



The Lithography Loophole: How China Is Printing Its Way to Chip Self-Sufficiency

Ryan Fedasiuk and Julia Torres

April 2026

Key Points

- Although US and allied export controls have prevented China from acquiring high-end chipmaking equipment, Chinese firms are starting to succeed in using older-generation lithography tools to fabricate near-frontier chips.
- China's fleet of several hundred deep ultraviolet (DUV) lithography machines will almost certainly be capable of printing millions of high-end logic dies in 2026, which Huawei will package into high-end AI accelerators.
- Unless the United States and its allies take urgent steps to restrict China's ability to purchase and upgrade older-generation lithography machines, Huawei will be more than capable of printing huge quantities of cutting-edge computer chips needed to contest US AI leadership.
- This report offers a three-pronged approach to close this gap: capability-based export controls that regulate tools by technical performance, a countrywide presumption of denial that closes entity-based gaps, and restrictions on servicing existing DUV machines in China.

US and allied export controls have successfully denied China access to the extreme ultraviolet (EUV) lithography machines required to print modern AI chips. Huawei's current production amounts to a fraction of the US-led semiconductor manufacturing ecosystem, starving Chinese AI labs of the compute they need to serve their models to the global public.

But the Biden administration's controls on semiconductor manufacturing equipment, which were enacted in 2022, left a critical gap. Chinese chipmakers—led by Semiconductor Manufacturing International Corporation (SMIC) and its principal customer, Huawei—are acquiring older-generation deep ultraviolet immersion (DUVi) lithography tools and repurposing them to fabricate near-frontier chips.

This process is inefficient, and the cost curve is punishing. But access to older lithography machines is allowing Chinese chipmakers to scale their production far faster than US policymakers had anticipated. SMIC has already produced and sold chips that are competitive with the US-led technological frontier—and it is actively developing a five-nanometer (nm) process that, while much more expensive than the Taiwan Semiconductor Manufacturing Company (TSMC) equivalent, would give Huawei a sanction-proof pathway to making near-frontier AI accelerators at scale.

Left unaddressed, this loophole risks undermining the entire architecture of US export controls on AI chips—and undercutting the United States' near monopoly on the compute needed to win the AI race.

To close it, this report recommends three complementary measures: capability-based export controls that regulate lithography tools by what they can produce (rather than what buyers declare), a countrywide presumption of denial for lithography exports to China, and restrictions on ASML’s servicing of DUVi machines already deployed in Chinese fabrication plants.

The Making of a Loophole

As previous American Enterprise Institute research has discussed, China’s AI chip ambitions are constrained by three critical bottlenecks: the fabrication of logic chips, the fabrication of memory, and the packaging of advanced accelerator modules.¹ Of these, logic chip fabrication is the most consequential and difficult to replicate.

A modern logic chip is produced through a sprawling network of chemicals, materials, and precision processes spanning dozens of countries and hundreds of suppliers. The single most concentrated node in that network is lithography. The Dutch company ASML holds a complete monopoly² on EUV lithography tool shipments and 90 percent³ of DUVi shipments. No company in China—really, no company on Earth—can match the resolution or throughput of ASML’s machines. This is why, in the United States’ broader quest to constrain China’s access to computational power, lithography tools are an optimal choke point.

Chipmaking begins with lithography—the process of printing circuit patterns onto silicon wafers using light. In a cutting-edge EUV machine, a laser vaporizes 50,000 tin droplets per second to generate light at a specific 13.5 nm wavelength—a frequency so tight and energetic that it is absorbed by almost every known material.⁴ The light then bounces off a series of ultra-precise mirrors to delicately etch features onto silicon wafers. These machines cost \$150–\$400 million each,⁵ contain over 100,000 parts, and are made only by ASML. Since 2019,⁶ the Dutch government has banned the export of these machines to China.

EUV is the best way to etch features into silicon wafers to turn them into logic chips—but it is not the only way. Traditional deep ultraviolet (DUV) tools use conventional lenses to pass light with a longer wavelength (193 nm) to produce older-generation chips with larger features, with more modern “immersion”

techniques further improving resolution by placing a layer of purified water between the lens and the wafer.⁷ DUVi machines are cheaper, more widely available, and—most critically—not subject to the same export restrictions that the United States or the Netherlands has enacted on EUV systems.

But through the process of “multi-patterning”—building a chip from the ground up through multiple lithographic exposures—chipmakers can achieve far finer features than they could with any single DUVi pass. This has allowed certain Chinese companies—namely, SMIC—to stretch the capabilities of a traditional DUVi tool and produce viable AI chips. SMIC produced and sold 7 nm chips in 2022 without access to a single EUV machine,⁸ and Chinese research groups are openly exploring whether DUVi multi-patterning can create 5 nm chips.⁹

DUVi forces punishing trade-offs, and for most chip fabrication plants (i.e., Taiwan’s TSMC or South Korea’s Samsung), the economics would not be sound: Printing a logic accelerator with the physical equivalent of dial-up internet significantly increases the cost to make a given silicon wafer (which will be sliced into individual chips) and the probability that it will include some defect, drastically lowering yield rates for a given patch of silicon. This is why SMIC’s 5 nm chip fabrication process—which relies on DUVi lithography combined with complex multi-patterning—is estimated to be 40–50 percent more expensive than TSMC’s equivalent, with yields as low as 20 percent.¹⁰ Still, Chinese foundry companies like SMIC (and their major clients, like Huawei) have been willing to absorb those costs—and as a result, they can produce small amounts of near-frontier chips without access to a single EUV machine.

China’s work-around for making logic chips with DUVi is an urgent matter for US national security. Left unaddressed, this loophole could allow China to produce future generations of Huawei’s near-frontier AI chips at scale—reducing US leverage over global AI build-outs, undercutting the American AI Exports Program, and weakening the strategic advantage that American export controls were designed to cement.

The Scale of Chinese Dependence

China is exploiting the DUVi loophole at a massive scale. Chinese entities accounted for 70 percent of

ASML's DUVi tool sales in 2024.¹¹ The company's total sales to China that year amounted to nearly \$12 billion, accounting for more than a third of the company's revenue.¹² These machines were shipped legally and then upgraded to produce the high-performing chips previously accessible only with EUV tools—a process made possible because, as discussed in greater detail below, current US and allied restrictions focus on equipment that meets specific performance thresholds bound for specially designated entities rather than considering the equipment's capability.

Dutch DUVi machines, which China imports on a large scale, are the backbone of Huawei's chip-production capacity—and the machines ASML ships are more than sufficient to allow Huawei to fabricate large numbers of high-end logic chips.

A back-of-the-envelope analysis gives a sense of what the existing stockpile of machines can actually produce: Of the 374 DUV lithography machines ASML shipped globally in 2024, 129 were argon fluoride immersion (ArFi) systems, which can be used to fabricate chips at and below 7 nm with multi-patterning. With Chinese entities accounting for 70 percent of the sales, SMIC and its peers likely acquired close to 90 ArFi machines—worth approximately \$5–\$7 billion.¹³ Most of these are ASML's NXT:1980Fi-series class of DUVi machines, capable of printing between 275 and 330 silicon wafers per hour—giving each machine a theoretical ceiling of 2.4 million “passes” over a 300 millimeter silicon wafer in a given year.¹⁴

Because each DUVi machine relies on multi-patterning to produce more sophisticated chips, it must expose each critical layer two, three, or even four times to produce features that could be printed with a single pass of an EUV machine. A modern 7 nm logic chip runs through more than 80 lithography steps, of which the dozen or so most critical layers must be doubled or quadrupled with an older-generation DUVi tool.¹⁵ We therefore estimate that Chinese fabrication plants must burn one-and-a-half to two times the number of ArFi scanner hours per wafer that TSMC does with ASML's most cutting-edge EUV machines.

Even assuming terrible yield rates—many silicon wafers will be printed incorrectly in multi-patterning—the capacity China gains from its access to older-generation Dutch lithography machines is enormous: We estimate the 90 or so machines Chinese entities

bought in 2024 could sustain several million 7 nm-class wafer starts. This is far more than Huawei needed to meet its reported 2025 shipments of 800,000 Ascend-class AI accelerators¹⁶—most of which were drawn from a bank of TSMC-fabricated wafers imported before US sanctions went into effect.¹⁷

China's fleet of several hundred existing DUVi machines will almost certainly be capable of printing Huawei's target of 1.6 million logic dies in 2026 as the company runs out of stockpiled TSMC dies and additional fabs come online.¹⁸

Export controls on lithography have been broadly effective at keeping the most advanced machines away from China.¹⁹ The country currently produces only 1–2 percent of the capacity of the US-led chip ecosystem—and far less than what Chinese AI labs need to serve their AI models to the global public.²⁰ But unless the United States takes urgent steps to close this loophole, China is on a path to narrowing its gap in logic chip fabrication at a rate far faster than many policymakers anticipate. The best way to understand DUVi is to treat it as one of three pieces of a skeleton key—along with memory and chip packaging—that will unlock China's capacity to build frontier chips at a massive scale.

The US Commerce Department's Bureau of Industry and Security (BIS) issued a rule in December 2024 that took initial steps to patch this gap by controlling the export of node-agnostic tools and specifically restricting licenses for software that could jailbreak DUV tools into configurations that are useful for multi-patterning.²¹ These were meaningful speed bumps, but they are not enough to slow Huawei's ambition. Given China's existing stockpile of physical DUVi machines and its robust domestic software industry, Chinese engineers have reportedly continued building their own tools capable of fabricating advanced 7 nm logic chips on ASML's older-generation equipment.²²

What US Partners Have Done About It

At a January 2023 trilateral meeting in Washington, DC, Japan, the Netherlands, and the United States reportedly reached an informal agreement to restrict the sale of certain lithography tools “above certain technology performance thresholds” to China.²³ While the precise details of this arrangement have not been made public,

all three countries have since issued public declarations detailing their own export controls on various semiconductor manufacturing equipment.

Japan expanded controls on a broader range of semiconductor manufacturing equipment related to DUVi lithography.²⁴ The Netherlands, meanwhile, introduced new controls requiring licenses for Dutch companies shipping advanced DUVi lithography tools overseas—but it did not expand its controls to cover advanced DUVi and measurement or inspection tools until September 2024.²⁵ This provided Chinese firms a two-year window to stockpile equipment before restrictions tightened. During this time, Chinese chipmakers purchased many of these instruments.

There is a growing bipartisan consensus in Washington that more must be done to restrict the various loopholes that Chinese companies are pursuing. The Multilateral Alignment of Technology Controls on Hardware Act—which was introduced by a bipartisan group of 15 members of Congress from 11 states—bans the sale or servicing of choke point tools bound for China, including DUVi machines.²⁶ It also establishes a specific timeline for diplomatic engagement before compelling the United States to adopt more restrictive export controls unilaterally.

This report provides complementary measures to that act: restrictions based on what tools can *do*, not what category they fall into, combined with a country-wide presumption of denial that eliminates reliance on outdated export control systems.

Our policy recommendations are as follows:

- Congress should direct the Department of Commerce to develop capability-based export controls on semiconductor lithography equipment, including older-generation DUVi tools that can be used to create near-frontier chips. BIS should consider including technology classes based on their observable technical performance rather than their declared production node or end use.
- Congress should mandate a countrywide presumption of denial for exports of advanced lithography systems to China and other designated high-risk locations, directing BIS to implement a presumption of denial for any country of concern.

- Congress should direct BIS to work with allied governments to restrict ASML and other allied firms from servicing and maintaining DUVi tools already in China that can produce near-frontier chips via multi-patterning.

Capability-Based Export Controls

Current export controls focus on the production node (the generation of chip-manufacturing technology) or the end use declared by the buyer (intended use), leaving a gap in which tools capable of producing near-frontier chips after refurbishment are legally exported.²⁷ This risk is not just theoretical; SMIC has been recently testing a DUVi lithography tool originally designed for creating 28 nm chips that is now being used for 7 nm—and possibly 5 nm—chips via multi-patterning.²⁸

By regulating tools via more technical metrics, US regulators can shift their focus from what a buyer claims a tool will do to what it can actually produce. This method ensures all equipment capable of supporting advanced chip production is included under regulatory oversight—thereby preventing China from acquiring machines technically classified as “mature-node” tools and then repurposing them for frontier production. Note that these expanded export controls would not halt the export of every DUV or DUVi tool but rather only those with technical characteristics that make them viable tools for advanced-node fabrication after refurbishment.

Although lithography machines are a feat of science and the product of decades of research and development investment, they are not black boxes—in fact, regulators understand and have thoroughly documented their operation.²⁹ Their capabilities are defined by measurable engineering parameters including aperture size, overlay accuracy, wavelength, and immersion capability. Congress can direct regulators to set technical performance thresholds that delineate between older-generation tools and those better adapted to refurbishing, borrowing a method used in existing chip export controls.³⁰ This would simultaneously eliminate the strain on BIS, which must currently evaluate each export application, while removing the burden to prove an importer or exporter’s knowledge or intent of technology misuse.³¹

One obvious counterargument is that China could get around capability-based controls by buying restricted components separately through other countries and assembling them at home, effectively smuggling the machine in pieces. This is a real risk, but it is not a new problem; BIS already deals with this sort of evasion. The fix is to extend capability-based controls to vital components, not just complete tools, and work with allied governments to cut off those work-around routes. That said, assembling a lithography tool from separate components is much more difficult and time-consuming than purchasing a complete machine, making whole-tool controls the foremost priority. Component-level restrictions can, and should, follow in subsequent legislation.

Controlling DUV tools that meet certain technical benchmarks would ensure the United States and its allies remain the only producers capable of reliably manufacturing the highest-performing chips on the market. Without capability-based restrictions, China would likely continue purchasing DUVi tools under the guise of mature-node production and, via multi-patterning, using that advantage to close the gap on frontier chip-making technology.

Countrywide Presumption of Denial

A nationwide presumption of denial—meaning that BIS regulators begin with a baseline understanding that lithography tools are likely to be rejected for export, forcing them to go through rigorous licensing scrutiny for any approval—tackles entity-based gaps in the current export control system.

The US Export Administration Regulations rely heavily on the Entity List,³² restricting exports to designated companies rather than a blanket nationwide ban for high-risk locations. This leaves room for unlisted entities to legally acquire advanced lithography tools. Congress should enact legislation that sets the framework of a nationwide presumption of denial for any country of concern,³³ and it should direct BIS to implement the technical details via its own rulemaking. Crucially, these restrictions cover a broad set of tools that might not be currently tagged as choke point tools in the chipmaking process but are still able to produce near-frontier-level chips through multi-patterning.

The United States should encourage allies—particularly the Netherlands and Japan—to adopt parallel measures. Much of the world’s advanced lithographic capacity is overwhelmingly concentrated in those two countries.³⁴ Diplomatic measures should aim for a binding, public, multilateral agreement.

But this reality entirely depends on the speed and willingness of Tokyo and The Hague to adopt such policies. China is already stockpiling and refurbishing DUVi lithography tools, and this practice is likely to only increase. For this reason, if diplomatic measures fail, the Trump administration should consider expanding the foreign direct product rules (FDPR) to cover allied-produced lithography equipment. FDPRs allow the regulation of foreign-made items that are considered “direct products” of US technology or software.³⁵ Many critical subsystems in a modern lithography machine fall under this jurisdiction, including products from California-based Cymer,³⁶ which makes light sources for the lasers used in ASML’s machines.

If allied controls fail to align with US policy, expanding FDPRs could give the United States legal authority to extend export restrictions to Dutch-made tools that incorporate American components. This should be a last resort, though; the Trump administration should first work diligently to exhaust all diplomatic channels.

Restricting DUVi Tool Maintenance and Servicing

The previous measures outlined in this report focus on halting China from buying older-generation machines that could be refurbished to produce near-frontier chips. But China already has a large installed base of DUVi tools, and these machines require specialized maintenance approximately every six months—maintenance that ASML itself often provides on-site in China.³⁷ If the Netherlands fails to restrict servicing for these machines, China’s existing DUVi fleet could remain operational indefinitely, undermining the impact of every other proposed export restriction and providing Huawei a significant production capability.

Congress should therefore direct the Commerce and State Departments to work with allied governments—particularly the Netherlands—to cut off servicing for machines that meet the capability-based thresholds outlined above. By tying service restrictions to technical

specifications rather than the operator’s identity, the United States ensures that unlisted facilities cannot maintain machines capable of producing advanced chips.

Diplomatic coordination with The Hague should be the primary course of action. If that fails, President Trump could expand FDPRs to restrict the use of American-made components and software in the servicing process.

Additional Considerations

These recommendations carry trade-offs. Greater licensing scrutiny may affect allied revenue—particularly for ASML, whose DUVi sales to China have been a significant revenue stream for the Dutch economy. These measures would therefore generate deep diplomatic friction with the Netherlands. If enacted, allies could perceive FDPR expansion as extraterritorial overreach—and although the United States and its partners would enact

controls on any and all “countries of concern,” China would likely retaliate with its own counter-restrictions or trade measures.

Still, even accounting for these risks, the large-scale provision of DUVi tools to Chinese chipmakers risks obviating US and allied control over the world’s most consequential technology: artificial intelligence. The measures this report outlines are designed to protect American leadership in AI chip production, maintain US and allied technological leverage over China, and preserve the strategic advantage that export controls were designed to deliver.

Capability-based controls, countrywide denial, and maintenance restrictions should be pursued simultaneously to close the technical, structural, and operational dimensions of the DUVi loophole. The alternative—allowing China to continue stockpiling and refurbishing its way to near-frontier chipmaking—is far costlier than any trade-off described above.

About the Authors

Ryan Fedasiuk is a fellow at the American Enterprise Institute, where he focuses on US-China relations, technology, and national power. Concurrently, he is an adjunct assistant professor at Georgetown University.

Julia Torres is a technology policy research assistant at the American Enterprise Institute, where she supports 10 senior fellows. She has previously worked in political fundraising and technology policy roles at the Abundance Institute and the Paragon Policy Fellowship and for Nikki Haley’s presidential campaign.

Notes

1. Ryan Fedasiuk, “China’s Transition to Scalable Intelligence” (working paper, American Enterprise Institute, February 18, 2026), <https://www.aei.org/research-products/working-paper/chinas-transition-to-scalable-intelligence/>.

2. Bao Tran, “Top Chip-Making Equipment Companies: ASML, Applied Materials, and Lam Research (Market Data),” PatentPC, April 4, 2026, <https://patentpc.com/blog/top-chip-making-equipment-companies-asml-applied-materials-and-lam-research-market-data>.

3. Michelle Nie, “Dutch Export Controls Don’t Go Far Enough on China,” *AI Policy Bulletin*, April 1, 2026, <https://www.aipolicybulletin.org/articles/dutch-export-controls-dont-go-far-enough-on-china>.

4. ASML, “Light and Lasers,” accessed April 2026, <https://www.asml.com/en/technology/lithography-principles/light-and-lasers>.

5. Carrick Flynn, “The Chip-Making Machine at the Center of Chinese Dual-Use Concerns,” Brookings Institution, June 30, 2020, <https://www.brookings.edu/articles/the-chip-making-machine-at-the-center-of-chinese-dual-use-concerns/>.

6. Arjun Kharpal, “A Globally Critical Chip Firm Is Driving a Wedge Between the U.S. and Netherlands over China Tech Policy,” CNBC, December 4, 2022, <https://www.cnbc.com/2022/12/05/us-ramps-up-pressure-on-netherlands-to-fall-in-line-with-china-chip-policy.html>.

7. ASML, “Light and Lasers.”

8. Mikołaj Barczentewicz, “US Export Controls on AI and Semiconductors: Two Divergent Visions,” International Center for Law & Economics, March 24, 2025, <https://laweconcenter.org/resources/us-export-controls-on-ai-and-semiconductors-two-divergent-visions/>.

9. Fred Chen, “Extension of DUV Multipatterning Toward 3nm,” SemiWiki, October 2, 2023, <https://semiwiki.com/lithography/336182-extension-of-duv-multipatterning-toward-3nm/>.
10. To@ast, “SMIC Reportedly on Track to Finalize 5 nm Process in 2025, Projected to Cost 40–50% More Than TSMC Equivalent,” TechPowerUp, March 28, 2025, <https://www.techpowerup.com/334789/smhc-reportedly-on-track-to-finalize-5-nm-process-in-2025-projected-to-cost-40-50-more-than-tsmc-equivalent>.
11. Michelle Nie et al., “CNAS Insights | The Export Control Loophole Fueling China’s Chip Production,” Center for a New American Security, December 19, 2025, <https://www.cnas.org/publications/commentary/cnas-insights-the-export-control-loophole-fueling-chinas-chip-production>.
12. Eleanor Olcott, “China Boosts AI Chip Output by Upgrading Older ASML Machines,” *Financial Times*, December 19, 2025, <https://www.ft.com/content/d10398db-b8b4-40f3-8c6d-b340470f5f3c>.
13. ASML, *2024 Annual Report*, 57, 343, <https://www.asml.com/en/investors/annual-report/2024>.
14. ASML, “ASML Ships New TWINSCAN NXT Immersion Lithography Platform,” press release, September 29, 2015, <https://www.asml.com/en/news/press-releases/2015/asml-ships-new-twinscan-nxt-immersion-lithography-platform>.
15. Mark Lapedus, “7nm Fab Challenges,” *Semiconductor Engineering*, April 21, 2016, <https://semiengineering.com/7nm-fab-challenges/>.
16. Liza Lin and Raffaele Huang, “China’s Huawei Develops New AI Chip, Seeking to Match Nvidia,” *The Wall Street Journal*, April 28, 2025, <https://www.wsj.com/tech/chinas-huawei-develops-new-ai-chip-seeking-to-match-nvidia-8166f606>.
17. Dylan Patel et al., “Huawei Ascend Production Ramp: Die Banks, TSMC Continued Production, HBM Is the Bottleneck,” *SemiAnalysis*, September 8, 2025, <https://newsletter.semianalysis.com/p/huawei-ascend-production-ramp>.
18. Anton Shilov, “China’s Chip Champions Ramp Up Production of AI Accelerators at Domestic Fabs, but HBM and Fab Production Capacity Are Towering Bottlenecks,” *Tom’s Hardware*, September 10, 2025, <https://www.tomshardware.com/tech-industry/artificial-intelligence/chinas-chip-champions-ramp-up-production-of-ai-accelerators-at-domestic-fabs-but-hbm-and-fab-production-capacity-are-towering-bottlenecks>.
19. Fanny Potkin, “Exclusive: How China Built Its ‘Manhattan Project’ to Rival the West in AI Chips,” *Reuters*, December 17, 2025, <https://www.reuters.com/world/china/how-china-built-its-manhattan-project-rival-west-ai-chips-2025-12-17/>.
20. Jared Cohen, “The Complicated Stakes of the AI Race Between the U.S. and China,” *Time*, February 18, 2026, <https://time.com/7379419/ai-race-us-china/>.
21. US Department of Commerce, Bureau of Industry and Security, “Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items,” *Federal Register* 89, no. 234 (December 5, 2024): 96790–830, <https://www.federalregister.gov/documents/2024/12/05/2024-28270/foreign-produced-direct-product-rule-additions-and-refinements-to-controls-for-advanced-computing>.
22. Che Pan and Brenda Goh, “SiCarrier Says Its Tools Can Help China Make Advanced Chips,” *Reuters*, March 27, 2025, <https://www.reuters.com/technology/sicarrier-says-its-tools-can-help-china-make-advanced-chips-2025-03-27/>.
23. Gregory C. Allen and Emily Benson, *Clues to the U.S.-Dutch-Japanese Semiconductor Export Controls Deal Are Hiding in Plain Sight*, Center for Strategic and International Studies, March 1, 2023, <https://www.csis.org/analysis/clues-us-dutch-japanese-semiconductor-export-controls-deal-are-hiding-plain-sight>.
24. Gregory C. Allen et al., “Japan and the Netherlands Announce Plans for New Export Controls on Semiconductor Equipment,” Center for Strategic and International Studies, April 10, 2023, <https://www.csis.org/analysis/japan-and-netherlands-announce-plans-new-export-controls-semiconductor-equipment>.
25. Arjun Kharpal, “Netherlands, Home to a Critical Chip Firm, Follows U.S. with Export Curbs on Semiconductor Tools,” *CNBC*, June 30, 2023, <https://www.cnn.com/2023/06/30/netherlands-follows-us-with-semiconductor-export-restrictions-.html>.
26. US Senate Foreign Relations Committee, “Risch, Ricketts, Kim Introduce MATCH Act; Level the Global Playing Field for U.S. Tech,” press release, April 8, 2026, <https://www.foreign.senate.gov/press/rep/release/risch-ricketts-kim-introduce-match-act-level-the-global-playing-field-for-us-tech>.
27. US Department of Commerce, Bureau of Industry and Security, “Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items.”
28. Anton Shilov, “China’s Largest Chipmaker Testing First Homegrown Immersion DUV Litho Tool—SMIC Takes Significant Step on Road to Wafer Fab Equipment Self-Sufficiency,” *Tom’s Hardware*, September 17, 2025, <https://www.tomshardware.com/tech-industry/semiconductors/chinas-largest-foundry-testing-first-domestic-immersion-duv-lithography-tool-smic-takes-significant-step-on-road-to-wafer-fab-equipment-self-sufficiency>.
29. *The Economist*, “The Race Is On to Build the World’s Most Complex Machine,” March 12, 2025, <https://www.economist.com/science-and-technology/2025/03/12/the-race-is-on-to-build-the-worlds-most-complex-machine>; Mark Lapedus, “Billions and Billions Invested,” *Semiconductor Engineering*, April 17, 2014, <https://semiengineering.com/billions-and-billions-invested/>; and Robert Hwang, “ASML: The Little-Known Source of the World’s Technological Progress,” *Michigan Journal of Economics*, April 5, 2023, <https://sites.lsa.umich.edu/mje/2023/04/05/asml-the-little-known-source-of-the-worlds-technological-progress/>.

30. Jiazhen Guo et al., “BIS Revises Export Review Policy for Advanced AI Chips Destined for China and Macau,” Morgan Lewis, January 16, 2026, <https://www.morganlewis.com/pubs/2026/01/bis-revises-export-review-policy-for-advanced-ai-chips-destined-for-china-and-macau>.
31. Samuel Hammond and Erich Grunewald, “Spreadsheets vs. Smugglers: Modernizing the BIS for an Era of Tech Rivalry,” Foundation for American Innovation, April 29, 2024, <https://www.thefai.org/posts/spreadsheets-vs-smugglers-modernizing-the-bis-for-an-era-of-tech-rivalry>.
32. 15 C.F.R. § 744.16 (2025).
33. University of North Carolina at Charlotte, “Countries of Concern,” <https://research.charlotte.edu/departments/office-research-protections-and-integrity-orpi/export-control/countries-concern/>.
34. Allen and Benson, *Clues to the U.S.-Dutch-Japanese Semiconductor Export Controls Deal Are Hiding in Plain Sight*.
35. Kevin J. Wolf et al., “US Government Clarifies, Reorganizes and Renames Descriptions of How Foreign-Produced Items Outside the United States Are Subject to US Export Controls as the US Contemplates New Restrictions on Russia,” Akin Gump Strauss Hauer & Feld, February 9, 2022, <https://www.akingump.com/en/insights/alerts/us-government-clarifies-reorganizes-and-renames-descriptions-of-how-foreign-produced-items-outside-the-united-states-are-subject-to-us-export-controls-as-the-us-contemplates-new-restrictions-on-russia>.
36. ASML, “Cymer,” <https://www.asml.com/en/company/about-asml/cymer>.
37. Nie et al., “CNAS Insights.”

© 2026 by the American Enterprise Institute for Public Policy Research. All rights reserved.

The American Enterprise Institute (AEI) is a nonpartisan, nonprofit, 501(c)(3) educational organization and does not take institutional positions on any issues. The views expressed here are those of the author(s).