

Export Control Loopholes: Chipmaking Tools and Their Subcomponents

November 20, 2025

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Chairman Huizenga, Ranking Member Kamlager-Dove, and distinguished members of the subcommittee:

Thank you for the opportunity to testify before this subcommittee today on this vitally important topic. My name is Dean Ball. I am a senior fellow at the Foundation for American Innovation and author of the AI-focused newsletter *Hyperdimensional*, where I focus on AI, emerging technologies, public policy, and geostrategy. The views I express in this testimony are my own and should not be construed as representing the official position of the Foundation for American Innovation or any other organization with whom I have a current or prior affiliation.

In July 2019, during his first term, President Trump successfully persuaded the Dutch government to block sales of extreme-ultraviolet lithography machines to Chinese semiconductor companies. These machines are the result of a tremendous range of scientific breakthroughs and technological miracles—employing lasers, for example, whose precision is akin to hitting a hole-in-one on the Moon from Earth, to paint sub-microscopic electrical circuits with light onto razor-thin wafers made of processed sand.

At the time, these lithography machines—made exclusively by the Dutch company ASML—were not widely known outside of the semiconductor industry and its close observers. But President Trump’s decision would prove wise and forward-looking: within a few short years, ASML and their advanced lithography technology became widely known the world over as key inputs in the manufacturing of advanced semiconductors. Today, it is widely believed that these controls represent the single most important technological chokepoint preventing China from manufacturing leading-edge semiconductors.

Since 2019, the significance of advanced semiconductors has risen dramatically. In particular, advanced semiconductors are at the heart of the revolution in artificial intelligence (AI) that is currently transforming science, software engineering, and many

other areas of business. This revolution is the seed of one of the largest infrastructure development efforts in American history.

Advanced semiconductors are the most complex objects humans have ever assembled—the product of generations of compounding scientific inquiry, human ingenuity, and untold billions of invested capital. A great deal of that inquiry, ingenuity, and investment has originated in American labs, corporations, and factories. But without doubt, it has been a collective effort as well, most notably in key U.S. allies such as Japan, Korea, the Netherlands, Taiwan, and elsewhere.

Of course, since 2022 the United States has imposed export controls on the advanced semiconductors most relevant to AI. The wisdom and prudence of these controls has been the subject of vigorous debate in recent months, but that is not my focus today. Instead, I want to focus on the issue President Trump identified in 2019: semiconductor manufacturing equipment. And the reality I wish to convey to you is stark: there are large gaps in current semiconductor manufacturing export controls today, and these gaps have meaningfully enabled China’s rapid progress in advanced semiconductor manufacturing in recent years.

We have set on the path of denying China access to the most advanced machines in the world—advanced AI compute. But we have failed to deny access to something perhaps even more important: the machines that make the machines. It should be no surprise, then, that China has managed to significantly advance its semiconductor manufacturing industry considerably even in light of our export controls. We are not comprehensively denying them access to the specialized equipment they need to build *their own* chips. Make no mistake: China’s goal is to catch up in advanced chips within the next several years, and once they do that, they will not only match the West in AI capabilities, but also seek to drive U.S. semiconductor firms out of business through the sale of heavily subsidized chips across the world.

The U.S. has constructed a sound export control regime for semiconductor manufacturing equipment made by domestic companies. Our major shortcoming, instead, is that we have struggled to harmonize those controls with allies who compete with our domestic companies, and sometimes hold near-monopolies over the production of certain equipment.

Sometimes, this lack of international harmonization results in insufficient controls on equipment that is short of the cutting edge, but still advanced. Perhaps the best example of this is deep ultraviolet immersion lithography machines, the predecessor to extreme ultraviolet lithography. Like EUV machines, these are made almost exclusively by the Dutch company ASML. These machines can be used to manufacture both legacy chips, such as those at the 28-nanometer node, and near-cutting-edge chips that fall within U.S. export controls, such as those on the 7-nanometer node.

While the Dutch government does impose export controls on many immersion DUV machines, they allow exports of some equipment, such as the NXT:1980i model, to certain Chinese firms for legacy semiconductor production. Once the machines are within the country, it is either stockpiled or diverted to more advanced production lines.

Two observations merit mention: first, China is dependent upon this equipment for all its advanced AI compute production. Every chip made by companies like Huawei, and every unit of the high-bandwidth memory that is also essential for AI, is made with ASML immersion DUV machines. Senior Trump Administration officials, including U.S. Crypto and AI Czar David Sacks, have recognized the threat these products pose to the long-term leadership of U.S. firms in AI chips.

Second, it is at least worth questioning whether the U.S. and its allies should enable China to develop a foothold even in legacy chip production. Legacy chips are commodity goods, sold at low margins, yet essential for a huge range of quotidian consumer and industrial goods. The semiconductor supply chain problems that led to shortages of automobiles, appliances, and much else during the COVID pandemic were largely the result of difficulty in accessing legacy, rather than leading-edge, chips.

A country with control over large fractions of legacy chip production could readily grind any advanced economy to a halt. China's recent export controls on refined rare earths and rare earth magnets demonstrate their willingness to use chokepoint control over low-margin, ubiquitous commodities as leverage over the rest of the world. Whether we should allow China to develop a similar chokehold over legacy-node semiconductors is a prudential question I will leave to the distinguished members of the subcommittee.

Our lack of international harmonization on export controls creates additional problems as well. In many cases, for example, U.S. firms are tightly export controlled even when there foreign competitors are not. American companies like Applied Materials, Lam Research, and KLA make complex tools for etching, deposition, cleaning, and metrology—all important parts of the semiconductor manufacturing process. Export of these tools to Chinese firms is largely forbidden by U.S. export controls. Yet the export of tools that are functionally the same from companies like Tokyo Electron—a Japanese company—is permitted.

Unsurprisingly, the result is that the China sales of foreign competitors has jumped after U.S. export controls, suggesting that American firms are being denied revenue while critical technology flows into China nonetheless. This is the worst of both worlds: our firms bear the cost of the policy, but the policy itself fails because our allies do not coordinate with us.

Finally, it is important to remember that many of the systems described above rely on components which are themselves highly specialized and the fruit of substantial R&D investment. Often these goods are not controlled either, allowing Chinese companies to re-build advanced semiconductor manufacturing equipment for themselves. Some subcomponents even of EUV lithography machines, for example, are permitted to be sold to China by U.S. and allied country firms.

The Trump Administration's AI Action Plan, which I helped to draft when I served as a Senior Policy Advisor at the White House Office of Science and Technology Policy, clearly recognizes this challenge:

Semiconductors are among the most complex inventions ever conceived by man. America and its close allies hold near-monopolies on many critical components and processes in the semiconductor manufacturing pipeline. We must continue to lead the world with pathbreaking research and new inventions in semiconductor manufacturing, but the United States must also prevent our adversaries from using our innovations to their own ends in ways that undermine our national security. This requires new measures to address gaps in semiconductor manufacturing export controls, coupled with enhanced enforcement.

Two policy tools are at our disposal: one is diplomacy. Diplomatic efforts have been ongoing since the 2022 imposition of export controls during the Biden Administration, and continue under the Trump Administration. If these efforts do not succeed in the near term, it is essential that policymakers employ the second tool: the Foreign Direct Product Rule. This allows the U.S. to impose export controls on foreign-made goods if they contain or are directly made with U.S. technology. Both options should be on the table, with an aim toward resolving these gaps in the near term.

Export controls, like all public policy, come with tradeoffs. Controls on advanced AI chips threaten to deny American firms like Nvidia and AMD the global software and developer ecosystem advantages that are the basis for their technology leadership today. And unilateral controls on semiconductor manufacturing equipment can harm domestic firms while giving foreign competitors an advantage. Right now, in semiconductor manufacturing equipment export controls, the United States gets the worst of both worlds: bearing substantial costs to domestic firms while gaining little of the benefit in terms of restraining Chinese advancement in the field.