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A PROPOSAL FOR A SEMICONDUCTOR EXPORT CONTROL TREATY

ANDRÉ BRUNEL*

“It is not because things are difficult that we do not dare; it is because we do not dare that things are difficult.” Seneca

ABSTRACT**

The United States (“U.S.”) is a party to the Wassenaar Arrangement, the only global export control association, which operates on a voluntary basis to address a wide range of technologies, including semiconductors, in both weapons and dual-use goods. Russia, a member of this arrangement, has laid bare this voluntary arrangement’s inherent weaknesses with its second and most recent invasion of Ukraine in 2022. Without an effective global semiconductor export control regime, the U.S. may lose its technological arms race with China, who is not a member of the Wassenaar Arrangement, and is threatening the U.S.’ regional allies, especially Taiwan. The U.S. should promote an international treaty that controls the exportation of advanced semiconductors among the U.S. and its critical allies in the semiconductor supply chain (i.e., Germany, Japan, the Netherlands, South Korea, and Taiwan). Such a treaty would address this massive U.S. national security omission of a fundamental, critical technology. While a few commentators have noted the weaknesses of the Wassenaar Arrangement, I take the next step and propose a treaty for the export control of semiconductors to address the manifest failings of this voluntary arrangement. Those who have examined the current disastrous state of domestically-owned, advanced semiconductor manufacturing in the U.S. have failed to examine all relevant aspects holistically. Consequently, their recommendations miss the mark.

I propose that the founding treaty members use the existing infrastructure of the Wassenaar Arrangement, with significant changes addressing its current shortcomings, as the basis for an international treaty focused solely on semiconductors, starting with export controls. The changes I propose start with the fundamental conversion of the Wassenaar Arrangement from a voluntary association, where each member of the arrangement could either accept or reject export control proposals, to that of a binding treaty on its members. Unlike the Wassenaar Arrangement, which was not focused on specific countries, the “Wassenaar Treaty” that

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I propose would protect its founding members by blocking exports of critical semiconductor technology to adversarial countries such as: China, Russia, Iran, and North Korea. This Wassenaar Treaty should be focused on one technical sector, i.e., semiconductors, instead of the wide range of technical sectors under the purview of the Wassenaar Arrangement.

I. INTRODUCTION: THE PREEMINENT IMPORTANCE OF THE SEMICONDUCTOR SECTOR AND ITS CURRENT U.S. AND GLOBAL CONTEXT

A. Background

1. Introduction

The subject matter of Senate-approved U.S. treaties are wide-ranging: protecting foreign investments, combating desertification, serving criminal sentences abroad, returning stolen vehicles and aircraft, extraditing nationals, protecting sea turtles, adopting children, avoiding double taxation, restricting certain conventional weapons, controlling nuclear weapons,¹ and the list goes on and on. What one will not find in cataloging the long list of U.S. treaty subject matter—semiconductor export controls—is more than a curious lacuna; it is a massive national security omission of a fundamental, critical technology. The U.S. is a party to a voluntary association known as the Wassenaar Arrangement, which deals with a wide range of technologies in both weapons and dual-use goods from an export control perspective to promote greater responsibility among its members and to prevent destabilizing accumulations. However, given that Russia is a member of this arrangement, the Wassenaar Arrangement's inherent weaknesses have been laid bare by Russia's second and most recent invasion of Ukraine in 2022. A new approach is needed that encourages ally-shoring within key democratic members of the entire semiconductors supply chain because (1) no single country can do it on its own and (2) the

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** At the outset, it is important to note that many of the uncited claims, examples, and arguments presented in the article are the direct result of the author's personal experience over more than three decades handling legal matters involving a wide range of technologies on a global basis. In particular, during the last decade and a half, the author has focused on the semiconductor sector in Asia, the U.S., and Europe and its myriad legal challenges, including semiconductor sector export controls.

1. CONG. RSCH. SERV., 106TH CONG., TREATIES AND OTHER INTERNATIONAL AGREEMENTS: THE ROLE OF THE UNITED STATES SENATE 416–18, 420–21 (Comm. Print 2001).

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voluntary approach of the Wassenaar Arrangement has plainly failed. Now is the time for such a semiconductor export control treaty, when the NATO alliance is showing unusual cohesion in responding to Russia's invasion of Ukraine and when regional security alliances, such as the Quadrilateral Security Dialogue (informally known as the "Quad," it is comprised of Australia, India, Japan, and the United States), are being formed in response to China's aggressive military actions, especially regarding Taiwan. If we do not act before China attacks Taiwan, it will simply be too late.

After first summarizing the importance of the semiconductor sector in its current U.S. global context, I then examine the historical U.S. political neglect towards the semiconductor manufacturing outmigration, primarily to Asia. The focus then turns to reviewing the U.S. military response to such outmigration with the creation of specific programs. After examining the current different options the U.S. has unsuccessfully tried to implement, I argue that the President should propose, and the Senate should approve, an international treaty controlling the export of advanced semiconductors among the members of our key allies who are critical in the semiconductor supply chain: Germany,² Japan, the Netherlands, South Korea, and Taiwan³ (the "Semi Allies" or "Semi Allies Group").

The proposed semiconductor treaty is then described, drawing upon the Wassenaar Arrangement. Finally, I argue that the time for adopting such a semiconductor export control treaty is now because the political window is open among the countries in the Semi Allies Group.

2. *The Semiconductor Industry*

In terms of technology, second only to electricity itself, semiconductors have become fundamental to the functioning of any modern society. Since

2. Germany and the Netherlands will need to enter into a treaty through the E.U. Any revisions to these countries' export control rules would generally need to be at the E.U. level, rather than at the national level, which is the level of enforcement. E.U. member states have only a limited ability to revise their export control rules beyond those covered by the E.U. regime, and these mainly relate to military items, i.e., a very limited number of dual-use items. The E.U. would, therefore, need to initiate any action that might align these countries' export controls with the October 7 Export Controls. *See infra* pp. 8–9.

3. *See infra* Section I(B)(1). Taiwan is not technically recognized as a sovereign country by most countries of the world, including any of the other proposed treaty members. Consequently, this awkward technicality will need to be finessed much like it is currently finessed with the unofficial bilateral relations between the current members and Taiwan. Taiwan will not technically be considered a member of this treaty, but the expectation will be that it will have unofficially all the rights and obligations of a treaty member.

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1958, when the integrated circuit was first invented in the United States, the number of electronic products involved in daily life, routine economic transactions, and military activity has dramatically increased. The scope and scale of this trend shows every sign of accelerating in the coming decades. For example, in 2021, the semiconductor industry had sales of approximately \$600 billion, and McKinsey forecasts the industry will surpass \$1 trillion by the end of this decade.⁴

Since the integrated circuit was developed, the industry has grown astoundingly powerful in its capabilities. Such capabilities require exceedingly complex and sophisticated manufacturing technologies, extraordinary capital expenditures, and a thoroughly global, integrated supply chain. Any single country, even the United States, would find bringing the entire supply chain for producing advanced chips onshore so costly that it would be commercially and politically unsustainable over the long term. The constantly increasing capital expenditures needed to stay at the leading edge throughout the semiconductor supply chain has also winnowed down the number of competitors in several of the key steps in the semiconductor manufacturing process, especially wafer manufacturing.⁵

B. Intel: Among the Last Advanced Semiconductor Domestic Manufacturer Based in the U.S.

The winnowing down of the number of competitors is not the only structural industry change in the past several decades. As with many other industries, such as solar panels, consumer electronics, passenger cars, railroad equipment, and machine tools,⁶ manufacturing various products necessary for the advanced, standard, and mature chip supply chain has migrated primarily from the U.S. to Asia. As of 2022, approximately three-quarters of all global semiconductor manufacturing capacity is now located in East Asia (i.e., China, Japan, South Korea, and Taiwan), with the U.S. retaining only 13%.⁷ As recently as 1990, the U.S. share of global

4. Ondrej Burkacky, Julia Dragon & Nikolaus Lehmann, *The Semiconductor Decade: A Trillion-Dollar Industry*, MCKINSEY & CO. (Apr. 1, 2022), <https://www.mckinsey.com/industries/semiconductors/our-insights/the-semiconductor-decade-a-trillion-dollar-industry>.

5. A semiconductor wafer is a thin slice of semiconductor substance, such as crystalline silicon, used in fabricating integrated circuits.

6. Asa Fitch & Greg Ip, *Chips Are the New Oil and America Is Spending Billions to Safeguard Its Supply*, WALL ST. J. (Jan. 14, 2023, 12:00 AM), <https://www.wsj.com/articles/chips-semiconductors-manufacturing-china-taiwan-11673650917>.

7. Jiyoung Sohn, *The U.S. Is Investing Big in Chips. So Is the Rest of the World*, WALL ST. J. (July 31, 2022, 5:30 AM), <https://www.wsj.com/articles/the-u-s-is-investing-big-in-chips-so-is-the-rest-of-the-world-11659259807>.

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semiconductor manufacturing was 37%.⁸ Most importantly, the U.S. no longer domestically mass produces the most advanced chips, which are considered to be those smaller than 5 nanometers (“nm”).⁹ One of the biggest drivers of this outmigration to Asia has been the incredibly successful Taiwanese behemoth Taiwan Semiconductor Manufacturing Company Ltd. (TSMC), which accounts for more than 90% of global output of the fabrication of the most advanced semiconductors.¹⁰ South Korea owns the rest of this market for the most advanced chips.¹¹

Intel is one of the few remaining U.S.-based manufacturers of advanced computer chips. While Intel has not migrated its production to Asia (except as noted below) or simply exited the business as other competitors have, such as IBM and AMD, Intel has unquestionably begun to fall behind in the global, incessant race to produce evermore advanced computer chips. Starting in 2020, Intel has acknowledged that it would be severely delaying its 7 nm node¹² wafers. Intel now trails the two industry leaders in advanced computer chip manufacturing: TSMC and Samsung. The former, as previously mentioned, is based in Taiwan and the latter is based in South Korea.

1. Intel’s Foundry Strategy Redux

In short, Intel is the only major advanced semiconductor manufacturer left in the U.S., so a few comments about the current state of this holdout are needed to contextualize the present place of the U.S. semiconductor industry within the global context. In 2010, Intel made its first attempt to become a foundry. Eight years later, they quit trying. Robert Maire, president of Semiconductor Advisors, said, “The reason they failed is because they didn’t have the mindset of being a foundry.... They were an IDM [an integrated device manufacturer], and perhaps they were a little arrogant. They weren’t aimed at being customer-service driven. You need

8. Fitch & Ip, *supra* note 6.

9. Yuka Hayashi, *Chips Act Will Test Whether U.S. Can Reverse Semiconductor Exodus*, WALL ST. J. (Feb. 22, 2023, 8:00 AM), <https://www.wsj.com/articles/chips-act-will-test-whether-u-s-can-reverse-semiconductor-exodus-f7c5a324>.

10. Yimou Lee, Norihiko Shirouzu & David Lague, *Taiwan Chip Industry Emerges as Battlefield in U.S.–China Showdown*, REUTERS (Dec. 27, 2021, 12:00 GMT), <https://www.reuters.com/investigates/special-report/taiwan-china-chips/>.

11. Hayashi, *supra* note 9. The slight percentage difference between the market share for the most advanced masks for Taiwan cited in this article of 85% versus the 90% for TSMC in the article cited in footnote 10 likely results from either a timing issue, a measuring difference regarding the cut-off point for the advanced nodes, or both. See Lee, Shirouzu & Lague *supra* note 10.

12. Semiconductor manufacturing nodes reflect increased transistor density and the introduction of significant technology changes used to create such increased density.

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a different mentality in the foundry business.”¹³ Intel will need to overcome such ingrained arrogance, a legacy of its ability to act as a quasi-monopoly for decades dictating terms to its customers, if it is to succeed as a foundry, which necessitates a customer-service focus.

The second factor for Intel’s initial failure as a foundry during the 2010s was its inability to execute its technology roadmap to remain at the leading technical edge of wafer manufacturing.¹⁴ Intel first began manufacturing 7nm chips in 2023.¹⁵ TSMC, in contrast, started producing in Taiwan its 3nm chips in 2022 with plans to produce 2nm by 2025.¹⁶ Samsung’s technical roadmap has it starting to manufacture chips at 2nm in 2025 and at 1.4nm in 2027.¹⁷ Intel is currently significantly behind these leading foreign competitors and has had to resort to hiring TSMC to produce its ARC GPUs on its 6nm process.¹⁸ Even more galling, the Chinese semiconductor national champion, Semiconductor Manufacturing International Corp. (“SMIC”), has, since 2021, been shipping semiconductors built using 7nm technology. This is despite heavy U.S. export control sanctions prohibiting SMIC from using the preferred, and most advanced, extreme ultraviolet (“EUV”) systems and instead having to make do with its existing deep ultraviolet (“DUV”) systems.¹⁹

Intel’s faltering behind the two global industry chip leaders is all the more telling because they surged ahead despite headwinds that Intel did not face. Samsung hoisted itself on its own petard with its de facto leader in jail in South Korea because of convictions for bribery and

13. Mark Lapedus, *Foundry Wars Begin*, SEMICONDUCTOR ENG’G (Apr. 19, 2021), <https://sem-engineering.com/foundry-wars-begin/> (internal quotations omitted).

14. *Id.*

15. Maria Deutscher, *Intel Begins Mass-producing Chips Using Cutting-edge EUV Technology*, SILICONANGLE (Sept. 29, 2023, 1:58 PM EDT), <https://siliconangle.com/2023/09/29/intel-begins-mass-producing-chips-using-cutting-edge-euv-technology/>.

16. Govind Bhutada, *The Top 10 Semiconductor Companies by Market Share*, VISUAL CAPITALIST (Dec. 14, 2021), <https://www.visualcapitalist.com/top-10-semiconductor-companies-by-market-share/>; Jiyoung Sohn & Yang Jie, *Samsung Kicks Advanced-Chipmaking Race into High Gear with Road Map*, WALL ST. J. (Oct. 3, 2022, 7:00 PM), <https://www.wsj.com/articles/samsung-kicks-advanced-chipmaking-race-into-high-gear-with-road-map-11664838001>; Alan Patterson, *Experts: U.S. Military Chip Supply Is Dangerously Low*, EE TIMES (Jan. 6, 2023), <https://www.eetimes.com/experts-u-s-military-chip-supply-is-dangerously-low/>.

17. Sohn & Jie, *supra* note 16.

18. Ashutosh, *Intel Explains Why It Is Outsourcing Chip Manufacturing to TSMC*, GIZMOCHINA (Sept. 22, 2021), <https://www.gizmochina.com/2021/09/22/intel-explains-why-it-is-outsourcing-chip-manufacturing-to-tsmc/>.

19. Che Pan, *China’s Top Chip Maker SMIC May Have Achieved Tech Breakthrough*, *Experts Say*, SOUTH CHINA MORNING POST (July 26, 2022, 11:00 PM), <https://www.scmp.com/tech/big-tech/article/3186672/chinas-top-chip-maker-smic-may-have-achieved-tech-breakthrough>.

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embezzlement.²⁰ TSMC labors on a small island with a small population in comparison to the landmass and population of the U.S. and is recognized as an independent country by only 12 economically insignificant countries, and the Vatican as a result of China's relentless, and ultimately successful, foreign policy goal to have Taiwan delegitimized at the international level.²¹ If Intel does not technologically at least begin to pace TSMC and Samsung, Intel's failure to execute may again be a leading cause for its failure to become a successful foundry.

Finally, there are the substantial switching costs that foundry customers must be willing to accept to move from one foundry to another.²² Intel must be able to convince its prospective customers that switching from their current foundry to Intel will result in long-term economic and technological benefits. However, Intel has unfortunately stumbled in its efforts to keep its largest customer, the U.S. Department of Defense ("DoD").²³ The DoD is, of necessity, highly motivated to work with Intel given Intel's status as the last U.S.-based advanced semiconductor manufacturer. If Intel could not keep its largest foundry customer, who is highly motivated to be an Intel customer, other prospective customers, who do not have such a motivation, now have yet another reason to question whether incurring the high switching costs will be worth it.

To put Intel's desire to enter the foundry business in context, TSMC currently has 54% of the world market for foundry business.²⁴ The next semiconductor company in line, Samsung, is significantly smaller at 17%.²⁵ The next semiconductor company in the semiconductor foundry business is UMC, which is also based in Taiwan.²⁶ The fourth semiconductor company is Globalfoundries at 7%.²⁷ In 2014, IBM announced the sale of its global semiconductor business to Globalfoundries, which is owned by Mubadala Development Co.—the Abu Dhabi government's investment fund. In 2018, Globalfoundries announced that it was abandoning its efforts to develop the most advanced chips at the time, i.e., at 7 nm, and beyond. In the top ten list of semiconductor companies in the foundry

20. Suranjana Tewari, *Lee Jae-Yong: Samsung Heir Released from Prison on Parole*, BBC NEWS (Aug. 13, 2021), <https://www.bbc.com/news/world-asia-58196575>.

21. Joyu Wang & Selina Cheng, *Honduras Establishes Diplomatic Ties with Beijing, Abandoning Taiwan*, WALL ST. J. (Mar. 26, 2023, 8:33 AM), <https://www.wsj.com/articles/honduras-establishes-diplomatic-ties-with-beijing-abandoning-taiwan-3ef6db21>.

22. Patterson, *supra* note 16.

23. *Id.*

24. Bhutada, *supra* note 16.

25. *Id.*

26. *Id.*

27. *Id.*

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business by market share, the only one that could be argued to be American-based—Globalfoundries—is at 7%. Unfortunately, it is not U.S.-owned and exited the technology treadmill years ago.²⁸

2. The Potential Loss of Almost All Domestically Owned Leading-Edge Wafer Fabs

If Intel fails a second time as a foundry, it will likely cement Intel's inability to ever regain its position as a leading-edge semiconductor manufacturer, as it will have lost access to the stupendous amount of customer revenue, which is needed to fund such leading-edge R&D. If that happens, the U.S. will have lost its most prominent domestically owned leading-edge wafer fab business. Even if Intel succeeds as a foundry, it is simply not enough. As previously noted, it is commercially and politically impossible to have the entire semiconductor supply chain located in the United States. While TSMC will keep the majority of its fabs in Taiwan, it began work in 2021 on building a new 5nm fab in Arizona, which should be online in 2024.²⁹ Samsung has also announced plans to build a \$17 billion chip plant in Taylor, Texas, which should also be operational in 2024.³⁰ While the onshoring of key parts of the semiconductors supply chain are certainly welcome, those efforts are not enough. There are currently no plans to bring onshore some critical aspects of advanced chip manufacturing that are no longer present in the United States. For example, there is no domestic manufacturer of EUV and DUV lithography systems, which are critical tools used in manufacturing advanced chips. The leader of such advanced chip-making equipment and lithography systems is ASML, which is located in the Netherlands. The U.S. also has no domestic producer of wafer materials, and its market share in the assembly, testing, and services subsector is in very low double digits.³¹

Ideally, of course, we would not only want the entire semiconductor supply chain to be onshore, but also owned by Americans. As previously

28. See generally *GlobalFoundries*, UAE USA UNITED, <https://www.uaeusaunited.com/stories/globalfoundries> (last visited Nov. 16, 2023).

29. *Id.*; Stephen Nellis, *TSMC Says Has Begun Construction at Its Arizona Chip Factory Site*, REUTERS (June 1, 2021, 11:09 PM), <https://www.reuters.com/technology/tsmc-says-construction-has-started-arizona-chip-factory-2021-06-01/>.

30. Sebastian Moss, *Samsung Plans \$17 Billion Chip Plant in Taylor, Texas*, DATA CENTER DYNAMICS (Nov. 24, 2021), <https://www.datacenterdynamics.com/en/news/samsung-plans-17-billion-chip-plant-in-taylor-texas/>.

31. Ondrej Burkacky, Marc de Jong & Julia Dragon, *Strategies to Lead in the Semiconductor World*, MCKINSEY & CO. (Apr. 15, 2022), <https://www.mckinsey.com/industries/semiconductors/our-insights/strategies-to-lead-in-the-semiconductor-world> (comparing Taiwan, China, Europe, and U.S. in semiconductor manufacturing and design capabilities as depicted in Exhibit 3).

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explained, that is realistically impossible. The next best alternative would be to have the entire chain onshore but with foreign ownership restricted to allies. Unfortunately, as will be explained, that is also impossible for all practical purposes. The next best alternative is possible: having the entire semiconductor supply chain onshore and allied shored. However, that will require deep political coordination among the U.S. and its major semiconductor industry allies. Such coordination is not yet present.

C. The Proposed Semiconductor Export Control Treaty Summarized

I propose that the Semi Allies Group use the existing infrastructure of the Wassenaar Arrangement, with significant changes to address its current shortcomings, as the basis for an international treaty focused solely on semiconductors, starting with export controls. Among the changes I propose is to resuscitate the portion of the Wassenaar Arrangement dealing with semiconductor articles by fundamentally converting it from a voluntary association, where each member of the arrangement could either accept or reject export control proposals, to that of a binding treaty. If the member countries pass resolutions prohibiting the export of certain semiconductor items, then they are obligated to abide by them.

Unlike the Wassenaar Arrangement, which was not focused on specific countries, the Wassenaar Treaty that I propose would focus on the countries most militarily threatening to the Semi Allies Group: China, Russia, Iran, and North Korea. Thus, the treaty would block critical semiconductor technologies from being exported to these adversaries. The Wassenaar Treaty should be focused on one technical sector—semiconductors—instead of the wide range of technical sectors under the purview of the Wassenaar Arrangement. Also, unlike the Wassenaar Arrangement, the proposed treaty would be self-executing, meaning no further implementation of legislation from treaty members is required.

Such a semiconductor export control treaty requires, however, significant political will. Fortunately, the global geopolitical window is open for such a treaty. But is such a treaty really needed? To answer that question, we first need to understand the historical U.S. political response to the semiconductor outmigration, primarily to Asia.

*Semiconductor Export Control Treaty Proposal***II. THE HISTORICAL U.S. POLITICAL RESPONSE TO THE SEMICONDUCTOR MANUFACTURING OUTMIGRATION**

There have been multiple proposals in response to the economic development and national security implications of both the semiconductor industry consolidation and the outmigration of the semiconductor industry's manufacturing center from the U.S. to Asia. As previously mentioned, semiconductors undergird most modern societal activities. Though, that is only the beginning of the story. From a next-generation advanced technology commercial development perspective, semiconductors also undergird the many emerging technologies that will likely appear in the next developmental phase of military weapons, such as hypersonic missiles and drones, and in the information economy, such as 5G telecommunications, quantum computers, artificial intelligence, robotics, and biotech. From the military perspective of the Semi Allies Group, there is a critical need to prevent such advanced chip technology from being exported to, or independently developed in, countries that are hostile to them, such as China, Russia, Iran, and North Korea.

A. Sematech

For decades, past presidential administrations and Congresses have been mostly silent about the outmigration of the U.S.'s semiconductor industry. The primary exceptions were Sematech and ASML. Sematech (short for Semiconductor Manufacturing Technology) was a semiconductor research consortium created in 1987 with 14 U.S. semiconductor companies based in Austin, Texas.³² Sematech was created primarily in response to Japan's majoritarian control of the global DRAM market in the 1980s.³³ Congress provided approximately \$870 million to Sematech through the Defense Advanced Research Projects Agency (DARPA) from its founding through 1996. DARPA funding was generally matched by funding from the consortium's industry participants.³⁴ DARPA provided no further funding after 1996, and the consortium abandoned its U.S.-centric focus.³⁵ Sematech, and the previously concluded 1986 U.S.-Japan semiconductor treaty opening the Japanese market to U.S. semiconductors,³⁶

32. MICHAELA D. PLATZER, JOHN F. SARGENT JR. & KAREN M. SUTTER, CONG. RSCH. SERV., R46581, SEMICONDUCTORS: U.S. INDUSTRY, GLOBAL COMPETITION, AND FEDERAL POLICY 48–49 (2020).

33. *Id.* at 48.

34. *Id.* at 48–49.

35. *Id.* at 49.

36. *Id.* at 48.

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were Congress's only reactions over the ensuing decades to the outmigration from the U.S. of key links in the semiconductor supply chain. Such efforts may have slowed the semiconductor manufacturing outmigration process, but ultimately failed because they did not fundamentally alter the economic reasons for the Asian outmigration trajectory. The only differences now are that (1) the resulting national security weaknesses are more acute, and (2) the country of national security concern is China instead of Japan.

B. ASML

The other instance is rich in irony because it involved the Clinton Administration not seeking to reverse the outmigration of American semiconductor technology to foreign countries, but instead promoting the export of advanced semiconductor lithography technology to a foreign company based on U.S. taxpayer-funded research. The George W. Bush Administration then permitted this foreign company to acquire the last remaining major lithography firm in America.

ASML is a semiconductor lithography company based in the Netherlands. In 1996, Intel created a consortium with Lawrence Livermore and Sandia National Labs, which are national laboratories operated by the U.S. Department of Energy, and six other chipmakers to build a prototype EUV semiconductor system.³⁷ When it came time to commercialize this technology, Intel and the federal government chose ASML over the only remaining major U.S.-based lithography company, Silicon Valley Group Inc. (SVG), because ASML was technologically superior. The other two possible contenders, Nikon and Canon, both based in Japan, were rejected by the U.S. government based on lingering concerns from the semiconductor trade wars of the previous decade.³⁸

At the time, it was not clear whether EUV technology would even work.³⁹ Nikon itself did not think it would. There was no immediate military application for EUV technology.⁴⁰ Except for a few officials in the Department of Defense, almost no one in Washington was concerned about this off-shoring of advanced American semiconductor technology funded by U.S. taxpayers even though, if this technology worked, the U.S. would become dependent on ASML for lithography tools fundamental to

37. CHRIS MILLER, *CHIP WAR: THE FIGHT FOR THE WORLD'S MOST CRITICAL TECHNOLOGY* 187 (2022).

38. *Id.*

39. *Id.*

40. *Id.*

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all computers.⁴¹ Half a decade later in 2001, ASML acquired SVG. DARPA and the DoD opposed the sale, as did three senators who accurately asserted to the George W. Bush Administration that “ASML will wind up with all of the U.S. government’s EUV technology.”⁴² Intel and the other large chipmakers argued that the sale of SVG to ASML was critical to developing EUV technology, and that without the merger, their development path to new tools in the U.S. would be delayed.⁴³ Their argument prevailed.

The mindset of these two administrations that led to foreign policy decisions resulting in ASML being the world’s sole manufacturer of advanced lithography equipment was a globalization viewpoint when America’s power was at its apex. As one commentator has noted, “[m]ost people in Washington thought globalization was a good thing. The dominant belief in the U.S. government was that expanding trade and supply chain connections would promote peace by encouraging powers like Russia or China to focus on acquiring wealth rather than geopolitical power. Claims that the decline of America’s lithography industry would imperil security were seen as out of touch with this new era of globalization and interconnection.”⁴⁴ Such foreign policy assumptions have turned out to be highly inaccurate. Unsurprisingly, the current Biden Administration is now forced to deal with the consequences. For example, ASML’s desire to sell EUV and DUV technology to China, as discussed later in this article.

C. Creating Helpful Incentives to Produce Semiconductors and Science Act of 2022

After well over two decades of silence since Sematech, Congress has finally taken note and tried to close the stable door after the horse has bolted by passing its extremely belated response to the Asian semiconductor manufacturing outmigration, the Creating Helpful Incentives to Produce Semiconductors and Science Act of 2022 (“CHIPS and Science Act”).⁴⁵ This law would, among other things, provide \$52.7 billion in subsidies to promote domestic, advanced chip manufacturing.⁴⁶ President Biden signed the legislation on August 9, 2022.⁴⁷ The loss by U.S.

41. *Id.* at 188.

42. *Id.* (internal quotations omitted).

43. *Id.* at 189.

44. *Id.* at 188.

45. CHIPS and Science Act of 2022, Pub. L. No. 117-167, 136 Stat. 1366.

46. *President Biden Signs CHIPS and Science Act into Law*, WHITE & CASE (Aug. 12, 2022), <https://www.whitecase.com/insight-alert/president-biden-signs-chips-and-science-act-law>.

47. *Id.*

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automotive manufacturers of \$210 billion in sales in 2022 because of their inability to obtain semiconductors abroad to manufacture their cars got the attention of Congress⁴⁸ and motivated bi-partisan action resulting in this legislation. As plainly stated by some commentators, “Only in the past two years has the U.S. fully grasped that semiconductors are now as central to modern economies as oil.”⁴⁹

This new act, in a strategic omission, does not address export controls. It is certainly old news that the world has become technologically flatter in part through the rise of the rest of the world in comparison to the United States after World War II.⁵⁰ Unfortunately, U.S. policymakers rarely take seriously the implication of this crucial development when crafting legislation regarding export controls in general, and the semiconductor industry in particular. What so many legislators fail to truly understand is that both U.S. semiconductor companies and their many foreign competitors could entirely avoid U.S. export control sanctions against China by building capacity outside of the U.S. with technology that was neither developed in the U.S. nor was the direct product of U.S. origin tools and technology. Without a multilateral semiconductor export control treaty, the U.S. is forced to rely on unilateral export control measures. The more extensive and draconian the U.S.’s export control regime becomes, such as the most recent, precedent-setting Chinese-oriented export controls on advanced computing and semiconductor manufacturing items announced by the Bureau of Industry and Security (“BIS”) within the Department of Commerce on October 7, 2022 (the “October 7 Export Controls”),⁵¹ the greater the incentive the global commercial semiconductor sector has to develop outside of such a U.S. centric technology regime.

48. Fitch & Ip, *supra* note 6.

49. *Id.*

50. THOMAS L. FRIEDMAN, *THE WORLD IS FLAT: A BRIEF HISTORY OF THE TWENTY-FIRST CENTURY* 5–8 (2005).

51. Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items, 87 Fed. Reg. 62186 (Oct. 13, 2022) (to be codified at 15 C.F.R. pts. 734, 736, 740, 742, 744, 762, 772, and 774).

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BIS summarized the need for these new export controls in its October 7 Export Controls announcement,⁵² stating:

*With this interim final rule, the Commerce Department's Bureau of Industry and Security (BIS) makes critical changes to the Export Administration Regulations (EAR) in two areas to address U.S. national security and foreign policy concerns. First, BIS imposes additional export controls on certain advanced computing semiconductor chips (chips, advanced computing chips, integrated circuits, or ICs), transactions for supercomputer end-uses, and transactions involving certain entities on the Entity List. Second, BIS adopts additional controls on certain semiconductor manufacturing items and on transactions for certain IC end use.*⁵³

This rule also solicited public comments on its proposed changes.⁵⁴ In October 2023, BIS published a new interim final rule that builds on the October 7 Export Control proposals.⁵⁵ Specifically, additional proposals that tighten controls on AI chips, cast a wider net in terms of geography and scope, require licenses for transfers to certain Chinese semiconductor fabrication plants, bring more technology equipment under U.S. regulation, and harmonize with rules from the Netherlands and Japan, which have each proposed their own export controls on semiconductor manufacturing.⁵⁶ The BIS summary also stated:

The restrictions implemented in th[e] [October 7, 2022] rule follow extensive United States government consideration of the

52. THEA D. ROZMAN KENDLER, BUREAU OF INDUS. & SEC., DEPT OF COM., Docket No. 220930-0204, IMPLEMENTATION OF ADDITIONAL EXPORT CONTROLS: CERTAIN ADVANCED COMPUTING AND SEMICONDUCTOR MANUFACTURING ITEMS; SUPERCOMPUTER AND SEMICONDUCTOR END USE; ENTITY LIST MODIFICATION (2022).

53. *Id.*

54. *Id.*

55. Trade Practitioner, *Semiconductor and Advanced Computing Export Control Rules Modifying and Reinforcing the Restrictions Initially Released on October 7, 2022*, THE TRADE PRACTITIONER (October 17, 2023), <https://www.tradepractitioner.com/2023/10/semiconductor-and-advanced-computing-export-control-rules-modifying-and-reinforcing-the-restrictions-initially-released-on-october-7-2022/>; Pablo Carrillo et al., *Upcoming Changes in U.S. Export Controls on Advanced Semiconductors & Related Tooling and Recent Development on U.S. Relief Given to Asian Chips Manufacturers*, THE TRADE PRACTITIONER (October 12, 2023), <https://www.tradepractitioner.com/2023/10/upcoming-changes-in-u-s-export-controls-on-advanced-semiconductors-related-tooling-and-recent-development-on-u-s-relief-given-to-asian-chips-manufacturers/>.

56. *Id.*

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*impact of advanced computing ICs, 'supercomputers,' and semiconductor manufacturing equipment on enabling military modernization, including the development of weapons of mass destruction (WMD) and human rights abuses. The Government of the People's Republic of China (PRC or China) has mobilized vast resources to support its defense modernization, including the implementation of its military-civil fusion development strategy, in ways that are contrary to U.S. national security and foreign policy interests.*⁵⁷

In order to provide the context for why this unilateral approach is inadequate as a national security strategy, which at a minimum must be both effective and sustainable, I present a few salient weaknesses of the CHIPS and Science Act and the October 7 Export Controls because they are so central to the current U.S. approach to addressing the economic development and national security challenges of the semiconductor industry. As the following comments make clear, the CHIPS and Science Act and the October 7 Export Controls are not a national security strategy; they are unsustainable tactics that will ultimately fail in the long term and thus require a semiconductor treaty focusing on export controls among the Semi Allies Group to backstop them.

I first turn to the CHIPS and Science Act. The Biden administration's policy is to bring the entire semiconductor supply chain to the U.S. On October 6, 2022, speaking about this recently passed legislation at IBM in Poughkeepsie, New York, U.S. President Joe Biden said, "More Americans have learned the phrase 'supply chain' and what it means. Well, guess what? The supply chain [for semiconductors] is going to start here and end here—in the United States. I'm not joking."⁵⁸

1. The CHIPS and Science Act Is an Unsustainable Tactic

Even though Congress has passed the CHIPS and Science Act, Congress will almost certainly not continue to provide the ever-larger subsidies that will be required on a recurring basis as the capital expenditures within the semiconductors supply chain continue to increase exponentially. The CHIPS and Science Act provides only construction subsidies;⁵⁹ it does nothing to reduce the significant, ongoing operating expenses of

57. KENDLER, *supra* footnote 52.

58. Remarks in IBM Poughkeepsie in Poughkeepsie, New York, 2022 DAILY COMP. PRES. DOC. 2 (Oct. 6, 2022).

59. *The CHIPS and Science Act of 2022*, NAT'L GOVERNORS ASS'N (Aug. 22, 2022), <https://www.nga.org/updates/the-chips-and-science-act-of-2022/>.

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fabs. In addition to the more than \$50 billion in subsidies to build semiconductor plants in the U.S., the act also provides a 25% tax credit for building and equipping these U.S. chip plants.⁶⁰ This investment tax credit, which expires after 2026, is an additional \$24.3 billion in support.⁶¹ Goldman Sachs estimates this “program might support an increase in the U.S. market share of global chip capacity of less than 1%,”⁶² primarily because of the massive U.S. cost disadvantages to manufacturing in Asia reviewed in the next section of this article.

Currently, for context, a top-of-the-line advanced chip manufacturing facility, on an all-in basis, is more than a \$10-20 billion investment.⁶³ Planned individual investments, by the two leading semiconductor companies in the world, provide further context for this recent subsidy legislation. TSMC alone—a single company—plans to spend \$100 billion on capital expenditures over the next three years.⁶⁴ Samsung, again on its own, plans to invest \$228 billion in building five advanced semiconductor plants near Seoul, South Korea.⁶⁵ The CHIPS and Science Act’s one-time dollop of substantial subsidies and tax credits is just that—a one-time subsidy grant and tax credit. To be effective, such subsidies and tax credits to the semiconductor sector will need to become dramatically higher over time and continuously and predictably provided.

While it is always difficult to predict what Congress will do over the long term, this is an easy call: Congress will not provide even greater subsidies and tax credits to the semiconductor sector on a continuous and predictable basis because it is simply politically unsustainable. Current yawning federal budget deficits make this a virtual certainty for the foreseeable future. Estimates exceed \$500 billion, including the initial \$52 billion, for the required follow-on semiconductor costs of building and operating enough fabs to provide the U.S. with a reliable semiconductor

60. *Id.*

61. Richard Rubin & Yuka Hayashi, *Chip Makers Find Out How to Get 25% Investment Tax Credit*, WALL ST. J. (Mar. 21, 2023, 1:16 PM), <https://www.wsj.com/articles/chip-makers-to-find-out-how-to-get-25-investment-tax-credit-ce414dd6>.

62. Hayashi, *supra* note 9.

63. Joel Hruska, *Why We Can't Build Our Way Out of the Semiconductor Shortage*, EXTREMETECH (May 11, 2021), <https://www.extremetech.com/computing/322695-why-we-cant-build-our-way-out-of-the-semiconductor-shortage>.

64. Lapedus, *supra* note 13.

65. Jiyoun Sohn, *South Korea Plans Mega Chip-Making Base to Stay Ahead*, WALL ST. J. (Mar. 15, 2023, 8:12 AM), <https://www.wsj.com/articles/south-korea-plans-mega-chip-making-base-to-stay-ahead-b2bec41f>.

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supply over the next two decades.⁶⁶ If the U.S. sought to create an entirely domestic semiconductor supply chain, the cost has been estimated to be \$1 trillion and would cause semiconductor prices to increase by 35–65%.⁶⁷

This “once and done” subsidy and tax credit approach is not a strategy—it is a tactic—and unfortunately, even as a tactic, it will ultimately fail just as Sematech failed. That the Biden Administration’s quixotic goal of bringing the entire semiconductor supply chain to the U.S. will fail is not a novel conclusion. Morris Chang earned degrees from Massachusetts Institute of Technology and Stanford University, worked for over two decades in the U.S., including as vice president at Texas Instruments for its worldwide semiconductor business, and most importantly, is the founder and first CEO of TSMC, which he built into one of the world’s most profitable semiconductor manufacturers.⁶⁸ Mr. Chang has publicly stated, “If you want to reestablish a complete semiconductor supply chain in the U.S., you will not find it to be a possible task.”⁶⁹ He went further stating, “Even after you spend hundreds of billions of dollars, you will still find the supply chain to be incomplete, and you will find that it will be very high cost, much higher cost than what you currently have.”⁷⁰

Given the extreme complexity and wide range of inputs in semiconductor manufacturing, examples confirming Mr. Chang’s thesis are easy to find. First up is one chosen by China itself. Effective August 1, 2023, China’s Ministry of Commerce has designated the metal gallium, along with more than three dozen other related metals, minerals, and other materials, as subject to export control to safeguard national security.⁷¹ Industry analysts view this move by China as retaliation for the October 7 Export Controls.⁷² The U.S. produces no unrefined gallium, which is a key

66. John M. Donnelly, *Cost to Rebuild U.S. Semiconductor Manufacturing Will Keep Growing*, ROLL CALL (Feb. 4, 2022, 11:42 AM), <https://rollcall.com/2022/02/04/cost-to-rebuild-u-s-semiconductor-manufacturing-will-keep-growing/>.

67. Jonathan Corrado, *Clash or Consensus?: The Conflicting Economic and Security Imperatives of Semiconductor Supply-Chain Collaboration in the Indo-Pacific*, J. INDO-PACIFIC AFFAIRS, Oct. 2022, at 74, 89, <https://media.defense.gov/2022/Nov/08/2003110685/-1/-1/1/JIPA%20-%20CORRADO%2022.PDF>.

68. *Morris Chang*, ENCYC. BRITANNICA ONLINE, <https://www.britannica.com/biography/Morris-Chang>.

69. Liam Gibson, *‘Impossible’: TSMC Founder Morris Chang on U.S. Dreams for Onshoring Chip Supply Chain*, TAIWAN NEWS (Oct. 28, 2021, 12:41 PM), <https://www.taiwannews.com.tw/en/news/4327937>.

70. *Id.*

71. James T. Areddy & Sha Hua, *China Restricts Exports of Two Minerals Used in High-Performance Chips*, WALL ST. J. (July 4, 2023, 3:25 AM), <https://www.wsj.com/articles/china-restricts-exports-of-two-metals-used-in-high-performance-chips-a649402b>.

72. *Id.*

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ingredient for a class of semiconductors used in phone chargers and electric vehicles.⁷³ China, in contrast, supplies approximately 94% of the world's production of this metal.⁷⁴

There are multiple other countermeasures along these lines that China has at its disposal. For example, if China were to ban neon exports to the U.S. for a prolonged time, it would shut down a significant portion of the U.S. semiconductor production after domestic inventories are depleted.⁷⁵ Why? The lasers that imprint the microscopic circuit blueprints on silicon wafers use purified neon gas, which is typically processed from the raw neon obtained from large air-separation units attached to steel plants. These facilities produce the neon when they separate oxygen from the air for use in steel furnaces. Since the steel industry largely moved out of the U.S. over the past half-century, there is currently very little neon gas being produced domestically. Most neon gas used to come from Ukraine, Russia, and China, but Russia's reinvasion of Ukraine has left China as the world's main source.⁷⁶ Another example: tungsten is one of the raw materials used in chipmaking, which is transformed into tungsten hexafluoride and used to build parts of transistors on semiconductors.⁷⁷ This raw material is not naturally found in the U.S.; it is primarily sourced from China.⁷⁸

2. The CHIPS and Science Act Is Not Enough

We highlight a few key points why the semiconductor component of this new legislation will not be enough to protect our national security. Such government subsidies simply ignore the plethora of reasons that manufacturing in general, and the semiconductor sector in particular, has outmigrated to foreign countries, especially in Asia. Critically, it is not the issue of U.S. companies lacking money to build fabs. "What drove the companies out of the production process in the first place was the high cost of operating such facilities compared to competitors abroad, who had the benefit of not only government subsidies but also in many cases lower labor, tax and regulatory compliance costs."⁷⁹ "The funds needed for

73. *Id.*

74. Archie Hunter & Alfred Cang, *China Restricts Export of Chipmaking Metals in Clash With US*, BLOOMBERG (July 3, 2023, 11:45 AM), <https://www.bloomberg.com/news/articles/2023-07-03/china-to-restrict-exports-of-metals-critical-to-chip-production>.

75. Fitch & Ip, *supra* note 6.

76. *Id.*

77. *Id.*

78. *Id.*

79. Donnelly, *supra* note 66.

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constructing fabs could always be bankrolled by loans or bonds ... but not so with operating expenses.”⁸⁰ Almost immediately after the CHIPS and Science Act was signed into law, Intel, in a dramatic fashion, made this point by entering into a \$30 billion funding partnership with Brookfield Asset Management Inc. to help Intel finance its expansion of its wafer fabrication factories.⁸¹ Intel also had another reason to avoid federal semiconductor subsidies with this unusual deal: the subsidies come with a “clawback” provision in the CHIPS and Science Act. Recipients of the semiconductor subsidies are generally prohibited from expanding semiconductor manufacturing in China for a period of ten years (except for manufacturing legacy chips).⁸² Intel had previously spoken plainly about being against such clawback provisions during the legislative process.⁸³

In any event, providing government subsidies would be a sustainable strategy only if it were part of a much more comprehensive policy to address such core reasons of the semiconductor manufacturing outmigration to Asia. We confidently predict that will never happen because it would require wages that engineers in the U.S. would not accept and relaxation of environmental, safety, and corporate governance regulations that a surfeit of government agencies at federal, state, and local levels would never implement. To give some sense of the types of dramatic changes that would be needed—and will never occur—we point to two examples, the labor cost differential and the construction cost differential, because they are so dramatic. “Median wages in manufacturing are higher in the U.S. than in other countries, and the U.S. labor cost for fab construction and operation are 40% above those in Singapore and Taiwan, and up to twice as high as in China.”⁸⁴ Regarding the construction cost differential, TSMC’s CFO Wendell Huang has reported that regarding the

80. *Id.*

81. Asa Fitch, *Intel, Brookfield Sign \$30 Billion Deal to Finance Chip Factories*, WALL ST. J. (Aug. 23, 2022, 3:16 PM), <https://www.wsj.com/articles/intel-inks-30-billion-funding-partnership-with-brookfield-to-finance-chip-factory-expansion-11661254261>. TSMC, in reference to the chip factory it is building in Arizona, has stated that it mostly relies on its own capital for such projects and “doesn’t view ‘access to capital as a significant barrier to growth’ in the US.” *TSMC Gives Insight into Arizona Factory to Compete for Federal Chips Funding*, ARIZ. TECH. COUNS.: TECH. BLOG, <https://www.aztechcouncil.org/tsmc-gives-insight-into-arizona-factory-to-compete-for-federal-chips-funding/> (last visited Sept. 28, 2023).

82. *President Biden Signs CHIPS and Science Act into Law*, *supra* note 46.

83. Gavin Bade, *Intel, Others Seek Weaker China Rules in Chips Bill*, POLITICO (July 18, 2022, 10:00 AM), <https://www.politico.com/newsletters/weekly-trade/2022/07/18/intel-others-seek-weaker-china-rules-in-chips-bill-00046278>.

84. ANTONIO VARAS, RAJ VARADARAJAN, JIMMY GOODRICH & FALAN YINUG, BCG & SEMICONDUCTOR INDUS. ASS’N, GOVERNMENT INCENTIVES AND US COMPETITIVENESS IN SEMICONDUCTOR MANUFACTURING 20 (2020).

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construction of its Arizona fab, “the major reason for the cost gap is the construction cost of building and facilities, which can be 4 to 5x greater for U.S. fab versus a fab in Taiwan. The high cost of construction includes labor costs, cost of permits, cost of occupational safety and regulations, inflationary costs in recent years and people and learning curve costs.”⁸⁵ These two daunting financial differentials alone give a clear indication as to why, over the past decades, semiconductor manufacturing has migrated away from the U.S. to Asia.

These very unfavorable cost differentials will, unfortunately, only become exacerbated for any recipient of the subsidies under the CHIPS and Science Act and the Biden Administration’s implementation of it. Labor costs, for example, will become even more expensive than they already are because funding recipients, depending on the size of the grant, will be required to provide a comprehensive suite of benefits for workers who both build and operate the semiconductor manufacturing facilities. These benefits include health insurance, retirement plans, Worker’s Compensation benefits, paid leave, subsidized childcare, employee training and education benefits, and paying union-scale wages for construction and using union labor for operating the facilities.⁸⁶ The labor requirements for semiconductor subsidy applicants are not only comprehensive, but also gold-plated. A single example from the notice announcing the funding opportunity under the CHIPS and Science Act makes the point:

[A]s part of their description of training commitments, applicants must describe any wraparound services and other barrier reductions they or their partners will provide to support facility workers’ access to and completion of training, as well as transition into and progression in a job (such as adult care, child care, transportation assistance, housing assistance, emergency cash assistance, language support, tools, uniforms, equipment,

85. James Freeman, *Who Wants to Build in the U.S.?*, WALL ST. J. (Jan. 13, 2023, 3:03 PM), <https://www.wsj.com/articles/who-wants-to-build-in-the-u-s-11673640235>.

86. NAT’L INST. OF STANDARDS AND TECH., CHIPS INCENTIVES PROGRAM – COMMERCIAL FABRICATION FACILITIES 8, 23 (2023), <https://www.nist.gov/chips/notice-funding-opportunity-commercial-fabrication-facilities> [hereinafter CHIPS FUNDING]; U.S. DEP’T OF LABOR, *Department of Commerce and Department of Labor Good Jobs Principles*, <https://www.dol.gov/general/good-jobs/principles> (last visited Sept. 22, 2023); 15 U.S.C. § 4652(a)(2)(B)(ii)(II)(aa). For example, the requirement to provide affordable childcare for facility and construction workers is only required for businesses that receive over \$150 million in subsidies. Jiyoung Sohn, *South Korea Says U.S. Chips Act Subsidies Have Too Many Requirements*, WALL ST. J. (Mar. 7, 2023, 9:54 PM), <https://www.wsj.com/articles/south-korea-says-u-s-chips-act-subsidies-have-too-many-requirements-825b3fe9>.

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application fees, and services like mentorships that aim to help retain workers, etc.).⁸⁷

The Secretary of the Department of Commerce, Gina Riamondo, candidly revealed her plans to include unrelated labor requirements, such as employer-subsidized or provided childcare, in her department's implementation of this national-security-focused legislation:

When it became clear last year that sweeping plans to expand and subsidize child care [sic] would not make it into the climate, health and tax bill, the culmination of Mr. Biden's economic efforts in Congress, Ms. Raimondo gathered aides around a conference table. She told them, she said, that "if Congress wasn't going to do what they should have done, we're going to do it in implementation" of the bills that did pass.⁸⁸

In a further revealing comment, Ms. Riamondo acknowledged the Biden Administration does not know how to overcome these massive financial hurdles to expanding U.S. domestic semiconductor manufacturing:

We have got to figure out a way through every piece of leverage we have ... to push these [leading semiconductor manufacturers] to go bigger.... I need Intel to think about taking that \$20 billion facility in Ohio and making it a \$100 billion facility. We've got to convince TSMC or Samsung that they can go from 20,000 wafers a month to 100,000 and be successful and profitable in the United States. That's the whole game here.⁸⁹

Equally telling is the assumption in her comment that the three leading semiconductor manufacturing companies in the world have been unable to figure out on their own how to profitably expand their manufacturing fabs in the U.S.—but that the Biden Administration, which itself also does not know how, will nevertheless try to show them how to be profitable on such a grand scale of domestic semiconductor manufacturing. The U.S. semiconductor manufacturing industry, given its increased

87. CHIPS FUNDING, *supra* note 86, at 54; U.S. DEP'T OF LABOR, *supra* note 86.

88. Jim Tankersley & Ana Swanson, *Biden's Semiconductor Plan Flexes the Power of the Federal Government*, N.Y. TIMES (Feb. 27, 2023), <https://www.nytimes.com/2023/02/27/us/politics/chips-act-biden-commerce-department.html>.

89. Fitch & Ip, *supra* note 6 (internal quotations omitted).

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cost structure mandated by the CHIPS and Science Act, will become significantly less competitive on a global basis and result in a weakened national defense.

Even if a follow-on federal semiconductor subsidy program improbably overcame such Herculean cost hurdles, the federal government would still face other hurdles beyond its fiat, for example, a work ethic that would unlikely be culturally adopted by American workers and could not be mandated by government diktat. Indeed, simply lowering the cost of manufacturing fabs by itself would not be enough as the foregoing other challenges make clear. One aspect of such challenges makes the point. TSMC's hiring for its Arizona fab has laid bare the cultural differences between its corporate work expectations and those of its prospective U.S. hires:

[TSMC] is notorious for its long working hours, strict management and emphasis on discipline and hierarchy.... Many employees have stories of being called into work at all hours, even on holidays to deal with unexpected issues.... Most employees and suppliers (in Taiwan) think it will be very challenging to duplicate that agility and quick response time in the U.S.... TSMC's tough conditions are already turning off some [U.S.] hires.⁹⁰

One manager stated:

Over the years, I've been stationed at Intel, Micron, UMC and TSMC's plants, and I can say that TSMC has the strictest, most disciplined corporate culture of all of them.... My colleagues and I met and chatted with some of the trainees from the U.S. at TSMC's plant in Taiwan last year.... Many of them had culture shock and asked how TSMC employees could survive such a strict, military-like culture. A few actually dropped out of the program.⁹¹

Others have made similar observations. "If you've seen [TSMC's] stance on American engineers, they don't seem very pleased with them...." said Mike Burns, the founder of semiconductor companies such as Agere

90. Yifan Yu, Cheng Ting-Fang & Lauly Li, *From Somebody to Nobody: TSMC Faces Uphill Battle in U.S. Talent War*, NIKKEI ASIA (May 27, 2022), <https://asia.nikkei.com/Business/Business-Spotlight/From-somebody-to-nobody-TSMC-faces-uphill-battle-in-U.S.-talent-war>.

91. *Id.*

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Systems.⁹² The foregoing hiring cultural headwinds of TSMC are in the context of the broader labor headwinds of a declining U.S. workforce participation rate,⁹³ the recent Great Resignation, the perennial “funemployment” attitude, and the high social media visibility of the “quiet quitting” or “act my wage” movement.⁹⁴

It is important to make clear that this cultural gap is not just a mere annoyance to be managed, but has real, negative economic consequences that will make it more expensive to operate these new American fabs. A vignette from TSMC makes this clear. In 2009, Shang-yi Chiang again became the head of TSMC’s R&D division after having previously worked in Texas and California in between these two stints. Chiang explained:

“People work so much harder in Taiwan,”.... Because manufacturing tools account for much of the cost of advanced fab, keeping the equipment operating is crucial for profitability. In the U.S., Chiang said, if something broke at 1 a.m., the engineer would fix it the next morning. At TSMC, they’d fix it by 2 a.m. “They do not complain,” he explained, and “their spouses do not complain” either.⁹⁵

Finally, such semiconductor subsidy legislation suffers from an overwhelming defect: the semiconductor subsidies are a red herring because this limited focus ignores the exports by other semiconductor powerhouses that have export-driven economies, like Germany, Malaysia, South Korea, Singapore, Japan, and Taiwan, and their homegrown technology that is beyond the reach of the U.S.’s export control rules. Those countries play the subsidy game too. In 2014, China launched a \$150 billion semiconductor subsidy program; South Korea plans to spend as much as \$65 billion; the European Union \$49 billion; India \$10 billion; and Japan \$5.2 billion.⁹⁶ Over the past decade, Taiwan has had approximately

92. Patterson, *supra* note 16.

93. Michael R. Strain, *What’s Hollowing Out the US Workforce?*, PROJECT SYNDICATE (Aug. 22, 2022), <https://www.project-syndicate.org/commentary/us-labor-force-participation-not-recovering-from-pandemic-by-michael-r-strain-2022-08>.

94. Lindsay Ellis & Ray A. Smith, *Your Co-Workers Are Less Ambitious; Bosses Adjust to the New Order*, WALL ST. J. (Dec. 31, 2022, 12:00 AM), <https://www.wsj.com/articles/your-coworkers-are-less-ambitious-bosses-adjust-to-the-new-order-11672441067>.

95. MILLER, *supra* note 37, at 232 (emphasis added).

96. Rebecca Heilweil, *America is Trying to Fix the Chip Shortage One Factory at a Time*, VOX (May 2, 2022, 8:00 AM), <https://www.vox.com/recode/23048906/chip-shortage-manufacturing-america-biden>; Simon Sharwood, *Top Chipmakers Ignore India’s Semiconductor Factory Subsidies*, REGISTER (Feb. 21, 2022, 1:17 AM),

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150 government-sponsored projects for semiconductor manufacturing.⁹⁷ Even smaller countries, such as Singapore, have recently been quite successful in attracting new semiconductor investment because of its effective subsidy program, its trustworthy intellectual property laws, low tax rates, an educated workforce, and its central location in Asia.⁹⁸ In short, the U.S. is in a global race with other countries to subsidize semiconductor manufacturing.⁹⁹

D. Four Key Weaknesses of the October 7, 2022, Export Control Regulations

The timing of the CHIPS and Science Act, which became law on August 9, 2022, was the carrot to the semiconductor industry, but it quickly became apparent that a few sticks would also be needed. China's military exercises that resulted in a temporary, partial blockade of Taiwan from August 2 to August 6, 2022, in response to the simultaneous visit by Nancy Pelosi, the former U.S. Speaker of the House, were the most dramatic example among a multitude of the grey-zone warfare tactics China has been using against Taiwan for over a decade.¹⁰⁰ These dramatic exercises removed all doubt within the current Biden administration in general, and the Bureau of Industry and Security in particular, that the export control regulations rolled out on October 7, 2022, needed to be the equivalent of a very big stick.¹⁰¹ As noted by a semiconductor industry trade group, "The number of specific components, other commodities,

https://www.theregister.com/2022/02/21/india_semiconductor_subsidies/; Mayumi Hiroswawa, *Japan Chip Subsidy Requires 10-Year Pledge from TSMC, Others*, NIKKEI ASIA (Jan. 12, 2022, 1:21 AM), <https://asia.nikkei.com/Business/Tech/Semiconductors/Japan-chip-subsidy-requires-10-year-pledge-from-TSMC-others>.

97. Sohn, *supra* note 7.

98. Jon Emont, *How Singapore Got Its Manufacturing Mojo Back*, WALL ST. J. (June 22, 2022, 10:36 AM), <https://www.wsj.com/articles/singapore-manufacturing-factory-automation-11655488002>.

99. Sohn, *supra* note 7; Sohn, *supra* note 65.

100. For a description of the gray zone activities China has used against Taiwan over the past decade, including military exercises, missile drills, economic coercion, and cyber (or disinformation) warfare, see Chin-Kuei Tsui, *China's Gray Zone Activities and Taiwan's Responses*, STIMSON CTR. (Dec. 12, 2022), <https://www.stimson.org/2022/chinas-gray-zone-activities-and-taiwans-responses/> (description of the gray zone activities China has used against Taiwan over the past decade, including military exercises, missile drills, economic coercion, and cyber or disinformation warfare).

101. Chad P. Bown & Kevin Wolf, *National Security, Semiconductors, and the U.S. Move to Cut Off China*, PETERSON INST. FOR INT'L ECON. (Nov. 22, 2022, 9:00 AM), <https://www.piie.com/blogs/realtime-economics/national-security-semiconductors-and-us-move-cut-china>.

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software, and technology affected by the new rules is literally in the tens of millions.”¹⁰² We turn now to a few salient critiques of the October 7 Export Controls that demonstrate the critical need for a semiconductor export control treaty among the Semi Allies Group.

First, “Unilateral controls are eventually counterproductive and ineffective.”¹⁰³ Past unilateral U.S. export controls against Chinese entities have hobbled the leading U.S. semiconductor companies’ revenue growth.¹⁰⁴ When semiconductor products or services may no longer be sold by domestic companies to Chinese buyers, other foreign competitors, especially those in export-driven economies, remain free to do so to the extent they are not subject to U.S. export control laws or are willing to run the risk of being sanctioned by the U.S. To give some sense of the competitive challenge to the domestic semiconductor businesses that results from such unilateral U.S. export controls, South Korea exported \$162.9 billion in 2021 to its largest trading partner, China.¹⁰⁵ Such a significant amount of trade is a massive 162.4 times the \$1 billion in exports from South Korea to China in 1991, with the demand for memory chips as a key driving force for such overall export growth.¹⁰⁶ Significantly, “China has remained [South] Korea’s top trading partner for the past 20 years....”¹⁰⁷ The economic pressure to adopt an “analysis paralysis” approach to follow the U.S.’s lead on the October 7 Export Controls will be enormous. Inevitably, such a “go it alone” export control regime will fail as competitors outside of the U.S. centric export control regime sell to China with the boomerang effect of accelerating the weakening of the U.S. semiconductor industry. Such lost sales are only the first order damage to the U.S. semiconductor sector. The second order damage results from foreign buyers and sellers throughout the entire global semiconductor

102. Semiconductor Indus. Ass’n, Public Comment 13 on Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items; Supercomputer and Semiconductor End Use; Entity List Modification, 88 Fed. Reg. 2821 (Jan. 18, 2023) 4, <https://www.regulations.gov/document/BIS-2022-0025-0002/comment?filter=sia> [hereinafter Public Comment 13].

103. Kevin Wolf & Emily S. Weinstein, *COCOM’s Daughter? Why a New Multilateral Export Control Regime is Needed to Address Contemporary National Security and Human Right Issues*, WORLDECR, May 2022, at 24, 25.

104. ANTONIO VARAS & RAJ VARADARAJAN, BOS. CONSULTING GRP., HOW RESTRICTIONS TO TRADE WITH CHINA COULD END U.S. LEADERSHIP IN SEMICONDUCTORS 5 (2020), <https://media-publications.bcg.com/flash/2020-03-07-How-Restrictions-to-Trade-with-China-Could-End-US-Semiconductor-Leadership.pdf>.

105. Jung Min-kyung, *South Korea’s Exports to China Jump 162-Fold Over 30 Years*, KOREA HERALD (Aug. 23, 2022, 4:07 PM), <https://www.koreaherald.com/view.php?ud=20220823000680>.

106. *Id.*

107. *Id.*

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supply chain now having a strong economic incentive to avoid U.S.-origin products when designing next-generation products, which is one of the triggers requiring compliance with the October 7 Export Controls. Without such U.S. origin technology in their semiconductor products, foreign buyers and sellers minimize the risk to their ability to do future business without disruption from U.S. export control regulations. Once such U.S.-origin products are designed out of semiconductor products, changing that dynamic with the current U.S. unilateral export control approach becomes not only a Sisyphean task, but also results in the loss of additional, long-term sales revenue that is critical for continued R&D in the semiconductor sector.

The two trade groups representing the largest number of semiconductor companies in the U.S. corroborate this assessment. “Established in 1970, SEMI is the leading global industry association that works to advance the business of electronics manufacturing supply chain. SEMI has over 2,500 members worldwide, including more than 530 American companies, and represents a full range of U.S. semiconductor companies, including designers, equipment makers, materials producers, and subcomponent suppliers.”¹⁰⁸ SEMI’s comments to the October 7 Export Controls concluded with the following final comment:

The unilateral controls imposed by the U.S. on October 7, 2022, may temporarily slow the development of advanced IC manufacturing capability in China, but eventually these controls will not be successful. For nearly every advanced semiconductor manufacturing piece of equipment produced by U.S. companies, there is a non-U.S. alternative. In other words, if the U.S. Government fails at getting allies to impose comparable controls in the next several months, China could get the same tools to do advanced node work, just from non-U.S. companies.... Semiconductor equipment companies that are not bound by the October 7 action will be benefiting from the billions of dollars of sales revenue that U.S. companies would have received but for the new controls and will be investing a large percentage of that income to directly compete with U.S. innovation.¹⁰⁹

108. SEMI, Public Comment 26 on Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items; Supercomputer and Semiconductor End Use; Entity List Modification, 88 Fed. Reg. 2821 (Jan. 18, 2023) 1, <https://www.regulations.gov/document/BIS-2022-0025-0002/comment?filter=semi>.

109. *Id.* at 12.

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The other semiconductor trade group, the Semiconductor Industry Association (“SIA”), has member companies that “represent more than 99% of the U.S. semiconductor industry by revenue and are engaged in the research, design, and manufacture semiconductors.”¹¹⁰ SIA noted that:

[U]nless the type controls at issue are soon imposed by our close allies over their exporters that have capabilities in the areas covered by the rule, the rule becomes both ineffective and counter-productive. Companies not subject to the same controls are able to now, or eventually will be able to, export to China from their countries most of the types of items and services that cannot be shipped from the United States or provided by U.S. companies.... The companies not affected by U.S. export controls are thus able to use that income for research and development to out-compete those companies affected by the unilateral controls. They are also delivering to the restricted country or end-user the exact technology the U.S. has intended to restrict, undermining the national security objectives the U.S. government set out to achieve.¹¹¹

Legally binding treaty obligations for multilateral coordination of semiconductor export controls among the Semi Allies is not simply a desirable policy goal, but critically imperative for any successful U.S. national security semiconductor strategy.

Second, not only is U.S. origin technology being designed out of the semiconductor supply chain—so are Americans. For the first time ever, the October 7 Export Controls prohibit U.S. persons from engaging in certain types of business activities involving the development or production of integrated circuits at a semiconductor fabrication facility located in China that meets certain advanced technical specifications.¹¹² ASML makes this point well in its comments to the October 7 Export Controls regarding this novel part of the rules:

[T]he relevant provisions [about U.S. persons] continue to be mired in uncertainty. Companies, consequently, may choose to interpret the U.S. persons provisions broadly, and needlessly restrict their U.S. person employees and contractors from engaging in a number of business critical functions [sic], which prevents

110. Public Comment 13, *supra* note 102, at 1.

111. *Id.* at 5-6.

112. 15 C.F.R. § 744.6(c) (2022).

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*such persons from participating fully in company operations. In the long term, such restrictions, and risk of similar provisions in the future, may reduce the appetite of companies to hire U.S. persons in critical roles.... U.S. person individuals can often be readily replaced by non-U.S. person individuals....*¹¹³

It certainly is challenging enough for American semiconductor businesses and U.S. persons to face the legal prohibitions of exporting to China based upon the specific requirements of the October 7 Export Controls. Because the October 7 Export Controls contain, according to SIA, “among the most novel and complex EAR provisions ever published[.]”¹¹⁴ the damage has extended even further than the specific prohibitions themselves. SIA found that:

*The combination of uncertainly driven by complexity leads foreign companies to often design out or avoid U.S.-origin or U.S. company branded content to “de-risk” (i.e., over-control to avoid possible enforcement actions), reduce compliance costs, and reduce potential harm to their supply chains – even when these items are not subject to either item or end-use based controls.*¹¹⁵

Third, the export control bureaucracies in all of these major advanced economies have a multiplicity of ways of ensuring that their national domestic semiconductor champions continue to thrive by exporting to China and taking market share away from U.S. companies that are now prohibited from selling to China because of the October 7 Export Controls. They range from the blatant disregard of political agreements with the U.S. at the highest level, appearing in the headlines of national publications by simply granting contravening export licenses for semiconductor products to be shipped to China, to asking the local semiconductor manufacturer for the dates on which it plans to ship to China so that the dates remaining are the ones on which it is prohibited from exporting. Many problematic individual licenses can be conveniently obscured in bulk export control licenses. The games export control bureaucracies can play to achieve the results they want in order to grant the necessary licenses are endless.

113. ASML US LLC, Public Comment 32 on Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items; Supercomputer and Semiconductor End Use; Entity List Modification, 88 Fed. Reg. 2821 (Jan. 18, 2023) 6, <https://www.regulations.gov/comment/BIS-2022-0025-0050>.

114. Public Comment 13, *supra* note 102, at 3.

115. *Id.*

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Again, legally binding, multilateral, coordinated standards that are effective in practice among the Semi Allies are critical because that is the only way to mitigate each country from adopting idiosyncratic exceptions that favor their domestic semiconductor champions.

Finally, the unilateral nature of the October 7 Export Controls has also detrimentally harmed the U.S.'s relations with its Semi Allies. ASML succinctly drives home this point in its comments to the October 7 Export Controls:

The U.S. government has repeatedly declared its commitment to resolving export control issues within a multilateral framework. In particular, Annex II, Statement on Export Control Cooperation, of the U.S.-EU Trade and Technology Council Inaugural Joint Statement (“Statement”) serves as a blueprint of U.S.-EU understanding on the use of export controls. The Statement memorializes the U.S. government’s understanding “that a multilateral approach to export controls is most effective for protecting international security” and the importance of “consultations prior to the introduction of controls outside the multilateral regimes.” The U.S. government also specifically recognized that “export controls should not unduly disrupt strategic supply chains.” ASML US respectfully submits that imposition of broad unilateral controls undermines the United States’ commitment to its multilateral obligations. The U.S. government could be seen as adopting an ‘implement first, seek consensus second’ approach. Such a unilateral approach can have a significant impact on companies in allied countries.¹¹⁶

E. Domestic Semiconductor Carrots and Sticks Are Not Enough

In short, it is impossible to move the entire semiconductor supply chain to the U.S. Producing a single semiconductor typically involves over 1000 steps and 70 border crossings during the manufacturing process.¹¹⁷ The CHIPS and Science Act and the October 7 Export Controls will simply slow the continued rise of Asia—and China in particular—as the center of semiconductor manufacturing, much like Sematech also merely slowed the outmigration of semiconductor manufacturing to Asia. Unfortunately,

116. Public Comment 32, *supra* note 113, at 3-4.

117. Stephen Nellis & Hyunjoo Jin, *Biden’s Chip Dreams Face Reality Check of Supply Chain Complexity*, REUTERS (Apr. 13, 2021, 7:10 AM), <https://www.reuters.com/business/bidens-chip-dreams-face-reality-check-supply-chain-complexity-2021-04-13/>.

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the CHIPS and Science Act and the October 7 Export Controls will also, like Sematech, ultimately fail in the end.

If part of our national and economic security depends on precluding our adversaries from obtaining advanced computer chip technologies to build robust emerging technology industries and create advanced military technologies, subsidizing U.S. manufacturers to build advanced chips on-shore, alongside draconian unilateral export control regulations, will not ultimately succeed in advancing these other national security and economic goals. The Biden Administration, and the proponents of the CHIPS and Science Act and the October 7 Export Controls, present these actions as meaningfully resolving our economic and military challenges in the semiconductor sector. Such efforts notwithstanding, the U.S. still has not adequately addressed the national security threat stemming from China developing, with its allies, its own indigenous semiconductor supply chain. In light of this, I argue for a dramatically new and more robust approach.

III. THE U.S. MILITARY'S RESPONSE TO THE U.S. SEMICONDUCTOR OUTMIGRATION TO ASIA

A. Trusted Foundry

The U.S. military, given its unique electronic needs, has not ignored the dramatic changes in the semiconductor industry over the past decades and has provided implicit guidance for a new approach, unlike the political branches of this country. In those instances where the commercial industry simply no longer manufactures certain legacy semiconductors because the commercial market has evaporated, a little-known agency within the sprawling Department of Defense, the Defense MicroElectronics Activity ("DMEA") runs its own flexible foundry. This foundry is called the Advanced Reconfigurable Manufacturing for Semiconductors ("ARMS") facility and is located at the McClellan Air Force Base in Sacramento, California.¹¹⁸

In addition, the U.S. military's critical need for secure semiconductors, which are used in its wide range of military armaments and intelligence-gathering devices, has been severely challenged by both the outmigration of the semiconductor supply chain and foreign ownership of domestic semiconductor companies. Responding to these seismic semiconductor industry changes, the U.S. military created a semiconductor-specific program

118. John Rhea, *DMEA to Make Integrated Circuits In-House in New Flexible Foundry*, MIL. & AEROSPACE ELECS. (Sept. 1, 1999), <https://www.militaryaerospace.com/computers/article/16705879/dmea-to-make-integrated-circuits-inhouse-in-new-flexible-foundry>.

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that is unknown outside of the semiconductor industry and seldom has new participants within the semiconductor industry.¹¹⁹ Known as Trusted Foundry, this program ensures that semiconductor components incorporated into military systems have not been compromised by foreign agents. The DMEA is the accrediting authority for this program. As of January 4, 2023, 81 companies have met the security requirements to be accredited in this program.¹²⁰ As might be expected, for foreign-owned semiconductor companies to participate in the Trusted Foundry program, they need to also comply with Foreign Ownership, Control, and Influence (informally known as FOCI) mitigation requirements. These requirements entail a complex set of agreements that in one variation comprise a special security agreement, an electronic communications plan, a facility location plan, a technology control plan, and an affiliate operations plan.

Interestingly, not all of the Trusted Foundry accredited semiconductor companies are located in the United States. IBM has a subsidiary in Bromont, Quebec, Canada that handles post-processing, packaging, and assembly. While no longer an accredited Trusted Foundry participant, Silanna Semiconductor in New South Wales, Australia was, as recently as 2019, also accredited for design, foundry services, and post-processing.¹²¹

Ironically, the DoD currently has exclusively foreign manufacturers, i.e., TSMC in Taiwan and Samsung in South Korea, as the only options to purchase the most advanced semiconductors because there are no domestic manufacturers. The unfortunate result is that sometimes the chips DoD buys from the Trusted Foundries are two generations behind what is available on the commercial state-of-the-art market.¹²² Part of the problem is that the DoD is not a large purchaser of microelectronics, so many semiconductor companies are unable to make a business case for participating in the Trusted Foundry program.¹²³ Insider threats are also a significant problem with this program according to Mark J. Lewis, former Acting Deputy Under Secretary of Defense for Research and Engineering and Director of Defense Research and Engineering for Modernization. “We’ve seen a number of examples where the biggest threats that we face

119. C. Todd Lopez, *DoD Adopts ‘Zero Trust’ Approach to Buying Microelectronics*, U.S. DEP’T OF DEF. (May 19, 2020), <https://www.defense.gov/News/News-Stories/Article/Article/2192120/dod-adopts-zero-trust-approach-to-buying-microelectronics/>.

120. *Trusted Foundry Program: Accredited Suppliers*, DEF. MICROELECTRONICS ACTIVITY (Sept. 7, 2023), <https://www.dmea.osd.mil/otherdocs/AccreditedSuppliers.pdf>.

121. *Trusted Foundry Program: Accredited Suppliers*, DEF. MICROELECTRONICS ACTIVITY (Dec. 17, 2019), <https://www.dmea.osd.mil/otherdocs/AccreditedSuppliers.pdf>.

122. Lopez, *supra* note 119.

123. *Id.*

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often are the insider threat. It's the people inside the fence line, behind the guards, who we think we've cleared," he said.¹²⁴ "They're the ones that pose the biggest threats to us."¹²⁵ In light of these problems, the Trusted Foundry program has been deemed a failure and is currently being phased out, but the phaseout is behind schedule.¹²⁶ Perhaps it is unsurprising that such a shutdown is behind schedule, as DMEA continues to run the Trusted Foundry program in a business-as-usual mode, with no announcement regarding its closure, no winding up of existing contracts, and no website notice of the Trust Foundry program's demise. Instead, DMEA has focused on the next iteration of the Trusted Foundry program, which it calls the Trusted Foundry Access III program, through awarding contracts in 2023 "to ensure uninterrupted access to measurably secure, State-of-the-Art semiconductor foundry services over a 10-year period of performance."¹²⁷

B. RAMP Project

Given that the purchase of advanced semiconductors is not possible through the current Trusted Foundry program, in 2020, the DoD launched the Rapid Assured Microelectronics Prototypes Using Advanced Commercial Capabilities ("RAMP") Project to improve its access to state-of-the-art semiconductors and microelectronics technologies by developing secure design and manufacturing semiconductor prototyping capabilities.¹²⁸ Importantly, RAMP, and other related programs for semiconductor packaging, are not limited to just manufacturing onshore. The DoD is simply not waiting for advanced semiconductor manufacturing to develop onshore. Instead, the DoD is working to expand its range of advanced semiconductor manufacturers in other foreign countries, so it is not so dependent on purchasing advanced semiconductors from TSMC in Taiwan and Samsung in South Korea. In relatively short order, either one

124. *Id.* (internal quotations omitted).

125. *Id.* (internal quotations omitted).

126. *Id.*; INSPECTOR GEN., DEPT OF DEF., EVALUATION OF THE DEPARTMENT OF DEFENSE'S TRANSITION FROM A TRUSTED FOUNDRY MODEL TO A QUANTIFIABLE ASSURANCE METHOD FOR PROCURING CUSTOM MICROELECTRONICS (DODIG-2022-084) (2022), <https://www.dodig.mil/DesktopModules/ArticleCS/Print.aspx?PortalId=48&ModuleId=2973&Article=3019461>.

127. Contract Opportunity for Trusted Foundry Access III – Manufacturing, HIGHERGOV, <https://www.highergov.com/contract-opportunity/trusted-foundry-access-iii-manufacturing-hq072723r0001-k-64dea/> (last visited Sept. 22, 2023).

128. Lionel Grealou, *Microelectronics and Supply Chain Innovation: Siemens to Collaborate with Microsoft*, ENGINEERING.COM (Oct. 13, 2022), <https://www.engineering.com/story/microelectronics-and-supply-chain-innovation-siemens-to-collaborate-with-microsoft>.

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could become unavailable because of military action by China or North Korea.

C. Validation of Ally Shoring

These foreign exceptions to the Trusted Foundry program, and the “no borders” approach of RAMP, are important because they are a recognition of the sprawling semiconductor supply chain reality from a national security perspective. Furthermore, they, *sub silentio*, establish the precedent for the U.S. military to rely on semiconductor components and services manufactured and provided in allied foreign countries by foreign nationals who comply with certain security requirements. Our proposal for a treaty regarding export controls on semiconductors by members of the Semi Allies Group is a more robust version of this implicit foreign manufacturing semiconductor policy of the DoD.

**IV. THE SEMI ALLIES GROUP OF COUNTRIES SHOULD
ADOPT A TREATY CONTROLLING THE EXPORT OF
ADVANCED SEMICONDUCTORS**

A. Instructive Cases and Red Flags

Members of Congress who voted for the Chips and Science Act and view it as the “once and done” answer to our semiconductor national security vulnerabilities are gravely mistaken. Congress needs to focus on legislation that would be both sustainable over the long term and increase the likelihood that critical, chokehold semiconductor technologies remain either onshore or with allied countries while preventing their export to, or independent development in, hostile nations. In short, Congress should seek to adopt an international semiconductor export control treaty with Germany, Japan, the Netherlands, South Korea, and Taiwan, our key allies who are critical in the semiconductor supply chain.

Determining the initial members of the Semi Allies Group produces clear answers to this key question: which countries are U.S. allies with the most significant and critical semiconductor businesses in the semiconductor supply chain? Once the initial set of members is established within the Semi Ally Group, however, other possible members of this group should be considered, such as the United Kingdom¹²⁹ because of

¹²⁹ Oscar Williams, *The UK's Semiconductor Industry Is Dying – Will Liz Truss Save It?*, NEW STATESMAN (Aug. 24, 2022), <https://www.newstatesman.com/business/2022/08/uk-semiconductor-industry-dying-liz-truss>; Andrew Hill, Andrew Hill, *The Semiconductor Boom: Has the UK Missed*

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ARM, Malaysia because of its critical packaging (assembly) and semiconductor testing center,¹³⁰ and Singapore because it is, once again, becoming an important semiconductor manufacturer.¹³¹

Analyzing candidate countries in a second round of admissions will be a complex undertaking. The answer to the question of whether a country is a U.S. ally is sometimes ambiguous. For example, is Malaysia a U.S. ally? Sometimes, the answer to the question of whether a country has significant and critical semiconductor businesses in the semiconductor supply chain is also ambiguous. For example, is ARM enough of a reason to admit the United Kingdom? Finally, we must now ask an additional filtering question that was previously inapplicable: What are potential candidates' relationships with each of the existing members and the other potential candidates? For example, from a geo-military perspective, it makes no sense to admit Malaysia but to exclude Singapore, the city-state that sits at the tip of the Malaysian peninsula. Another example: Potentially admitting the United Kingdom when members of the E.U. (i.e., the Netherlands and Germany) are already members of the Wassenaar Treaty. This will unavoidably bring up a host of acrimonious and unrelated post-Brexit national security, economic development, and border control issues.

1. The Instructive Cases of China and Russia

The role of China in the semiconductor sector and the recent Western investment losses in Russia are instructive to understanding why the Semi Allies Group should adopt a semiconductor export control treaty. China is the largest growth market for semiconductors and funds a significant amount of U.S. semiconductor research and development through profits from the sales of semiconductor goods in China. Indeed, Chinese orders for chipmaking equipment from overseas suppliers rose 51% in 2021, making it the largest market for these products for the second year running. A gradual withdrawal from China, through ever tighter export control laws led by the U.S., is better than the alternative, which we have recently seen as Western companies suffer because of Russia's second invasion of Ukraine. Either of their own volition in reaction to such invasion or as a consequence of the draconian sanctions imposed under Western export control laws, almost a thousand Western companies were forced to

Its Chance?, FIN. TIMES (Aug. 14, 2022), <https://www.ft.com/content/470bf7d8-cd32-472d-b75f-6019eb4b100a>.

130. Scott Foster, *Big Chip and Tech Investment Pouring into Malaysia*, ASIA TIMES (Dec. 23, 2021), <https://asiatimes.com/2021/12/big-chip-and-tech-investment-pouring-into-malaysia/>.

131. Emont, *supra* note 98.

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completely and almost instantaneously withdraw from Russia. Such unplanned abandonment of such extensive foreign investment has resulted in economic losses to Western companies in excess of \$59 billion.¹³² Western oil and gas industries, and virtually all the other foreign investors in the wide range of sectors in Russia, along with the Western governments, essentially looked away during Russia's 2014 Ukraine invasion, in which it annexed Crimea and supported the Donbas separatists in eastern Ukraine. The extremely expensive price from Western companies and governments' inaction is now being paid.

If China attacks Taiwan, there will be even more massive economic losses to the Semi Allies Group's economies and industries than simply those who lost semiconductor sales through export controls in China. First, the Western investment in China is orders of magnitude greater than that in Russia. Factories in China bought almost \$30 billion in chip-making equipment in 2021 alone, which was more than any other country and up 58% from the prior year.¹³³ For example, sales to China make up approximately a third of Lam Research Corporation's global revenue.¹³⁴ Lam Research Corporation, an American supplier of wafer fabrication equipment and related services to the semiconductor industry, has warned of a \$2-2.5 billion revenue loss in 2023 resulting from the October 7 Export Controls.¹³⁵ If the decoupling of Western investment in China is abrupt, the economic losses will likely be in the hundreds of billions of dollars. Added to that will be the untold amount of revenue lost through the new economic growth opportunities such as 5G, artificial intelligence, quantum computing, etc. if they are successfully developed and sold globally by China instead of the Semi Allies Group.

2. The First Red Flag: The Restrained Export Controls of the Netherlands and Japan

The recent red flags of our current semiconductor practices are telling. For example, in 2021, the U.S. stopped ASML from selling EUV

132. Jean Eaglesham, *Business Losses from Russia Top \$59 Billion as Sanctions Hit*, WALL ST. J. (June 10, 2022, 11:59 PM), <https://www.wsj.com/articles/business-losses-from-russia-top-59-billion-as-sanctions-hit-11654853400>.

133. Stephen Nellis, *The U.S. Weighs a Broader Crackdown on Chinese Chipmakers*, INFORMATION (May 9, 2022, 6:00 AM), <https://www.theinformation.com/articles/the-u-s-weighs-a-broader-crackdown-on-chinese-chipmakers>.

134. Yuvraj Malik, *Lam Research Warns of up to \$2.5 Bln Revenue Hit from U.S. Curbs on China Exports*, REUTERS (Oct. 19, 2022, 6:24 PM), <https://www.reuters.com/technology/lam-research-warns-up-25-bln-revenue-hit-us-curbs-china-exports-2022-10-19/>.

135. *Id.*

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manufacturing equipment to China through ad hoc strong-arming of the Netherlands' export control regime. Unsurprisingly, given that each unit costs approximately €160 million,¹³⁶ ASML did not support the U.S.'s position. ASML Holding NV Chief Executive Officer Peter Wennink said, "Export controls against China will not only fail to halt its technological progress but also hurt the U.S. economy ... after trade tensions between Washington and Beijing led to restrictions on the sale of the Dutch company's advanced chip equipment to Chinese firms."¹³⁷ In 2022, the U.S. began trying to stop ASML from selling to China DUV manufacturing equipment, which is a generation behind the more advanced EUV, but still the most common method in making some less advanced chips required by computers, cars, and phones. Again, ASML resisted such sales restrictions regarding DUV manufacturing equipment. Specifically, Mr. Wennink said "ASML has already sacrificed," referencing the previous prohibitions on ASML from selling EUV manufacturing equipment to China.¹³⁸ Wennink also implied that his company was being unfairly targeted by the U.S.¹³⁹ Such resistance is entirely predictable given that China makes up 15% of ASML's sales.¹⁴⁰

Because it has no effective global strategy, the U.S. is again resorting to *ad hoc* strong-arming of the Netherlands' export control regime.¹⁴¹ Unlike in the EUV case, the U.S. has no control over the intellectual property ASML uses in its DUV manufacturing equipment,¹⁴² so it truly is a strong-arming operation. In 2023, the U.S. finally succeeded in convincing the Netherlands to bar ASML "from selling to China at least some immersion lithography machines, the most advanced kind of gear in the

136. Jillian Deutsch ET. AL., *US Wants Dutch Supplier to Stop Selling Chipmaking Gear to China*, BLOOMBERG (July 6, 2022, 3:12 AM), <https://www.bloomberg.com/news/articles/2022-07-05/us-pushing-for-asml-to-stop-selling-key-chipmaking-gear-to-china>.

137. Debby Wu, *ASML CEO Says Trying to Control Chip Sales to China Won't Work*, BLOOMBERG (Apr. 14, 2021, 9:20 AM), <https://www.bloomberg.com/news/articles/2021-04-14/asml-ceo-says-trying-to-control-chip-sales-to-china-won-t-work?embedded-checkout=true>.

138. Nicholas Gordon, *Biden's Efforts to Starve China of Chips Are Rewriting the Rules of Global Trade—and Even U.S. Allies are Balking at the Upheaval*, FORTUNE (Dec. 17, 2022, 7:00 AM), <https://fortune.com/2022/12/17/semiconductor-exports-free-trade-subsidies-china-ban-biden-morris-chang-tsmc/>.

139. *Id.*

140. *Id.*

141. Deutsch ET. AL., *supra* note 136.

142. Max A. Cherney, *The US Plans to Block Sales of Older Chipmaking Tech to China*, PROTOCOL (Aug. 17, 2022), <https://www.protocol.com/policy/biden-china-ban-chipmaking-finfet>.

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company's deep ultraviolet lithography line."¹⁴³ One could hear the bones cracking from across the pond from the U.S. arm-twisting to extract even this limited DUV concession from the Dutch (i.e., ASML). Mr. Wennink gave some context to this singular restriction, stating there have been no publicly disclosed details and any new restrictions would take months to be drafted and then enacted by the Dutch government. Mr. Wennink consequently did not anticipate this specific concession to have a material effect on their sales for 2023.¹⁴⁴

As if this were not problematic enough, there are also competing Japanese DUV manufacturers willing to sell to China, so now the U.S. also needed to strong-arm Japan.¹⁴⁵ In 2023, Japan released planned export controls on 23 items used to make semiconductors in response to U.S. pressure.¹⁴⁶ The proposed measures are now subject to public comment and are anticipated to affect approximately ten large companies, such as Nikon and Tokyo Electron.¹⁴⁷ In Tokyo Electron's case, for example, China accounted for almost 25% of its total sales in a recent nine month period.¹⁴⁸ Nevertheless, the head of the Japanese Ministry of Economy, Trade and Industry, Yasutoshi Nishimura, "predicted only limited impact on Japanese companies, saying most of the country's chipmaking-equipment exports wouldn't be affected."¹⁴⁹

The less than a dozen combined domestic companies in the Netherlands and Japan that will be minimally affected by these highly targeted, more stringent export controls for advanced semiconductor technology sold to China, leaves a wide swath of American semiconductor businesses entirely on their own. Because of the October 7 Export Contracts, American semiconductor businesses have already lost billions of dollars in revenue collectively due to the restrictions on their sales to China and at

143. Yuka Hayashi & Vivian Salama, *Japan, Netherlands Agree to Limit Exports of Chip-Making Equipment to China*, WALL ST. J. (Jan. 28, 2023, 8:26 PM), <https://www.wsj.com/articles/japan-netherlands-agree-to-limit-exports-of-chip-making-equipment-to-china-11674952328>.

144. Toby Sterling, *ASML: Trade War Risks Increasing, but No 2023 Impact on China Sales*, REUTERS (Feb. 15, 2023, 4:50 AM), <https://www.reuters.com/technology/asml-trade-war-risks-increasing-no-2023-impact-china-sales-2023-02-15/>.

145. Cherney, *supra* note 142.

146. Kyoko Hasegawa & Hiroshi Hiyama, *Japan Unveils Export Control Plans for Chip Equipment*, BARRON'S (Mar. 31, 2023), <https://www.barrons.com/news/japan-unveils-export-control-plans-for-chip-equipment-3cb5c114>.

147. *Id.*

148. Peter Landers, *Japan Curbs Semiconductor-Gear Exports as Ties with China Chill*, WALL ST. J. (Mar. 31, 2023, 10:53 AM), <https://www.wsj.com/articles/japan-restricts-semiconductor-equipment-exports-as-ties-with-china-chill-80885567>.

149. *Id.*

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least a 20% decline in Chinese semiconductor market share.¹⁵⁰ Overwhelmingly, their direct competitors in the Semi Allies Group remain free to sell semiconductor technology in China without such restrictions. This enables those competitors to capture the entire American semiconductor products market share because it is now illegal for American companies to sell in China. America's foreign competitors can use this additional, significant revenue stream for research and development, that may enable them to overtake U.S. technological leadership.¹⁵¹

China has, of course, been closely monitoring the U.S.'s efforts to tighten semiconductor equipment export controls. To defeat any subsequent successful semiconductor export control efforts, China has encouraged its domestic national champions to buy as much as possible by providing those companies with financing. As one commentator colorfully noted: "China has been buying everything it can from the store before it closes."¹⁵²

3. The Second Red Flag: No Other Followers to the U.S.'s October 7 Export Controls

Only two members of the proposed Semi Allies Group, the Netherlands and Japan, have agreed to adopt limited changes to their national security export control laws to prohibit very specific advanced semiconductor technology from being sold to China. None of the Semi Allies Group have even the intention of adopting a set of regulations similar to the October 7 Export Controls. As previously discussed, the economic damage to these individual allies would be very significant, so it is not surprising they are reluctant to follow the October 7 Export Controls. They also, quite legitimately, point out that their export control regimes are significantly different from the U.S. export control regime with its broad policy purposes unrelated to traditional non-proliferation objectives.¹⁵³ Aside from the tactics mentioned above for these countries to avoid substantively

150. SEMI, Public Comment 26 on Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items; Supercomputer and Semiconductor End Use; Entity List Modification, 88 Fed. Reg. 2821 (Jan. 18, 2023) at 2, 5 <https://www.regulations.gov/document/BIS-2022-0025-0002/comment?filter=semi>.

151. *Id.* at 1.

152. Gregory C. Allen, *Choking Off China's Access to the Future of AI*, CTR. FOR STRATEGIC & INT'L STUD. (Oct. 11, 2022), <https://www.csis.org/analysis/choking-chinas-access-future-ai>.

153. Kevin Wolf ET. AL., PUBLIC COMMENTS OF KEVIN WOLF, EMILY KILCREASE, AND JASPER HELDER REGARDING AREAS AND PRIORITIES FOR US AND EU EXPORT CONTROL COOPERATION UNDER THE ES-EU TRADE AND TECHNOLOGY COUNCIL 17-18 (Jan. 14, 2022), <https://www.akingump.com/a/web/da8PXpEZoaPekNsTPUmfmr/011422us-euttewolfkilcrease-holderfinal.pdf>.

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responding, they will have legitimate questions for the U.S. First, they will question why they should follow U.S. centric export control regulations that they were not involved with establishing. Second, our semiconductor allies will ask why they should give up their competitive semiconductor advantages in China if other members of the Semi Allies Group do not follow the U.S. lead. Finally, they will rightly ask how likely is it that members of the Semi Allies Group will voluntarily adopt any individual aspect of the October 7 Export Controls. Any country that chooses not to will retain its pre-existing semiconductor commercial advantage in China and will also be the only commercial supplier for that particular advanced semiconductor technology.

4. A Final Red Flag: The “Chip 4” Group of Countries

We should not, and cannot, assume the window for negotiating a semiconductor treaty will remain open forever. The export driven economies of Germany, the Netherlands, Japan, South Korea, and Taiwan make it almost inevitable that there will be differing perceptions of national security risks, economic trade-offs required to address those changing security risks, and the political will to take economic hits for the greater collective good of the Semi Allies Group. It only takes a few critical countries, pursuing their own narrow economic self-interest, to permit the export of advanced semiconductor products enabling China to fill in the remaining gaps of its internal supply chain. The U.S. has tried doing it alone, and this approach has unequivocally not worked. As previously mentioned, the reason is clear: unilateral export controls are eventually counterproductive and ineffective. In truth, our transnational semiconductor export control policy vis-à-vis China is really a U.S. export control policy requiring hectoring tactics to convince allies to follow suit that will fail over the long-term.

The hectoring tactic appears to be the basis for the “Chip 4” group of countries comprised of the U.S., Japan, Taiwan, and South Korea.¹⁵⁴ Semiconductors are South Korea’s leading export product and China is its largest trade partner.¹⁵⁵ “According to a survey of 300 exporters in South Korea by the Korea Chamber of Commerce and Industry announced on Wednesday [August 17, 2022], 53% of respondents said that South Korea should join the U.S.-led group, 41% said it should hold off on joining for

154. Hyonhee Shin & Joyce Lee, *S.Korea to Attend Preliminary Meeting of U.S.-Led Chipmaker Group*, REUTERS (Aug. 18, 2022), <https://www.reuters.com/technology/skorea-attend-preliminary-meeting-us-led-chipmaker-group-2022-08-18/>.

155. *Id.*

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now, while 5% opposed South Korea joining.”¹⁵⁶ South Korea has not announced any more stringent export controls on semiconductor technology sold to China. Neither has Taiwan nor Germany. That, in a nutshell, gives a clear sense of how this tactical approach to encouraging other allies to follow the U.S. export control lead vis-à-vis China requires a more robust approach.

B. The Need for a Sustainable, Effective Semiconductor Foreign Policy

1. The Goal of the Semiconductor Export Control Treaty

The next generation of foundational technologies is not waiting for the U.S. military-industrial complex to analyze them for risks to the country. The 5G rollout continues apace. 6G research is ramping up. No longer do we simply worry about whether a software program can pass the Turing Test. Google fired an engineer after he claimed that one of the company’s AI chatbots had become sentient.¹⁵⁷ OpenAI, a San Francisco-based artificial intelligence laboratory, has made shockwaves with its two industrial-grade generative artificial intelligence products: ChatGPT, a chatbot that answers questions in human-simulated prose, and Dall-E, an image creator based on user descriptions of the desired picture.¹⁵⁸ An industrial quantum computer has recently been developed and cloud-based quantum-computing services have been created.¹⁵⁹

Currently, the critical chokehold semiconductor technologies include advanced materials, electronic design automation software, advanced semiconductor manufacturing equipment, and licenses to chip design intellectual property.¹⁶⁰ The Semi Allies Group should, as a treaty-bound group, halt the export of such chokehold technologies to China, Russia, Iran, and North Korea.

156. *Id.*

157. Erin Griffith & Cade Metz, *A New Area of A.I. Booms, Even Amid the Tech Gloom*, N.Y. TIMES (Jan. 7, 2023), <https://www.nytimes.com/2023/01/07/technology/generative-ai-chatgpt-investments.html>.

158. *Id.*

159. Lorenzo Pautasso ET AL., *The Current State of Quantum Computing: Between Hype and Revolution*, MCKINSEY DIGITAL (Feb. 19, 2021), <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/tech-forward/the-current-state-of-quantum-computing-between-hype-and-revolution>.

160. Saif M. Khan, *Securing Semiconductor Supply Chains*, CTR. FOR SEC. & EMERGING TECH 7 (Jan. 2021), <https://cset.georgetown.edu/publication/securing-semiconductor-supply-chains> (select “Download Full Report”).

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2. The Wassenaar Arrangement and Coordinating Committee for Multilateral Export Controls

Such chokehold semiconductor technologies are currently not subject to any export control treaty. Instead, they are addressed by the 42 members of the Wassenaar Arrangement,¹⁶¹ which was established in 1996 as a voluntary export control regime promoting the exchange of information on transfers of conventional weapons, dual-use goods, and technologies. Members of the Wassenaar Arrangement include not only the United States and its allies: Germany, Japan, the Netherlands, and South Korea, but also Russia. Neither China nor Taiwan is a member. The Wassenaar Arrangement is the successor to the Coordinating Committee for Multilateral Export Controls (COCOM), which the Western Block established in 1950¹⁶² during the Cold War to create an embargo on Comecon countries. With the collapse of communism in the Soviet Union and other countries of Eastern Europe, the military and political threat of international communism that had galvanized the creation of COCOM had largely dissipated. On March 31, 1994, COCOM was formally dissolved.¹⁶³ The then-current control list of embargoed goods was retained by the member nations until the successor, the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, was established in December 1995 to prevent rogue states, such as Iran, Iraq, Libya, and North Korea, from acquiring advanced technology to be used in their state-sponsored terrorism.¹⁶⁴

Unlike its predecessor, the Cold War-era COCOM, the Wassenaar Arrangement:

is not targeted at any region or group of states, but rather at “states of concern” to [its] members. Wassenaar members also lack veto authority over another member’s proposed exports, a

161. The 42 participating states in the Wassenaar Arrangement are Argentina, Australia, Austria, Belgium, Bulgaria, Canada, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom, and the United States. *The Wassenaar Arrangement at a Glance*, ARMS CONTROL ASS’N n.1 (Feb. 2022), <https://www.armscontrol.org/factsheets/wassenaar>.

162. U.S. CONG. OFF. OF TECH. ASSESSMENT, TECHNOLOGY AND EAST-WEST TRADE, 153 (1979).

163. Michael Knes, *Coordinating Committee for Multilateral Export Controls and the Wassenaar Arrangement*, REFERENCE FOR BUS. (Oct. 6, 2023, 10:32 AM), <https://www.referenceforbusiness.com/encyclopedia/Con-Cos/Coordinating-Committee-for-Multilateral-Export-Controls-and-the-Wassenaar-Arrangement.html>.

164. *Id.*

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*power that COCOM members exercised. To promote transparency, Wassenaar calls on states to make a series of voluntary information exchanges and notifications on their export activities related to weapons and items appearing on the arrangement's two control lists.*¹⁶⁵

The munitions list for conventional weapons has “eight broad weapon categories: battle tanks, armored combat vehicles (ACVs), large-caliber artillery, military aircraft/unmanned aerial vehicles, military and attack helicopters, warships, missiles or missile systems, and small arms and light weapons.”¹⁶⁶ The second list covers dual-use goods and technologies,¹⁶⁷ which means they may be used for civilian or military purposes. The purpose of such information exchanges is “... to promote ‘greater responsibility’ among its members in exports of weapons and dual-use goods and to prevent ‘destabilizing accumulations.’”¹⁶⁸

3. Russia and China Lay Bare the Ineffectiveness of the Wassenaar Arrangement

A 2015 statistical analysis of the Wassenaar Arrangement's effectiveness as a nonproliferation regime for conventional weapons concluded it was “minimally effective.... [T]he conventional armed trade appears to have been unaffected by the Wassenaar Arrangement.”¹⁶⁹ In a telling comment from that time, the study's author also concluded:

There is no evidence to suggest that the Wassenaar Arrangement increased international arms trade; only, that there has been no noticeable affect [sic] on the size of weapon imports according to these data sets. Proponents of the [Wassenaar Arrangement] regime point to the fact that there have not been any instances

165. *The Wassenaar Arrangement at a Glance*, *supra* note 161.

166. *Id.*

167. *Id.*

168. *Id.*

169. Austin Lewis, *The Effectiveness of the Wassenaar Arrangement as the Non-Proliferation Regime for Conventional Weapons* 51 (May 2015) (B.A. Thesis, Stanford University), <https://stacks.stanford.edu/file/druid:mz349xm4602/The%20Effectiveness%20of%20the%20Wassenaar%20Arrangement%20as%20the%20Non-proliferation%20Regime%20for%20Conventional%20Weapons%20-%20Austin%20Lewis.pdf>.

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*similar to Iraq's invasion of Kuwait, indicating the absence of destabilizing accumulations of weapons.*¹⁷⁰

Russia's reinvasion of Ukraine on February 24, 2022 provides a subsequent, similar example with an exclamation point. Russia being a member of the Wassenaar Arrangement, along with the Arrangement's voluntary nature—it is an arrangement, not a treaty—makes clear the arrangement's current, grave inadequacy for the present task of controlling semiconductor exports to our enemies and promoting the development of such technologies onshore and with our key allies. The U.S. needs to be part of a treaty, which by its own nature would be binding on its members, with each member having a veto right over other members' exports—like COCOM—of advanced semiconductors so no single country is disadvantaged by other countries taking advantage of sales lost by the country seeking to limit exports of certain semiconductor technologies or materials to China.

Russia's 2022 reinvasion of Ukraine, and the extensive cooperation shown by NATO in responding to this attack, has opened up a political window for such a semiconductor export control treaty. While that window is open now, it will not remain open forever. For example, after his state visit to China in April 2023, French President Emmanuel Macron stated that Europe should not become a “vassal” of the U.S. and should instead eschew adopting American foreign policies in the conflict between the U.S. and China about Taiwan.¹⁷¹ While France is not a significant semiconductor country, Germany recently emerged as an example of a significant semiconductor country that is not aligned with U.S. policies regarding China. The 2023 Munich Security Conference, attended by the leading heads of state, security chiefs, and spies, took place in a five-star hotel with multiple telecommunication antennas in the area. “Some of these antennas, within 300 meters of the hotel, are equipped with hardware supplied by the controversial Chinese telecoms giant Huawei.... ‘If you look at the percentage of Chinese equipment in Germany, you could say it is the most unsafe country in Europe,’ said John Strand, founder of Strand Consult.” Strand quipped, “Welcome to the Munich Security Conference: We can't guarantee your security....”¹⁷² Thus, the need to act now.

170. *Id.* at 53.

171. Jennifer Rankin, *Macron Sparks Anger by Saying Europe Should Not Be 'Vassal' in US-China Clash*, *GUARDIAN* (Apr. 10, 2023, 11:04 AM), <https://www.theguardian.com/world/2023/apr/10/emmanuel-macron-sparks-anger-europe-vassal-us-china-clash>.

172. Louis Westendarp, et al., *Chinese Mobile Masts Loom over the Munich Security Conference*, *POLITICO* (Feb. 13, 2023, 9:41 PM), <https://www.politico.eu/article/munich-security-conference-huawei-mast-5g-germany/>.

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As previously mentioned, it only takes one or perhaps two countries to provide China with the means of overcoming the chokepoint semiconductor technologies. The proposed Wassenaar Treaty would prevent companies within the member countries from selling these critical-path semiconductor technologies to China and the other hostile powers. As the war in the Ukraine drags on, and political and military fortunes shift, the window may start to close.

The threat posed by China using military force to bring Taiwan to heel has been extensively researched. It was even recently demonstrated by China's de facto, temporary, and partial blockade of Taiwan during the first week of August 2022, in response to then U.S. House Speaker Nancy Pelosi's high-level trip to Taipei.¹⁷³ I will not set out the conclusions of such research here except to quote the two most widely cited U.S. military officers to comment on the timeline of such an event:

In an exclusive interview with Japan's Kyodo News on Monday (Dec. 20[, 2021]), Philipp Davidson, a four-star admiral and former commander of the U.S. Indo-Pacific Command, reiterated his concern that China may try to take Taiwan by force within the next six years. In March, Davidson said China is the biggest strategic threat to the U.S. and is accelerating its efforts to replace the country as a global superpower. He also predicted Beijing may attack Taiwan within the next six years.... Davidson told Kyodo that when he said that China would use force within the next six years, it not only included the possibility of a full-scale amphibious assault on the island of Taiwan but also could entail the People's Liberation Army (PLA) using a missile bombardment or a naval blockade of the country. "I believe the next six years is going to be a very worrying time for Taiwan, the U.S., Japan, and all of East Asia," he says. "I still believe that now."¹⁷⁴

Arguing for even a shorter timeframe than the Davidson Window, Gen. Michael A. Minihan, head of Air Mobility Command, has predicted that

173. Stuart Lau, *China Direct: Taiwan Crisis – 4-Day De Facto Blockade – G7 Slam Drills*, POLITICO (Aug. 4, 2022, 11:00 AM), <https://www.politico.eu/newsletter/china-watcher/taiwan-crisis-4-day-de-facto-blockade-g7-slam-drills/>.

174. Liam Gibson, *Former US Admiral Clarifies 'China Attacking Taiwan Within Six Years' Statement*, TAIWAN TIMES (Dec. 22, 2021, 2:32 PM), <https://www.taiwannews.com.tw/en/news/4385080>.

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the U.S. will be at war with China in 2025.¹⁷⁵ The DoD has said his prediction is not representative of its view on China. Even if the two-to-six-year prediction is only directionally correct, there is precious little time for the proposed members of the Semi Allies Group to both negotiate and accede to a semiconductor export control treaty.

4. The Benefits of a Semiconductor Treaty Structure

The recommendation of building upon the Wassenaar Arrangement increases the likelihood of a speedier adoption of such a treaty because most of the proposed treaty members would be starting from a known administrative quantity. Equally important, the export control laws of the Semi Allies Group ex-U.S. are consistent with such an arrangement. They would not require the extensive retooling necessary if they were modeled on the U.S. export control regime—which is not politically possible. Furthermore, building upon the Wassenaar Arrangement would also allow its goal of transparency to be used to enable each member of the semiconductor export control treaty to challenge the exports of its members that are believed not to follow the treaty terms. While it is likely that each member of the treaty would have greater reason for its own administration of export controls to minimize legerdemain because it will have participated in the creation of these controls, such chicanery will not be eliminated entirely. A treaty structure enables for such gamesmanship to be challenged by other members, which is simply not a possibility otherwise.

As previously mentioned, the U.S.'s current policy of enacting ever more stringent export controls on its domestic companies from selling in China, supplemented by leaning on other key countries to block similar exports from their domestic manufacturers, is quite suboptimal for U.S. domestic semiconductor businesses. They have no assurance that the U.S. will be persuasive enough to stop competing foreign companies from selling to China, especially those countries such as Germany, the Netherlands, South Korea, Japan, and Taiwan, whose economies are export-driven. U.S. semiconductor businesses should support this multilateral treaty approach because if they are prohibited from exporting a particular semiconductor technology to China, all of their main competitors will be equally prohibited.

In order to further encourage semiconductor industry participants to support this treaty, and to increase the chances that an entire

175. Dan Lamothe, *U.S. General Warns Troops That War with China is Possible in Two Years*, WASH. POST (Jan. 27, 2023, 10:42 PM), <https://www.washingtonpost.com/national-security/2023/01/27/us-general-minihan-china-war-2025/>.

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semiconductor supply chain will migrate, develop, and remain among the industry members of the treaty's signatory countries, the treaty should ensure that all members are playing by the same set of semiconductor export control rules so that individual semiconductor companies within the Semi Allies Group are not disadvantaged, as they are now, if their competitors can take away their market share in China, because their country did not voluntarily accept the favored export control regulations adopted by the U.S. The entire U.S. semiconductor industry will support such an approach because it has already been voicing deep concerns about its foreign competitors not being subject to such export control regulations. This is especially true because they derive so much revenue from China to support their extremely large R&D expenditures.¹⁷⁶ Billions in lost revenue are at stake.¹⁷⁷

While the incentive for the U.S. to support such a multilateral treaty approach is clear, the other members of the Semi Allies Group will have a different reason for supporting such an approach. They currently have no influence on BIS's development of its export control regulations, as most recently demonstrated by the unilateral development by BIS of the October 7 Export Controls. As expected, one of the retorts by the other members of this semiconductor group to the U.S. is that they were not involved in the creation of the October 7 Export Controls, so they do not feel compelled to adopt them in part or in total. A multilateral treaty governing semiconductor product export among the members of the Semi Allies Group would provide these countries, and their local semiconductor industry, with the exact influence they are currently demanding.

The risks to our national security of the unilateral October 7 Export Controls, lacking support of a multilateral treaty, can be seen by the decimation of our domestic satellite industry, which started in the 1990s because of unilateral export controls. In discussing U.S. export control policy, one commentator succinctly summarized what happened. "[I]n response to concerns about technology transfer benefitting the Chinese missile development program, the U.S. government in 1999 unilaterally moved satellites from the Commerce Control List under BIS to the U.S. Munitions List under the State Department, thereby changing the export

176. Ian King & Jenny Leonard, *US Chip-Gear Makers Told to Wait for Relief from China Curbs*, BLOOMBERG (Nov. 4, 2022, 4:59 PM), <https://www.bloomberg.com/news/articles/2022-11-03/us-chipmaking-gear-makers-told-to-wait-for-relief-on-china-curbs>.

177. *Id.*

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control classification of satellites from dual-use to munitions.”¹⁷⁸ The commentator further stated:

*In unilaterally moving satellites from the CCL to the U.S. Munitions List, the U.S. government inadvertently destroyed the competitiveness of the U.S. satellite industry. The U.S. share of worldwide satellite exports decreased from 73 percent in 1995 before the policy change in 1999, to just 25 percent in 2005. In 2014, BIS estimated that the U.S. satellite industry lost between \$988 million and \$2 billion in foreign sales between 2009 and 2012 due to export controls. To add insult to injury, a 2020 report from [the U.S.-China Economic and Security Review] Commission argued that China has now emerged as a leading player in space technologies despite U.S. efforts, partly due to a domestic push to indigenize space R&D capabilities.*¹⁷⁹

We are now at one of those pivotal moments and need to get this right more than ever. We may never be in a position to recover from a misjudgment if we do not respond effectively to this critical national security challenge. If we do not get semiconductors right, we have no hope of limiting the advances by hostile states of the advanced technologies built upon semiconductors previously mentioned.

V. THE PROPOSED SEMICONDUCTOR TREATY DESCRIBED

A. Building upon the Wassenaar Arrangement

I propose that the Semi Allies Group should use the existing infrastructure of the Wassenaar Arrangement with significant changes to address its current shortcomings. I make this suggestion because there is no advantage to reinventing the existing export control infrastructure, and time is of the essence. By way of example, I propose that pre-existing protocols, experts, bureaucratic structures, geographic locations of sector meetings, etc. of the Wassenaar Arrangement would all be used. In addition, pre-existing semiconductor export control terminology, and existing regulations, would be used as the basis for creating export control regulations that must on a mandatory basis be complied with by each member.

178. *Testimony before the U.S.-China Economic and Security Review Commission: Hearing on “Challenges from Chinese Policy in 2022: Zero-Covid, Ukraine, and Pacific Diplomacy*, 117th Cong. n.20 (2022) (statement of Emily S. Weinstein, Research Fellow, Georgetown University), https://www.uscc.gov/sites/default/files/2022-08/Emily_Weinstein_Testimony.pdf.

179. *Id.* at 15-16 (citation omitted).

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1. The Key Differences in the Proposed Treaty

I propose resuscitating the portion of the Wassenaar Arrangement dealing with semiconductor articles by fundamentally converting it from a voluntary association, where each member of the arrangement could either accept or reject export control proposals, to that of a treaty that binds its members. If treaty members pass resolutions prohibiting the export of certain semiconductor articles as a way to mitigate military threat risk, all members are bound to comply with such prohibitions.

In addition, each member would have a veto right to block proposed exports to a designated country by another member. While certainly quite controversial, this right is a critical difference and component to making the Wassenaar Treaty successful. It would provide the teeth needed to ensure that the countries most determined to militarily challenge the Semi Allies Group will not have the ability to directly import advanced semiconductors, or obtain them through illicit transshipments, i.e., the transfer of products from their place of origin through an intermediary country to an unauthorized final destination.

Unlike the Wassenaar Arrangement, which was not focused on specific countries, the Wassenaar Treaty that I propose would be focused on countries most militarily threatening to the Semi Allies Group: China, Russia, Iran, and North Korea, with the purpose of blocking critical semiconductor technologies from being exported to these adversaries. Currently, such critical semiconductor technologies include advanced materials, electronic design automation software, advanced semiconductor manufacturing equipment, and licenses to chip design intellectual property.¹⁸⁰

The Wassenaar Treaty should initially be focused on one technical sector, semiconductors, instead of the wide range of technical sectors under the purview of the Wassenaar Arrangement. Semiconductors are not simply another important technology or even a “first among equals” technology. Semiconductors are alone in a class of the first order because they undergird all other advanced technologies. If the initial semiconductor export control treaty is successful, other advanced military and dual-use technologies (e.g., military hypersonic missiles and drones, 6G telecommunications, quantum computers, artificial intelligence, robotics, and biotech) should be considered for subsequent inclusion through further treaty amendments.

In addition, the Wassenaar Treaty should be self-executing for several reasons. First, this means no national implementing legislation is required for it to come into force, but instead, it automatically becomes

180. KHAN, *supra* note 160.

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effective as domestic law upon entry into force.¹⁸¹ Second, national legislation across each member state would likely take significant time and could cause relevant domestic semiconductor companies to lose billions of dollars in domestic sales, leading to slow, or no, implementation of the Wassenaar Treaty export controls. As previously mentioned, during this likely long delay in implementing legislation, China will, as they have done in the past, accelerate buying from whatever open stores that may be closed by Treaty adoption.

Second, consistency in the implementation of each export control decision under the Wassenaar Treaty is decidedly important so that there will be no differences in the effective legislation in each member state because they do not have to pass implementing legislation to make an export control decision effective. The lobbying by the relevant semiconductor industry members to protect their businesses from being cut off from the Chinese market will be intense and will inevitably result in differences in the implementing legislation, which China will exploit to the fullest.

Finally, with the exception of the U.S., many of the member states of the Wassenaar Treaty are forced to rely upon “catchall” domestic legislation to enact export control laws because the regulations currently promulgated in the U.S.’s October 7 Export Controls go well beyond the export control regime strictures of these other members, which require their export controls to be related to weapons of mass destruction, nonproliferation, and arms embargo objectives.¹⁸² The U.S.’s October 7 Export Controls do not have such limitations and thus are substantially broader in scope. A self-executing Wassenaar Treaty would immediately provide the legislative authority for all member states to follow the more expansive approach demonstrated by the U.S. in its October 7 Export Controls.

B. A Voluntary Trade Association Will Not Work as an Alternative

The semiconductor industry needs to adapt now to the coming dramatic changes resulting from China’s resolute revanchist commitment to regaining political control over Taiwan and supplanting the Semi Allies Group’s economic order. Some U.S. semiconductor equipment manufacturers believe that a voluntary trade association would fulfill the U.S.’s objective of suppressing China’s semiconductor development while causing minimal harm to its own industry. In particular, U.S. Semiconductors Equipment Manufacturers (“SEM”) started Semiconductors in America Coalition (“SIAC”), to identify workable export controls under which less

181. See CONG. RSCH. SERV. *supra* note 1, for an explanatory summary of self-executing treaties.

182. WOLF, *supra* note 153; WEINSTEIN, *supra* note 178, at 12.

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advanced equipment not used in leading-edge manufacturing may be sold to China, while prohibiting the sale of more advanced equipment. This proposal hinges on getting U.S. allies Japan and the Netherlands to implement similar export controls, especially Tokyo Electron Ltd. and ASML, respectively.¹⁸³ Whether the voluntary association is an arrangement like the Wassenaar Arrangement, or a voluntary trade group, it will not matter. The voluntary nature of the association means it will fail in this context because the economic self-interest of each member will be too strong and override the collective good of all members. Consequently, even if Japan and the Netherlands were to join SIAC, it would fail, just like the Wassenaar Arrangement did, because of this economic self-interest.

C. A Successful Wassenaar Treaty Can Be a Springboard for Other Concerns

Coordinating effective export controls of semiconductors among the Semi Allies Group, if successful under the proposed Wassenaar Treaty, could pave the way for inclusion of other critical aspects of the global trade in semiconductors. The Biden Administration has stated it is seeking to coordinate the subsidies undergirding certain members of the Semi Allies Group's industrial policies to promote domestic semiconductor manufacturing so that these efforts do not become counterproductive by leading to production overruns or overlapping government investments.¹⁸⁴ Such subsidy coordination, which would, of necessity, lead to greater interdependence among the Semi Allies Group, could also become an additional topic to be addressed by the Semi Allies Group as part of the treaty.

In addition, on August 9, 2023, the Biden Administration issued an executive order instructing the Treasury to issue regulations prohibiting American investment in certain advanced technologies, including semiconductors, in China that would advance their military.¹⁸⁵ Again, there will also be a need for multilateral, coordinated restrictions on outbound investments in China among the Semi Allies Group, so that U.S. private equity or venture capital are not singularly disadvantaged, because VC and PE shops in the other member countries are still permitted to invest. This could become yet another topic for the Semi Allies Group to coordinate under this treaty.

183. KING & LEONARD, *supra* note 176.

184. Sohn, *supra* note 7.

185. Proclamation No. 155, 88 Fed. Reg. 54961 (Aug. 11, 2023).

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Finally, other semiconductor-related topics, such as inclusion of chemicals used to manufacture semiconductors, could be added if they are deemed helpful in shutting down the advanced semiconductor sector in the countries of concern.

CONCLUSION

The Semi Allies Group is at a unique moment in time because of Russia's invasion of Ukraine and China's unyielding and multifaceted political, military, economic, and technological campaign against Taiwan's independence. The surprisingly extensive coordination and cooperation in NATO's response to Russia's invasion of Ukraine is a clear sign that the political window is open for multilateral cooperation on military matters. Most critically, Germany has abandoned its decades-long policy of "Wandel durch Handel" (German for change through trade): its policy of supporting economic trade with the goal of politically changing authoritarian countries like Russia, which would have been considered unthinkable only last year.¹⁸⁶ Independent of the Russian reinvasion of Ukraine, the creation of the Quad to bolster regional defenses against China's expansionism, especially against Taiwan particularly and in Southeast Asia generally, has opened up a second window in Asia. There really is no other viable option other than a treaty because the U.S.' "go it alone" approach, and the voluntary associations, have both comprehensively failed. Given the semiconductor industry is an extremely complex and critical industry sector, the Wassenaar Treaty should follow the single-topic approach of most other U.S. treaties and focus on just this one issue.

The U.S. has had decades of missed semiconductor opportunities as the industry became global. If this pivotal opportunity is missed, the results will be catastrophic from a national security perspective. The list of the many types of treaties mentioned at the beginning of this essay all address important transnational matters. Semiconductors are at least as important, if not more important, than many of the topics addressed, because of both the very real economic and military challenges the U.S. will face if left unaddressed.

Perceptions of national security risks will never be completely aligned among the Semi Allies Group, but they are more aligned now than ever before. That global political window is currently open. The bipartisan nature of the Chips and Science Act demonstrates the domestic political

186. Joseph C. Sternberg, *With Friends Like Putin, Xi May Lose Europe*, WALL ST. J. (May 5, 2022), <https://www.wsj.com/articles/with-friends-like-putin-xi-may-lose-europe-china-germany-russia-ukraine-invasion-foreign-policy-japan-scholz-11651759600>.

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window may also be open on the topic of semiconductors and regimes hostile to the U.S., like China. Concern about China's takeover threat of Taiwan in particular is a rare spot of bipartisanship. The two-thirds vote for the adoption of a Wassenaar Treaty by the U.S. Senate will nevertheless be a challenge, requiring significant political will, even though it is such an important national security matter. Rather than analyzing all the different reasons why a Wassenaar Treaty is politically impossible, and thus not worth pursuing, we should take Seneca's aphorism quoted at the beginning of this article seriously, and instead figure out how to get the Wassenaar Treaty done, just like the U.S.-Japan semiconductor treaty in 1986, which opened the Japanese market to U.S. semiconductors.

China's attempt at political control over Taiwan through grey-zone tactics has already started, and additional non-military tactics and military actions are likely, not an "if," but a "when." We are unprepared for that "when" regarding the export of the keystone technology of semiconductors. China is learning from the sanctions being placed against Russia because of its invasion of Ukraine. Will the Semi Allies Group make the same mistake of waiting for China to take over Taiwan, as the Western oil and gas industry did after Russia invaded and annexed parts of Ukraine in 2014? The Semi Allies Group cannot afford to get this wrong. It is not a mystery as to what needs to be done. The challenge ahead is clear. The time to act is now, before the global and domestic political windows close.