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East Asia, the Pacific, and International Cybersecurity Policy Subcommittee

"China's Challenge to American AI Leadership"

A Testimony by:

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Chairman Ricketts, Ranking Member Shaheen, distinguished Members of the Committee, I am honored to share my views with you on this important topic. The Center for Strategic and International Studies (CSIS) does not take policy positions, so the views represented in this testimony are my own and not those of my current or former employer.

I currently serve as the Senior Advisor for the Wadhwani AI Center at CSIS, where I conduct policy research at the intersection of technology, economics, and national security. Prior to CSIS, I spent three years working at the U.S. Department of Defense Joint Artificial Intelligence Center, where I served as the director for strategy and policy, and participated directly in government-to-government conversations with China and the People's Liberation Army related to AI. My primary professional background is corporate strategy roles in technology-driven industries, including artificial intelligence, semiconductors, robotics, and space systems. Over the past ten years, I have focused intensely on the geopolitical and national security implications of Artificial Intelligence technology with a special emphasis on U.S.-China competition. My remarks today reflect my conclusions from the research I have conducted while at CSIS as well as my prior professional experiences.

To begin, both the current administration of President Donald Trump and the prior administration of President Biden have likened the current race in AI between the United States and China to the Cold War-era space race between the United States and the Soviet Union. This is a helpful analogy in terms of capturing the strategic importance of this competition. However, the current AI race is bigger in terms of its absolute scale and different in its competitive dynamics. Between 1960 and 1973, the United States government spent $28 billion on the Apollo program, which is the equivalent of $326 billion in inflation-adjusted dollars.[1] In 2026, just five U.S. companies—Meta, Alphabet, Microsoft, Amazon and Oracle—are expected to spend more than $450 billion[2] in aggregate AI-specific capital expenditures. Other U.S. companies, such as OpenAI, Anthropic, and xAI, will add hundreds of billions of additional investment to that total. This reflects the fact that far more of the activity of the AI race is taking place in the commercial private sector than was the case with the space race. Overall, U.S. companies will invest far more in AI in a single year than the entire U.S. government spent over the entire 13-year life of the Apollo program. AI investment is not only bigger than Apollo in inflation adjusted dollars, but it is also bigger as a share of U.S. gross domestic product. The investment firm Goldman Sachs estimates that total AI-related investment in the United States already represents 1 percent of U.S. GDP,[3] whereas during its peak years the Apollo program comprised only 0.4% of GDP.[4]

[1] In 2024 dollars. Source: Dreir, Casey. The Planetary Society "How much did the Apollo program cost?" https://www.planetary.org/space-policy/cost-of-apollo Updated 2024 figures available at https://docs.google.com/spreadsheets/d/e/2PACX-1vTKMekJW9F8Z3fWnx-IxvHSPD35iZxZxDVoqIp25FaxxXjOqJ2Rk-zS858dND0N_3cwcacbIX8gr9xt/pubhtml

[2] https://know.creditsights.com/insights/technology-hyperscaler-capex-2026-estimates

[3] https://www.businessinsider.com/ai-bubble-boom-goldman-sachs-crash-risk-forecast-outlook-valuation-2025-10

[4] https://www.everycrsreport.com/files/20080924_RL34645_e964463dec69061c93c8d2fce3658558c4e9d4d9.pdf

The United States government is not directing U.S. companies to invest such astonishing sums of money, so why are they doing it? The clearest answer comes from Google DeepMind CEO Demis Hassabis, who claimed earlier this year that leading AI systems "will exhibit all the cognitive capabilities humans have, maybe in the next five to 10 years" and that the AI revolution is "going to be 10 times bigger than the Industrial Revolution, and maybe 10 times faster."[5] Leadership in a revolution that transformative provides a free market incentive sufficiently large to justify such investments, and the current demand for AI services is already enormous. Google reports that even the eight-year old versions of its AI chips are 100 percent utilized.[6]

The most obvious product of these investments is the computing hardware infrastructure—data centers full of advanced AI chips—that powers AI software. The largest single AI datacenter cluster as of March 2025[7] included more than 200,000 AI chips and is planned to grow to more than one million[8] AI chips in the near future. The current market price for the leading AI chips is in the range of $25,000-$60,000, implying chip costs alone in the tens of billions of dollars for a leading AI facility.

Experts in China have also paid close attention to the strategic importance of AI chips. A 2018 report[9] by Tsinghua University in Beijing put it in stark terms:

> "Whether it is the realization of algorithms, the acquisition and a massive database, or the computing capability, the secret behind the rapid development of the AI industry lies in the one and only physical basis, that is, the chips. Therefore, it is no exaggeration to say, 'No chip, no AI' given the irreplaceable role of AI chip as the cornerstone for AI development and its strategic significance."

Thus, the most strategically significant move that the U.S. government has taken in the AI race with China to date is working to deny China access to the most advanced AI chips and also to deny China the means to make its own chips. Key aspects of this strategy began during the first Trump administration and then were greatly expanded during the Biden administration. While the implementation of this strategy has been flawed (as I have repeatedly written[10, 11, 12, 13, 14] about), it has nevertheless contributed significantly to continued overall U.S. leadership in AI.

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[5] https://www.theguardian.com/technology/2025/aug/04/demis-hassabis-ai-future-10-times-bigger-than-industrial-revolution-and-10-times-faster
[6] https://www.datacenterdynamics.com/en/news/google-says-tpu-demand-is-outstripping-supply-claims-8yr-old-hardware-iterations-have-100-utilization/
[7] https://arxiv.org/pdf/2504.16026
[8] https://www.datacenterdynamics.com/en/news/xai-elon-musk-memphis-colossus-gpu
[9] You Zheng and Wei Shaojun, eds., "White Paper on AI Chip Technologies," Beijing Innovation Center for Future Chips, Tsinghua University, 2018, https://www.scribd.com/document/412276111/AI-Chip-2018-EN
[10] https://www.csis.org/analysis/understanding-us-allies-current-legal-authority-implement-ai-and-semiconductor-export
[11] https://www.csis.org/analysis/deepseek-huawei-export-controls-and-future-us-china-ai-race
[12] https://www.csis.org/analysis/understanding-biden-administrations-updated-export-controls
[13] https://www.csis.org/analysis/true-impact-allied-export-controls-us-and-chinese-semiconductor-manufacturing-equipment
[14] https://www.csis.org/analysis/chip-race-china-gives-huawei-steering-wheel-huaweis-new-smartphone-and-future

If the Biden administration had not blocked exports of advanced AI chips, it is possible, perhaps even likely, that the first million chip AI cluster would be built in China, rather than the United States. China has many advantages in the AI race and the disparity in computing resources stands out as almost certainly the largest single advantage that the United States enjoys over China. Two senior executives in key Chinese AI firms have explicitly stated that lack of access to advanced AI chips is the most significant challenge that they face. In May 2025, Wang Qi, still vice-president at Tencent's cloud computing unit, said that "The most severe problem is the [limited] resources of [graphics] cards and computing resources," and that tighter U.S. export controls would, "widen the gap [regarding AI adoption] between China and the US in the short term."[15] Similarly, in July 2024, DeepSeek CEO Liang Wenfeng said, "We do not have financing plans in the short term. Money has never been the problem for us; bans on shipments of advanced chips are the problem."[16] Liang has also said in an interview with a Chinese media outlet that U.S. restrictions on AI chips mean that Chinese companies must use two to four times the computing power to achieve the same results, referring to the penalty of using Nvidia H800 chips instead of H100 chips for large model training.[17]

Similarly, if the first Trump administration had not blocked Chinese chipmakers from acquiring advanced semiconductor manufacturing equipment, such as Extreme Ultraviolet Lithography (EUV) tools it is possible that Chinese chip-making firms would be at or near parity with the global leaders. Without access to such equipment, China's most advanced producer of logic chips, SMIC, has been stuck at the 7 nanometer (nm) technology node for years and may continue to be stuck there for more years to come. According to a report,[18] SMIC had placed an order for an EUV lithography tool in April 2018 prior to being blocked.

The first Trump administration also blocked leading Chinese chip designers, such as Huawei's HiSilicon subsidiary, from accessing U.S. semiconductor manufacturing equipment via contract manufacturers such as Taiwan's TSMC. In August 2018, Huawei was the second company to launch a 7 nm smartphone application processor, the Kirin 980, trailing Apple's A12 by mere weeks.[19] Huawei launched an HiSilicon-designed, TSMC-manufactured 7 nm AI accelerator chip, the first Ascend 910, in mid-2019. Huawei deployed it with commercial partners later that year.[20] Nvidia did not begin selling its first 7 nm AI accelerator, the A100, until 2020.[21] At the time, Huawei was preparing to capitalize the so-called 3-5-2 policy,[22] in which the CCP's Central Office ordered all government agencies and many state-owned enterprises[23] to eliminate the use of all non-Chinese technology within three years. However, Huawei was unable to fulfill

[15] https://www.scmp.com/tech/big-tech/article/3310656/chinas-lack-advanced-chips-hinders-broad-adoption-ai-models-tencent-executive
[16] https://www.chinatalk.media/p/deepseek-ceo-interview-with-chinas
[17] https://www.36kr.com/p/2872793466982535
[18] https://asia.nikkei.com/business/companies/chinese-chipmaker-takes-on-tsmc-and-intel-with-cutting-edge-tool
[19] https://spectrum.ieee.org/apple-huaweii-both-claim-first-7nm-smartphone-chips
[20] https://www.sohu.com/a/342013025_115978
[21] https://nvidianews.nvidia.com/news/nvidias-new-ampere-data-center-gpu-in-full-production
[22] https://www.ft.com/content/b55fc6ee-1787-11ea-8d73-6303645ac406
[23] https://www.wsj.com/articles/beijing-orders-agencies-to-swap-out-foreign-tech-for-chinese-gear-11575921277

demand because of the first Trump administration's updated 2020 entity listing,[24] which temporarily cut Huawei's Ascend and Kirin lines off from TSMC. Apple,[25] TSMC, and Nvidia were all major beneficiaries of these early U.S. export controls, which delivered a setback to Chinese efforts to eliminate dependence on U.S. AI and semiconductor technology.

It is worth stressing that the competitive dynamics in the Chinese market are not the same as those outside of it. The competitive advantages that have resulted in Nvidia leading in the AI chip market around the world are not enough to guarantee a leading position in the Chinese market. This is because Chinese firms benefit from dramatic government support (including forced technology transfer, industrial espionage, and intellectual property violations) and because the Chinese domestic market is in and of itself large enough to reach globally-relevant economies of scale, which was not the case for the export-dependent growth strategies of South Korea or Taiwan.

There is not a simple relationship between export controls and China's rate of technological progress. China's greatest progress came in sectors with no export controls.

A September 2024 analysis by Bernstein Research, an equity research firm, included a review of China's semiconductor self-sufficiency goals from the 2015 roadmap and found that "China has made impressive progress and likely will beat the 'Made in China 2025' targets for integrated circuit (IC) Design and Manufacturing, but may miss the goals for IC equipment and Materials." As the Bernstein analysis shows, the rate of China's progress toward self-sufficiency is best predicted by the market and technological complexities of each semiconductor market segment, not by the extent to which export controls were applied. It is certainly not the case that the segments in which China has made the most progress—or even devoted the most resources—are the areas in which the United States has applied export controls most forcefully.

That there is not a simple relationship between export controls and China's technological progress should be obvious given that China has made rapid progress[26] in other technological domains—such as solar cells[27] and electric vehicles[28] (EVs)—where the United States applied no export controls and in some cases actively supported the rise of a Chinese supply chain. The United States applied no export controls in the case of the equipment used to manufacture silicon solar cells, yet today China dominates[29] both production of solar cells and production of the equipment used to make them. This equipment is in many ways similar to (though less sophisticated than) the equipment used to make and process silicon wafers for semiconductors. In fact, one Chinese company, Naura, is a domestic leader in both manufacturing equipment for both solar cells and semiconductors. The biggest difference in Chinese outcomes between those

[24] https://www.federalregister.gov/documents/2020/08/20/2020-18213/addition-of-huawei-non-us-affiliates-to-the-entity-list-the-removal-of-temporary-general-license-and
[25] https://stratechery.com/2025/apple-earnings-openai-deep-research-the-unbundling-of-substantiation/
[26] https://www.csis.org/blogs/trustee-china-hand/chinese-ev-dilemma-subsidized-yet-striking
[27] https://www.nytimes.com/2024/03/07/business/china-solar-energy-exports.html
[28] https://www.bloomberg.com/opinion/articles/2024-04-11/us-squandered-its-tesla-edge-in-ev-race-with-china
[29] https://www.iea.org/reports/solar-pv-global-supply-chains/executive-summary

two industries is not the presence or absence of export controls but the far greater technological complexity of producing semiconductor manufacturing equipment.

The EV maker Tesla made a major push into Chinese manufacturing in late 2018, launching deep partnerships with many local Chinese suppliers, such as battery-maker CATL. As a November 2024 commentary in a major Chinese state-run newspaper stated:

> "Tesla's rapid growth in sales, fueled by its technological and branding advantages and backed by China's massive consumer market, has driven the rapid development of upstream and downstream supply chains. Today, the localization rate of parts for Tesla's Shanghai Gigafactory exceeds 95%, with more than 60 suppliers integrated into Tesla's global supply chain."[30]

The Chinese EV supply chain, which Tesla helped dramatically increase in both scale and technological sophistication, is now also supplying Tesla's competitors.[31] Defections of Tesla-trained skilled employees are also a challenge. An April 2024 New York Times report[32] claimed that most of Tesla's early Chinese employees now work at competing Chinese firms. In a January Tesla earnings call, Tesla CEO Elon Musk said[33] "The Chinese car companies are the most competitive car companies in the world. . . . Frankly, I think if there are not trade barriers established, they will pretty much demolish most other companies in the world." In October 2025, Carlos Tavares, the former CEO of Stellantis (which owns Chrysler) predicted[34] that Tesla will "end up completely overtaken by Chinese manufacturers."

The point here is not to suggest with unwarranted certainty that export controls would have definitively prevented China's rise in the solar and EV industries. Rather, it is to caution the against those who rely too heavily on cursory anecdotal evidence to reach conclusions about when export controls do or do not work and what the counterfactual outcome would have been if export controls were or were not applied. Much depends upon the state of the global market landscape, the complexity of the controlled technology, the current technological sophistication of the targeted country, the design of the export control regulations, and the robustness of the controls' implementation and enforcement. Only a detailed analysis can hope to reach anything approaching insight.

Semiconductor export controls—as implemented thus far—have in different ways and at different times both helped and hindered Chinese firms.

Just as foreign firms have supported Chinese competitor growth in solar cells and EVs in the absence of export controls, so have they done in semiconductor manufacturing. The major

[30] https://www.geopolitechs.org/p/chinas-peoples-daily-highly-praises
[31] https://www.digitimes.com/news/a20230328PD205/battery-catl-china-ev-battery.html
[32] https://www.nytimes.com/2024/04/09/podcasts/the-daily/tesla-china-ev.html?showTranscript=1
[33] https://www.cnbc.com/2024/01/25/elon-musk-says-chinese-ev-makers-will-demolish-other-companies.html
[34] https://www.ft.com/content/555499db-9ea5-45df-949d-20321556eee3

semiconductor manufacturing equipment providers all have major service businesses, where, among other things, they train customer companies on how to get the most out of their equipment. Prior to the October 2022 changes in U.S. export controls, this could include assisting with the facility planning, installation, repairs, and operational troubleshooting of equipment as part of advanced chip manufacturing operations. Industry sources told me that this sometimes included contract research and development (R&D) of advanced node semiconductor process technology on behalf of or in partnership with Chinese clients. As of now, this is still legal in the case of providing support to Chinese legacy chip manufacturing operations, and there is reason to suspect that some Chinese firms have deceived U.S. firms in order to receive advice related to their advanced chipmaking efforts.

By contrast, earlier U.S. export controls meaningfully reversed progress in some segments of the Chinese semiconductor sector, such as NAND memory manufacturing and smartphone chip design, though the durability of those setbacks, even if temporary, will depend on many factors. More recent export controls have also made life harder in many ways for Chinese semiconductor equipment firms, who can no longer legally obtain U.S. subcomponents or technical expertise.

Thus, it is simply wrong to say that export controls always, in isolation, accelerate Chinese technological indigenization and that making it easier for U.S. firms to export will always slow Chinese indigenization.

At the same time, it is unambiguously the case that the United States' use of semiconductor export controls, beginning with ZTE in April 2018, made a massive impression on both political and corporate leaders in China. Speeches at the time by Chinese leadership, including General Secretary Xi Jinping, indicate that ZTE was viewed as a turning point and justified China's aggressive pursuit of "self-reliance" in science and technology. Pony Ma, the chairman of Tencent, one of China's largest technology firms, said in May 2018, "The recent ZTE incident made us see clearly that no matter how advanced our mobile payment is, without mobile devices, without microchips and operating systems, we can't compete competently."

The evidence goes beyond talk to specific actions. China made significant changes to its semiconductor policy in the years following ZTE, and China's central government directed local governments to "do everything in their power" to promote the semiconductor sector. Some Chinese companies also took drastic measures to respond after ZTE. For example, Nikkei Asia reported that Yangtze Memory Technologies Corporation (YMTC)—one of China's most advanced semiconductor manufacturers—began a full-blown de-Americanization campaign in 2019 involving the full-time work of more than 800 staff (both YMTC and its suppliers). This included the establishment of multiple new major partnerships with domestic Chinese equipment producers. Of note, at the time when YMTC began this de-Americanization initiative, no significant U.S. export controls applied to the company. YMTC began their work based on fear of future controls, not the reality of current ones.

Combined, this provides strong evidence that the export controls did increase the desire of both the Chinese government and Chinese companies to increase the capabilities of local semiconductor equipment providers, but that is not the same thing as saying that export controls caused accelerated indigenization, which depends upon more than just desire.

I believe the most important export controls that the United States has established are those related to advanced semiconductor manufacturing equipment. Export controls changed the composition of equipment demand both technologically (decreasing the technological sophistication of equipment purchased by China) and geographically (shifting more of advanced node demand outside of China and more legacy node demand to China) but likely did not change the overall demand trajectory.

China has continued to be a large and growing market for equipment exports even after the more recent export controls, but Chinese firms have changed their focus from a rush to compete at the most advanced semiconductor technological nodes to maximizing both domestic self-sufficiency and global leadership in legacy chip[35] production. China was likely to pursue a massive expansion[36] of chip production capacity regardless of U.S. actions, but the export controls helped ensure that this capacity did not drive the U.S. and allies toward a strategic dependence on China for the most technologically advanced chips, such as those that power AI systems or high-end smartphones.

Moreover, the overall demand for semiconductor manufacturing equipment fundamentally depends on the overall demand for manufactured chips. As the demand for advanced chips grows, that demand will translate into demand for advanced equipment. And if China is not in a position to purchase advanced equipment, then the purchase and production will instead take place outside of China. The chief financial officer of ASML, Roger Dassen, said[37] this explicitly during ASML's July 2024 earnings call with investment analysts:

> ". . . the way we look at the demand for our tools is not from a specific geography. In this case, China. We look at—and that's the way we model our sales medium term and long term. We look at what is the global demand for wafers and whether those wafers are being produced in country X or country Y, at the end of the day, it doesn't matter. And I think that is very important to recognize in looking at your model. We don't have a specific China element in our models. It is the global demand for wafers that drives our modeling."

Accordingly, U.S. and allied controls did not so much destroy demand as change its composition. China is buying fewer advanced tools than it would have otherwise and is instead purchasing more legacy tools. The advanced tools that would have been sold to China have instead been sold to

[35] https://www.csis.org/analysis/strategic-importance-legacy-chips
[36] https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/220523_DiPippo_Red_Ink.pdf
[37] https://seekingalpha.com/article/4704620-asml-holding-n-v-asml-q2-2024-earnings-call-transcript

places like the United States, Taiwan, South Korea, Japan, and Europe. Likewise, given that many foreign players are wary of investing in legacy nodes due to fears of Chinese overcapacity, the tools are being largely sold to China for those production lines, not elsewhere.

There is no change in U.S. or allied policy that will persuade the Chinese government and Chinese firms to abandon their semiconductor equipment de-Americanization and decoupling efforts. However, the United States can take steps to make those efforts more difficult and to extract more strategic benefits in semiconductor and AI competition.

Critics of export controls oftentimes make two related arguments. First, revenues from China can be reinvested in R&D and thus contribute to increased U.S. technological competitiveness, including against Chinese firms. Second, prohibiting exports increases willingness on the part of Chinese firms and the Chinese government to invest in competitors to U.S. firms, decreasing U.S. technological competitiveness.

However, these arguments assume that the strategic approach of the Chinese government and Chinese firms depends solely or primarily upon U.S. actions, which is contradicted by the review of Chinese policy at the beginning of this paper and from the experience of the EV and solar industries.

Consider a thought experiment: What would be the likely policy response of the Chinese government if the United States decided to begin unrestricted exports of nuclear submarines to China? U.S. nuclear submarines are widely regarded as the best in the world, and China's spies have long devoted major efforts to stealing U.S. submarine technology secrets.

Presumably, therefore, China would leap at the chance to buy U.S. nuclear submarines on the open market. And, under the logic of the above two arguments—increased U.S. revenue and decreased Chinese investment—these sales would increase, not decrease, the U.S. technological advantage in nuclear submarine technology. Are American policymakers fools for using export controls to block nuclear submarine sales to China?

Of course not.

Even if a hypothetical reckless U.S. president and Congress were to allow China to buy as many submarines as U.S. firms could make, China would never accept that this state of affairs is likely to continue on a permanent basis. China would obviously take the submarines they could get and reverse engineer the technology as fast as possible and transfer that technology to their domestic submarine industry, which they would continue to financially support. The increased revenue from R&D for U.S. firms is not going to make nearly as much of a difference as China's hands-on opportunity to reverse engineer U.S. technology. Neither would the lost sales among Chinese submarine manufacturers decrease China's commitment to supporting a domestic industry. This is not to even mention the grave risks to national security of a hypothetical Chinese navy equipped with U.S.-built nuclear submarines.

This admittedly extreme thought experiment bears consideration because, while some in the West question whether semiconductor manufacturing equipment deserves to be viewed as a strategic technology of major importance to national security, China's leaders do not. This belief is evident not only in words but also the deeds, whether that be Chinese state-backed espionage[38] against equipment firms, aggressive reverse engineering[39] of purchased Western equipment, or the astonishing amount of financial resources dedicated to indigenization.

There is simply no policy that the United States could articulate that would persuade China to abandon its goals of de-Americanization and decoupling in the semiconductor equipment sector. As the United States and allied governments consider reforms to semiconductor equipment controls, they should focus less on how to change China's goals and more on how to make achieving those goals as expensive and complicated as possible.

Thank you for the opportunity to testify today, and I look forward to your questions.

[38] https://www.scmp.com/news/world/europe/article/3259528/chinese-spies-targeted-dutch-industries-including-chipmaker-asml-strengthen-military-intelligence
[39] https://www.digitimes.com/news/a20231011PD201/academia-china-reverse-engineering-us.html