities in order to win access to coveted procurement contracts.[29] Foreign firms that do not choose to engage in such technology partnerships are at a clear disadvantage to their competitors who choose to do so.

Indeed, the *IC Promotion Guidelines* explicitly seek to leverage government control over key economic sectors to create demand for its local semiconductor industry.[30] The IC Promotion Guidelines call for public and SOE procurement decisions in sectors such as telecommunications and internet service providers (major consumers of ICs) to be "based on projects aimed at expanding domestic demand" and "based on secure and reliable" software and hardware products – similar to the "secure and controllable" standard China has sought to adopt in relation to ICT products used in the financial, insurance, and telecoms sector.[31]

5. Key Semiconductor-Related Issues Most Relevant to the 301 Investigation

Under the broader context described in the aforementioned section, semiconductor companies face pressure to disclose or transfer their intellectual property to Chinese entities, or at least develop and/or register their own IP in China in order to do business in that market. These policies place a significant and unreasonable burden on U.S. commerce, and ultimately harm the U.S. economy. As the President's Council of Advisors on Science in Technology noted in 2017:

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[26] China's "Server Sinification" Campaign for Import Substitution. Clark Edward Barrett, Jamestown China Brief, December 19, 2014: https://jamestown.org/program/chinas-server-sinification-campaign-for-import-substitution-strategy-and-snowden-part-1/

[27] Apple Opening Datacenter in China to Comply with Cybersecurity Law. New York Times, July 12, 2017. https://www.nytimes.com/2017/07/12/business/apple-china-data-center-cybersecurity.html?_r=0

[28] Among the *"2016 Annual China Electronic Information One Hundred Strong Enterprises"* list published by the Ministry of Industry & Information Technology (MIIT), approximately half of the top 20 listed firms are state-owned or invested firms according to a shareholder analysis done by SIA.

[29] For example, in May of 2016, the CEO of a major American tech company was personally asked by the President of China's largest state-owned electronics conglomerate and major player in China's government procurement contracts to *"strengthen partnership in the area of using domestic CPU's, operating systems, and servers"* in Dell products. Source: China Electronics Corporation Website: http://www.cec.com.cn/Company-Info/Management/Executive-Team/rxw/important/18101.aspx

[30] See footnote 12

[31] So far, the most egregious Chinese effort to promote secure and controllable technology products has been in the financial sector. Specifically, the *"Notice on the Promotion Guidelines for Banking Applications of Secure and Controllable Information Technology (2014-2015) ("CBRC Notice 317"))* published in 2014 would have placed secure and controllable mandates on dozens of ICT products in order to be purchased by Chinese commercial banks. These mandates included among other issues, source code disclosure. These rules were only suspended after significant push back at the highest levels of Government by the United States and their allies. See also: China Introduces Comprehensive New Cyber Security Rules for Banking Procurement. Freshfields LLC, 2014: http://knowledge.freshfields.com/m/Global/r/1514/china_introduces_comprehensive_new_cyber_security_rules and: China Halts New Policy on Tech for Banks. New York Times, April 16, 2015 https://www.nytimes.com/2015/04/17/business/international/china-suspends-rules-on-tech-companies-serving-banks.html?_r=0

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"These are policies that shift business to China while raising, not lowering, costs. These policies are harmful because they hurt otherwise sound businesses without bringing countervailing economy-wide benefits, raise prices for consumers and other businesses that use semiconductors, and can deter innovation."[32]

The following are some of the key policies and practices creating this pressure that should be considered within the scope of the Section 301 Investigation:

A. Lack of IP Protection in China's "Secure and Controllable" Measures

We believe a top priority should be to examine how IP owned by U.S. semiconductor companies is treated under China's "secure and controllable" measures mandated by China's *National Security Law*[33] (NSL) and *Cybersecurity Law*[34] (CSL) that apply to technology products. These measures encompass a variety of laws, rules, and policies that may induce or force the localization of semiconductor design or manufacturing processes as a way to achieve compliance. The localization requirements are ostensibly intended to ensure the supply of technology products is "controllable." While these laws are founded upon the premise of protecting national security, Chinese definitions of national security baked into both the NSL and the CSL are essentially limitless, providing wide discretion to Chinese authorities in determining what meets these criteria.[35]

Even more concerning, under the pretext of attempting to ensure technology products are secure, some of these measures also require the disclosure of sensitive information and/or that the intellectual property rights (IPRs) be Chinese-owned. These types of measures are the most troublesome from a U.S. competiveness perspective and induce technology transfer as a condition of market access. Indeed, since these rules were introduced in draft form, numerous Sino-foreign joint-ventures, licensing agreements, and other forms of IP sharing business partnerships have been formed, many of them directly intended to ensure compliance with these rules.[36]

For example, one of several cybersecurity-related issues raised in this submission are draft Chinese technical measures that would require American innovators of microprocessor technology (otherwise known as CPUs), enterprise servers, and operating systems, which are

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[32] Ensuring Long-Term U.S. Leadership in Semiconductors. Executive Office of the President President's Council of Advisors on Science and Technology, January 2017

[33] See Article 24, 25, and 59 of the National Security Law (NSL) of the People's Republic of China (Passed on July 1, 2015 at the 15th meeting of the Standing Committee of the 12th National People's Congress). English Translation available at http://www.chinalawtranslate.com/2015nsl/?lang=en.

[34] See Article 22 and 23 of the Cyber Security Law (CSL) of the People's Republic of China (Signed into effect on November 7, 2016 by Chinese President Xi Jinping). English Translation available at http://www.chinalawtranslate.com/cybersecuritylaw/?lang=en

[35] Article 2 of the NSL includes a relatively broad definition of national security: *"National security refers to the relative absence of international or domestic threats to the state's power to govern, sovereignty, unity and territorial integrity, the welfare of the people, sustainable economic and social development, and other major national interests, and the ability to ensure a continued state of security."*

[36] For examples see; New H3C Group Targets Government Procurement Deals. China Daily, May 7, 2016: http://www.chinadaily.com.cn/business/tech/2016-05/07/content_25124704.htm and; Cisco Joins Flurry of U.S. – China Tech Partnerships. Reuters, September 24, 2015: https://www.reuters.com/article/us-cisco-systems-china/cisco-joins-flurry-of-u-s-china-tech-partnerships-idUSKCN0RO0AE20150924

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amongst the most coveted "crown jewels" of American technology, to disclose their design secrets to Chinese entities.[37]

Yet, ironically, by interfering in the development and protection of IPRs, they will discourage China's participation in the global value chain. It is a risky bet that China can succeed with go-it-alone industrial policies that call into question the trustworthiness and security of Chinese products, while denying Chinese technology and electronics firms an opportunity to use leading-edge U.S. semiconductor products that lack indigenous IPR.

These measures include, among others:

- China's *Cyber Review Regime*[38] (established informally in 2014,[39] then codified into both China's *National Security Law*[40] and *Cybersecurity Law* in 2016[41]) is the most critical area with rules and policies that force IP disclosure or transfer.
    - Within China's *Cyber Review Regime*, the information security standards body, TC260 is developing a set of "secure and controllable" standards, at least some of which explicitly require the disclosure of highly sensitive semiconductor source code and design information to achieve compliance with the standards (for example the draft TC260 standards for microprocessors and general computers).[42]

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[37] Over the past 10 years, an estimated combined total of $170 billion has been spent by leading U.S. semiconductor companies on R&D related to CPU development. This represents roughly 63 percent of all R&D spending by the entire U.S. semiconductor industry over the past 10 years. Source: SIA research.

[38] For a detailed overview of the *PRC Cyber Review Regime* see: China's New Rules on Security Review of Network Products and Services Fail to Alleviate Foreign Investor Concerns. Hogan Lovell, June 27 2017: https://www.hoganlovells.com/en/publications/china-new-rules-on-security-review-of-network-products-and-services-fail-to-alleviate-foreign-investor-concerns and: Building an Institutional Framework for Cyber Security Review — Understanding the Measures for Security Review of Network Products and Services (Tentative). King & Wood LLC, June 1, 2017: http://www.chinalawinsight.com/2017/06/articles/corporate/building-an-institutional-framework-for-cyber-security-review-understanding-the-measures-for-security-review-of-network-products-and-services-tentative/

[39] China to Establish Cybersecurity Review Regime. State Internet Information Office of the People's Republic of China, October 31, 2014: http://www.scio.gov.cn/xwfbh/xwbfbh/wqfbh/2014/20141030002/zy31954/Document/1385228/1385228.htm

[40] See Article 59 of the NSL: "*The State establishes national security review and oversight management systems and mechanisms, conducting national security review of foreign commercial investment, special items and technologies, internet information technology products and services, projects involving national security matters, as well as other major matters and activities, that impact or might impact national security."*

[41] See article 23 and 35 of the CSL: *"Article 23: Critical network equipment and specialized network security products shall follow the national standards and mandatory requirements, and be safety certified by a qualified establishment or meet the requirements of a safety inspection, before being sold or provided. The state network information departments, together with the relevant departments of the State Council, formulate and release a catalog of critical network equipment and specialized network security products, and promote reciprocal recognition of safety certifications and security inspection results to avoid duplicative certifications and inspections."* "*Article 35: Critical information infrastructure information infrastructure operators purchasing network products and services that might impact national security shall go through a national security review organized by the State network information departments and relevant departments of the State Council."*

[42] See TC260 standards: "*Information Security Technology – Controllability Evaluation Index for Security of Information Technology Products – Part 2: Central Processing Unit"* (Draft) October 25, 2016, "*Information Security Technology – Controllability Evaluation Index for Security of Information Technology Products – Part 5: General Purpose Computer"* (Draft) April 28, 2017, and , "*Information Security Technology – Controllability Evaluation Index for Security of Information Technology Products – Part 1: General Principles"* (Draft) April 30, 2017. Some of the highly sensitive and business proprietary information potentially required for disclosure by the draft TC260 Standards (see footnote 47) include *"complete design database including behavior models, logical models, gate level implementations, standard cell libraries, and even the floorplan and physical layout of a CPU"* – essentially all of the elements needed to understand and replicate some of the worlds most advanced microprocessors. For a more detailed review of the draft microprocessor standard, see "SIA Comments on TC260: *Information Security Technology – Controllability Evaluation Index for Security of Information Technology Products – Part 2: Central Processing Unit"* December 15, 2016.

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- The issuance of the *Security Review Measures for Network Products and Services* requires "cyber review" for certain technology products and will rely on the TC260 standards under development.[43] Interestingly, cyber reviews have been ongoing despite the fact that TC260 standards remain under development.[44]

- The second "secure and controllable" measure worth investigation is the recently issued *Catalogue of Network (Cyber) Critical Equipment and Cybersecurity Specific Products*.[45] The Catalogue was developed in accordance with Article 23 of the Cybersecurity law,[46] which requires *Network (Cyber)-Critical Equipment and Cybersecurity-Specific Products* to be certified or tested by Government-authorized bodies per the mandatory requirements of relevant Chinese national standards. Of concern, this Catalogue expands the compulsory information security testing that requires source code and other proprietary product design information disclosure to include new product areas that have high semiconductor content such as routers, rack-mounted servers, and programmable logic controllers.

- The third type of "secure and controllable" measures USTR should evaluate are encryption standards and certification schemes designed to ensure encryption used in technology (including semiconductors) meets the requirements of the *Draft Cryptography Law of China*, published in April 2017.[47] Prior Chinese policies and regulations required the disclosure of source code and other confidential information as part of complying with specific encryption requirements until various governments pushed back.[48] The draft encryption law (e.g., Articles 18 and 23)[49] suggests implementing regulations, standards, and certification schemes may follow the same pattern. Because encryption is a standard feature of almost all technology products, including commonly used commercial technologies, the draft Cryptography Law could significantly affect the importation, sale, and use of semiconductor products developed by our member companies.

- Finally, the *Regulations on Classified Protection of Information Security* (known as the Multi-Level Protection Scheme, or MLPS) is quite problematic in terms of inducing

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[43] Ibid

[44] China's New Cybersecurity Law is Worryingly Vague. The Economist, June 1st, 2017 https://www.economist.com/news/business/21722873-its-rules-are-broad-ambiguous-and-bothersome-international-firms-chinas-new-cyber-security. According to Chinese officials responsible for the Cyber Review Regime, Microsoft is one of the firms that has completed or is in the process of undergoing a cybersecurity review of its Windows software (see China Southern Daily, June 12, 2017: https://m.mp.oeeee.com/a/BAAFRD000020170612402l4.html), which led to the formation of a joint-venture with Chinese state-owned enterprise China Electronics Technology Group to field a special version of Windows that could be submitted for inspection to the Review Regime (See: Microsoft Develops Windows 10 Version for China's Government. Seattle Times, May 23rd, 2017: https://www.seattletimes.com/business/microsoft/microsoft-develops-windows-10-version-for-chinas-government/). This review if ongoing, has been done without any finalized or completed standards by TC260.

[45] Chinese Authorities Release Catalog of Network and Cybersecurity Products Subject to Pre-Sale Inspection. Covington LLC, June 20, 2017: https://www.insideprivacy.com/international/china/chinese-authorities-release-catalog-of-network-and-cybersecurity-products-subject-to-pre-sale-inspection/

[46] See footnote 41

[47] See *Encryption Law of the People's Republic of China (Draft for Comment)* published by the China State Cryptography Administration on April 28, 2017: http://www.sca.gov.cn/sca/hdjl/2017-04/28/content_1011759.shtml

[48] We point out that 83% of American companies note that protection of core IP is a concern when complying with Chinese testing and certification schemes. US-China Business Council 2015 Member Survey: https://www.uschina.org/reports

[49] See Article 18 of the Draft Cryptography Law of China: *"The State conducts categorized and hierarchical evaluation of the security of encryption used in critical information infrastructure, and conducts security reviews of encryption products, encryption-related services and encryption protection systems that influence or may influence national security, according to requirements of the national security review."*

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technology transfer in the name of security, economic and social development.[50] This regulation affects a high number of information systems and related products/components deemed sensitive for national security and economic reasons, and, for such, requires that the IPR related to the core technology/critical components of those systems be owned by indigenous Chinese entities.[51] MLPS applies to procurements by the Government of China, as well as an increasing number of state-owned enterprises and even some private-owned entities in industries deemed by the Government to be strategic. The scope of the IT systems and industries to which MLPS may apply is very broad compared to the industries other governments consider to be sensitive or strategic.[52] In addition, the Cyberspace Administration of China (CAC) on July 12, 2017 published a new set of revamped and expanded regulations for critical industries information protection (CIIP). These draft measures for CIIP reference and re-iterate the importance of MLPS, and also tie in references to both the *Cyber Review Regime*, the *Critical Products List*, and *China's Draft Encryption Law.*[53] In brief, MLPS and new draft CIIP law induces the localization of IPR in China as a condition of market access by mandating adoption of indigenous IP.

B. Technology Transfer Mandated in China's Regulation on Technology Import and Export Administration

The *Regulation on Technology Import and Export Administration* (i) mandates Chinese ownership of any technology improvements for imported technology, and (ii) imposes other non-market terms in licensing and technology contracts.[54] USTR noted this regulation in its Federal Register Notice for this 301 Investigation as a classic example of a regulation that can deprive U.S. companies of the ability to set market-based terms in licensing and other technology-related negotiations with Chinese companies.

Because technology products are complex and the semiconductor industry is built on a global supply chain, a fair amount of technical collaboration between U.S. and foreign semiconductor companies is a necessity. Yet, this regulation undermines U.S. companies' control over their technology in China by requiring ownership of any improvements made by a Chinese partner in a joint-venture or other form of collaboration to vest in that entity. Coupled with the pressure on multinational tech firms to set up formal business entities as a means of market access in China,

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[50] The Five Levels of Information Security in China. China Business Review, December 5, 2016: http://www.chinabusinessreview.com/the-5-levels-of-information-security-in-china/ and: National Security and China's Information Security Standards. Center for Strategic & International Studies, November 8, 2012: https://www.csis.org/analysis/national-security-and-china%E2%80%99s-information-security-standards

[51] Ibid

[52] Cybersecurity & Trade: National Policies, Global and Local Consequences. Allan A. Friedman, Brookings Institute. September 2013: https://www.brookings.edu/wp-content/uploads/2016/06/BrookingsCybersecurityNEW.pdf

[53] *Cyberspace Administration of China Notice concerning the Public Solicitation of Opinions on the "Critical Information Infrastructure Security Protection Regulations (Opinion-seeking Draft)."* English translation available at https://chinacopyrightandmedia.wordpress.com/2017/07/10/critical-information-infrastructure-security-protection-regulations/. Specifically, Article 31 of the new draft regulations reiterates language in the Cybersecurity Law requiring products must undergo the *Cyber Review Regime*. For a more detailed analysis of the *Draft CIIP Measures* see: China's Ambitious Rules to Secure 'Critical Information Infrastructure. Paul Triolo, Rogier Creemers, and Graham Webster for New America, July 14, 2017: https://www.newamerica.org/cybersecurity-initiative/blog/chinas-ambitious-rules-secure-critical-information-infrastructure/

[54] The Regulation also requires, among other terms, that the owner of the transferred technology (i) warrant that it is "complete, error free, effective, and capable of reaching the agreed technical target"; (ii) indemnifies the Chinese transferee for infringing a third party's IP caused by the using of the transferred technology in the way specified in the Regulation; and (iii) not prohibit the Chinese transferee from challenging the validity of the IPR in the licensed technology.

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this onerous IP transfer requirement further undermines the protection of these valuable commercial technologies.

C. Overbroad Compulsory Licensing Provisions in the Intellectual Property Enforcement Guidelines Being Implemented Pursuant to China's Anti-Monopoly Law

In 2015, the State Administration for Industry and Commerce (SAIC) finalized its antitrust-related IP enforcement regulation. Article 7 of SAIC's IP rule makes certain refusals to license critical IP to third parties, most notably including competitors, an antitrust violation under China's Anti-Monopoly law (AML). Specifically, one violates the AML if: (i) a license to the IP right is "essential" for others to compete, and a refusal to license would adversely affect competition or innovation in the relevant market and damage consumers or the public interest; (ii) licensing the IP right would not cause unreasonable damage to the IP holder; and (iii) the IP cannot be substituted by reasonable means in the relevant market. A similar provision is included in the draft IP guidelines that all three AML agencies are co-developing and plan to finalize this year. Fortunately, these overbroad compulsory licensing provisions have yet to be enforced in a particular case. However, the AML agencies recently have made the prevention of IP abuse a priority.

The factors listed in Article 7 of SAIC's IP regulation and in the draft agency guidelines would allow virtually any unilateral refusal to license to be characterized as an abuse of IPR. There is no guidance on how to weigh or otherwise apply these factors, and thus nothing to prevent officials from applying them, broadly or in a discriminatory way. In fact, these overbroad compulsory licensing provisions stem from a concern by some PRC officials at SAIC that successful multi-national technology companies are gaining too much market share in China and not sharing their core IP with nascent Chinese competitors.[55] If the AML agencies were to deem the most important and valuable innovations as "essential facilities"[56] that their owners must license to competitors, this would seriously undermine the incentives needed to generate the types of technologies these undertakings need to develop. Such application of these compulsory licensing provisions may prompt parties to invest their resources in endeavors for which remuneration is less likely to be constrained by incentive-stifling government regulation.

Any practice of broadly treating unilateral refusals to license IP as antitrust violations is inconsistent with general global antitrust law and will seriously undermine U.S. IPR. The essential facility doctrine has been applied only very sparingly to unilateral and unconditional refusals to license.[57] SIA points out that both Article 11 of China's Patent Law and relevant

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[55] "Multinationals' Anti-Competition Behavior in China and Counter-Measures Therefore," *Industry and Commerce Administration,* Section (1)D, Issued by the Anti-Monopoly Division, Fair Trade Bureau, State Administration for Industry and Commerce (March 1, 2004).

[56] These provisions are an attempt to apply *intellectual property* the "essential facilities" antitrust doctrine originally developed in the United States, which has been used only in very limited circumstances with *physical facilities* owned by a monopolist that cannot be duplicated and that competitors must have access to in order to compete. This "essential facility" antitrust doctrine has fallen in disfavor in American antitrust jurisprudence and has been limited to very narrow circumstances, all of which are outside of the intellectual property arena, where prior dealing and anticompetitive behavior exist. *See Verizon Communications Inc. v. Law Offices of Curtis V. Trinko, LLP,* 540 U.S. 398 (2004).

[57] To our knowledge, there have been only a handful of cases in the European Union involving compulsory licensing. These cases imposing a duty to license have addressed non-inventive IPR, such as television program schedules or zone maps for data reporting, as well as arbitrary information, such as certain communication protocols necessary to interface with a dominant operating system. *See e.g. IMS Health GmBG & Co OHG v NDC Health GmBH & Co KG,* [2004] All ER (EC) 81 '3(2004) (The IPRS involved

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provisions of the WTO TRIPS Agreement (e.g., Article 28) vest in IP holders strong and broad rights to exclude others from using their IP.

Neither China's Patent Law nor the TRIPS agreement allows broad compulsory licensing of IP deemed essential to competition and innovation, nor do they distinguish between the essentiality of the IP that China and other WTO members are obligated to protect. In other words, a broad essential facility doctrine as reflected in existing Article 7 of SAIC's rule and in the agencies' draft guidelines is inconsistent with both China's Patent Law and binding international law.

D. Lack of Enforcement Against Counterfeit Semiconductors

While industry data has shown that less than 0.01% of *legitimate* semiconductor products will ever fail during operation in electronics systems, *counterfeit* semiconductors have much higher failure rates. Industry data indicates that semiconductor counterfeiting is a major issue, representing $169 billion in potential risk per year for the global electronics supply chain as of 2012.[58] Data also suggests that China is a major source of counterfeit semiconductors that undermine the quality and reliability of electronics products both inside and outside of China.

China has made strides in recent years toward curbing local traffic in counterfeit semiconductors. In 2001, China adopted regulations to protect semiconductor mask work (layout design) IP. In 2013, the 24th Joint Commission on Commerce and Trade (JCCT) set out commitments to increase enforcement against counterfeit and substandard semiconductors and enhance cooperation on cross-border investigations. In 2015, two State Council reports set forth guidelines on strengthening IP enforcement actions, connecting administrative enforcement and criminal justice of IP, and increasing international cooperation.[59] In its policy on reducing counterfeits sold on the internet, electrical and electronic products were included, along with medical equipment and auto parts, as needing special focus because of the health and safety impact of counterfeits.

However, as China's market and industry continue to grow, the successful implementation of these new regulations and guidelines are increasingly important, and China should be encouraged to curb traffic in counterfeit semiconductors by:

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did not reflect technical inventions, but instead, protected information regarding the boundaries of geographical blocks that were used for sales reporting purposes; nevertheless, the commission determined that access to such IPR may only be compelled where IPR is essential to compete in the market and there are no feasible alternatives; an upstream market for the supply of the IPR exists; the party seeking access proves that it ether intends to sell a new product for which demand exists or to supply a different market; and the refusal to license would exclude all competition in the secondary market). In the United States, the U.S Court of Appeals for the Federal Circuit, which has exclusive jurisdictions over patent appeals from trial courters, has stated that there is "no reported case in which a court has imposed antitrust liability for a unilateral refusal to sell or license a patent." *In re Independent Service Organizations Antitrust Litigation,* 203 F.3d 1322, 1326 (Fed. Cir. 2000).

[58] Top 5 Most Counterfeited Parts Represent a $169 Billion Potential Challenge for Global Semiconductor Market. IHS ISuppli press release, April 4, 2012: http://www.isuppli.com/Semiconductor-Value-Chain/News/Pages/Top-5-Most-Counterfeited-Parts-Represent-a-$169-Billion-Potential-Challenge-for-Global-Semiconductor-Market.aspx.

[59] *State Council on the strengthening of infringement and counterfeiting in the field of Internet Governance Guo Ban Fa [2015] No. 77*; and *Several Opinions of the State Council on Accelerating the Building of China into A Powerful Country in Intellectual Property under the New Circumstance Guo Fa [2015] No. 71*.

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- reconsidering interpretation of Article 29 of the Criminal Law regarding instigation so that trademark owners can provide evidence to law enforcement officials that a vendor is knowingly and repeatedly selling counterfeits, and that any action against the vendor is not acting against someone with no original criminal intent;
- allowing the Administration of Industry and Commerce (AIC) to have additional powers that would allow AIC access to warehouses that contain counterfeits (currently only the Public Security Bureau (PSB) can enter locked warehouses so counterfeit vendors thwart AIC enforcement by storing their volume inventory in warehouses and only keep samples below the criminal threshold at their store fronts to avoid PSB intervention);
- substantially lowering the criminal threshold for semiconductors and other intermediate goods because of the large losses to consumers who purchase expensive final products that contain the inexpensive, unreliable counterfeit part;
- better educating its customs officials on the detection of counterfeits to prevent proliferation and educate Chinese consumers about the dangers of using counterfeit semiconductors;
- empowering customs officials to aggressively seize counterfeit products and take actions leading to the arrest of counterfeiters and counterfeit traders, including shutting down retail malls where counterfeits can be readily purchased; and
- continuing to enhance cooperation with international partners and industry associations to identify and shut down counterfeiting operations and vigorously prosecute those knowingly involved in the manufacture, distribution, and sale of counterfeit semiconductors.

E. Theft of Intellectual Property & Trade Secrets

Finally, Chinese industrial policy subsidy programs that set specific technology development goals may entice and enable malicious groups and individuals to illegally acquire or misappropriate intellectual property from foreign companies to reach these goals. Some of the state-owned firms tasked with these objectives are starting from scratch and do not possess the necessary intellectual property and know-how to develop advanced manufacturing process techniques and designs. Presumably, the majority of Chinese entities that receive these subsidies to develop the targeted technology do so through legal means. This includes efforts to invest in R&D and/or acquire necessary technology from existing international industry incumbents.

However, motivated by massive subsidies tied to industrial policies, a smaller number of Chinese state institutions, firms, and/or associated individuals may choose to steal or misappropriate the targeted technology from foreign firms as a short-cut to developing the technology. This includes a notable shift from M&A to a more sophisticated process of acquiring hundreds of talented engineers and managers from foreign companies located in both China and foreign jurisdictions.[60] It has been reported that these Chinese state-owned firms have been highly successful in recruiting this high-tech engineering talent, which is enabled by massive Chinese government subsidies that allow for salaries to be offered at high, non-market

[60] China Poaching Taiwanese Tech Talent. Nikkei Asian Review, March 4, 2016: https://asia.nikkei.com/Business/Trends/China-poaching-Taiwanese-tech-talent

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rates.[61] Often high-level managers are lured away from targeted companies with compensation packages four or five times the market rate. These managers then target key former employees in technology development, manufacturing and facilities, promising outsized compensation.[62]

In addition, in numerous publicly reported instances, individuals employed by Chinese state-owned firms and or their partners/affiliates have chosen to steal or misappropriate intellectual property, including trade secrets from their previous employer.[63] In sum, while there is no indication that IP theft and other related illegal activities are an official state-sanctioned means to achieving industrial policy goals, China's massive non-market industrial subsidies granted to state-owned enterprises do often create the conditions ripe for encouraging bad actors to inappropriately acquire key IP.

6. Conclusion

In conclusion, SIA welcomes China's participation in the global value chain as long as it is in conformance with its international obligations, is consistent with market-based principles, and is not the result of interventionist government policies. China's commitment to further economic development, innovation, and liberalization can provide tremendous market opportunities for U.S. semiconductor firms as global demand for semiconductor products continues to grow. Done appropriately, China's support for its domestic high-tech sectors, including semiconductors, is a welcome development, and will aid China in its economic and social transition. The alignment of China's efforts in the semiconductor space in a way that embraces, not separates, from international rules and global best practices is in the interests of all market-oriented firms in the ICT sector and their respective governments.

China must ensure the protection of intellectual property if it hopes to develop a strong semiconductor sector. This is why effectively addressing concerns regarding Chinese government policies that pressure U.S. semiconductor companies to disclose or transfer their intellectual property to Chinese entities would be beneficial for both countries. In order to achieve this, governments and industries should work with China's leadership to address the issues which are the subject of the investigation and course correct in a meaningful and timely manner.

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[61] China Expected to Poach More Taiwan Chip Execs. EEtimes, January 1, 2017: https://www.eetimes.com/document.asp?doc_id=1331144

[62] Exposing How Taiwan IC Engineers Jump Ship to the Mainland: Hired as Soon as They Depart With 2x-3x Salaries. EEtimes China, March 23, 2017: http://www.eet-china.com/news/article/201703231458. Talent Hunt in China's Memory Triangle. EETimes, January 26, 2017: https://www.eetimes.com/document.asp?doc_id=1331262 and: Taiwan Chipmakers Worried About Brain Drain. Asian Nikkei Review, April 29, 2017 https://asia.nikkei.com/Business/AC/Taiwan-chipmakers-worried-about-brain-drain

[63] Authorities Bust Group Stealing Win Semiconductors Trade Secrets. Focus Taiwan, November 6, 2015 https://www.eetimes.com/document.asp?doc_id=1331144 and: Samsung Electronics Executives Pass on Core Technology. SBS News, September 22, 2016: http://v.media.daum.net/v/20160922211514100 (Korean).

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