SEPTEMBER 2023

The Post-October 7 World

International Perspectives on Semiconductors and Geopolitics

EDITOR

Gregory C. Allen

CONTRIBUTORS

Wonho Yeon
Julian Ringhof
Jan-Peter Kleinhans
Kazuto Suzuki
Rem Korteweg
Chau-Chyun Chang
Francesca Ghiretti
Antonia Hmaidi
Emily Benson
Catharine Mouradian

A Report of the CSIS Wadhwani Center for AI and Advanced Technologies

CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

SEPTEMBER 2023

The Post-October 7 World

International Perspectives on Semiconductors and Geopolitics

EDITOR

Gregory C. Allen

CONTRIBUTORS

Wonho Yeon
Julian Ringhof
Jan-Peter Kleinhans
Kazuto Suzuki
Rem Korteweg
Chau-Chyun Chang
Francesca Ghiretti
Antonia Hmaidi
Emily Benson
Catharine Mouradian

A Report of the CSIS Wadhwani Center for AI and Advanced Technologies

CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

About CSIS

The Center for Strategic and International Studies (CSIS) is a bipartisan, nonprofit policy research organization dedicated to advancing practical ideas to address the world's greatest challenges.

Thomas J. Pritzker was named chairman of the CSIS Board of Trustees in 2015, succeeding former U.S. senator Sam Nunn (D-GA). Founded in 1962, CSIS is led by John J. Hamre, who has served as president and chief executive officer since 2000.

CSIS's purpose is to define the future of national security. We are guided by a distinct set of values—nonpartisanship, independent thought, innovative thinking, cross-disciplinary scholarship, integrity and professionalism, and talent development. CSIS's values work in concert toward the goal of making real-world impact.

CSIS scholars bring their policy expertise, judgment, and robust networks to their research, analysis, and recommendations. We organize conferences, publish, lecture, and make media appearances that aim to increase the knowledge, awareness, and salience of policy issues with relevant stakeholders and the interested public.

CSIS has impact when our research helps to inform the decisionmaking of key policymakers and the thinking of key influencers. We work toward a vision of a safer and more prosperous world.

CSIS does not take specific policy positions; accordingly, all views expressed herein should be understood to be solely those of the author(s).

© 2023 by the Center for Strategic and International Studies. All rights reserved.

Center for Strategic & International Studies
1616 Rhode Island Avenue, NW
Washington, DC 20036
202-887-0200 | www.csis.org

Acknowledgments

This compendium is part of a year-long collaborative effort between multiple programs at CSIS on multilateral technology and economic security cooperation. I would like to thank my current and former colleagues across the Wadhwani Center, the Trade and Technology Project, the Economics Program, and the Scholl Chair in International Business for their support. I am grateful to each of the authors for their participation in this project, and after reading their work, I am confident that readers will be as well.

This report was made possible by the generous support of the CSIS Strategic Investment Fund as well as the Survival and Flourishing Fund.

Contents

Foreword | The Importance of Understanding Allied Perspectives 1
Gregory C. Allen

South Korean Perspective | South Korea Needs Increased (but Quiet) Export Control Coordination with the United States 3
Wonho Yeon

German Perspective | A German Foreign Policy and Export Control Overhaul Is Underway 12
Julian Ringhof and Jan-Peter Kleinhans

Japanese Perspective | Japan Embraces Its Strategic Indispensability in Alliance with the United States 19
Kazuto Suzuki

Dutch Perspective | How the Netherlands Followed Washington's October 7 Export Restrictions 25
Rem Korteweg

Taiwanese Perspective | Geopolitical Challenges Should Not Dilute Taiwan's Focus on Mastering Advanced Technologies and Critical Applications 33
Chau-Chyun Chang

European Union Perspective | Current EU Regulations Struggle to Adapt to a Post-October 7 World 41
Francesca Ghiretti and Antonia Hmaidi

United States Perspective | Export Controls as an Instrument of Foreign Policy 48
Emily Benson and Catharine Mouradian

About the Authors 56

Related Works 59

Endnotes 60

Foreword

The Importance of Understanding Allied Perspectives

By Gregory C. Allen

October 7, 2022, was a turning point in the history of U.S.-China relations. On that day, the United States enacted a new set of export controls designed to choke off China's access to the future of military artificial intelligence (AI) capabilities. In doing so, the October 7 regulations marked a reversal of nearly three decades of U.S. trade and technology policy toward China in at least two ways: First, rather than restricting exports to China on an end-use or end-user basis, the new regulations included many controls that applied to China as a whole. Second, the policy sought to degrade the peak technological capability of China's AI and semiconductor industries. Fifteen years ago, such measures would have been almost unthinkable.

Though the end target of the October 7 export controls was China's military AI development, the means to that end was restricting U.S. exports of advanced semiconductor technology. As such, October 7 marks not only a turning point in geopolitical history, but also a turning point for the global semiconductor industry and the countries at the center of semiconductor value chains.

Today, semiconductors are vital inputs not only to datacenters and smartphones, but also to cars, critical infrastructure, military systems, and even household appliances like washing machines. As the global economy has become more and more digitized, it has also grown more and more dependent upon chips. It is for good reason that national security experts routinely declare semiconductors to be "the new oil" when it comes to geopolitics and international security.

The United States is the overall leader in the global semiconductor industry, but other U.S. allies—particularly Japan, the Netherlands, Taiwan, South Korea, and Germany—also play critical roles. If other countries fill the gaps in the Chinese market left by the October 7 regulations, then the policy will most likely backfire. U.S. companies could suffer a huge loss of market share and revenue in China and in return for only a fleeting national security benefit.

Thus, the long-term success of the U.S. policy depends upon the actions of the governments in those other key countries. This was the inspiration behind this compendium of essays. Much has been written about the October 7 export controls in the United States, but too often the U.S. conversation suffers from a shortage of international perspectives, as well as a minimal understanding of the political and policy dynamics within those key U.S. allies.

This compendium seeks to address that shortage. The Wadhwani Center for AI and Advanced Technologies at CSIS has assembled a distinguished group of international experts who have a rich understanding of both the global semiconductor industry and its geopolitical dimensions. Each of their essays provides an overview of the situation facing their home country or region in the post-October 7 era.

South Korean Perspective

South Korea Needs Increased (but Quiet) Export Control Coordination with the United States

By Wonho Yeon

U.S.-China Strategic Competition and U.S. China Policy

Economic security can be defined as protecting a nation from external economic threats or risks. Response to military threats or dangers is the domain of traditional security, while economic security is about protecting a country's economic survival and future competitiveness. Disruption of supply chains threatens the survival of a country, while the fostering of advanced technology determines future competitiveness. Thus, economic security strategy mainly deals with supply chain policies and advanced technology policies as core fields.[1]

The goals of U.S. economic security policy are clear: to manage risk from China. In terms of supply chain resilience, it is about reducing dependence on China for critical goods, and in terms of the maintaining high-tech supremacy, it is about containing China's rise. This view consistently appears in speeches and white papers including Secretary of State Antony J. Blinken's May 2022 speech titled "The Biden Administration's Approach to the People's Republic of China," the White House's *National Security Strategy* released in October 2022 and National Security Advisor Jake Sullivan's April 2023 speech at the Brookings Institution.[2]

The strategic approach of the Biden administration toward China can be summarized as "invest," "align," and "compete." "Invest" means strengthening domestic production capabilities by investing in key items with high supply chain vulnerabilities. The Biden administration also emphasizes "solidarity" with friendly nations. Ultimately, the goal is to build a strong and resilient high-tech industrial base that both the United States and like-minded partners can invest in and rely on. "Compete" refers to realizing the American vision and maintaining a competitive edge over China, which challenges the U.S.-led order. Specifically, the Trump administration's bipartisan export control, import control, and investment screening policies are designed to keep China in check as a competitor and simultaneously strengthen efforts to create a new, transparent, and fair international economic partnership for a changing world.

In 2023, the United States began using the new phrase "de-risking" to describe its policy toward China. However, the U.S. government's use of de-risking refers to China risk management in the broadest sense and does not imply a specific change in U.S. policy toward China. Diversification, selective decoupling, and full decoupling are all possible means of de-risking, and the United States has adopted a policy of selective decoupling. This can be read literally in the phrase "small yard, high fence" that National Security Advisor Sullivan emphasizes at every speech. The idea is to block Chinese access in selective areas.

As evidence of this, the United States has been building a high fence against China in certain areas. In particular, the United States is no longer willing to tolerate China's rise in the high-tech sector. In a speech at the Special Competitive Studies Project Global Emerging Technologies Summit on September 16, 2022, Sullivan pointed out that the strategy of maintaining a certain gap with China is no longer valid and emphasized that the United States considers it a national security priority to widen the gap with China in certain science and technology fields as much as possible. Specifically, he mentioned computing-related technologies, biotechnology, and clean technology, but he also noted the strategic use of export controls.[3] Indeed, the prevailing view among U.S. industry is that Sullivan's statement guides current export controls.

Semiconductors, A Key Item for Economic Security

One of the defining features of the international order in 2023 is the strategic competition between the United States and China over economic security. Moreover, as Secretary of State Blinken noted in an October 2022 speech at Stanford University, technology is at the heart of U.S.-China strategic competition. China's rapid technological advancement has kept the United States on guard, and despite the various measures taken to date to keep China in check, the United States recognizes that China's technological strengths pose a threat to U.S. national interests. For example, *The Great Tech Rivalry: China vs. the U.S.*, published in December 2021 by the Belfer Center at Harvard University, with experts including Graham Allison, raises the possibility that China could overtake the United States in foundational technologies such as artificial intelligence (AI), 5G, quantum communications, semiconductors, biotechnology, and green energy in the next decade.[4]

Semiconductors are core components and a key enabler for these critical, emerging, and foundational technologies. Semiconductors are the quintessential dual-use product and have become one of the most important strategic assets for economic and national security. They enable nearly all modern industrial and military systems, including smartphones, aircraft, weapons systems, the internet, and the power grid. Furthermore, semiconductors are at the heart of all emerging technologies, including AI, quantum computing, the Internet of Things, autonomous systems, and advanced robotics, which will power critical defense systems as well as determine economic competitiveness. Therefore, it is no exaggeration to say that the country that leads the world in advanced semiconductor research and development (R&D), design, and manufacturing will determine the direction of global hegemony. China's efforts to develop all parts of the semiconductor supply chain are unprecedented in scope and scale. This is why there is bipartisan support for the United States to revitalize advanced semiconductor manufacturing and research as well as to maintain an advantage over China.

Characteristics of the Semiconductor Industry and Its Importance to the South Korean Economy

Phrases such as "oil of the twenty-first century," "twenty-first century horseshoe nail," and "heart of industry" have all been used to describe the importance of semiconductors. A range of recent activity also serves to demonstrate this importance, including the shortage of automotive semiconductors; the U.S. government's

100-day supply chain review report; the demand for supply chain information from semiconductor companies; decisions by the Taiwan Semiconductor Manufacturing Company (TSMC) and Samsung to invest in foundries in the United States; Japan's hosting of a TSMC fab and the launch of the Rapidus project; the U.S.-China conflict over Dutch company ASML's extreme ultraviolet (EUV) lithography equipment; President Biden's visit to the Samsung semiconductor plant in South Korea; and the launch of the South Korea-U.S.-Japan-Taiwan FAB4 consultation. The interest in reorganizing the global semiconductor supply chain has never been greater.

Making a single semiconductor chip typically requires a production process that spans four countries.[5] The three main parts of the semiconductor production process are design, manufacturing, and assembly, test, and packaging (ATP). Ninety percent of the value added in semiconductors occurs equally in the design and manufacturing stages, with 10 percent added in the ATP stage.[6] In semiconductor manufacturing, where South Korea is particularly strong, there are three types of companies: integrated device manufacturers (IDMs) that do both design and manufacturing in-house, fabless companies that do only design, and foundries that do only contract manufacturing. IDMs are overwhelmingly strong in the memory market, while fabless companies and foundries are dominant in the system semiconductor market.

As new generations of semiconductors become smaller and more integrated, the complexity and cost of production increases, leaving only a few companies capable of continuous technological improvement. The memory chip manufacturing market has become an oligopoly, and the division of labor between design and manufacturing has accelerated in the system semiconductor market. The surging demand for semiconductors has led to a geographic spread of demand across the globe, while suppliers have become concentrated in specific countries and regions.

The concentration of the semiconductor supply chain is recognized as a risk. Major countries have recognized semiconductors, which are used in all high-tech devices, as a strategic asset and are competing fiercely to secure their domestic semiconductor technology and manufacturing base as part of their economic security. The United States has a strategy to raise its domestic production capacity as a proportion of global capacity to 30 percent from 12 percent through funding worth $52.7 billion over the next five years, while China is implementing a strategy to localize semiconductor production through full tax support and a national semiconductor fund.[7] Elsewhere, Europe is planning to increase its share of global production to 20 percent by 2030 from the current 9 percent; Japan is strengthening its domestic manufacturing capabilities by attracting Taiwanese foundry TSMC and launching the Rapidus project, a 2-nanometer (nm) foundry; and Taiwan has established an Angstrom (Å) strategy for pre-empting sub-1 nm semiconductors as a consolidation strategy.[8]

South Korea ranks second in global semiconductor production and first in memory production, and the semiconductor industry serves as a core sector, leading the national economy in various fields such as exports and investment.[9] In particular, South Korea's semiconductor manufacturing capacity is 80 percent domestic and 20 percent overseas, generating most of the production and value added within the country and accounting for about 20 percent of total exports.[10] In 2021, a particularly active year for investment, the industry generated KRW 52 trillion ($39.0 billion) in investment, accounting for about 55 percent of the country's total manufacturing capital expenditure.[11] In line with this, the government has strengthened the foundation for semiconductor growth by enacting a special law to protect and foster national high-tech strategic industries centered on semiconductors in August 2022; announced a $25 billion mega-cluster project in March 2023; and announced a semiconductor future technology roadmap in April 2023, declaring its intention to foster 45 core semiconductor technologies.[12]

Strengthening U.S. Checks on China's Semiconductor Industry

Fundamentally, the South Korean government and semiconductor companies recognize that the demand for semiconductors will increase in the long term as the digital and green transformations accelerate, which will ultimately create opportunities for the South Korean economy. At the same time, however, the U.S. government's tightening of sanctions against China poses a major risk to South Korea's semiconductor industry.

There have been two turning points in the U.S. government's sanctions against China's semiconductor industry. The first turning point was the semiconductor sanctions against Huawei in 2020. After the enactment of the Export Control Reform Act and the Foreign Investment Risk Review Modernization Act in 2018, the United States focused its regulatory efforts on China's information and communications technology industry.[13] The main targets were two 5G-related companies, Huawei and ZTE. In May and August 2020, the United States imposed semiconductor sanctions as part of its crackdown on Huawei. The U.S. Foreign Direct Product Rule prohibited any company from producing and providing semiconductors designed by Huawei and its subsidiary HiSilicon. Samsung and TSMC, for example, were directly affected by this measure and stopped doing semiconductor business with Huawei. Huawei, which held the top spot in terms global smartphone market share in 2020, has since all but exited the smartphone market due to a lack of access to advanced semiconductors. This made the U.S. government realize that China's weakness lies in the semiconductor sector. Since then, the U.S. government has tightened its grip on China's semiconductor industry through its own export control regulations, including on the Semiconductor Manufacturing International Corporation (SMIC) in 2020, supercomputing CPU developer Tianjin Phytium Information Technology in 2021, and Yangtze Memory Technologies (YMTC) and Shanghai Micro Electronics Equipment (SMEE) in 2022.[14]

The second turning point was a July 2022 TechInsights analysis about SMIC's production of 7 nm chips.[15] The article reported that SMIC had broken through the 10 nm barrier by incorporating multi-patterning technology using only older-generation deep ultraviolet (DUV) lithography equipment without using EUV equipment, which was already under export control. The U.S. government responded immediately. As testified by U.S. semiconductor equipment companies such as Applied Materials, LAM Research, and KLA, the U.S. government extended the existing export ban on manufacturing equipment related to sub-10-nm processes to sub-14 nm processes.[16] The report also seems to have prompted the United States to abandon its previous strategy of maintaining a two-generation technology gap with China in semiconductors and instead think about widening the gap as much as possible. In August 2022, shortly after the news of SMIC's breakthrough, President Biden signed the CHIPS and Science Act into law. One month later, National Security Advisor Jake Sullivan gave a speech in which he stated that, for some technologies the United States will no longer use sliding-scale dynamic controls but rather static controls that prevent China from acquiring technology beyond what it has already acquired.

While most of the U.S. actions have been aimed at stopping China from catching up in the advanced semiconductor technology, South Korean semiconductor factories in China have also been affected. For example, in 2019, the United States blocked China from importing ASML's EUV lithography equipment, which is needed to manufacture advanced logic semiconductors below the 10-nm technology node. While the target was probably Chinese foundry SMIC, SK Hynix, which produces DRAM memory semiconductors in China, was also banned in November 2021 from importing the EUV equipment needed to manufacture next-generation DRAM.

In recent years, the intensity of U.S. checks against China in the semiconductor sector has increased. Such restrictions are no longer limited to 10 nm advanced semiconductors but are beginning to resemble broader sanctions. A prime example is the CHIPS and Science Act, which took effect in early August 2022. The new law aims to inject $52.7 billion into the domestic semiconductor industry to encourage companies to build

and expand domestic manufacturing capacity, but one of its key provisions prohibits investments in China involving logic semiconductors below the 28 nm technology node for 10 years for companies that benefit from U.S.-government subsidies.[17] In the memory sector, the March 2023 release of a Notice of Proposed Rulemaking for national security guardrails also prohibits investments in NAND memory above 128 layers and DRAM memory below 18 nm. In order to extend the investment restrictions to all future semiconductors, the United States also defined "semiconductors critical to national security" for the first time. This includes compound semiconductors, photonic semiconductors, and semiconductors for quantum communications. In summary, the U.S. measures appear to have been designed to allow China to grow to the level of technology it has achieved, but not beyond. The Chinese government strongly criticized the legislation, calling it a product of a "Cold War approach with a zero-sum mentality."[18]

Another example is the United States' use of multilateral platforms. The United States also utilizes the Wassenaar Arrangement to contain China. On August 12, 2022, the U.S. Department of Commerce's Bureau of Industry and Security (BIS) added gallium oxide-diamond, used in ultra-wide bandgap semiconductors, and electronic CAD software for integrated circuit development to its list of export-controlled technologies. These technologies were included in the list agreed to at the December 2021 Wassenaar Arrangement meeting and are part of the U.S. strategic effort to contain China's advances in semiconductor technology. In addition, the United States is seeking to designate advanced etching equipment needed to manufacture advanced NAND memory chips as a strategic item through the Wassenaar Arrangement. If this equipment is designated as an export control item, Samsung and SK Hynix, which produce NAND memory in China, could be severely impacted in their ability to produce next-generation products.

In addition, the Netherlands and Japan have announced that they will impose export controls on DUV-related equipment in 2023, following persuasive efforts by the United States. If the equipment and materials needed for the sub-28 nm process, including DUV equipment, cannot be easily procured in China, South Korean semiconductor companies will no longer be able to manufacture semiconductors in China.

The U.S. Government's Technical Redline: South Korea's Perspectives on the October 7 Regulations

1. **How long can South Korea enjoy a reprieve from export controls?**

Given that China (including Hong Kong) accounts for 60 percent of South Korea's semiconductor exports each year, the most direct impact on the South Korean economy is the restrictions on the Chinese semiconductor industry announced by the BIS on October 7, 2022.[19] This measure includes three main parts: new export controls targeting semiconductors of certain performance levels and supercomputers containing these chips; new controls targeting the activities of U.S. persons supporting China's semiconductor development and equipment used to manufacture certain semiconductors; and measures to minimize the short-term disruptions of these measures on the supply chain.

The United States was concerned that the measures could impact the global semiconductor supply chain by causing immediate production disruptions for companies producing semiconductors in China. As a result, foreign companies producing semiconductors in China—Samsung, SK Hynix, and TSMC—were granted a one-year reprieve to utilize U.S.-made equipment and U.S. technicians.[20] In other words, how long South Korean companies can continue to operate semiconductor factories in China depends on how long they are able to get a reprieve from the October 7 regulations.

Given that granting the exception was a temporary action, it is not surprising that it could end at any time. No one knows for sure, but the clue may be found in Section 5949 of the United States' National Defense Authorization Act for Fiscal Year 2023.[21] This provision has two main parts. It prohibits certain Chinese semiconductor companies from participating in the U.S. government procurement market, and it also prohibits foreign companies whose products use certain Chinese chips as components from participating in the U.S. government procurement market.[22] However, the timetable for implementation of these provisions offers a hint as to when exceptions to the October 7 regulations will end.

Section 5949 first requires the Federal Acquisition Security Council to submit recommendations to minimize supply chain risks applicable to federal government procurement of semiconductor products and services, as well as suggestions for regulations implementing the restrictions, for which it provides a two-year window. Then, within three years, specific regulations must be written to prohibit Chinese semiconductor companies from participating in U.S. government procurement markets, with implementation to begin five years later.

In brief, whether and when the October 7 regulations are strictly enforced on South Korean fabs in China is likely to be tied to how the United States builds its diversification strategy and what specific rules it writes to reduce its dependence on China. In return, it will determine whether South Korean companies can continue to produce semiconductors in China. In the worst-case scenario, South Korea's semiconductor fabs in China will be forced to exit the country in three to five years when they need to upgrade their equipment.

2. Is the United States' technical redline likely to change?

South Korean companies are also interested in whether the U.S. technological redlines will change. As semiconductor technology advances, the definition of "high technology" changes. In fact, when the U.S. government enacted the CHIPS Act in August 2022, no memory-related technical redlines were announced, and in logic semiconductors alone, investments in Chinese production facilities below the 28-nm technology node are prohibited. On October 7, the BIS export control regulations set technical red lines for NAND memory above 128 layers, for DRAM below 18 nm, and for logic FinFET and GAAFET technologies.

Table 1: Technical Thresholds Released in Recent U.S. Acts and Regulations

	August 9, 2022	October 7, 2022	February 28, 2023	March 21, 2023
	CHIPS Act Guardrail	**October 7 BIS Regulations**	**CHIPS Act NOFO**	**CHIPS Act Guardrail**
NAND	N/A	≥ 128 layer	≥ 200 layer	≥ 128 layer
DRAM	N/A	≤ 18 nm half-pitch (1α)	≤ 13 nm half-pitch (1β)	≤ 18 nm half-pitch (1α)
Logic	< 28 nm	FinFET, GAAFET	< 5 nm	< 28 nm

Note: Leading-edge (5 nm ≤ current generation ≤ 28 nm; mature-node > 28 nm).
Source: Author's analysis.

With the release of the CHIPS Act Notice of Funding Opportunity on February 28, 2023, it was confirmed that the definition of leading-edge tech eligible for priority grant funding will be different than the red lines in the October 7, 2022, export control regulations. NAND memory was set to be above 200 layers, DRAM memory was set to be 13 nm or less, and logic semiconductors was set to be less than 5 nm.[23] Within the framework of U.S.-China strategic rivalry, this sparked optimism among South Korean companies on the potential revision of technological boundaries by the United States.

However, on March 21, 2023, when the CHIPS Act's Notice of Proposed Rulemaking for the national security guardrails was released, the technical red lines were once again reaffirmed at the same technical level set on October 7, 2022.[24] This was a clear confirmation that the United States currently has no plans to modify its technical thresholds aimed at curbing China's semiconductor industry in the foreseeable future, which led to disappointment among South Korean companies.

Conclusion

In general, South Korea holds a supportive stance regarding the United States' approach to China's semiconductor industry.[25] Semiconductor technology lies at the core of advanced and emerging technologies that can be converted to military use. Therefore, South Korea aligns itself with the U.S. endeavors to restrict the transfer of semiconductor technology to countries of concern.[26]

However, the perception of threats to economic security varies by country. Especially in the case of the semiconductor industry, where a clear division of roles exists, countries' economic security interests are bound to differ. In this regard, the United States, with its strength in design and equipment, and South Korea, with its strength in manufacturing, are bound to have different perspectives on semiconductor risk management.

In the short term, South Korean industry and policymakers broadly believe that the U.S. export control policies will delay the rise of Chinese semiconductor capabilities. For example, some analysts have reported that South Korea would have already been overtaken by China in the NAND memory sector without the recent U.S. export controls against China.[27]

However, South Korea also believes that if the current situation continues, companies will suffer greatly in the medium to long term. While South Korea and the United States share the same policy goals, it is more important for South Korea to consider China's strategy since it is directly exposed to Chinese competition in the memory chip market. China will continue to pursue an import substitution strategy and will strategically use indigenous products if the technology gap between foreign and indigenous products is not large. Thus, South Korea needs to widen the technology gap to the point where China cannot substitute imports with indigenous semiconductors. This is exactly the same objective as the United States' China strategy elaborated by National Security Advisor Sullivan. However, South Koreans are generally more concerned than Americans about losing a huge market that brings a steady cash flow that is also essential for R&D.[28]

China (including Hong Kong) currently accounts for 60 percent of global semiconductor consumption.[29] At the heart of this demand is the domestic electronic device manufacturing industry, which consumes most semiconductors. In this respect, neither the United States nor its allies can suddenly replace China. The United States has a number of world-class fabless companies, but China is ultimately the biggest consumer of the chips they sell. If China, which sees Western pressure as unfair, aggressively tries to replace its demand for semiconductors with homegrown semiconductors, companies such as Samsung and SK Hynix will not be able to secure stable cash flows, limiting their ability to invest in R&D and to reorganize their supply chains. Although the United States, Europe, and Japan have announced plans to support these companies in their market, the loss of the Chinese market cannot be offset by such subsidies.

South Korea wants close policy coordination with the United States. If the U.S. government's real goal is to get South Korean fabs out of China, the United States needs to support a gradual and managed exit while maintaining a certain level of sales in China. Exit planning needs to be a bilateral effort. It should be aligned with the U.S. and South Korean semiconductor strategies and be carefully prepared by calculating revenue

flows over time as well as accounting for global semiconductor market shocks. Both countries should also plan how to support the industry in the event of Chinese retaliation during the exit process.

South Korea also prefers to keep its discussions with the United States low-key. Since semiconductor export controls are being used as a key tool in strategic competition, they can easily get into the spotlight and could be used in domestic politics in both the United States and South Korea. They should not be readily used to stir up unnecessary anti-Chinese sentiment without understanding the semiconductor industry. In terms of being unobtrusive, South Korea favors a solution that utilizes existing U.S. regulations rather than a newly created device. One such measure is the Validated End User list. However, many experts are skeptical that the list can fundamentally outpace the October 7 regulations.

Interestingly, the United States' use of excessive China containment measures has acted as an incentive for South Korea to join U.S.-led plurilateral frameworks such as FAB4 or any potential iteration of the multilateral semiconductor export control regime. South Korea believes that a forum such as FAB4, if properly utilized, can help moderate the level of U.S. containment of China and ultimately minimize damage to South Korean semiconductor companies.[30] By participating as a key member of a group that brings together global semiconductor manufacturing powerhouses, South Korean input into important decisionmaking processes can reduce uncertainty for the South Korean semiconductor industry.

Following the release of the October 7 regulations, the United States accelerated discussions with the Netherlands and Japan to harmonize semiconductor equipment export control measures. In the first half of 2023, the Netherlands and Japan eventually tightened their semiconductor equipment export controls.[31] South Korea, one of the countries most affected by the measures, was not included in the discussions and was left in the dark about what decisions were being made. This should never happen again. As a key stakeholder in the semiconductor supply chain, South Korea should participate in export control discussions from the outset. South Korea needs to reduce uncertainty by making and implementing decisions together with its key partners, protecting not only its own technology but also that of its partners.

Simultaneously, South Korea should endeavor to ensure that the United States realizes that South Korean semiconductor firms in China solely produce memory chips, which are fundamentally different from logic chips. Logic semiconductors have both legacy and advanced semiconductors, and all of them are marketable depending on their usage. However, memory chips are not marketable unless they are advanced memory chips. If you cannot produce advanced memory in China, you cannot keep your factories operating in China. In addition, unlike most advanced logic semiconductors, such as AI chips, which are subject to export controls, the United States does not consider memory semiconductors to be subject to export controls. South Korea, however, will also have to think about how to fundamentally address the concern of technology leakage of advanced equipment from fabs in China.

Again, policymakers need to think about why the semiconductor industry has become oligopolized. This phenomenon happened not only in the semiconductor manufacturing industry but also in the semiconductor manufacturing equipment industry and the semiconductor components and materials industry. The answer is simple. Recent technological development requires an astronomical investment of money, and few companies can raise such funds. In other words, when seeking to widen the technology gap to guarantee a country's advantage, securing a stable flow of funds is as crucial as preventing technology leakage. South Korea thinks a balanced approach is needed for the United States to succeed in its China policy. The core of the U.S. and South Korean strategy should be to widen the technology gap through a combination of export controls and utilization of the Chinese market. The widening of the technological gap must be accomplished simultaneously

in two directions: by locking down Chinese capabilities and by developing advanced technologies. The United States should not only focus on export controls to close China's semiconductor production capacity but also figure out how to capitalize on the Chinese market, the world's largest consumer of semiconductors, at the same time.[32] Now is the time to find a win-win strategy between the United States and South Korea based on an accurate understanding of the semiconductor industry. In particular, it is important to keep in mind that even the slightest policy failure is unforgivable, given the ongoing dynamics of U.S.-China strategic competition.

German Perspective

A German Foreign Policy and Export Control Overhaul Is Underway

By Julian Ringhof and Jan-Peter Kleinhans

German foreign policy is going through a sea change. As a result of Russia's war against Ukraine and China's rise and increasing political assertiveness, Germany is reconfiguring its security and economic policies toward de-risking its ties with autocratic states and closing the ranks with its democratic allies. Since the country's semiconductor industry was hardly affected by the United States' October 7 export controls, the measures have triggered little debate in Germany. Nevertheless, Germany's export controls vis-à-vis China have already become more restrictive in recent years, and discussions on new approaches to German and European export controls are gaining momentum in Berlin and Brussels.

Germany's Ongoing Foreign Policy Rehaul and the Wandel of Wandel durch Handel

German foreign policy is going through a sea change—called a *Zeitenwende* by German chancellor Olaf Scholz in a February 2022 speech.[1]

The principal cause of this new era is the Russian war of aggression against Ukraine launched in 2022, which was a watershed moment for Germany in many ways. After decades of negligence, the war was a wake-up call for Germany to reinvest in its military and security partnerships. But beyond this remarkable shift in Germany's defense policy, the outbreak of the war and Putin's subsequent weaponization of Germany's fossil-fuel dependency on Russia was also a reckoning for Germany's perception of the interconnected relationship between its policies on economics, trade, foreign affairs, and national security.[2]

Prior to Russia's invasion of Ukraine, Germany's foreign policy dogma involved inducing beneficial political change in authoritarian regimes through increased trade—*Wandel durch Handel* ("change through trade").

After the invasion, a new foreign policy consensus emerged that this policy had not only failed, but backfired, threatening Germany's own economic security and stability. German foreign minister Annalena Baerbok said in August 2022 that Germany "must put an end to the self-deception that we ever received cheap gas from Russia. . . . We paid for Moscow's gas supply with security and independence," (author's translation).[3]

The war and its economic ramifications have fueled a reconfiguration of Germany's approach to the nexus between trade and security policy, driving efforts toward de-risking and diversifying Germany's trade relationships, particularly vis-à-vis autocratic states. Moreover, the war also has showed that both the European Union and its democratic allies are more capable than expected of acting cooperatively and decisively during security crises. The allied response has also showed that Western economic and technological strongholds are key assets to degrading the economic and military capacity of an aggressor through decisive and coordinated sanctions.[4]

Russia's invasion of Ukraine is the most significant cause of new thinking in German foreign policy, but it is far from the only one. The Covid-19 pandemic revealed that a lack of resilience and diversity in key supply chains, such as medical products or semiconductors for Germany's automotive industry, is a significant risk for economic and political stability. Additionally, the change in leadership in both Germany and the United States brought about a new era in U.S.-German relations. U.S.-German relations had suffered significantly during the Trump administration and were arguably at the lowest point in decades, but relations quickly improved once President Biden was elected. Even before the 2022 invasion of Ukraine, there was clear rapprochement between Germany and the United States. The compromise over the controversial Nord Stream 2 pipeline, struck in July 2021, while Angela Merkel was still chancellor, was a clear signifier of improving U.S.-German ties. [5]

However, from a German perspective, it is the Biden administration's handling of Russia's war and U.S. cooperation with Germany and key allies in response to the war that has had the most significant positive impact on U.S.-German relations. Close transatlantic cooperation in the development and enforcement of sanctions against Russia and Belarus, and even more importantly on weapons delivery to Ukraine, has fueled the rebuilding of trust and close cooperation.

In particular, the German government appreciates that the Biden administration has avoided public criticism of German decisions and has given Berlin some room for maneuvering even when decisions have been controversial and may have affected the United States, including Scholz's reluctance to deliver Leopard tanks to Ukraine unless the United States similarly contributed Abrams tanks.[6] Meanwhile, there is strong alignment on key security topics such as the conditions and timeline for Ukraine's NATO accession.[7] Although there is some fundamental skepticism toward certain U.S. hegemonic policies, as well as a residual level of distrust toward the United States across several parties and at the working level in German ministries, the U.S.-German relationship is arguably in the best shape of all of Germany's key relationships with allies at the moment. And crucially, beyond improved trust and closer cooperation on European security matters, there are also clear signs of greater alignment regarding China policies, exemplified by Germany's increasing military presence in the Indo-Pacific announced in June 2023 by German defense minister Boris Pistorius. More importantly, Germany's first China strategy, published in July 2023, shows a clear shift in Germany's China policy and a clear positioning of Germany on the U.S. side in the U.S.-China rivalry.[8] The policy states that, "Germany's security is founded on . . . the further strengthening of the transatlantic alliance . . . and our close partnership, based on mutual trust, with the United States. China's antagonistic relationship with the United States runs counter to these interests."[9]

Germany's view on China, also long characterized by the *Wandel durch Handel* dogma under various Merkel governments, had already evolved toward greater skepticism during the later parts of Merkel's reign. The Chinese

acquisition of German robotics leader Kuka in 2015 led to growing awareness and concerns in German politics about Beijing's ambitions to become the global powerhouse of future technologies.[10] As a result, Berlin pushed the European Commission to launch an EU-wide investment screening mechanism, which was then introduced in the European Union in 2019.[11] Also in 2019, the Federation of German Industries called upon Germany and the European Union "to counter problems with the state-dominated Chinese economy" and first coined the language that China represented both "a partner and systemic competitor" to Germany and Europe.[12]

This concept, that China is at once partner, competitor, and systemic rival, then featured centrally in the European Commission's strategic outlook on China in 2019 and became an EU mantra for engaging with China. And although Merkel still pushed through an EU principle agreement on investment with China—the Comprehensive Agreement on Investment (CAI)—at the end of 2020, despite wide criticism including from the Biden administration, the CAI's ratification was put on immediate hold as part of the Scholz government's coalition agreement.[13] As a result, increasingly difficult conditions for German companies in China, Beijing's greater assertiveness in foreign and trade policy—including economic coercion against Lithuania in 2021—and the change in German government in 2021 have led to significant changes in Germany's views of and policy toward China, culminating in the Scholz government's China strategy.[14]

The China strategy clearly spells out, for the first time, many of the risks China and its policies pose to Germany's security and economic development, as well as the global order. It emphasizes that although the German-Sino relationship remains a combination of partnership, competition, and systemic rivalry, "China's conduct and decisions have caused the elements of rivalry and competition in our relations to increase in recent years."[15] It is hence the stated goal of the Scholz government to de-risk and diversify from China in critical areas and to work together closely within the European Union and with allies to foster innovation and strengthen supply chains in key technologies, protect critical infrastructure, and prevent the drain of security and human rights-sensitive technologies to China. Green technologies, telecommunications, semiconductors, and artificial intelligence (AI) are specifically mentioned.

Germany's Export Control Policy to Date: Semi-restrictive, Multilateralist, and Human-Centered

Germany's export control policy has for a long time been somewhat particular. For historic reasons, weapons exports generally, similar to the defense industry, have been perceived rather critically by broad parts of the German population and across most political parties. This is particularly true for the parties left of center, such as the Social Democratic Party, the Greens, and the Left. Accordingly, German export control policy with regards to conventional weapons exports has been comparatively restrictive for decades.[16] Germany's export control policy has been closely anchored in the four multilateral regimes as a result, whereby Germany has—according to officials—often pushed for new listings and advocated for broadening the membership of multilateral regimes, such as India joining the Wassenaar Arrangement in 2017.[17]

As noted in Germany's China strategy, the German government generally has interpreted the EU arms embargo against China strictly and will continue to do so. The embargo has been in place since 1989 as a result of the violent suppression of protests in Beijing's Tiananmen Square.[18] As a result, conventional weapons exports from Germany to China have been largely restricted for decades and will certainly not become less restrictive under the current Scholz government. But in recent years, beyond conventional weapons exports, exports of dual-use items to China have also become more restricted. According to private sector representatives, licensing applications for dual-use exports to China are being scrutinized more closely by the

Federal Ministry for Economic Cooperation and Development, and fewer licenses are being granted. German officials interviewed for this project confirmed that German dual-use export control policy toward China has become more restrictive since 2018.

This more restrictive policy is the result of increasing concern regarding German dual-use exports directly contributing to China's military modernization or to infringements on human rights due to the Chinese Communist Party's (CCP) increasing assertiveness internationally and domestic backsliding on civil and political rights. Unlike the October 7 measures, this change toward a more restrictive export control policy vis-à-vis China should therefore not be viewed as a strategic shift toward slowing down China's ability to develop foundational technologies, but rather as an effort to narrowly prevent very concrete contributions to further military rearmament or internal oppression.

Germany currently maintains a very narrow national control list of around 20 dual-use technologies that are not listed multilaterally—and hence not on the common European list—and is generally opposed to unilateral measures, including by the United States.[19] This is in part because Germany believes such unilateral measures are ineffective in the long run and finds most of these measures in violation of international trade law. But it is also because Germany is concerned with how such measures may be perceived by third countries. For Germany, one of the key values of adhering closely to multilateral agreements and export control lists, rather than implementing national or minilateral measures, is the legitimacy multilaterally agreed restrictions have in countries that are not members of these regimes. There remains great concern in the current German government that new unilateral or minilateral measures would feed into the narrative spun by China that the West is seeking to contain the technological development of developing countries through export restrictions.[20] Given the importance the Scholz government has attributed to working more closely with countries in the Global South, and avoiding any further alienation, any non-multilateral export control measures aimed at China must be weighed carefully against the damage such measures may have on relations with developing countries.

Germany's Role in the Semiconductor Supply Chain: Chips for Das Auto and Supplying the Suppliers

Germany's semiconductor industry is one of the largest in Europe. It is also home to the largest regional cluster in Europe, dubbed "Silicon Saxony."[21] Below is a brief overview of companies headquartered in Germany that are active in the semiconductor value chain.

Semiconductor Suppliers: Infineon, Germany's largest integrated device manufacturer (IDM) and semiconductor supplier, focuses mainly on power semiconductors, microcontrollers, and analog chips. It is among the leading automotive chip suppliers globally.[22] Another example of a semiconductor supplier is Bosch, which focuses on automotive chips, sensors, and micro-electromechanical systems.[23] Beyond these two companies, Germany's semiconductor supplier ecosystem is dominated by smaller players, such as Elmos (automotive chips) and Semikron Danfoss (power semiconductors), among others.[24] Similar to their peers in the United States, Japan, and other European member states, many German IDMs follow a "fab-lite" business model, outsourcing wafer fabrication for some types of chips (such as microcontrollers) to foundries, such as the Taiwan Semiconductor Manufacturing Company (TSMC), while producing other chip types in house.[25] This also explains why TSMC's investment in Germany is backed by Infineon, Bosch, and Dutch semiconductor designer and manufacturer NXP—all of which are already customers of the Taiwanese contract manufacturer.[26] Importantly, German semiconductor suppliers are not active in memory chips or most types of processors,

such as for smartphones, laptops, servers, or machine learning. This is also reflected in Germany's foundry ecosystem that, beyond U.S.-headquartered Globalfoundries in Dresden, consists of smaller specialty foundries, such as X-Fab and UMS.[27]

Equipment Suppliers: With companies such as Aixtron, AP&S, SÜSS MicroTec, and Zeiss, Germany is home to several semiconductor manufacturing equipment (SME) suppliers for wafer and photomask fabrication as well as back-end manufacturing (assembly, test, and packaging). While German SME suppliers do not have the same scale as some foreign firms, such as Dutch company ASML, Japan's Tokyo Electron, or the United States' Applied Materials, they still control a market-leading position in certain segments of the SME market: Aixtron is a leading supplier of deposition equipment for power semiconductors and LEDs; Zeiss has a leading position in photomask inspection, metrology, and repair equipment; and ERS Electronic, whose acquisition by a Chinese investor was blocked by the German government in 2022, is a leading supplier of wafer bonding solutions.[28]

Component Suppliers: One of the strong suites of Germany's semiconductor ecosystem is equipment component suppliers—companies that develop parts, subsystems, and components for SME suppliers and fabs. Some of the more well-known examples include Zeiss developing and manufacturing the projection optics for ASML's lithography machines and Trumpf supplying the laser for ASML's extreme ultra-violet (EUV) lithography machines.[29] But beyond these often-cited examples are many smaller, lesser-known German component suppliers with strong market positions in their respective niches. Examples include Berliner Glas (acquired by ASML), Feinmetall, FITOK, Jenoptik, Nynomic, Physik Instrumente, Pink, and Pfeiffer Vacuum, among others, often with substantial business in China.[30]

Chemical, Material, and Wafer Suppliers: Because of its long history in chemistry and materials sciences, Germany is also home to large semiconductor-grade chemical suppliers, such as Merck KGaA, BASF, and Wacker Chemie.[31] German Siltronic is among the leading silicon wafer suppliers globally;[32] its planned acquisition by Taiwanese competitor Globalwafers was denied by the German government in 2022.[33]

Impact of October 7 on Germany: A Near Miss

The impact of the October 7 controls on Germany's semiconductor industry was rather limited, mainly for three reasons.

First, as mentioned before, German semiconductor suppliers are not producing high-performance processors nor the AI accelerators that were impacted by the U.S. controls (if the German supplier also has U.S. content in their products). As an example, the U.S. export controls were not even discussed in Infineon's investor call on November 16, 2022.[34]

Second, German chemical and material suppliers were largely unaffected because the controls did not extend to these technologies.[35] As an example, German wafer supplier Siltronic stated in its investor call on October 28, 2022, that it "studied the new U.S. export rules and the impact to [their] China activities in great detail" and emerged "without any negative implications."[36]

Third, while there was the potential for some impact on German equipment and component suppliers, this was quite limited—especially in comparison to their Dutch peers, such as ASM International.[37] This is partially because the types of equipment or components produced by these companies are not addressed by the controls or because these companies' production and research takes place outside of the United States. As an example, Aixtron—one of Germany's largest SME suppliers by revenue—stated in its investor call on October 27, 2022:

> . . . our market segment of [metal organic chemical vapor deposition] tools for compound semiconductors is not affected [by the U.S. controls]. Even if we were a U.S.-based company, we would not be affected by these rules. We have also checked that none of our active customers are on the expanded entity list. Furthermore, we do not expect negative implications on our supply chain for U.S. based parts, some of which we are using in our tools. Overall, we do not expect that this has an impact on our business behavior.[38]

In essence, while German companies, especially the ones with production or research and development in the United States, were certainly scrambling to understand the potential impact of U.S. controls, there has not been a lot of impact so far, particularly compared to South Korean memory chip suppliers or Japanese and Dutch equipment suppliers.[39]

Deafening Silence: Reactions to October 7 by Policymakers and Businesses

Because most of Germany's semiconductor technology suppliers were not directly or substantially impacted by the U.S. controls and the subsequent and complementary measures by the Netherlands and Japan, public reactions from policymakers, businesses, and industry associations as well as from think tanks have been almost nonexistent.

For comparison, the reaction to the U.S. Inflation Reduction Act included hearings in the German parliament, assessments and policy recommendations from leading German industry associations and think tanks, and substantial media coverage.[40] This starkly contrasts with the October 7 controls. While there has been some media coverage, the various industry associations have stayed quiet, there have been no parliamentary hearings, and think tanks have published limited public analyses—even at the European level.[41]

However, some German semiconductor technology suppliers have seemed to "de-risk" by accelerating an "in China, for China" business strategy, potentially as a reaction to the October 7 controls. This is something that the U.S. Semiconductor Industry Association warned against in their public comment to the U.S Department of Commerce's Bureau of Industry and Security, stating that "the combination of uncertainty driven by complexity leads foreign companies to often design out or avoid U.S.-origin or U.S. company branded content to 'de-risk.'"[42] Merck is a useful example among many. The company recently stated that they "are trying to limit . . . imports of important raw materials from other countries into China, especially from the U.S.," instead seeking to create "a China-for-China approach, so that also the vast majority of products we are going to produce in China is actually supposed to be for the Chinese market."[43]

The Future of German Export Control Policy: More European, More Minilateralist, and More Restrictive?

Although public reactions to and debates on the U.S., Dutch, and Japanese measures have been sparse in Germany, it appears that there is an ongoing change in thinking in the German government. This change in thinking related to export controls seems to have largely resulted from engagement within the G7 (where economic security and export controls featured prominently under the 2022 Japanese presidency), development of Germany's China strategy, and accelerating EU discussions on economic security and export controls.[44] Three trends can be observed when looking to the future of German export control policy.

First, to German government representatives and officials, the Dutch decision, which was interpreted by officials to be primarily the result of U.S. pressure, according to interviews for this project, has illustrated that European coordination and solidarity in export control policy must be improved so that individual member states are less exposed to external pressure. Although the 2021 EU export control regulation significantly improved coordination of measures between member states, there appears to be an acknowledgement in German ministries that it would serve Germany and the European Union's interests to develop a more coherent approach among member states. This would not only strengthen member states' positions vis-à-vis third countries such as the United States and China but also improve the effectiveness of European export controls.[45]

Second, within Germany's China strategy, the Scholz government specifically acknowledges that China's military-civil fusion policy must be taken into account in Germany's export control policy.[46] To the authors' knowledge, this was not a publicly stated consideration previously in German export control policy and could hint at a more restrictive export control policy vis-à-vis China that may also cover items that are less immediate inputs to final defense technologies. Interestingly, the China strategy also mentions that "longer-term security risks for Germany, the EU and their allies, created by the export of new key technologies" require an adjustment of national and international export control lists.[47] This is particularly interesting because this wording reflects parts of the Dutch government's justification for its controls on advanced semiconductor manufacturing. Furthermore, this wording and justification could certainly be interpreted as a nod to the fact that economic security considerations—"longer-term security risks"—should now play a role in European export control policy.[48] At the very least, it suggests that security risks have grown in regards to China and certain technologies.

Third, there is an acknowledgment in Germany that multilateral regimes, such as the Wassenaar Arrangement, are currently not sufficiently functional. Importantly, Germany does not attribute these problems just to Russia's membership but also to other dynamics at play, including time-consuming decisionmaking processes that fail to keep pace with technological developments. While there is consensus in Germany and the European Union that the Wassenaar Arrangement and the three other regimes must remain the central pillars of German and EU export control policy because of the effectiveness of multilateral export control regimes and the legitimacy these regimes have internationally, discussions are currently ongoing in Germany on how these multilateral regimes can be improved and, where necessary, complemented without further undermining them. What these improvements and complementary measures should look like from Germany's perspective is not currently clear. But based on Germany's China strategy, it appears that Germany does see "strengthened cooperation in the field of export controls between the G7 and further partners" as one path to improve Germany's security and reduce risks emanating from China.[49]

Japanese Perspective

Japan Embraces its Strategic Indispensability in Alliance with the United States

By Kazuto Suzuki

Introduction

In the 1980s, Japan's semiconductor industry held a 50 percent share of the global market.[1] However, in the U.S.-Japan trade friction, Japanese semiconductors were criticized for being supported by unfair government spending, which lasted 10 years after the U.S.-Japan semiconductor trade agreement was implemented in 1986.[2]

The semiconductor industry in Japan has been in decline since then and currently holds only a 10 percent share of the global market. In order to recover from this decline, the Japanese government began making major moves in 2021 to reinvigorate the semiconductor industry.[3] These moves were triggered by Covid-19, which led to semiconductor supply shortages and significantly impacted various economic activities. Furthermore, the 2022 Russian invasion of Ukraine, in Japanese minds, has suggested that there is a possibility of a Taiwan contingency that could have serious impacts on the global semiconductor supply chain.

However, although there are calls in Japan for the revitalization of the semiconductor industry, the issue has not been discussed in conjunction with security concerns, namely the rise of China's military. China's military rise has been recognized in Japan in terms of pressure in the gray zone over the Senkaku Islands and issues related to a Taiwan contingency, but the improvements in China's military capabilities have been largely perceived as inevitable and related to China's technological development.[4]

In this context, the tightening of U.S. restrictions on semiconductor exports to China in October 2022 came as a great shock to Japan. Even though the White House had provided the information several weeks prior to the announcement, the fact that the announcement did not give enough time to scrutinize the impact of the measure was a surprise to the Japanese community. However, the October 7 measures provided some relief

to the Japanese semiconductor industry because they only limited advanced semiconductors at the 14- and 16-nanometer nodes or narrower, which are not manufactured in Japan.[5]

Review of Japan's Semiconductor Strategy

Japan's semiconductor policy has been characterized as a state-oriented policy since the success of the ultra-LSI development project in the 1970s made Japan a semiconductor superpower surpassing the United States. This success created an illusion that if Japanese companies worked together to develop an industrial strategy, Japan's advantage would be rock solid. Therefore, even after the 1986 Japan-U.S. semiconductor trade agreement, the semiconductor strategy continued under the leadership of the Ministry of Economy, Trade and Industry (METI, at the time known as the Ministry of International Trade and Industry), and "all-Japan" projects such as ASUKA and MIRAI were launched. However, these projects were not successful because the semiconductor manufacturing companies did not send their best personnel to the projects and instead looked to their competitors.

One of the reasons for the failure of this semiconductor strategy was the failure to recognize structural changes in semiconductor manufacturing driven by the industry's bifurcation into design and manufacturing with the advent of the Taiwan Semiconductor Manufacturing Company (TSMC) and the development of the global horizontal division of labor. Even amid these structural changes, Japan has maintained vertical integration—the semiconductor sector was treated as a part of the electronics industry. Furthermore, amid strong competition, companies were not able to substantially invest in the semiconductor sector, which accounted for only a part of their businesses. As a result, it was not realistic for a single company to continue to cover the huge amount of capital required, and such depressed capital investment could no longer keep pace, which resulted in Japan losing its global competitiveness in semiconductors.[6]

In order to rebuild the industry, the Japanese government decided to restructure its semiconductor strategy in the 2020s. For one thing, Japan will strengthen its competitiveness in areas where it still has strengths, such as semiconductor manufacturing equipment and materials, and in 2021, the advanced semiconductor manufacturing act was enacted to provide subsidies to the semiconductor industry. This subsidy will not only attract Taiwan's TSMC to Japan but will also launch LSTC, a joint research institute between TSMC and the National Institute of Advanced Industrial Science and Technology (AIST), as well as provide ¥330 billion ($2.26 billion) in subsidies to Rapidus, a group of 10 private companies that will cooperate in the development of semiconductors. Rapidus is a foundry that takes a different approach than previous METI-led projects in that it is a consortium of companies that will work together to promote Japan's participation in the manufacture of cutting-edge semiconductors under the slogan "Beyond 2 nano."[7]

Thus, rather than regaining its former glory, Japan has been in the process of reassessing the importance of its semiconductor industry in the modern global marketplace in light of its past failures and has been completely reconfiguring its semiconductor strategy.

The Impact of the October 7 Controls

When the United States announced tighter restrictions on semiconductors from China, Japan was surprised, not so much by the direct impact on Japan's semiconductor industry, but rather by the fact that the United States had made a full-fledged change in its approach to export controls, using the export control system to pressure specific countries rather than focusing on the proliferation of weapons of mass destruction (WMDs).

There was a concern that Japan would need to change its long-standing commitment to the nonproliferation of WMDs and, furthermore, that it might create a situation where Japan would have to consider using export controls for strategic purposes in the future.[8]

The reason for this concern was that Japan had already experienced an instance of export controls being used for national strategic purposes. When tensions between Japan and South Korea rose in 2019 over the issue of ex-consignment, Japan changed its export control system with punitive intent for South Korea, removing it from the "White Country" category (now Category A) and increasing the effort needed to export fluoride. Japan also took measures to make exporting more difficult by changing three items, including hydrogen fluoride, from a general license to an individual license. These measures caused a strong backlash in South Korea, resulting not only in a decrease in exports from Japan but also in a strengthening of South Korea's domestic production capabilities. Japan has officially attributed this to inadequacies in South Korea's export control system, but the measures continued even after South Korea strengthened its export control system.[9] They remained unchanged until President Yoon Suk Yeol was finally inaugurated and improved relations between the two countries were established.

The strengthening of U.S. export controls against China was not necessarily seen as a desirable outcome, as such economic pressure by means of export controls is perceived as likely to not only have a limited effect but could also improve other countries' capabilities in the semiconductor sector vis-à-vis Japan. However, Japan accepted the measures under the assumption that there are no factories in Japan that make such advanced semiconductors and that therefore Japanese factories would not be directly affected. In addition, the fact that the October 7 measure was limited to "U.S. persons" meant that it was not directly applicable to companies based in Japan. Likewise, even if they used U.S. products or technologies subject to the re-export controls, firms would not be subject to the controls if their exports to China were limited to general-purpose semiconductors. The general response has been to wait and see how the U.S. regulations are implemented. Instead, the extended use of such export controls as a means of exerting economic pressure in the future has been seen as more problematic.[10]

U.S. Determination Impacted Japanese Thinking

However, the assumption that Japan would not be affected was naive, as the U.S. industry quickly began to criticize Japanese and Dutch semiconductor equipment manufacturers, which are not subject to re-export restrictions, for unfairly benefiting from the measure. Japanese companies such as Tokyo Electron and other semiconductor equipment manufacturers make equipment using their technology rather than relying on U.S. technology, and in the Netherlands, ASML is the only company in the world that makes extreme ultraviolet (EUV) lithography equipment, which is essential for the production of the most advanced semiconductors. If these devices are exported to China and it develops better design capabilities, it will be able to make advanced semiconductors even if the United States stops exporting designs and software.[11]

This has led the United States to urge Japan and the Netherlands not to export semiconductor manufacturing equipment to China. Both Japan and the Netherlands are allies of the United States and, like the United States, do not consider it desirable for China to increase its military capabilities by acquiring advanced semiconductors. However, China's semiconductor market is the fastest-growing such market in the world, and it would be a great blow to Japanese and Dutch companies to lose this lucrative market. Although the United States emphasized that it was only regulating advanced semiconductors in China and not legacy or foundational semiconductors, both Japan and the Netherlands were hesitant to restrict the interests of private companies for political purposes.

As a result, Japan, the United Sates, and the Netherlands agreed to strengthen export controls, and Japan decided to add 23 new items, including semiconductor manufacturing equipment, to the list of items subject to export controls.[12] However, unlike the United States, there were legal difficulties in establishing an export control system with the ability to target particular countries for the purposes of national security, since the export control system was designed to be prevent proliferation of WMDs. Therefore, the newly added items likely will require an export license for all destinations, but certain measures will be taken, such as not issuing licenses to China, on an operational basis.[13]

For Japan, it was not a surprise that the United States took the position of thoroughly blocking advanced semiconductor exports to China, but it is nonetheless important to understand the determination of the United States to do so. During the Trump administration, economic coercion against China, particularly additional tariffs on China and protectionist measures under the guise of security under Section 232 of the U.S. Trade Expansion Act, was seen as policy pursued by domestic hardliners against China or as an effort to preserve domestic jobs, not a policy driven by security concerns. However, the Biden administration's October 7 controls signaled a full-fledged U.S. commitment to maintaining its technological superiority and preventing China's military buildup, even at the expense of domestic industry.[14]

Reactions in Japan

Japanese business groups such as Keidanren or Keizai Doyukai (the Japan Association of Corporate Executives) or industry groups such as the Semiconductor Equipment Association of Japan have not expressed any explicit opposition or opinions regarding the agreements that the Japanese government has reached with the United States and the Netherlands. Nor has the issue been taken up in the Diet. In Japan, the government can enforce export controls through ministerial ordinances, and public lobbying is not a common practice. As a result, semiconductor export control issues are often resolved through direct dialogue between the government, industry associations, and individual companies.

In this context, it is noteworthy that Japan has spent more than six months since October 7 negotiating with the United States. Naturally, China is a huge market with respect to semiconductor manufacturing equipment, which is the target of the regulations, and there is a large market to be lost by tightening export controls. In addition, in the case of semiconductor manufacturing equipment, it is not possible to define specifications by channel length, as is the case with semiconductors themselves, and it is necessary to carefully determine what type of equipment would be subject to export controls. Therefore, as the Japanese government continued its negotiations with the United States, it engaged in a series of negotiations with Japanese industry associations and individual companies to reach a consensus on which products would be subject to the restrictions.

The result of these negotiations was an agreement in May 2023 and the implementation of stricter export controls in July. In Japan, this issue is more of a process of making adjustments so that it does not contradict its own interests too much and acknowledging the importance of the security measures pursued by the United States without it becoming a major issue. The process is not necessarily satisfactory for companies exporting semiconductor manufacturing equipment, but there was a general consensus that the measures were a necessity for improving national security.

Japan's Dilemma

How will the October 7 measures and the subsequent framework of tighter restrictions on semiconductor exports to China by Japan, the United States, and the Netherlands affect Japan's geoeconomic strategy going

forward? The first key question will be the extent to which China will take retaliatory measures. For example, from August 1, China will tighten its controls on gallium and germanium exports.[15] What is important about this response is that China is also strengthening export controls for "security" reasons. While this measure does not target any particular country, it is believed that China sees Japan as a weaker link in the containment policy against it, as the measure came just after Japan tightened its export controls. China will also strengthen export controls for commercial drones, in which China holds a large majority share in the global market, on the grounds of "security." Additionally, there is a strong possibility that China will continue to use such export controls as a means of economic coercion in the future. Japan is trying to avoid risk by reducing its dependence on China in accordance with the Economic Security Promotion Act (ESPA), but now that the "export control war" between the United States and China has begun, a response is required as soon as possible.

Second, even though the Chinese economy is slowing down, China is still a very attractive market for Japanese companies. Likewise, there are still many items that are dependent on procurement from China. Even if Japan were to diversify its supply chain in accordance with the ESPA, it would be a great burden for companies to procure more expensive items from other countries when they could procure them at a lower price from China. Such actions that go against economic rationality are difficult for companies to explain to their shareholders and stakeholders. In this sense, the government's decision to strengthen export controls will facilitate companies' decisionmaking and give them guidance for avoiding risks.

Based on these strategic conflicts, Japanese companies are expected to take actions that are not economically rational and are likely to incur the risk of economic harassment by China. It is important for the government to draw up a clear strategy and provide predictability to companies in order to encourage such actions. At the same time, even if the government makes a decision, there can be a variety of risks involved in doing business with China. It is up to companies to decide how to respond to such risks, and there will be a limit to how much they can rely on the government.

What Should the Japanese Government Do?

Under these circumstances, what should Japan do in the future, especially in the semiconductor field? First, Japan must protect its superior technologies and companies from foreign investment, especially from China, as it did with the acquisition of JSR, a major semiconductor materials company, by the Japan Investment Corporation (JCI), a government-affiliated fund.[16] To this end, in addition to investment screening based on the current Foreign Exchange and Foreign Trade Law, Japan should also consider the introduction of an investment screening system similar to the U.S. Committee on Foreign Investment in the United States (CFIUS) as well as measures such as delisting, as was the case with the acquisition of JSR.

Second, it is necessary to further strengthen initiatives such as Rapidus and LSTC, the joint research institute with TSMC, which are currently being promoted with government involvement. The semiconductor industry is fundamentally an equipment industry, and it is not possible to maintain competitiveness without renewal of equipment through a continuous cycle of new investment. In addition, semiconductor research and development require enormous resources, and it is difficult to ask private companies to have the financial strength to make continuous investments. In this sense, the government must be fully involved. The era of neoliberalism, in which government intervention in the market was undesirable, is over. Japan is now in an era in which the government is involved in the market—maintaining, nurturing, and protecting strategic industries. The private sector needs to be aware that it, alongside the government, stands at the forefront of national economic security.

Third is the need to secure human resources in the semiconductor industry. The semiconductor manufacturing business has long received an inadequate amount of investment, not only in Japan but also in the United States and Europe, and even if the Japanese government provides leverage to the semiconductor industry, there is still a shortage of human resources. In Japan, the opening of TSMC's plant in Kumamoto Prefecture has led to a strain on highly skilled personnel from all over the country, causing problems such as skyrocketing wages and a shortage of personnel in the Kyushu industry.[17] A similar situation is also occurring in Hokkaido, where Rapidus is expanding. Universities and technical colleges in Kyushu and Hokkaido are working on how to resolve this shortage of human resources, but these efforts are insufficient.[18] The government as a whole should improve the supply of semiconductor human resources and actively attract human resources from India and other countries with strong semiconductor design capabilities.

The United States is prepared to use its technology and economy as weapons in its strategic competition with China. Japan, as an ally and a strategic security partner, has no choice but to support the U.S. policy toward China while balancing its own economic interests and strategic rivalry in semiconductors. Regardless of Japan's desires, technology and the economy have become strategic tools. The best way to develop some advantage in this situation is for Japan to establish its "strategic indispensability" by refining its own technology and acquiring international competitiveness, thereby increasing its ability to resist coercion from other countries. In this sense, a modern security strategy must recognize that it is not only the government, military, and diplomatic authorities—but also business and enterprises—that must achieve the nation's strategic goals together. In this sense, Japan's economic security strategy is more effective when the government and businesses have less friction on economic security issues.

Dutch Perspective

How the Netherlands Followed Washington's October 7 Export Restrictions

By Rem Korteweg

Introduction

This chapter looks at the development of Dutch semiconductor export control policies in response to growing U.S.-China tensions and the October 7, 2022, export restrictions.

The Dutch reaction to the October 7 controls is embedded in a growing deterioration of Dutch relations with China, several years of intense U.S.-Dutch diplomacy about semiconductor export policies, and a Dutch ambition to preserve its unique position in the global semiconductor value chain.

While the Dutch semiconductor industry includes more than 300 companies, the new policies were mainly related to advanced lithography and semiconductor manufacturing machinery. One Dutch company, ASML, plays a crucial role here.

The Netherlands' Role in the Semiconductor Supply Chain

A conservative estimate by the Dutch government puts the Dutch semiconductor industry at more than 300 companies, employing around 50,000 people and generating €30 billion ($32.46 billion) in revenue annually.[1] However, the overarching semiconductor ecosystem in the Netherlands is probably larger. For example, lithography machine manufacturer ASML says its supply chain in the Netherlands relies on more than 100 small and medium-sized enterprises.

Dutch semiconductor firms are predominantly active in machinery and equipment, chip design, and the production of leading-edge as well as legacy semiconductors. One of the unique characteristics of the Dutch ecosystem is that it brings together government, knowledge institutions and technical universities, and private companies to drive innovation, with a demonstrated history of success. According to the central bank

of the Netherlands, in December 2022, the semiconductor industry accounted for 24 percent of the market capitalization of the Amsterdam stock exchange.[2]

According to the Netherlands branch organization of the semiconductor industry, "on average 85% of the integrated circuits in all electronic devices worldwide, are made on machines designed and manufactured in the Netherlands."[3] ASML sits at the apex of the Dutch semiconductor ecosystem, given its global market dominance in the field of advanced semiconductor lithography machines. Currently, its leading-edge technology is extreme ultraviolet (EUV) lithography, for which it has a monopoly. Other notable companies include NXP, ASM International, BE Semiconductors, STMicroelectronics, and Axelera AI. Yet because of ASML's outsized importance to the global semiconductor value chain, this company is also the focal point for how the Netherlands deals with the geopolitics of the semiconductor industry and how it developed its export control regime. That regime took shape in a context of changing relations with China.

Changing Views on China's Economic Ambitions

The Netherlands was slow to come to terms with China's economic challenge, but when it did, things moved quickly. In 2019, the Netherlands published a new China policy paper.[4] In the paper, which could not be called a strategy due to intergovernmental disagreements about its scope, the government took a much more critical view of China than it did in the previous edition from 2013. Instead of prioritizing the economic promise that access to China's market offered, the 2019 paper sought to strike a balance between working with China and scrutinizing it. The main tagline of the document became "open where possible, protective where needed, and based to a greater extent on reciprocity."[5] It also gave the necessary political cover for the development of a Dutch investment screening mechanism.

When the China policy paper was taking shape, concerns about China's human rights record and regional security—not its economic activities—dominated discussions in the Dutch parliament. But gradually relations between Beijing and The Hague started to deteriorate. In a new low, a Dutch parliamentarian and a high-ranking diplomat were sanctioned by the Chinese government and received travel bans in 2021 because of their criticism of human rights violations in Xinjiang.[6]

The Covid-19 pandemic put the issue of undesired economic dependencies with China into focus. In 2020, while the Netherlands struggled to contain infections, a diplomatic row erupted over the Dutch decision to change the name of its trade and investment office in Taiwan to the Netherlands Office Taipei.[7] China's *Global Times* newspaper reported that the move might have repercussions for China's provision of medical aid and face masks to the Netherlands.[8] It set off alarm bells in the Dutch parliament and focused minds on the issue of economic coercion. Could China leverage its growing economic footprint against Dutch foreign policy or security interests? Chinese investments in Dutch companies, including in the semiconductor sector, became suspect. For instance, the Netherlands blocked the Chinese takeover of semiconductor firm SmartPhotonics in 2020 and helped put together a public-private consortium to keep this technology in Dutch hands.[9] In the same period, a backlash against Huawei—driven by security concerns about the possibility of Chinese espionage or sabotage—led to its exclusion from the Dutch 5G telecom infrastructure market. In November 2019, the government decided that telecom providers could only use "trusted suppliers" in critical parts of the 5G backbone.[10] Later, in 2021, Huawei confirmed it had been excluded.[11] And in the European Union, the Netherlands spearheaded an EU initiative to scrutinize and limit investments by foreign state-owned enterprises in the single market. In 2023, the China policy paper was updated. Unsurprisingly, it placed a much stronger emphasis on "protection."[12]

Various parliamentary motions were put forward to shape a new China policy, but most were directed at preventing certain Chinese investments in Dutch critical infrastructure or reducing dependencies on Chinese imports. For instance, in October 2021 a motion called for reducing Dutch and European strategic dependencies on "authoritarian states, mainly China" as this would increase the effectiveness of Dutch and European human rights policies.[13] The following month, parliament adopted a motion calling for "an ambitious plan to reduce the dependency of Dutch consumers and producers on China."[14] And in May 2023, a cross-party motion called for greater government action, including a credible timeline, to reduce Dutch exposure to "problematic dependencies in critical materials, chips, semiconductors and high-tech products" from China.[15] De-risking, if not decoupling, was widely embraced by the Dutch parliament, but it was focused on Chinese inbound investments and dependencies on Chinese imports, not on Dutch exports that could give China a strategic industrial edge. That would change with U.S. action.

Initial Responses

The October 7 measures had an impact on Dutch companies, particularly ASML. U.S. employees of Dutch semiconductor firms were covered by the new legislation, as was U.S. content in semiconductor technologies used by Dutch semiconductor firms.[16] This meant that their products became susceptible to export restrictions. A number of Dutch companies—such as ASML, ASM, and NXP—were affected further because they have U.S. subsidiaries.

ASML generates approximately 15 percent of its revenue in China.[17] In response to the U.S. measures, the company has transferred some of its repair and maintenance activities to China.[18] This allows it to continue to service the lithography machines that it has previously sold to Chinese customers. But there is no doubt that the U.S. measures have had a chilling effect on ASML's business in China.

Across the political spectrum, there is wide-ranging interest in the new U.S. regulations. In mid-October, the government organized a confidential briefing for parliament on the new measures. But already in September 2022, when news was starting to spread about pending U.S. export controls on semiconductors, questions were being asked in the Dutch parliament. The pro-EU party Volt Netherlands asked the ministers of foreign affairs, economic affairs, and international trade whether new U.S. export controls would influence Dutch and European "digital autonomy," and therefore needed to be assessed on its geopolitical merits (which is one component of the European Union's ambition to develop its economic "strategic autonomy"). The government responded with an emphatic yes, adding the following:

> Due to its strategic importance and the globalized structure of the value chain, semiconductor technology plays a key role in geopolitical affairs and thus for the 'open strategic autonomy' of the EU. The government is therefore committed to remaining an international leader in this area in the future. This requires a geopolitical consideration, in which good cooperation with like-minded partners is of great importance.[19]

In a separate note, Volt Netherlands complained that the October 7 export controls served U.S. interests and unduly damaged ASML without giving the company adequate compensation. Instead, the party called for a stronger and more coherent European approach to semiconductors.[20] It reflected earlier criticism by some academics who suggested that the Netherlands was becoming increasingly vulnerable to U.S. extraterritorial legislation in high-tech fields.[21]

In December 2022, ASML CEO Peter Wennink was critical of the new U.S. export restrictions.[22] He said that ASML had already paid a price by no longer being able to export its most advanced EUV lithography machines

to China and that restricting less-advanced deep ultraviolet (DUV) immersion technologies would go a step too far. He also said that EUV export restrictions were benefiting U.S. semiconductor firms that were still able to trade with China and that DUV technology had already proliferated widely, including to China. Meanwhile the Dutch government was mulling over its response.

No Export Licenses for EUV Technology

The Dutch response to the October 7 controls cannot be understood without giving due regard to the previous years of U.S.-Netherlands cooperation on semiconductor export policy. In the run-up to October 7, the Biden administration had continued the Trump administration's earlier campaign to restrict ASML's export of lithography machines to China.

EUV machines are covered by the Wassenaar Arrangement. In late 2018, under the terms of the arrangement, ASML asked for an export license for two EUV machines to China. The intended customer was most likely the Semiconductor Manufacturing International Corporation (SMIC), which the United States would later designate as a military end user and add to its Entity List. Because the United States is member to the Wassenaar Arrangement, it received information of the intended sale. The United States initially tried to block the sale itself, but the content requirement that would allow the United States to do so was not met.[23] A number of rounds of diplomacy between the Netherlands and the United States followed. In June 2019, then secretary of state Mike Pompeo visited The Hague and pointed out that the sale of EUV technology to China was undesirable. According to reports, during Prime Minister Mark Rutte's visit to the White House in July 2019, he was given an intelligence report on the implications of China's use of ASML's EUV technology.[24] The Dutch government did not renew ASML's export license.[25] But ASML, like similar firms around the world, continued to sell its less-advanced DUV immersion technology machines to Chinese customers, including to SMIC.

Meanwhile, the policy cogs in The Hague were churning. A new, more restrictive export policy for semiconductor technology was in the making. On October 10, 2020, more than a year after Rutte's visit to the White House, the Netherlands Ministry of Defence published an internal semiconductor strategy.[26] The strategy underlined ASML's key position in the field of lithography machines and the ability of EUV technology to produce the most advanced chips. It also warned that the most advanced chips are most likely to be used in the most advanced military systems.

With the EUV machines, the strategy stated, China could aim to increase its ability to produce advanced chips and make headway to develop its own indigenous semiconductor industry. The semiconductor strategy also flagged China's ambition to be a military superpower by 2049. Crucially, the Ministry of Defence concluded the following (author's translation):

> The chance that a NATO member state will have to defend itself against advanced indigenously-produced weapon systems in the future will increase considerably when EUV machines are exported, especially if China sells such weapon systems to third parties. In addition, the export of advanced technology may lead to undesirable economic dependencies in the (near) future. Finally, our most important strategic security partner, the United States, has made an emphatic appeal to the Netherlands not to export EUV technology to China.[27]

The Ministry of Defence continued: "From the perspective of Dutch military and security interests in the medium and long term, it is important that the Netherlands does not grant ASML an export license for the supply of EUV machines to China and that this unique technology is protected as much as possible."[28] The

Defence Ministry's strategy provided a clear justification for not awarding the export license to ASML, but it came more than a year after U.S. pressure on the Dutch.

From EUV to DUV

While EUV exports to China were now off the table, the focus fell on ASML's less advanced, but still very sophisticated, DUV immersion technology machines. Together with U.S. etching and deposition equipment, Chinese engineers had been able to use DUV technology to make several innovative breakthroughs and develop advanced semiconductors of their own.

Feeling the increased pressure, ASML tried to get a carve-out for its lithography machines in November 2020 from the U.S. Export Control Reform Act. Importantly, regarding DUV, ASML stated that "as deep ultraviolet ('DUV') lithography systems have become trailing edge, DUV technology has been decontrolled from national security requirements including multilateral controls and for many years has been extensively shipped globally, including to China."[29] ASML's argument was basically that the technology had already proliferated widely, and that therefore export restrictions on this technology would be meaningless. Conversations with Dutch policymakers at the time confirmed the impression that the Hague considered DUV to be less sensitive than EUV.

The dynamic changed with the October 7 regulation. With the new controls, the United States emphasized that it saw export restrictions on semiconductor technology as part of its overall geopolitical competition with Beijing and its strategic posturing in the Asia-Pacific. In that context, the United States was intent on preserving its technological edge, including by reducing China's access to high-end lithography machines. The Biden administration now needed to convince the Netherlands to see the issue the same way.

An intensive amount of diplomacy ensued in 2022. Deputy Secretary of Commerce Don Graves visited the Netherlands in June 2022 to speak with the Dutch government and ASML about new export controls.[30] In the wake of the October 7 regulation, a bipartisan delegation from the U.S. Senate visited the Netherlands on November 4, 2022.[31] According to Prime Minister Mark Rutte's social media feed, their discussions included "stability in the Indo-Pacific," which makes it highly likely that semiconductor supply chains were discussed.[32] That same month, Under Secretary for Commerce Alan Estevez and Tarun Chhabra, senior director for technology and national security at the National Security Council, traveled to the Netherlands to discuss the October 7 measures, their implications for Dutch semiconductor firms, and the desire to expand export licensing to include DUV technology.[33] This was most likely the preparatory meeting for the January 2023 bilateral meeting between Prime Minister Rutte and President Biden.

Meanwhile, policymakers in the Netherlands were keeping up. On December 1, 2022–almost two months after October 7–the government published new guidelines for the export of dual-use semiconductor technologies.[34] The Netherlands formulated three criteria on the basis of which export licenses in semiconductor technologies would be assessed:

1. Preventing Dutch goods from contributing to undesirable end uses, such as a military application or weapons of mass destruction
2. Preventing unwanted strategic dependencies
3. Preserving Dutch technological leadership and Western standards[35]

On January 17, 2023, Prime Minister Rutte arrived at the White House to meet President Biden. The meeting came on the heels of Japanese prime minister Fumio Kishida's visit to Washington on January 13. It had all

the hallmarks of an attempt by the United States to choreograph a diplomatic agreement on new export restrictions with the Japanese and the Dutch. On January 27, National Security Advisor Jake Sullivan met Dutch and Japanese counterparts in a trilateral setting to coordinate a new set of policies.[36]

It would be six weeks later, on March 8, 2023, that the first details of the new Dutch policy emerged.[37] While specific details remained unclear, the Netherlands announced that it would expand its export licensing requirements for semiconductor technologies. DUV immersion technology was explicitly mentioned. The technology that previously was considered "trailing edge" was now thrust into the limelight.

In an attempt to explain why it had decided to widen the scope of its export policies beyond EUV, the government said semiconductor technology continues to evolve, thereby necessitating a continuous review to what extent these technologies impact international security. The government also stressed that this meant it would scrutinize technologies that were not previously covered by export controls. "Given the technological developments and the geopolitical context," the Dutch government concluded, "it is necessary in the name of (inter)national security to expand the existing export control of specific semiconductor production equipment," (author's translation).[38] The note did not mention China, nor did it refer to pressure from the United States. The government did say it would use an EU directive that allows national restrictions in the export of dual-use goods in the interest of preserving public security.[39]

Then, on June 23, 2023, the government announced the details of its expanded export licensing requirements for the semiconductor industry. They included EUV lithography and two types of DUV immersion lithography machines. But besides these technologies, which heavily focused on ASML, other parts of the Dutch semiconductor industry were also affected. Systems and technologies for atomic layer deposition, epitaxy, and deposition were also included in the new rules, which impacted ASM International, among other companies.

The accompanying explanatory note said that these technologies warrant export licensing because they "can create risks for public security, including international peace and stability."[40] Aside from the possibility that the technologies can be used for advanced military equipment, the government argued that the "uncontrolled export [of these technologies] . . . can have significant implications for the public security interests of the Netherlands and its allies in the long term."[41] This is an open-ended formulation, which contains an explicit reference to the security of allies, like the United States. The government justified the new export regime by saying it is a proportional measure given the Netherlands' unique position in the global semiconductor value chain—a position it wants to preserve.

The measures came into effect on September 1, 2023, though ASML indicated it would continue to ship DUV machines to China under existing licenses until January 1, 2024. In anticipation of the new measures, Chinese customers stockpiled ASML's equipment. In the first half of the year, demand surged as ASML's sales to China increased 64.8 percent year on year to $2.58 billion.[42] As could be expected, Chinese government media warned that the new Dutch measures would be costly.[43]

Conclusion

Dutch semiconductor export controls were developed in response to unilateral U.S. measures combined with Washington's diplomatic efforts to cajole the Netherlands to toughen its approach to high-tech semiconductor exports. Though the Netherlands has gone to great lengths to avoid the impression that U.S. pressure alone was the reason why new export restrictions were imposed following October 7, policymakers in The Hague have effectively been playing catch-up with Washington.

The United States may have nudged the Netherlands in a certain direction; initially to block EUV exports to China, and later to focus more on DUV technology. But given more time, policymakers in the Netherlands claim, the Dutch would have reached the same conclusions by themselves. This aligns with public statements by Dutch ministers insisting that the Netherlands makes its own decisions.[44] Within Dutch business circles, however, it is widely believed that U.S. pressure was the dominant factor that led to Dutch action. Indeed, without the unilateral U.S. measures and Washington's diplomatic campaign, it is questionable whether the Netherlands would have adopted the enhanced export licensing regime it did. The Netherlands developed an export control regime that addressed U.S. concerns about high-tech exports to China, but only after the United States took the first step—although the Netherlands did design a policy that fit the Dutch and European political and regulatory context.

One of those specific characteristics has been that The Hague would not agree to blanket restrictions, but would take a case-by-case, country-agnostic approach, avoiding singling out China. Even though the mood in the Netherlands is shifting toward taking a tougher line against China's assertive industrial and technological ambitions, the Netherlands does not see the "China challenge" in the same way as the United States.

This raises a number of important questions. Transatlantic unity is a Dutch security interest, particularly in light of the Russian threat to European security. However, the country's trade relationship with China is substantial.[45] The Netherlands therefore aims to walk a fine line between preserving its economic ties with China as much as possible while sustaining its deep economic and security relationship with Washington. The Netherlands has always been a staunch transatlantic ally, but it wants to avoid being drawn into a U.S.-China geopolitical stare-down that would hurt the country's economic interests. The new semiconductor export regime shows how difficult this is likely to be.

One of the main concerns emerging from the new Dutch export control regime is that Chinese ambitions to substitute ASML's kit with indigenous lithography technology will now become a national Chinese obsession. This obviously has short-term commercial implications, but it could also make Dutch-Chinese relations more tense and spur a program of domestic Chinese innovation that might ultimately put the Dutch semiconductor industry at a disadvantage. This could undermine the unique position in the field of semiconductor equipment that it wishes to preserve.

Another concern is that the new policy will be implemented on an ad hoc, case-by-case basis. In practice, this means that the United States and the Netherlands will continue to have an intensive dialogue about semiconductor export licensing. Each time a company applies for an export license, U.S. officials will be ready to weigh in with an opinion on the technology to be exported and the end user involved.

The Hague expects around 20 export license requests annually based on its June 23 export regime.[46] But it is plausible that additional measures will be put in place in the next few years. Currently, the trend is toward a more—not less—restrictive attitude to exporting to China. For example, in its 2022 annual report, the Dutch military intelligence agency MIVD warned extensively about China's economic and technological ambitions.[47] "China" and its derivatives were mentioned 96 times, which was only surpassed by mentions of Russia. Economic security is of increasing concern.

Similarly, implementation of the new inbound investment screening law will start in 2023.[48] Chinese investments will receive a lot of attention.[49] On May 31, 2023, the Netherlands designated semiconductor technology as "very sensitive" under the recently enacted Dutch foreign direct investment screening regime, meaning it will receive the highest degree of investment scrutiny.[50] In August 2023, the United States adopted an executive order to screen certain outbound investments.[51] There is a growing possibility that the European

Union and its member states could move in a similar direction and adopt an outbound investment screening mechanism of its own. So far, the Netherlands has taken a lukewarm approach. But the mood is shifting. The upcoming parliamentary elections on November 22, 2023, may well put a new Dutch government in office that embraces a tougher line on exports to, and investments in, China's high-tech sectors. Should an outbound investment screening policy be adopted, implementing it along with a toughened export control regime will require substantially more government resources to increase economic intelligence, as well as underscore the need for more transatlantic coordination.

Given the differences in government capacity between the Netherlands and the United States, the different transatlantic economic and security interests at stake, and the need for the Netherlands to be able to make autonomous decisions regarding the export of critical technologies, The Hague would be well advised to consider the following recommendations:

- **Increase its economic intelligence capabilities and its economic security apparatus**. If the Netherlands wants to preserve its unique position in the global semiconductor value chain, it should make commensurate investments to increase government capacity to monitor, screen, and understand how semiconductor technology is impacting geopolitics. It should not be dependent on the United States for this. Some promising but limited steps have been taken. For instance, the government is increasing its technical expertise and hiring more staff to oversee export controls, and diplomats dealing specifically with economic security have been posted in Beijing and Taipei. But more should be done, particularly in the area of improving its economic intelligence capabilities. With its unique position comes unique responsibility.
- **Embed Dutch efforts in a broader European initiative to preserve and grow a strategic semiconductor ecosystem**. The EU Chips Act is a good start, but more action will be needed. Export controls are a national competence, albeit embedded in EU legislation.[52] European countries that are key nodes in ASML's supply chain, most notably Germany, must be made aware of how the October 7 measures necessitate stronger European cooperation and coordination. Similarly, the Netherlands must understand that ASML is not just a Dutch champion, but also a European one. The Hague has announced that it will publish a national technology strategy by the end of 2023. Paradoxically, that strategy should make a strong case for European technology cooperation.

Unsurprisingly, the Netherlands wants to develop a multilateral framework within which to coordinate new export policies for sensitive dual-use technologies. It has no interest in keeping this a bilateral Dutch-U.S. affair and having its arms twisted repeatedly by Washington. Traditionally, the Netherlands has sought security in multilateralism, and in light of the June 23 Dutch export controls it has promised to put new ideas forward in the Wassenaar Arrangement. However, The Hague is clear about the limitations of the current Wassenaar Arrangement; decisions are made by consensus, and current geopolitical tensions mean Russia's membership of Wassenaar frustrates effective decisionmaking. From this perspective, a new multilateral "Wassenaar-like" arrangement appears desirable. Yet the politics are tricky. If such an arrangement were to exclude Russia and China, as it would most likely do, it will be seen as a U.S.-inspired, anti-Chinese technology bloc. It would make Dutch–and European–efforts to manage tensions with China while not siding explicitly with Washington increasingly complicated. So a smaller framework with a more limited scope could offer the best way forward. It could focus on one or a number of key technologies instead of the full range of dual-use technologies. For example, a first step could be to bring the main semiconductor machine manufacturing economies–including Japan, the United States, South Korea, the Netherlands, Germany, and the European Union–together to discuss common export policies and develop a common understanding of how the geopolitics of semiconductor technology is changing. Without such multilateral action, the Netherlands may be left to play catch-up with Washington for some time.

Taiwanese Perspective

Geopolitical Challenges Should Not Dilute Taiwan's Focus on Mastering Advanced Technologies and Critical Applications

By Chau-Chyun Chang

Introduction

Since the Trump administration initiated a trade war with China in 2018, the United States has been continuously escalating its policy of containment toward China in the economic realm.[1] Under the Biden administration, the trade war has evolved into a technology war, elevating economic issues to the level of values and ideology and treating economic security as a matter of national security. The United States has increasingly tightened its grip on China's technological industry, collaborating with allies to jointly block and restrict China's access to technology, equipment, and talent. The United States has actively promoted precise controls through the concept of "high fences around small yards" and established a new normal of "selective decoupling" between the U.S. and Chinese economies, while avoiding a complete decoupling.[2]

Through the fabless manufacturing model, Taiwan's semiconductor industry has propelled the development of the upstream integrated circuit (IC) design and downstream packaging and testing industries. In 2022, Taiwan's semiconductor industry achieved a production value of $162.3 billion, making it the global leader in the foundry and packaging/testing industries, and the second-largest in terms of overall production value and design.[3] As the U.S.-China tech war intensifies, the Taiwan Semiconductor Manufacturing Company (TSMC), which produces over 90 percent of the world's advanced chips, has become a strategic focal point in a new cold war between the United States and China.[4] This article explores how TSMC and the Taiwanese government are responding to the changing geopolitics through multilateral cooperation with the United States, Japan, and the European Union to enhance semiconductor supply chain resilience. These efforts are aiming to strike a balance between national security and industry development, allowing the semiconductor industry to continue serving as Taiwan's "guardian mountain."

Taiwan's Response to U.S. Export Controls on China and the CHIPS Act

Since the initiation of the trade war with China by the Trump administration in March 2018, the technology war led by the Biden administration has continued to escalate, with the United States implementing an expanding series of export control measures. Prior to 2022, the United States had successively added Fujian Jinhua, Huawei, and the Semiconductor Manufacturing International Corporation (SMIC) to the Entity List, and through adjustments to the Foreign Direct Product Rule (FDPR), it restricted Huawei and its affiliated companies (such as HiSilicon Semiconductor) from using software and technology on the U.S. Commerce Control List, thereby limiting the design and production of their products.[5] Additionally, without U.S. licenses, U.S. companies were prohibited from selling advanced semiconductor technologies and equipment with process nodes of 10 nanometers (nm) and below to SMIC, hampering its progress in advanced processes.[6]

In 2022 and beyond, the United States has adopted more flexible export control measures against China from various angles, particularly in the semiconductor field. For instance, in August 2022, the United States targeted advanced technologies below the 5 nm node for multilateral export controls based on the consensus reached in the Wassenaar Arrangement. The same month, the U.S. government unilaterally implemented control measures on GPU chips, restricting U.S. suppliers, such as Nvidia and Advanced Micro Devices (AMD), from selling chips used in artificial intelligence (AI) and supercomputers to China.[7] Furthermore, it also imposed restrictions on KLA, Lam Research, and Applied Materials regarding selling semiconductor manufacturing equipment used in the production of 14 nm logic chips to China.[8]

On October 7, 2022, the United States expanded its export restrictions on Chinese chips and equipment by modifying the Export Administration Regulations through an announcement by the Bureau of Industry and Security under the U.S. Department of Commerce.[9] The main objective of these restrictions is to limit China's capabilities in advanced computing chips, supercomputer development and maintenance, and advanced semiconductor manufacturing, thus initiating a new wave of export controls on China.[10] The new rules leverage the United States' dominant position by prohibiting foreign manufacturing facilities that use U.S. equipment and technology from selling relevant products to China. Additionally, the Netherlands and Japan also announced new export control measures regarding advanced semiconductor manufacturing equipment necessary for the production of logic chips below the 14 nm node in January 2023.[11] Future export control measures may continue to escalate and involve a broader range of control tools to maintain the United States' leading position rather than just following principles that lead by multiple generations.

Furthermore, recognizing the lack of advanced domestic semiconductor manufacturing capacity as a national security issue amid the U.S.-China tech war and the post-pandemic chip shortage, the United States enacted the CHIPS and Science Act to enhance domestic semiconductor chip production and research capabilities, reducing dependence on other countries for manufacturing.[12] The CHIPS Act also provides a 25 percent investment tax credit for semiconductor manufacturing companies, narrowing the cost gap between investments in the United States and overseas.[13] In relation to these subsidies, the Department of Commerce has released details of the CHIPS Incentives Program for commercial fabrication facilities and has proposed national security guardrails.[14] The proposed guardrails are meant to ensure that the technology and innovation funded by the CHIPS Act are not used by hostile countries (including China, Russia, Iran, and North Korea) for malicious actions against the United States or its allies and partners.

The guardrails provision, which restricts chip production, research, or technology licensing in China, has sparked opposition from various sectors, as it affects market layout and the existing operational plans of companies. The Semiconductor Industry Association (SIA) in the United States believes that the guardrails proposed by the Department of Commerce go beyond the scope of the CHIPS Act. The SIA argues that the proposed regulations overly expand restrictions from joint research and technology licensing to include general business activities such as patent licensing and participation in standard-setting organizations, which will impact industry and market development.[15] The SIA suggests that subsidies under the CHIPS Act should prioritize activities related to national and economic security, but the current scope is too broad and ambiguous.

The South Korean government, along with its companies, and Taiwanese manufacturers believe that (1) the provision of revenue sharing is not a commonly used norm to attract foreign investment, as it requires the disclosure of commercially sensitive information, and (2) revenue sharing may affect subsidized companies' operational plans in China. Instead, they propose ensuring that overseas facilities can operate normally.[16] They will continue to negotiate with the United States and hope that an optimal balance can be achieved through negotiations. Otherwise, the CHIPS Act will become too complex and interdependent to be implemented.[17]

Impact on Taiwanese Industries and Countermeasures

The United States has shifted its focus from targeting specific companies through entity lists to controlling technologies and setting thresholds for U.S. suppliers. By implementing control measures at the source, the scope of the measures has expanded to include not only Chinese companies but also foreign companies operating in China. Rather than imposing a complete export ban, the current series of high-tech control measures implemented by the United States requires manufacturers to undergo review.

Foreign companies in China, such as Samsung, SK Hynix, and TSMC, obtained temporary general licenses for six months after the implementation of the October 7 controls to prevent disruptions in their supply chains for goods produced in China but ultimately destined for customers outside of China.[18] However, after the expiration of the temporary licenses, these measures will increase compliance costs for pertinent companies and potentially lead to their withdrawal from China. The World Bank said the ongoing trade war is creating non-tariff barriers, which will result in fragmenting markets and supply chains, as well as reducing collaboration and knowledge sharing in technology innovation.[19] Therefore, it is likely that the link between the U.S. and Chinese semiconductor industries will weaken, leading to fragmented standards, differentiated supply chains, and a potential slowdown in global semiconductor technological diffusion and innovation.

The United States is expanding its export controls on China in the semiconductor manufacturing and supercomputer industries, indicating a shift in the U.S. regulatory mindset.[20] This not only slows down China's progress in advanced technology research and innovation but also extends the impact to well-established mature-process (16 nm or larger) industries in China, potentially even leading to their downgrading. This measure has prompted Chinese companies to shift their focus toward mature-process capacity development.[21] It is expected that China's mature-process capacity will significantly increase in the coming years.

The United States aims to restrict the operational planning of international companies in China by implementing export controls and the provision of guardrails. Faced with production restrictions and increased geopolitical risks, it is anticipated that international companies will adjust their China footprint by shifting investment focus back to their home countries or diversifying regional investments. International integrated circuit design companies, driven by customer demands and autonomous risk-mitigation factors, are

also gradually transferring mature-process orders to non-China foundries. In the short term, this shift benefits non-China foundries, but in the long term, they will still have to face the low-cost competition from Chinese counterparts who have made significant investments in mature processes. This situation creates a complex landscape of short-term opportunities and long-term challenges for non-China foundries.

Many technology companies have utilized the six-month grace period provided by temporary general licenses to shift their supply chain operations outside of China, but it is not technically or financially feasible for some other companies. Therefore, they actively seek potential alternatives, such as arguing that their products should be classified outside of the scope of the new restrictions. The feasibility of such claims may be tested in court by the Bureau of Industry and Security. Another potential point of contention is the FDPR, which determines whether a product is truly a "direct product" of U.S.-defined "technology" and "software" under the Export Administration Regulations.[22]

Taiwan's semiconductor industry has developed over 40 years and has established more than 1,000 related companies in its supply chains, making it one of the most efficient global production clusters. In response to U.S. requirements, TSMC plans to invest $40 billion to build two wafer fabs in Arizona.[23] This investment is a result of confirming local customer demands in the United States and having long-term contracts in place. Customers and the U.S. federal government have committed to sharing part of the costs to enhance return on investment. However, TSMC currently faces challenges, such as rising costs in construction and operation, which will reduce profitability. Additionally, the eligibility requirements for subsidies under the U.S. CHIPS Act, difficulties in attracting global talent to work in the United States, and the complexities of managing U.S. employees pose further obstacles for TSMC.[24]

The primary applications of TSMC's advanced processes, including high-performance computing (HPC) chips for AI and supercomputers, are within the scope of the current export restrictions. In the first quarter of 2023, these HPC applications accounted for 44 percent of TSMC's revenue.[25] However, related restricted companies such as Nvidia have indicated the availability of alternative downgraded products for sustained export to China. In the short to medium term, it is not expected to significantly impact the revenue of TSMC.[26] If the scope of the restrictions is expanded in order to prevent any loopholes and includes other advanced process chips (such as mid-range GPUs and HPC chips used in consumer products), it will affect TSMC's revenue from advanced process manufacturing and weaken its capability to invest in advanced processes in the long run.

TSMC announced that it is building additional mature-node capacity outside of Taiwan.[27] In Japan, TSMC and its Japanese partners are building a specialty technology fab which will utilize 12 nm, 16 nm, and 22 nm/28 nm process technologies. Volume production is scheduled for late 2024.[28] TSMC is also considering building a second fab in Japan, as long as customer demand and the level of government support makes sense. TSMC announced that it will jointly invest in European Semiconductor Manufacturing Company (ESMC) with Robert Bosch (Bosch), Infineon, and NXP to establish a €10 billion ($10.8 billion) 12-inch (300-millimeter) wafer fab in Dresden, Germany. TSMC will invest €3.5 billion ($3.8 billion) alongside an allocated €5 billion ($5.4 billion) of support from the German government. TSMC will hold 70 percent of the shares and other companies will each hold 10 percent of the shares. Construction will begin in 2024, with first production expected to begin in 2027.[29] In China, TSMC is expanding 28 nm capacity in Nanjing as planned to support local customers and continues to fully follow all rules and regulations.[30]

TSMC's overseas investments have sparked debates in Taiwan regarding whether it is "hollowing out Taiwan" or pursuing "global expansion."[31] TSMC continues its research and development of 3 nm (N3), 2 nm (N2), and 1 nm (N1) advanced processes in Taiwan.[32] It is expected to advance to N3E, an enhanced version of N3, in

the second half of 2023, with the N2 process entering risky production trials in the second half of 2024 and reaching mass production in 2025.[33] As for location, TSMC plans to establish N2 fabs in Hsinchu's Baoshan and the Central Taiwan Science Park, and even the N1 process is planned to be located in Longtan, Taoyuan.[34] Therefore, TSMC's Taiwan headquarters will continue to maintain its leadership in process technology and keep the most advanced technologies and research capabilities in Taiwan to ensure Taiwan's global leadership position and alleviate concerns of "hollowing out Taiwan."

Talent development is key to TSMC's success. TSMC has hired more than 900 U.S. employees to date in Arizona and more than 370 in Japan.[35] In addition to providing extensive training program for new overseas employees, many of them are brought to Taiwan for "hands-on" experience in fabs so that they can further their technical skills. Talent cultivation is vital to support TSMC's future expansion of its global footprint, and pertinent assistance provided by host countries at both the local and central levels will bring positive impacts for building robust, localized semiconductor ecosystems.

Taiwanese Government Strategies and Actions in Response to U.S. Policy

Taiwan's high-tech industry holds a crucial position in the global supply chain. While some exported goods have commercial applications, they can also be used for military purposes. To fulfill international responsibilities and protect the export interests of Taiwanese manufacturers, the Taiwan government established the Strategic High-tech Commodities Management System on July 1, 1995 under the "Regulations Governing Export and Import of Strategic High-tech Commodities," which was enacted on March 31, 1994.[36] Export controls for semiconductor wafer fabrication process technology were implemented in accordance with the Wassenaar Arrangement.

A significant portion of production equipment, technology, and products in the semiconductor industry is subject to controls. Export of semiconductor wafer manufacturing equipment falls under the "Export Control List for Dual Use Items and Technology and Common Military List" and requires applying for an export license.[37] The exporter must also specify the wafer size and process technology level in the export license.

Regarding applications for Taiwanese semiconductor manufacturers to invest in China, the Ministry of Economic Affairs (MOEA) has issued the "Operational Guidelines for Key Technology Review and Supervision of Investment in Foundry, Integrated Circuit Design, Integrated Circuit Packaging, Integrated Circuit Testing, and LCD Panel Plants in Mainland China."[38] These guidelines include several key points. First, for new foundries, an overall quota-control approach should be adopted, with a maximum limit of three 12-inch fabs approved for investment. There are no quantity restrictions for mergers, acquisitions, or investment in mainland China's foundries. Second, the invested process technology must be one generation behind the company's most advanced technology in Taiwan. And third, the applicant must be a Taiwanese foundry company.

Concerns about TSMC investing overseas and potentially "hollowing out" Taiwan have prompted the MOEA to promote amendments to Article 10-2 of the Statute for Industrial Innovation, commonly known as the Taiwan Chip Act.[39] This amendment aims to provide tax incentives to Taiwanese companies that hold critical positions in the international supply chain, with the main goal of encouraging research and development in Taiwan and enhancing the country's industrial research capabilities to maintain its leading position. The Taiwan Chip Act, dubbed the "largest investment incentive in history," includes forward-looking innovative research and development incentives, which account for 25 percent of the expenses incurred. Additionally, the purchase

of new machinery or equipment for advanced manufacturing processes is eligible for a 5 percent deduction, reducing the amount of corporate income tax payable for the current year.[40]

To safeguard Taiwan's competitiveness and economic interests in the high-tech industry and prevent China from stealing technology and poaching Taiwanese talent, the Taiwanese government announced amendments to the National Security Act on June 8, 2022.[41] The revised law incorporates protection for trade secrets related to national core critical technologies under Article 3, aiming to deter malicious talent poaching and unauthorized outflow of key core technologies to competitors such as China. Furthermore, the Cross-Strait Relations Act and the National Security Act were simultaneously amended and announced on June 8, 2022, adding provisions that individuals, corporations, groups, or other institutional members engaged in national core critical technology businesses under the commission, subsidy, or investment of government agencies or organizations must obtain approval through a review process coordinated by the Ministry of the Interior and other government agencies before going to China.[42] The same applies to those who have terminated their commission, subsidy, or investment or have resigned within three years.

In March 2022, the U.S. government proposed the formation of the Chip 4 Alliance, also known as Chip 4, with Japan, South Korea, and Taiwan.[43] After the passage of the CHIPS Act, the United States actively accelerated the alliance's promotion. The United States claims that Chip 4 will provide a platform for governments and companies to discuss and coordinate supply chain security, semiconductor talent, research and development, and subsidy policies. The United States' potential intention may be to form an "anti-China alliance" by jointly promoting semiconductor exports and technology control measures with Japan, South Korea, and Taiwan. In summary, the United States plans to bring governments and companies together under the alliance framework. With Japan's competitive advantage in semiconductor equipment and materials, Taiwan's complete semiconductor industry clusters, and South Korea's leading position in memory, Chip 4 will enable the United States to view Japan, South Korea, and Taiwan as part of its semiconductor strategic influence. According to an analysis by the *Korea Times*, the United States' preparations for Chip 4 may appear to be aimed at countering China's semiconductor rise, but its true purpose could be to buy time and strengthen U.S. chip manufacturer Intel.[44] Meanwhile, Taiwan's MOEA has proposed two major directions under the Taiwan Initiative for Chip 4 focusing on semiconductor supply chain collaboration and resilience as well as ensuring the security of vital chip supplies.[45]

The semiconductor industries in Japan, South Korea, and Taiwan are closely intertwined with the Chinese market, making it impractical to form an alliance that completely cuts off the semiconductor supply chain to China.[46] In practice, relevant companies are caught between the U.S.-China confrontations. Companies need to devote extra resources to develop downgraded products to comply with U.S. policy restrictions to maintain their position in the Chinese market. On the other hand, companies also need to endure unfair competition brought by the Chinese government through the Dual Circulation as well as looming retaliations.[47] Additionally, the semiconductor supply chains of South Korea and Taiwan have been engaged in mutual competition with their U.S. counterparts for years. South Korea and Taiwan collectively hold over 80 percent of the global chip manufacturing market, making it essential to properly safeguard their critical intellectual property rights and corporate value.[48] It is not feasible for them to become mere followers of the U.S. semiconductor industry monopoly within the framework of Chip 4, and there are significant concerns regarding the goals and benefits of establishing Chip 4.

Facing the changing geopolitics, Taiwanese companies expect the Taiwanese government to fully grasp the evolution of foreign policies, communicate promptly with industry players, and devise strategies to adapt

to the changing global supply chain. This includes comparing and analyzing the geo-economic strategies of various countries and examining the compatibility and responsiveness of Taiwan's own strategies, ensuring the indispensability of relevant industries in Taiwan within the global supply chain. Furthermore, the government should address the requirements for Taiwan's supply chain autonomy and resilience. It should carefully evaluate national security and domestic and international needs and assist relevant businesses in implementing decentralized layouts to maintain the position of Taiwanese businesses in the global supply chain.

Conclusion and Recommendations

The United States' efforts to contain China's rise through export controls and restructuring the global semiconductor industry are unlikely to yield substantial results in the long run. Imposing restrictions on the semiconductor industry will only push China toward self-reliance and accelerate the development of its domestic semiconductor industry. This may lead to Beijing successfully developing advanced semiconductor manufacturing processes and even constructing an independent semiconductor industry supply chain free from U.S. technology. U.S. containment of China will be effective only in the short to medium term, and industry analysts are optimistic that China will eventually break through the U.S. blockade to establish its own advanced semiconductor industry.[49]

China is actively seeking breakthroughs in U.S. technology restrictions through independent innovation. Some Chinese companies are shifting toward the open-source RISC-V architecture, fearing the loss of access to Intel x86 and ARM instruction set architectures.[50] Over half of the 22 premier members of the RISC-V International Association are Chinese enterprises and research institutions. Chinese companies account for nearly half of the association's 3,180 members.[51] Several large Chinese companies have already released RISC-V chips, formed a new international grouping, and demonstrated China's ability to overcome U.S. technology restrictions.

Experts believe that completely isolating U.S. technology and talent from the Chinese semiconductor market may cause the United States to lose its strategic weapon of using technology to constrain China. It could also result in companies participating in the U.S. blockade losing access to the Chinese market. Overall, U.S. policy toward China is based on an illusion, which is the root cause of the ineffectiveness of U.S. policies toward China.[52] Therefore, some experts suggest that to contain China it would be more effective to let China rely on Western chips and technology.

However, as the scope of the U.S. blockade on the Chinese semiconductor industry expands, it is described as casting a "silicon curtain" over China.[53] The global semiconductor production chain will be divided into two poles: China and non-China. Taiwan mainly serves U.S. customers through foundry services, and in the future, convincing U.S. customers to place orders at the higher-priced Arizona fabs will be an operational challenge that TSMC needs to overcome. China is the largest semiconductor market globally, but the United States dominates critical semiconductor technology, equipment, and materials, and its international political influence far exceeds that of China. Finding a balance in the technology war between the United States and China will be a crucial issue for Taiwanese companies to address.

The United States, Japan, and Europe have attracted major domestic and foreign manufacturers to invest in research and development and establish fabs through semiconductor policies, aiming to build resilient supply chains. TSMC, considering the evolving government policies, overall economic environment, customer demands, and market trends in the United States, Japan, and Europe, has announced plans to establish fabs in Arizona in the United States, Kumamoto in Japan, and Dresden in Germany, taking a global perspective

on investment projects.[54] However, the challenges faced by TSMC in setting up overseas plants require cooperation between TSMC and pertinent central and local governments—whether the goals set by various countries can be achieved in the future remains to be seen. For example, the cost of investing in the United States is 50 to 70 percent higher than in Taiwan.[55] The CHIPS Act alone is definitely not enough to compensate for this difference, especially because many peripheral suppliers cannot apply the CHIPS Act at all. Therefore, accelerating the promotion of the Taiwan-U.S. double taxation agreement has become the general expectation of Taiwanese industries.[56]

The geopolitical factors and regulatory supervision triggered by the U.S.-China tech war and various countries' semiconductor bills will continue to reshape the global semiconductor industry's landscape. The decisionmaking process for multinational corporations' investment layouts has shifted from traditional considerations such as production costs, market attractiveness, technological support, and talent supply based on market dynamics and business realities to decisions made under the interference and restrictions of international relations and geopolitics. This is likely to significantly dampen the competitiveness of related industries. The Taiwanese semiconductor industry approaches geopolitical rivalry more discreetly. Even when forced to comply with relevant regulatory measures and respond to political pressures, the focus should still be on the deployment of advanced technologies and critical applications. By mastering more core technologies, Taiwan can maintain its global competitiveness and preserve its critical position in the global semiconductor industry.

European Union Perspective

Current EU Regulations Struggle to Adapt to a Post-October 7 World

By Francesca Ghiretti and Antonia Hmaidi

Introduction

In the European Union, export control regulations have become an increasingly pressing issue, especially since the Netherlands decided to expand its national export controls to "certain types of advanced semiconductor manufacturing equipment" by using articles 9 and 10 of the European Union's 2021 regulation on dual-use export controls.[1] While the new expansion of Dutch export controls does not officially target China, the process of adoption and the technology they focus on leave little doubt over who is the target. The Dutch expansion of export controls partially aligns with the United States' new export controls adopted on October 7, which explicitly target China, and Japan's new export controls, which do not.

The issue of new export controls is twofold: China and the United States are engaged in a deepening great power competition that, for better or for worse, involves Europe as well. Technology plays a major role in that competition, but Europeans are traditionally not used to using protective measures strategically.

The European Union has mostly been relying on traditional, multilateral dual-use export controls such as the Wassenaar Arrangement. Unfortunately, export controls under Wassenaar are unlikely to be expanded since Russia is a member and will block any such expansion. A proliferation of different export control regimes in the world, but especially within the European Union, which is possible under EU law, would be dangerous for EU unity, create gaps in the control of exports, and not help Brussels or national capitals to address the new challenges posed by the systemic competition between the United States and China, nor the role technology plays within it.

The Changing EU Assessment of China

The European Union has been rethinking its foreign and security policy in a context of tension and uncertainties. The elements that led to the rethinking are known: the Covid-19 pandemic, the tensions

between the United States and China, and the war in Ukraine. To that, one might add the tensions with the Trump administration for the tariffs introduced in 2018 and 2020 on steel and aluminum (suspended since October 2021) and China's frequent use of coercive economic practices.[2] The result is an unofficial shift in the European Union's approach to China. In the 2019 *EU-China Strategic Outlook,* the European Union adopted a three-part framework that views China as partner, economic competitor, and systemic rival. That framework remains in effect, and the European Union is still actively seeking to find areas of cooperation and collaboration with China. However, the "partner" element of the relationship has become more difficult to carry on.[3]

Hence, there is a slow reckoning that the "competitor" and "systemic rival" elements have become more predominant in the bilateral relationship than "partner." The European Council conclusion of June 30 mentions the European Union's intentions to "continue to reduce critical dependencies and vulnerabilities, including in its supply chains" and "de-risk and diversify where necessary and appropriate."[4] Two reasons make this important. First, it shows that the European Council views elements of European economic security, such as de-risking and diversifying, as core goals for the relationship with China. Second, through the use of the word "continue," it demonstrates that the effort to increase the European Union's resilience vis-à-vis China is not new and preceded both the European Council's conclusions on China and the EU Economic Security Strategy from June 2023.[5]

The EU Toolbox for Economic Security

A few weeks before the publication of the European Council's conclusions, the European Commission and the European External Action Service articulated the EU Economic Security Strategy in a joint communication that presented yet another three-pronged approach: promote, protect, and partnership.[6] Many of the policies and measures—the so-called toolbox—listed in the communication have already been presented or adopted by the European Union in past months and years. Table 1 attempts to organize them in the three approaches identified, though there will be some overlap that is not reflected.

Table 1: The European Union's Economic Security Toolbox: Promote, Protect, and Partnership

Promote	Protect	Partnership
Deepening the single market (capital market union)	Trade defense instruments	Free trade agreements
Cohesion funds	Cyber Resilience Act	Cooperation with partners (including long-standing, like-minded partners, such as the members of the G7, as well as others with whom the European Union shares common interests)
NextGeneration EU	Foreign subsidies regulation	Global Gateway
Industrial strategy	Toolkit on Tackling Foreign R&I Interference	Trade and Technology Councils
Strategic Technologies for Europe Platform	Directive on the Resilience of Critical Entities	Partnership with developing countries
–	Revised Directive on the Security of Network and Information Systems (NIS2)	Partnership for Global Infrastructure Investments
European Chips Act	5G/6G security (5G Toolbox)	European Chips Act

Promote	Protect	Partnership
Critical Raw Materials Act	Foreign direct investments screening	Critical Raw Materials Act
Net-Zero Industry Act	Export controls	Critical Raw Materials Club
Global Gateway	Anti-Coercion Instrument Cyber Resilience Act Cyber Solidarity Act Outbound investment screening	–

Source: Authors' analysis.

Semiconductor export controls will be an important trial by fire for the new EU Economic Security Strategy as well as for assessing how successful the European Union can be as a strategic actor, but it will not be the last test the strategy faces. By the end of 2023, the European Commission has pledged to do the following:

> review the existing Foreign Direct Investment Screening Regulation . . . fully implement the EU's export control regulation on dual use and make a proposal to ensure its effectiveness and efficiency . . . [and] propose an initiative to address security risks related to outbound investments.[7]

Embedding export controls in a larger economic security strategy and basing them on the list of critical technologies the European Commission is currently identifying could increase member states' buy-in, decrease potential blowback, and ensure uniform application across the European Union. But that is not an easy outcome based on the current state of the European Union, and member states especially, on this issue. There are three primary areas that may challenge the European Union's ability to use semiconductor export controls strategically: (1) the current design of EU export controls, (2) the European Union's focus on legacy semiconductors, and (3) disagreement with the United States over the October 7 export controls.

Current EU export controls are not up for the challenge of critical emerging technologies such as semiconductors, but an expansion is tricky.

EU export controls are still narrow in scope and cover only dual-use goods, and in theory member states have given the mandate to the European Commission to expand the list of items included in the export controls to harmonize it with multilateral agreements such as Wassenaar.[8] The traditional interpretation of this statute would suggest that the commission should not make amendments to the list beyond that purpose; for example, it should not amend it in line with the new Dutch export controls on semiconductors or similar nationally adopted export controls in the future. However, the commission could test the flexibility of the mandate.

Other member states could follow the Netherlands, which used article 9, and use the procedure envisioned in article 10 to themselves adopt the same export controls at the national level. The European Commission and the Netherlands can incentivize the adoption of cohesive lists via dialogues and diplomatic engagement.

Alternatively, following an internal risk assessment and the publication of the list of critical technologies in September, the European Commission could interpret its mandate broadly and make the case to change the list to protect those technologies. According to the potential risks identified in the internal assessment, the commission will propose different measures, among them potentially the expansion of the list of items subject to export controls. In that instance, however, at least informal support from member states would be required. In fact, member states can revoke the mandate given to the commission via a qualified majority

vote, which is likely to happen if member states perceive the actions from the commission as a "power grab" of a national competence. Furthermore, even if the commission expands the list of items, the competence for licensing stays with member states, and they would not be forced to screen the items in the list proposed by the commission but would be strongly encouraged to adapt national licensing accordingly.

A lack of strategic and cohesive expansion of export controls by the European Union and member states would leave the block vulnerable not only to the export of sensitive technologies, but also to being pushed around by great power competition instead of setting its own agenda. Nonetheless, the formal process to expand export controls is only one of the many obstacles the European Union faces when thinking about export controls. The others include the difficulty in separating commercial and military uses of emerging technologies and the complexity of supply chains for these technologies, which makes controlling such components exceedingly difficult.

Commercial and dual-use technology is increasingly difficult to keep apart, making the strict division the European Union's export controls currently relies on not fit for purpose. With China's expanding definition of security, progressing military-civil fusion, and the "all-of-nation system" to address technology bottlenecks, "strategic technology" is everything China's state needs to survive, according to the Chinese Communist Party. The party's goal is for all strategic technologies to be produced indigenously in China to secure supply chains against sanctions and the effects of export controls. New technologies further blur the lines between military, commercial, and dual use. Semiconductors are inherently dual-use, and while there are some semiconductors that are specifically made for the military, such as radiation-hardened semiconductors, which more easily fall in the list of controllable items, off-the-shelf semiconductors are becoming more powerful and increasingly can be used for military purposes, making targeted export controls ever more difficult and less effective.[9] Commercial technologies such as artificial intelligence and off-the-shelf semiconductors are increasingly being used in the military sector.[10]

The European Union plays an important role in semiconductor supply chains, but this activity is not equally distributed among all EU member states, making coordination of policies more challenging. Overall, the European Union is a net importer of integrated circuits and a net exporter of production equipment. On materials needed for semiconductors such as silicon and gallium, the European Union is again a net importer.[11]

While a lot of the semiconductor supply chain is concentrated in Germany and the Netherlands, other EU member states play a role as suppliers or in some applications and research. The Netherlands, with ASML and ASM International, hosts world-leading companies, which, in the case of ASML, have a monopoly on specific advanced machinery, specifically extreme ultraviolet lithography. Germany plays a dual role, as a supplier of key chemicals, optics, and materials for both tool producers and chipmakers and as an important supplier of niche semiconductors. Mentor Graphics, a U.S.-headquartered subsidiary of German industrial giant Siemens, is one of only three producers of electronic design automation software, with a market share of roughly 20 percent.[12]

The European Union's strength is in legacy semiconductors not directly impacted by recent U.S. export controls.

Europe also has an important role in research and development (R&D). Belgium-based Institut de Microélectronique et Composants is an R&D center collaborating with semiconductor firms worldwide.[13] While Europe is very good at research and innovation, it is so far much less successful in translating this to industrial benefits.[14] Very few chips today are designed or manufactured without U.S.-origin intellectual property.[15]

The European Union currently holds roughly 10 percent of global chipmaking revenue, which is concentrated in power and industrial semiconductors.[16] The most important European companies include the Netherlands'

NXP Semiconductors, Swiss-headquartered STMicro, Germany's Infineon and X-FAB Silicon Foundries, and Austria's AMS AG.[17] These are focused on larger node sizes, analog chips, power semiconductors, sensors, and micro-electronic mechanical systems. Demand for these semiconductors is set to grow, especially with the green transition. While these semiconductors are often called legacy because they do not need to use small node sizes (and often even cannot use small node sizes due to physical properties), there is a lot of innovation happening, especially process innovation. As a result, China is increasingly competing with European semiconductor companies in areas of traditional European strength.

Regarding important consumers of semiconductors, Europe has a strong industrial base, with 37 percent of European semiconductor demand coming from the automotive industry and 25 percent coming from industrial manufacturing.[18] Communications accounts for a further 15 percent, driven by European telecommunication equipment companies Nokia and Ericsson. Europe currently does not have a strong consumer electronics industry, one of the key direct consumers of current-generation chips.

Furthermore, power semiconductors and other wide-band gap semiconductors have very clear military applications, making them dual-use. Additionally, new materials such as silicon carbide and gallium nitrate are used both for dual-use chips and for some military components such as radars.

The EU Chips Act is an EU policy aimed at strengthening the European Union as a chip producer while also addressing shortages and improving coordination. While it makes EU funding available, its most important provision makes it possible for EU member states to subsidize semiconductor companies in their own countries. Since the European Union is a single market, there are usually clear limits to subsidizing industries internally, but these have been effectively halted for semiconductor companies, provided they will build a "first-in-its-class" facility in Europe. This currently mostly applies to manufacturing and has the goal of increasing the European Union's share of global semiconductor revenue to 20 percent. For instance, Germany is subsidizing an Intel fab in Magdeburg with $10 billion, 30 percent of the overall investment costs.[19] This fab is set to house Intel's most advanced manufacturing processes.

Europe does not completely buy into the arguments for the United States October 7 export controls.

EU member states and officials are not happy with the United States' unilateral imposition of extraterritorial sanctions and export controls.[20] This became an especially important point when Trump reneged on the Iran deal, thus forcing European companies to halt their Iran business or try to completely separate their business with Iran from the rest of the world.[21]

The United States' October 7 controls received mixed reactions in Europe. Many countries, as well as Brussels, have increasingly recognized the risks of the relationship with China, and they do not wish for European technology to contribute to China's military modernization nor its repressive surveillance programs. At the same time, while the European Union sees China as a systemic rival, it does not see China as a security threat. The European Union still wants to construct a positive agenda with China, and from several conversations with EU officials it is clear that the bloc does not want to adopt policies, especially economic security policies, that explicitly target China. This difference is at the core of obstacles to transatlantic coordination on economic security policies, including export controls.

Most EU companies do not produce the cutting-edge chips covered under the October 7 controls. The pressure has thus been most acutely felt by equipment manufacturers. Since the United States did not originally invoke the Foreign Direct Product Rule on semiconductor manufacturing equipment, EU companies are less

affected.[22] Interviewees—including figures from EU companies and research organizations—frequently pointed out the administrative burden these export controls put on European actors. Out of necessity, many EU companies have become experts at U.S. export control law.

European stakeholders are concerned by the unintended consequences of U.S. export controls. China is already increasing investment in nonrestricted sectors such as legacy chips, areas of strength for Europe.[23] U.S. export controls are seen as further encouraging China's drive toward self-reliance in technology, hurting European businesses in China if they do not indigenize their entire supply chains. During the last Trade and Technology Council, held in Sweden, parties expressed that they "share concerns about the impact of non-market economic policies, on the global supply of semiconductors, particularly in legacy chips."[24]

There is also worry about possible retaliation from China against the European Union or member states, should they implement export controls similar to those adopted by the United States.[25] In July, China announced the introduction of new licenses for the export of gallium and germanium starting in August. The two metals are needed for the production of semiconductors and electronic components.

Furthermore, EU companies and politicians are increasingly worried about the United States' approach. The decision by the United States to engage with the Netherlands directly, instead of with the European Union, has been criticized.[26] Belgian prime minister Alexander De Croo, for instance, argued that the United States making deals with individual countries instead of the European Union as a whole makes these countries vulnerable to "bullying" by the United States.[27]

The EU-Specific Risk

On the one hand, targeting key countries may appear to be a faster and efficient solution. After all, why wait for the slow process of EU coordination when you only really need a handful of member states? And this may actually be a preferred solution for those member states who do not want to adopt extra export controls when they have no relevant interests or are not directly involved in semiconductors. It is also a good way to get the ball rolling, and then maybe other member states and the European Union as a whole will follow, which is likely to be the outcome of these new rounds of export controls.

However, such an approach presents two very specific issues for the European Union. Firstly, if the controls introduced at the state level vary greatly, gaps and blind spots are likely to emerge. With the single market, nonrestricted goods can flow internally, and thus goods could be exported via other countries. Secondly, single member states can be exposed and singled out. In fact, it is undeniable that one member state has less negotiating power than the whole of the European Union, and by being bilaterally targeted, it is also deprived of the protection the bloc can provide. Furthermore, possible eventual retaliation could be targeted at one member state rather than the whole of the European Union, leaving the state exposed to economic coercion.

As China has been shown to target the weakest link, this can facilitate the emergence of internal divisions and self-interest in EU member states who may not be willing to take a hit to protect another member state. The EU Anti-Coercion Instrument partially addresses this issue, but does not do so entirely. That is probably one of the reasons why The Hague has kept communication and coordination with Brussels open throughout the process—to avoid being isolated as the sole culpable actor in case of economic coercion.

A Constructive EU Economic Security Agenda beyond Export Controls

While the European Union is firmly in the U.S. camp when it comes to security, EU leaders also want to maintain a clear difference from the United States when it comes to economics and dealing with China. While the United States views China as a threat to national security, European perceptions of China remain based on the three-pronged approach of partner, economic rival, and systemic rival, with oscillations within this spectrum based on events and member states' preferences.[28] On top of this, the European Union and member states are still digesting the possibility and need to strategically use measures such as export controls.

Those two elements will have an impact beyond export controls on the broader economic security agenda. That is why the European Union's own list of critical technologies and its risk assessment are key to the construction of an effective EU economic security agenda. They provide evidence and a logic to the expansion and strategic use of measures such as export controls. Those two steps will largely determine the direction of the economic security strategy and provide solid guidelines for the adoption, update, and implementation of the policies mentioned as well as others. In the economic security strategy, Brussels has already identified four macro risks—to (1) the resilience of supply chains, including energy security; (2) the physical and cybersecurity of critical infrastructure; (3) technology security and leakage; and (4) the weaponization of economic dependencies or economic coercion—but these need further elaboration regarding the specific risks they entail, their potential impact, and the likelihood of their occurrence.

Although Brussels' assessment is going to be key, the risk assessment of member states is also going to be fundamental for the success of the EU Economic Security Strategy. Member states know better than Brussels what risks they face and will better foresee how to prepare and respond to them. And in most instances, member states are the only ones that can implement economic security measures. The two levels then can debate which instances need a national response and which are better addressed by the European Union as a whole and in coordination with partners.

If the European Union is able to use the Dutch expansion of export controls to adopt a more strategic approach to economic security, it could position itself better in the new world of great power competition and build its own agenda-setting power.

United States Perspective

Export Controls as an Instrument of Foreign Policy

By Emily Benson and Catharine Mouradian

Introduction

Export controls have long played a central, albeit relatively quiet, role as an instrument of foreign policy. In short, export controls are regulations and laws implemented by governments to restrict and monitor the export of certain goods, technologies, and services from one country to another.[1] Governments have used them extensively throughout history to control the outflow of critical technologies. The primary objective of export controls is to protect national and international security by preventing the proliferation of weapons of mass destruction. While export controls are not a panacea to achieve non-proliferation and other strategic objectives, they are a useful tool in denying or delaying the ability of foreign actors to obtain technology needed to advance weapons programs.

Multilateralism is key to the effectiveness of controls.[2] If one country produces an item that can be used in a foreign military context and regulates the outflow of those products, but other producers do not, then the likelihood of backfilling–the practice of others supplying to meet the now unfilled demand–weakens the controls. It can also depress the revenue of domestic suppliers of those critical inputs. Therefore, multilateralizing controls can be a determinant factor in whether or not export controls succeed.

In recent decades, the United States has been at the forefront of export control policy. In the aftermath of World War II, the U.S. Export Control Act of 1949 established the modern U.S. system for controlling dual-use goods. During the Cold War, the United States established the Coordinating Committee for Multilateral Export Controls (COCOM) that brought together 17 mostly European countries as well as Japan and Turkey.[3] COCOM was characterized primarily by "East versus West" competition during the Cold War.[4] This manifested in broad geographic-based controls, as participating members believed that certain items allowed for export to the Soviet Union would likely leak to the Russian military. After the dissolution of the Soviet Union, COCOM ceased

functioning in March 1994. As a replacement, allies sought a more liberal export control system that would benefit the private sector and warm relations with former adversaries.

After the Cold War, in 1996, the United States and allies stood up the Wassenaar Arrangement, the successor to COCOM.[5] Whereas COCOM was colored by strategic policymaking among member states aimed at delaying Warsaw Pact military capabilities, the intention for the Wassenaar Arrangement was to stand up a regime aimed at preventing the destabilizing accumulation of conventional arms and dual-use goods, or those with both civilian and military applications, in a country-agnostic fashion. The Wassenaar Arrangement control list functions somewhat like an export control constitution for member states.[6] Most member states build their domestic control lists to align with the Wassenaar Arrangement list. This legal reliance can make it difficult, if not impossible, for countries to promulgate controls that exceed the items covered by the Wassenaar Arrangement list.

Since the inception of the Wassenaar Arrangement, the geostrategic threat environment has changed substantially, begging fundamental questions about the suitability of the arrangement for the contemporary era.[7] The Wassenaar Arrangement is a consensus-based organization that includes Russia, and while Russia has long played a complicated role inside the organization, it has become increasingly obstreperous since the 2022 invasion of Ukraine, essentially halting new additions to the control list. Concurrently, an exponential growth in digitization obscures the ability in some cases to work through an institution that was largely built for the hardware era. Further compounding problems is that the regime is not geographically tailored. This feature cripples it from carrying out controls specifically aimed at China at a time when China is pursuing a doctrine of civil-military fusion.[8] These factors have led to calls to establish a new export control regime or, at a minimum, to rethink many of the core functions of the Wassenaar Arrangement and allied approach to export controls.[9]

In addition to changes in the "protect" side of the agenda, the "promote" pillar is also changing with the renewed use of industrial policy. In August 2022, the United States passed the $52 billion CHIPS and Science Act package.[10] The European Union has since passed the $46.7 billion (€43.9 billion) EU Chips Act, while South Korea's K-Chips Act expands tax deductions on investments into the semiconductor industry.[11] The simultaneous expansion of the "promote" and "protect" pillars of an international policy is reshuffling supply chains, infusing geopolitical risk calculations into decisionmaking, and calling into question the foundations of the multilateral approach to managing strategic trade.[12]

This confluence of factors—a hobbled multilateral export control regime, the need to recover domestic production capacity, and national security concerns about chip-driven weapons—has led the United States to assume, as it has done in the past, a leadership role in designing and enforcing export controls for allied producers of advanced technology. In promulgating the October 7 controls, the United States has once again significantly retooled the global export control landscape. In moving export controls to the forefront of the international agenda, the United States is communicating that export control cooperation is in most cases a prerequisite for deeper integration of high-tech sectors such as semiconductors.

The October 7 Export Controls

In a September 2022 speech previewing the administration's thinking on controls, U.S. National Security Advisor Jake Sullivan explained that "export controls can be more than just a preventative tool."[13] Rather than maintaining the status quo of using export controls to delay foreign adversaries from gaining advanced technology, the United States needed instead to adjust controls to gain "as large a lead as possible." Onlookers have broadly observed that this speech acknowledged a U.S. shift away from simply "delaying" foreign military capabilities to one of "degrading" them.[14]

Chinese military acquisition contracts show that China is using U.S. chips in military applications, including hypersonic missile and nuclear weapons simulation.[15] Expanding export controls to cover advanced chips is predicated on the idea that allies should not export items to certain countries where such items could be used against them in a military conflict. The U.S. response has centered around expanding controls on its own exports and securing buy-in from other countries that maintain chokepoints over the supply chain.

On October 7, 2022, the United States announced a new tranche of controls aimed at constraining Chinese artificial intelligence (AI) capabilities.[16] First, the October 7 controls added several advanced-node chips used for AI development and supercomputers to the Commerce Control List (CCL).[17] The controls also implemented rules on all related software, components, and semiconductor manufacturing equipment (SME) that meet certain criteria. Not only did the Department of Commerce's Bureau of Industry and Security (BIS) add these items to the CCL, expanding the Export Administration Regulations, but the BIS also included "deemed export" rules, which ban the transfer of controlled items and data to foreign nationals within the United States.[18] The October 7 regulations also include "U.S. persons" rules, creating new licensing requirements for employees of U.S.-headquartered firms working to service covered technology.[19] These rules extend to foreign nationals working in China even if they are not U.S. citizens.

As acknowledged in Sullivan's September 2022 speech, the aim of these controls is to limit the advance of Chinese semiconductor production past a certain threshold.[20] The BIS threshold for the controls is logic chips produced using the 16-nanometer (nm) process node or lower (generally, the lower the node number, the more advanced the chip), short-term memory chips (DRAM) of 18 nm node or lower, and long-term memory chips (NAND), or 128 layers or higher. There are further rules surrounding the export of node-agnostic SME, which is manufacturing equipment used in the production of chips both above and below the node limit. Under the new rules, node-agnostic equipment can only be exported to factories that only produce older models of chips, also known as legacy chips.[21] Foundries that produce more advanced chips will now face a "presumption of denial," meaning BIS operates under the assumption that related licenses will not be granted.[22]

William A. Reinsch, the former Commerce Department undersecretary in charge of the BIS, has surmised that that, without explicitly acknowledging it, the bureau has likely ended the policy of trying to identify "reliable" end users in China, as a result of China's pursuit of civil-military fusion and crackdown on the due diligence firms operating in China that provide vital assessments of end-user reliability.[23] If that is the case, this would mark a significant U.S. reversion toward an export control regime that more clearly parallels U.S. policy toward Warsaw Pact members under COCOM.

In conjunction with the announcement of the new export controls on October 7, the BIS unveiled two new Foreign Direct Product Rules (FDPRs).[24] The FDPR provides the United States with the means to claim extraterritorial legal authority over items with U.S. inputs, including design.[25] The legal basis for these rules has recently surfaced as a statutory tool included in the Export Control Reform Act of 2018 (ECRA).[26] The updated rules allow the United States to promulgate and enforce the extraterritorial application of U.S. export control rules by enabling the United States to claim jurisdiction over items containing U.S. inputs. The FDPR is distinct in that it applies when there is not necessarily any U.S. physical content but the item is produced on U.S. machinery or embodies U.S. technology.

A recent wave of FDPRs accelerated with the Trump administration's use of the rules to close a loophole in export controls on Huawei.[27] The FDPR has also featured prominently in the Biden administration's response to Russia's unlawful invasion of Ukraine and has been used to exercise jurisdiction over consumer product supply chains that contain U.S. inputs, although certain countries have received broad exemptions.[28] The two

recent October 7 FDPRs apply to items used for advanced computers and supercomputing.[29] The FDPRs attempt to preemptively address loopholes in the controls that would allow items containing U.S. technology to be exported to China from another country. This affects foreign firms such as ASML, which use U.S. software and components to develop advanced extreme ultraviolet (EUV) and deep ultraviolet (DUV) machines.[30] This new FDPR meant that the United States could have exercised extraterritorial enforcement of controls if the Dutch government did not reach an affirmative decision to pursue licensing policy changes that align with the U.S. rules.

The U.S. Role in Global Semiconductor Supply Chains

The United States' powerful position in the global semiconductor industry affords it significant geopolitical leverage over chip supply chains.[31] The United States is responsible for 39 percent of the total value of the supply chain, and U.S. firms accounted for 47 percent of sales in 2019. The United States maintains a dominant position throughout several points of semiconductor supply chains.[32] It particularly excels in electronic design automation (EDA), core intellectual property (IP), and some advanced SMEs.[33] It controls 55 percent of overall chip design, 61 percent of logic chip design, and nearly 100 percent of high-end CPUs, GPUs, and FPGAs (advanced logic chips). It further controls 41.7 percent of the overall SME market, including major portions of vital technologies, including deposition (63.8 percent), etch and clean (53.1 percent), process control (71.2 percent), symmetric multi-processing (SMP) (67.5 percent), and ion implanters (90.1 percent). According to CSIS analysis, 11 of these advanced SMEs have no foreign substitutes.[34]

Despite a dominant position in the overall market and control of critical chokepoints, the United States has several vulnerabilities. In terms of fabrication capacity, the United States has experienced a significant decline in recent years, dropping from 40 percent of total fabrication in 1990 to 12 percent in 2020, a trend the CHIPS and Science Act hopes to reverse.[35] The United States maintains little to no capacity to produce extreme ultraviolet scanners (EUVs), argon fluoride scanners (ArFs), krypton fluoride scanners (KrFs), and wafers, as well as medium to low ability to produce other forms of lithography equipment.[36]

Production of advanced SME, namely lithography equipment such as EUV and DUV scanners and ArF immersion scanners, is located outside of the United States, primarily in Japan and the Netherlands. Dutch company ASML maintains a near monopoly over EUV technology, while Japan leads in key areas of material and chemical production.[37] Failure to secure buy-in from these two countries risked depressing the efficacy of chip controls while creating new market opportunities for foreign firms to fill space that U.S. firms had previously occupied.

Unilateral Changes Form a Trilateral Outcome

After months of negotiations, reports emerged in January 2023 that the United States had secured an arrangement with Japan and the Netherlands to align their licensing policies on advanced semiconductor exports.[38] Due to the sensitivity of the issues and fear of Chinese retaliation, details about the possible "agreement" have been sparse. In March 2023, Japan announced that they would control 23 separate types of advanced SMEs, including ArF immersion scanners.[39] However, there are important differences between the U.S. and Japanese policies.[40] For example, Japanese nationals working on advanced semiconductor projects in other countries do not face the same restrictions as U.S. nationals, making the Japanese controls potentially more forgiving than their U.S. counterparts.

On March 8, 2023, the Netherlands announced new controls to align with the October 7 controls.[41] In a letter to the Dutch parliament, Dutch trade minister Liesje Schreinemacher explained that the Netherlands would

restrict the sale of DUV technology and place such products on a national control list.[42] On June 30, the Dutch government officially published their export control measures, which will require authorization for the export of certain high-level technologies, such as DUV machines, starting on September 1. Minister Schreinemacher commented, "We've taken this step on national security grounds."[43]

A commonality between the Japanese and Dutch controls is that they remain country-agnostic. This largely aligns with their preference to adhere to the World Trade Organization's non-discrimination principles and fear of Chinese economic retaliation.[44] Nevertheless, these controls do represent a significant expansion in Dutch and Japanese export control and licensing policy. Furthermore, the three countries have taken extra steps to affirm both their preference for multilateral controls and the national security justifications for taking these actions. The Dutch indicated that they would submit these updates to the Wassenaar Arrangement, although the chances of Russia blocking the updates remain all but certain.

Shortcomings of the U.S. Policy

While the October 7 controls were designed to stem the outflow of U.S.-produced items to China under the assessment that China was using U.S. inputs in military applications, the controls also expose certain drawbacks.

CLARIFYING THE NATIONAL SECURITY JUSTIFICATIONS

Firms and foreign partners alike remain wary about the U.S. explanation undergirding the controls. The United States claims that it has irrefutable evidence that China is using Western-made technology in its military programs.[45] Providing additional details, where possible, and enhancing communication among allies will secure more durable buy-in throughout the value chain.

EFFECTS ON U.S. FIRMS

Policymakers have always had to walk a fine line when it comes to export controls because they inherently restrict revenue for domestic firms, which often rely on export-derived income to invest in next-generation research and development). This remains true for the October 7 controls. Firms impacted immediately include Nvidia, AMD, KLA, and Lam. LAM warned that they face a loss of up to $2.5 billion in 2023, while KLA expects losses of $600–900 million.[46] Applied Materials also anticipates first-quarter losses of nearly $400 million.[47] Furthermore, the imposed loss of market share naturally creates new market opportunities for foreign entrants not otherwise subject to similar controls, making it even more important to multilateralize the controls.

CHINESE RETALIATION

Two other drawbacks center around Chinese responses to the controls via retaliation and indigenization. In May 2023, China banned the use of Micron chips in critical infrastructure.[48] Micron relies on China for 20 percent of sales but claims that it will endure the effects of this policy change. In July 2023, China further retaliated by implementing new licensing requirements on gallium and germanium, two critical inputs for semiconductor production.[49] China has over 86 percent of the world's low-purity gallium production capacity and over 67 percent of the world's refined germanium production, meaning prices for those inputs will spike without the commensurate onboarding of additional production capacity in allied economies.[50]

The United States and its allies have long recognized this retaliation capability, particularly following similar restrictions on Chinese rare-earth mineral exports to Japan roughly a decade ago.[51] Despite precedence and the obvious likelihood of Chinese retaliation, many policymakers and experts were surprised by the recent announcement and have vowed to pursue additional "de-risking" policies.[52] However, it is relatively easy

to scale up production capacity outside of China, indicating that the Chinese restrictions serve mostly as a "warning shot." Furthermore, previous CSIS work has demonstrated the inefficacy of Chinese economic coercive measures, finding that China's attempts at saber-rattling typically contravene its objectives by dissuading countries from deeper economic engagement with China.[53]

DESIGNING OUT: INDIGENIZATION AND DUAL SUPPLY CHAINS

Designing out—developing supply chains free of U.S. inputs—has long been a hedging strategy against foreign regulations, as witnessed with commercial satellites during the 1990s.[54] In the wake of the trade war with China under the Trump administration, companies began to implement an "in China, for China" strategy in which firms would produce locally for domestic consumption and free of U.S. inputs.[55] As Sarah Bauerle Danzman and Emily Kilcrease, two export control and investment screening experts at the Atlantic Council and the Center for New American Security, respectively, write, "The recent unprecedented expansion of extraterritorial rules in U.S. export controls turbocharges these concerns, heightening the risk that other countries or firms will ice out U.S. suppliers as a matter of protecting their autonomy and preserving their ability to sell globally—including in China."[56] Indeed, the Chinese government has pressured domestic firms to accelerate indigenization efforts to de-risk from foreign exposure. Huawei recently announced that it has created software for all chips above 14 nm, providing a Chinese alternative to companies who previously acquired foreign products.[57]

China is also attempting to strengthen supply chains not subject to export controls. The National Silicon Industry Group, China's largest silicon wafer producer, recently announced attempts to increase capacity from 300,000 wafers per month to 1.2 million, allowing it to cover domestic needs and become the sixth-largest wafer producer worldwide.[58] This shift aligns with broader Chinese efforts to pursue a "dual circulation" agenda that seeks to build more autonomous and domestic supply chains in China free of international dependencies, but it could also indicate the Chinese weaponization of trade via overcapacity.[59] Either way, a loss of U.S. market share means less visibility into Chinese high-tech industries over time and a drop in revenue for firms seeking to retain a competitive edge.

CLOSING LOOPHOLES: WHACK-A-MOLE AND THE CLOUD

In addition to ongoing attempts to attract additional countries to join the new U.S. export control policy, the United States is concluding its formalization of the October 7 rules. In June 2023, reports emerged that new controls from BIS could be announced as soon as the end of summer, which would close October 7 loopholes.[60] For example, Nvidia produced the A800 AI chip, which is its A100 chip engineered to reduce the interconnect speed to comply with the regulations.[61] While some observers regard this as "out-engineering" the controls, this also reflects insufficient thresholds that could be broadened to accommodate the A800 chips, although broadening the scope would result in additional revenue hits for the firms affected. Circumvention is also likely occurring via the provision of cloud services to Chinese companies, which allow access to controlled chips. Overall, the U.S. government needs to contend with innovation "whack-a-mole," in which mitigating one problem means another pops up elsewhere.[62] This means that export control rules should be flexible and updated frequently to achieve their intended objectives.

SECURING ADDITIONAL PARTNERS

While Japanese and Dutch cooperation has enhanced the efficacy of these controls, there are growing calls for additional partners, such as South Korea, to join. South Korean firms Samsung and SK Hynix maintain a major share of the memory chip market, controlling over 70 percent of DRAM market share in 2021, and 53 percent

of the NAND market (along with Japanese company Kioxia).[63] Memory chips play an important role in AI, meaning that they may be critical to national security. For example, Samsung currently supplies Nvidia with high-bandwidth memory chips for their A100 AI chip.[64]

Securing buy-in from South Korea would enhance the credibility of the U.S. export controls but could come at significant cost to South Korean firms, who maintain major operations in China.[65] As of the summer of 2023, the United States granted South Korea a one-year waiver extension that permits South Korean firms to continue operating in China.[66] The private sector views perennial waiver extensions as unreliable, subject to change, and responsible for infusing the industry with added uncertainty. (BIS undersecretary Alan Estevez has said that the waivers will likely be extended "for the foreseeable future.")[67]

Another complicating factor is China's ban on Micron's memory chips, which has left a supply gap that Samsung and SK Hynix could fill, although the U.S. government is urging against backfilling.[68] South Korea's vice minister of trade commented, "Regarding what the U.S. tells us to do or not to do, it is actually up to our companies. Both Samsung and SK Hynix, with global operations, will make a judgment on this."[69] Regardless, the extraterritorial application of controls and attempts to reduce South Korean chip investment in China has put South Korea in a geopolitically awkward position of having to choose a partner amid U.S.-China tensions. The United States should not underplay what it is asking of its allies.

Building a Sufficient "Promote" Agenda

When coupled with an expanded domestic industrial policy, the combination of domestic incentives and additional—and sometimes extraterritorial—restrictions can frustrate the private sector and allies. As the definition of national security continues to expand to include economic security concerns, skeptics of the Biden administration's expanded use of controls argue that protectionism and economic considerations are the true drivers of this policy.[70] Given the growing importance of AI in national security, the security justifications of controlling the export of advanced AI chips is clear, but the administration should do a better job communicating its underlying security concerns, particularly to combat the notion that these controls are driven primarily by domestic economic considerations.

These policies do not materialize in a vacuum. Allies have witnessed the expanded use of the FDPR under the Biden administration and are weary of becoming subject to those rules. Other policies that can be viewed as coercive—or at least demanding—remain fresh. These include attempts to encourage a "rip and replace" policy of Huawei components from critical infrastructure, or the Treasury Department's sanctions that resulted in a 15 percent price spike of aluminum products in a week.[71] It was also only a decade ago that the United States threatened the vitality of the European financial markets during the "de-SWIFT" policy that sought to induce the European Union to adopt the U.S. stance on Iran.[72] Given that relations with Russia are not likely to improve in the near future and that tensions with China will continue to climb, it is incumbent on the United States to build a trade policy that can offset costs and more effectively secure long-term allied buy-in.

Conclusion

Having secured Japanese and Dutch alignment on U.S. export controls, the United States seems once again to have taken the lead on establishing a new export control regime—or, in this case, a "mini-regime" of three unilateral policy changes. In short, U.S. leadership and external action-forcing events such as the Russian invasion of Ukraine and Chinese pursuit of civil-military fusion have propelled producers of advanced

technology into a new chapter of export control cooperation. This is evidenced not only in the Japanese and Dutch adoption of additional controls but also in allies' focus on the utility of controls as an instrument of foreign policy in the G7 Hiroshima Leaders' Communiqué, the EU Economic Security Strategy, and Germany's new Strategy on China.[73] However, new controls come with pronounced risks, serious geopolitical downsides, and steep economic costs. If the United States and its friends are building a new export control architecture, they need to account for—and try to mitigate—these distinct challenges to prevail.

About the Authors

Gregory C. Allen is the director of the Wadhwani Center for AI and Advanced Technologies at the Center for Strategic and International Studies (CSIS). Prior to joining CSIS, he was the director of strategy and policy at the Department of Defense (DOD) Joint Artificial Intelligence Center, where he oversaw development and implementation of the DOD's AI Strategy and policy. Allen's expertise and professional experience spans AI, robotics, semiconductors, space technology, and national security. Prior to working at the DOD, he was the head of market analysis and competitive strategy at Blue Origin and an adjunct senior fellow at the Center for a New American Security. He holds a joint MPP/MBA degree from the Harvard Kennedy School of Government and the Harvard Business School.

Wonho Yeon is a research fellow and the Head of the Economic Security Team at the Korea Institute for International Economic Policy (KIEP). He received his BA in East Asian History and English Literature from Yonsei University, MA in International Relations from UC San Diego's School of Global Policy and Strategy, and PhD in Economics from Stony Brook University. His research interests include U.S.-China trade conflict, U.S.-China technological rivalry, and economic security. His recent publications include: "How to Enhance the U.S.-ROK Alliance through Economic Security Policy" (NBR 2023), "The U.S. Leads China in the Chip Race" (GlobalAsia 2022), and "U.S.-China Strategic Competition and Economic Security Strategy of Korea" (Wilson Center 2022). Currently, He is a member of the policy advisory committees for the National Security Office Office of the President and the Ministry of Foreign Affairs. In April 2022, He was a member of then president-elect Yoon Suk Yeol's R.O.K.-U.S. policy consultation delegation, where he oversaw economic security issues.

Jan-Peter Kleinhans is the director of Technology and Geopolitics at Stiftung Neue Verantwortung (SNV), a nonpartisan, nonprofit, independent tech policy think tank in Berlin. Since 2020, his focus is on the analysis of semiconductors as a strategic asset, how resilient the global semiconductor value chain is to external shocks, and how Europe's competitiveness can be strengthened. Kleinhans's work informed the EU Chips Act as well as several European governments. He testified at the U.S.-China Economic and Security Review Commission and is co-leading the China Semiconductor Observatory. Before analyzing the global semiconductor value chain, Kleinhans worked on mobile network security, in particular 5G security and the trustworthiness of equipment vendors. He presented his work to the Foreign Affairs Committee of the German Bundestag and the NATO Parliamentary Assembly, among others. He holds a BS in business informatics from Darmstadt University of Technology and an MS in communication theory from Uppsala University.

Julian Ringhof was a policy fellow with the European Power program at the European Council on Foreign Relations (ECFR). At ECFR his research focused on the implications of digital and emerging technologies for international affairs, including the topics of export control policy, internet governance, technical standards, digital diplomacy and EU technological sovereignty. Before joining ECFR as a policy fellow, Ringhof was a visiting expert at the European Commission's Directorate General for Communications Networks, Content, and Technology and a visiting fellow at ECFR under the Mercator Fellowship on International Affairs. He also worked as an analyst and research manager in autonomous driving at the European Centre for Information and Communication Technologies and as an innovation manager at Fab Lab Berlin. Ringhof holds an MPhil in technology policy from the University of Cambridge and a dual BS/BA in mechanical engineering from the University of San Diego.

Kazuto Suzuki is a professor at the Graduate School of Public Policy at the University of Tokyo, Japan, and director of the Institute of Geoeconomics at International House of Japan. He graduated from the Department of International Relations, Ritsumeikan University, and received PhD from Sussex European Institute, University of Sussex, England. He has worked in the Fondation pour la Recherche Stratégique in Paris, France as assistant researcher and the Associate Professor at the University of Tsukuba from 2000 to 2008 and served as Professor of International Politics at Hokkaido University until 2020. He served as an expert in the Panel of Experts for Iranian Sanction Committee under the United Nations Security Council from 2013 to July 2015. He currently serves many advisory committees of the government of Japan, inter alia, the National Space Policy Committee of the Cabinet Office, the Government of Japan, and the President of Japan Association of International Security and Trade. His research focuses on the conjunction of science/technology and international relations; subjects including space policy, non-proliferation, export control and sanctions. His recent work includes Space and International Politics (2011, in Japanese, awarded Suntory Prize for Social Sciences and Humanities), Policy Logics and Institutions of European Space Collaboration (2003) and many others.

Rem Korteweg is a senior research fellow at the Clingendael Institute in the Netherlands. He works on Europe's strategic role in the world, with a specific focus on the intersection between trade, foreign policy, and security. Among his current research interests are European trade and industrial policy, the geopolitics of critical technologies, and UK-EU ties. He is also the host of the AIG Global Trade Series podcast. Prior to this, Rem was a senior research fellow at the Centre for European Reform (CER) in London, and in 2012 was seconded to the Netherlands' Ministry of Foreign Affairs. Rem holds a PhD in International Relations from Leiden University and was a Fulbright scholar at the Johns Hopkins-SAIS Center for Transatlantic Relations.

Chau-Chyun Chang currently serves as senior strategy executive director, Sustainability in the Industry, Science and Technology International Strategy Center (ISTI) of the Industrial Technology Research Institute (ITRI). He joined ITRI in 1991 and previously served as researcher, manager, division deputy director, director as well as deputy general director until December 2021, when he assumed his current role. He is the author of more than 100 articles and research reports and has extensive experience in technology forecasting and foresight, market and industry analysis, government policy formulation, IP management, and strategic consulting. He was elected as a fellow of Asia Pacific Industrial Analysis Association in 2004. Chang earned his BS degree in Chemical Engineering from the Department of Tatung Institute of Technology in May 1981. He received his MS degree in December 1988 and PhD degree in December 1990 from the Chemical Engineering Department of Louisiana State University.

Francesca Ghiretti is an analyst at the Mercator Institute for China Studies (MERICS). She is an expert in economic security, EU-China relations and the Belt and Road Initiative. Francesca is part of the Advancing Economic Security Forum, and she has published extensively on the matter of economic security and de-risking. She obtained her PhD from King's College London as Leverhulme fellow at the Centre for Grand Strategy and her thesis was awarded the Outstanding Thesis Award. Before joining MERICS, she worked as a research fellow for Asia at the Istituto Affari Internazionali (IAI) in Rome leading a project on the Belt and Road Initiative in Italy.

Antonia Hmaidi is an analyst at the Mercator Institute for China Studies (MERICS), where she works on China's pursuit of tech self-reliance (especially in areas like semiconductors and operating systems), its internet infrastructure, and disinformation and hacking campaigns. Hmaidi also develops modelling and big data analysis tools. She gained experience as a project manager at the Bertelsmann Stiftung, worked at the German Corporation for International Cooperation (GIZ), as a journalist in Asia and at the German

Institute for International and Security Affairs (SWP). Antonia holds a bachelor's degree in East Asian Politics and Economics from Ruhr University Bochum and Renmin University of China, and a master's degree in international relations from the Graduate Institutes of International and Development Studies (IHEID) in Geneva and New Delhi.

Emily Benson is the director of the Project on Trade and Technology and a senior fellow of the Scholl Chair in International Business at CSIS, where she focuses on trade, investment, and technology issues primarily in the transatlantic context. Prior to joining CSIS, she managed transatlantic legislative relations at a European foundation, focusing on trade relations and emerging technologies such as artificial intelligence. She also worked to combat money laundering via the illicit flow of art from conflict zones and spent several years at an international law firm focused on sanctions and export controls. During graduate school, Emily spent a summer in the trade section at the EU Delegation to the United States, working on digital regulation and trade remedies. Her commentary and research have appeared in publications such as the New York Times, Washington Post, Wall Street Journal, Foreign Policy, and Politico, and she is regularly quoted in domestic and international news outlets. She received her joint BA in international affairs and political science from the University of Colorado and her MA in political science from the University of Geneva in Switzerland. Fluent in French, Emily has lived abroad in France, Indonesia, and Switzerland.

Catharine (Katya) Mouradian is a program coordinator and research assistant with the Project on Trade and Technology. Before joining CSIS, she studied in Brussels and concurrently interned at an economic intelligence and global consulting firm. Her work has focused on the European Union and technology ecosystem in the transatlantic context, including the geopolitics of semiconductor supply chains. Katya previously interned in the Senate, where she worked on issues related to foreign affairs, defense, and cryptocurrency. She holds a BA in international studies and a minor in history from American University.

Related Works

Gregory C. Allen, *China's New Strategy for Waging the Microchip Tech War* (Washington, DC: CSIS, May 2023), https://www.csis.org/analysis/chinas-new-strategy-waging-microchip-tech-war.

Gregory C. Allen, *Choking China's Access to the Future of AI* (Washington, DC: CSIS, October 2022), https://www.csis.org/analysis/choking-chinas-access-future-ai.

Gregory C. Allen, "CSIS Translation: Updated Dutch Export Controls on Semiconductor Manufacturing Equipment and Related Government Documents," CSIS, *Commentary*, July 21, 2023, https://www.csis.org/analysis/csis-translation-updated-dutch-export-controls-semiconductor-manufacturing-equipment-and.

Gregory C. Allen, "CSIS Translation: Updated Japanese Export Controls on High-Performance Semiconductor Manufacturing Equipment," CSIS, *Commentary*, July 18, 2023, https://www.csis.org/analysis/csis-translation-updated-japanese-export-controls-high-performance-semiconductor.

Gregory C. Allen and Emily Benson, *Clues to the U.S.-Dutch-Japanese Semiconductor Export Controls Deal Are Hiding in Plain Sight* (Washington, DC: CSIS, March 2023), https://www.csis.org/analysis/clues-us-dutch-japanese-semiconductor-export-controls-deal-are-hiding-plain-sight.

Gregory C. Allen, Emily Benson, and Margot Putnam, "Japan and the Netherlands Announce Plans for New Export Controls on Semiconductor Equipment," CSIS, *Commentary*, April 10, 2023, https://www.csis.org/analysis/japan-and-netherlands-announce-plans-new-export-controls-semiconductor-equipment.

Emily Benson and Gregory C. Allen, "A New National Security Instrument: The Executive Order on Outbound Investment," CSIS, *Commentary*, August 10, 2023, https://www.csis.org/analysis/new-national-security-instrument-executive-order-outbound-investment.

Akhil Thadani and Gregory C. Allen, "Mapping the Semiconductor Supply Chain: The Critical Role of the Indo-Pacific Region," CSIS, *Commentary*, May 30, 2023, https://www.csis.org/analysis/mapping-semiconductor-supply-chain-critical-role-indo-pacific-region.

Endnotes

SOUTH KOREAN PERSPECTIVE

1 Wonho Yeon, "The U.S. Leads China in the Chip Race," *Global Asia* 17, no. 4 (2022): 12, https://www.globalasia.org/v17no4/focus/the-us-leads-china-in-thechip-race_wonho-yeon.

2 Antony J. Blinken, "The Administration's Approach to the People's Republic of China," (speech, George Washington University, May 26, 2022), https://www.state.gov/the-administrations-approach-to-the-peoples-republic-of-china/; The White House, *National Security Strategy* (Washington, DC: October 2022), https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf; and Jake Sullivan, "Remarks by National Security Advisor Jake Sullivan on Renewing American Economic Leadership at the Brookings Institution," The White House, April 27, 2023, https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/04/27/remarks-by-national-security-advisor-jake-sullivan-on-renewing-american-economic-leadership-at-the-brookings-institution/.

3 Jake Sullivan, "Remarks by National Security Advisor Jake Sullivan at the Special Competitive Studies Project Global Emerging Technologies Summit," The White House, September 16, 2022, https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/09/16/remarks-by-national-security-advisor-jake-sullivan-at-the-special-competitive-studies-project-global-emerging-technologies-summit/.

4 Graham Allison et al., *The Great Tech Rivalry: China vs. the U.S.* (Cambridge, MA: Harvard Belfer Center for Science and international Affairs, December 2021), 1, https://www.belfercenter.org/sites/default/files/GreatTechRivalry_ChinavsUS_211207.pdf.

5 Nathan Associates, *Beyond Borders: The Global Semiconductor Value Chain* (Washington, DC: Semiconductor Industry Association, 2016), https://www.semiconductors.org/wp-content/uploads/2018/06/SIA-Beyond-Borders-Report-FINAL-June-7.pdf.

6 "Global Value Chains: Explaining U.S. Bilateral Trade Deficits in Semiconductors," Executive Briefing on Trade, U.S. International Trade Commission, March 2018, https://www.usitc.gov/publications/332/

executive_briefings/ebot-semiconductor_gvc_final.pdf.

7 Wonho Yeon, *China's Semiconductor Industry Fostering Policy, US-China Semiconductor Hegemony Competition and Global Supply Chain Reorganization* (Sejong City, South Korea: Korean International Economic Policy Institute, 2021), 21–28, 89–128.

8 "European Chips Act," European Commission, 2023, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-chips-act_en; and "Å 世代半導體-先端技術與產業鏈自主 發展計畫" [A Generation Semiconductor - Advanced Technology and Industrial Chain Independent Development Plan], Korean Ministry of Economic Affairs, 2020.

9 Wonho Yeon, "함께보기: 자국 내 반도체 기술·제조 기반 확보를 위해 치열한 경쟁 중," 월간통상 [*View Together: Fierce Competition to Securing Domestic Semiconductor Technology and Manufacturing Bases*] (Seoul: Monthly Commerce, 2022).

10 Author's own calculation based on UN COMTRADE data.

11 "반도체 산업 글로벌 경쟁 파고에 공동 대응 나서다" [Joint response to the wave of global competition in the semiconductor industry], Korea Ministry of Trade Industry and Energy, 2022; and "2021년 제조업 설비투자 동향 및 특징" [2021 Manufacturing Facility Investment Trends and Characteristics], KDB Future Strategy Research Institute, 2022, https://rd.kdb.co.kr/fileView?groupId=CAC73969-BD6C-33AF-96D4-7EF808DAA716&fileId=9CD0E4E0-6F14-DC04-9123-7D165B72510D.

12 "尹 대통령, 민간 투자로 세계 최대 '반도체 메가클러스터' 조성 나선다" [President Nang sets out to create the world's largest 'semiconductor megacluster' with private investment], Office of the President of Korea, March 15, 2023, https://www.president.go.kr/download/6411227aef66c; and "3대 주력기술 초격차 연구개발(R&D) 전략 발표" [Announcement of R&D strategy for the super-gap of three major technologies], Korea Ministry of Science and ICT, November 2, 2023.

13 U.S. Congress, House, *John S. McCain National Defense Authorization Act for Fiscal Year 2019*, HR 5515, 115th Cong., 2nd sess., introduced in House April 13, 2018, https://www.congress.gov/bill/115th-congress/house-bill/5515/text.

14 Bureau of Industry and Security, "Commerce Adds China's SMIC to the Entity List, Restricting Access to Key Enabling U.S. Technology," U.S. Department of Commerce, press release, December 18, 2020, https://2017-2021.commerce.gov/news/press-releases/2020/12/commerce-adds-chinas-smic-entity-list-restricting-access-key-enabling.html; Bureau of Industry and Security, "Commerce Adds Seven Chinese Supercomputing Entities to Entity List for their Support to China's Military Modernization, and Other Destabilizing Efforts," U.S. Department of Commerce, press release, April 8, 2021, https://www.commerce.gov/news/press-releases/2021/04/commerce-adds-seven-chinese-supercomputing-entities-entity-list-their; and Bureau of Industry and Security, "Commerce Adds 36 to Entity List for Supporting the People's Republic of China's Military Modernization, Violations of Human Rights, and Risk of Diversion," U.S. Department of Commerce, press release, December 15, 2022, https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3195-bis-press-release-clean-2022-12-14/file.

15 "SMIC 7nm technology found in MinerVa Bitcoin Miner," TechInsights, n.d., https://www.techinsights.com/blog/disruptive-technology-7nm-smic-minerva-bitcoin-miner.

16 Debby Wu et al., "US Quietly Tightens Grip on Exports of Chipmaking Gear to China," *Bloomberg*, July 30, 2022, https://www.bloomberg.com/news/articles/2022-07-29/us-pushes-expansion-of-china-chip-ban-key-suppliers-say.

17 "FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China," The White House, August 9, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-

chains-and-counter-china/.

18 Matt Haldane, "US Chips and Science Act ramps up China semiconductor tensions with Taiwan (again) caught in the middle," *South China Morning Post*, August 20, 2022, https://www.scmp.com/economy/article/3189695/us-china-chip-war-overheating.

19 Author's calculation based on UN COMTRADE data.

20 Laura Dobberstein, "SK hynix, Samsung, TSMC granted one-year reprieve from China chip restrictions," The Register, October 13, 2022, https://www.theregister.com/2022/10/13/sk_hynix_china_chip_reprieve/.

21 U.S. Congress, House, *James M. Inhofe National Defense Authorization Act for Fiscal Year 2023*, HR 7776, 117th Cong., 2nd sess., introduced in House May 16, 2022, https://www.congress.gov/bill/117th-congress/house-bill/7776/text.

22 Semiconductor Manufacturing International Corporation (SMIC), ChangXin Memory Technologies (CXMT), Yangtze Memory Technologies Corp (YMTC), and any subsidiary, affiliate, or successor of such entities.

23 "Notice of Funding Opportunity (NOFO): CHIPS Incentives Program – Commercial Fabrication Facilities," CHIPS Program Office, National Institute of Standards and Technology, June 23, 2023, https://www.nist.gov/system/files/documents/2023/06/23/CHIPS-Commercial%20Fabrication%20Facilities%20NOFO%20Amendment%201.pdf.

24 "Preventing the Improper Use of CHIPS Act Funding," *Federal Register* 88, no. 56 (March 23, 2023): 17439, https://www.federalregister.gov/documents/2023/03/23/2023-05869/preventing-the-improper-use-of-chips-act-funding.

25 Author's analysis based on interviews with South Korean government officials and industry representatives, including the Ministry of Trade, Industry, and Energy, Samsung, and SK Hynix.

26 "The Spirit of Camp David: Joint Statement of Japan, the Republic of Korea, and the United States," The White House, August 18, 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/08/18/the-spirit-of-camp-david-joint-statement-of-japan-the-republic-of-korea-and-the-united-states/.

27 Jaeyoung Lee, "미중 공급망 경쟁과 양안 갈등 속 한국의 경제안보 외교" [Korea's Economic Security Diplomacy in the midst of US-China Supply Chain Competition and Cross-strait Conflict], Korea institute for National Unification, January 20, 2023, https://www.kinu.or.kr/pyxis-api/1/digital-files/d6c50cd7-8361-41fa-8b57-870ec8b93d43; Jeong Se-jin, "[불붙은 미중 반도체 전쟁] ③ 중국 견제나선 미국의 히든카드는 통할까" [The U.S.-China Semiconductor War on Fire ③ Will the U.S. Hidden Card Work in Control of China?], OpinionNews Korea, https://www.opinionnews.co.kr/news/articleView.html?idxno=48896; Wonho Yeon, "U.S.-China Strategic Competition and Economic Security Strategy of Korea," (article presented at the Wilson Center Event: Between the Eagle and the Dragon: Challenges and Opportunities for South Korea in the US-China Competition, Washington, DC, November, 2022), https://www.wilsoncenter.org/event/between-eagle-and-dragon-challenges-and-opportunities-south-korea-us-china-competition; and Martin Chorzempa, "How U.S. chip controls on China benefit and cost Korean firms," Peterson Institute for International Economics, *Policy Brief*, July 2023, https://www.piie.com/publications/policy-briefs/how-us-chip-controls-china-benefit-and-cost-korean-firms.

28 Author's analysis based on interviews with South Korean government officials and industry representatives, including the Ministry of Trade, Industry, and Energy, Samsung, and SK Hynix.

29 Foreign Policy Analytics, *Semiconductors and the U.S.-China Innovation Race* (Washington, DC: FP Group, February 2021), https://foreignpolicy.com/2021/02/16/semiconductors-us-china-taiwan-technology-

innovation-competition/; and author's calculation based on UN COMTRADE data also supports that China (including Hong Kong) imports 60 percent of all chips exported in the world every year.

30 Author's analysis based on interviews with Korean government officials and industry representatives, including the Ministry of Trade, Industry, and Energy, Samsung, and SK Hynix.

31 "Government publishes additional export measures for advanced semiconductor manufacturing equipment," Government of Netherlands, June 30, 2023, https://www.government.nl/latest/news/2023/06/30/government-publishes-additional-export-measures-for-advanced-semiconductor-manufacturing-equipment; and Michelle Toh and Junko Ogura, "Japan joins the US and Europe in chipmaking curbs on China," CNN, March 31, 2023, https://www.cnn.com/2023/03/31/tech/japan-china-chip-export-curbs-intl-hnk/index.html.

32 Ibid.

GERMAN PERSPECTIVE

1 "Policy statement by Olaf Scholz, Chancellor of the Federal Republic of Germany and Member of the German Bundestag, 27 February 2022 in Berlin," Federal Government of Germany, February 27, 2023, https://www.bundesregierung.de/breg-en/news/policy-statement-by-olaf-scholz-chancellor-of-the-federal-republic-of-germany-and-member-of-the-german-bundestag-27-february-2022-in-berlin-2008378.

2 Noor Nanji, "Gas prices jump as Russia cuts German supply," BBC News, July 27, 2023, https://www.bbc.com/news/business-62318376.

3 Roman Eichinger, et al., "Putins Wahnvorstellung ist nicht aufgegangen" [Putin's Delusion Did Not Work], *Bild*, August 28, 2022, https://www.bild.de/bild-plus/politik/ausland/politik-inland/aussenministerin-baerbock-im-grossen-bams-interview-putins-wahnvorstellung-ist-n-81137970.bild.html?t_ref=https%3A%2F%2Ft.co%2F.

4 Julian Ringhof, "Give and tech: How technology sanctions can help counter the threat from Russia," European Council of Foreign Relations, March 4, 2022, https://ecfr.eu/article/give-and-tech-how-technology-sanctions-can-help-counter-the-threat-from-russia/.

5 "Germany, US strike Nord Stream 2 deal," DW, July 21, 2021, https://www.dw.com/en/germany-us-strike-nord-stream-2-compromise-deal/a-58575935.

6 Lauren Gambino and David Smith, "US joins Germany in sending tanks to Ukraine as Biden hails 'united' effort," *The Guardian*, January 25, 2023, https://www.theguardian.com/us-news/2023/jan/25/us-m1-abrams-biden-tanks-ukraine-russia-war.

7 Lili Bayer, "NATO skirts final call on Ukraine membership, leaving unity-testing fight for later," *Politico*, July 9, 2023, https://www.politico.eu/article/nato-skirts-final-call-on-ukraine-membership-leaving-unity-testing-fight-for-later/.

8 Federal Government of Germany, Strategy on China (Berlin: Federal Government of Germany, 2023), https://www.auswaertiges-amt.de/blob/2608580/49d50fecc479304c3da2e2079c55e106/china-strategie-en-data.pdf.

9 Ibid.

10 Angela Stanzel, "Germany's turnabout on Chinese takeovers," European Council on Foreign Relations, March 21, 2017, https://ecfr.eu/article/commentary_germanys_turnabout_on_chinese_takeovers_7251/.

11 Cynthia Wrage and Jakob Kullik, "After Kuka – Germany's Lessons Learned from Chinese Takeovers," China Observers in Central and Eastern Europe (CHOICE), July 21, 2022, https://chinaobservers.eu/after-kuka-

germanys-lessons-learned-from-chinese-takeovers/; and "Investment screening," European Commission, n.d., https://policy.trade.ec.europa.eu/enforcement-and-protection/investment-screening_en.

12 "Partner and Systemic Competitor – How Do We Deal with China's State-Controlled Economy?," BDI, January 10, 2019, https://english.bdi.eu/publication/news/china-partner-and-systemic-competitor.

13 Social Democratic Party of Germany, *Mehr Fortschritt Wagen: Bündnis für Freiheit, Gerechtigkeit und Heit, Gerechtigk* [More Courage for Progress: Alliance for Freedom and Equality] (Berlin: Social Democratic Party, December 2021), https://www.spd.de/fileadmin/Dokumente/Koalitionsvertrag/Koalitionsvertrag_2021-2025.pdf.

14 Matthew Reynolds and Matthew P. Goodman, "China's Economic Coercion: Lessons from Lithuania," CSIS, *Commentary*, May 6, 2022, https://www.csis.org/analysis/chinas-economic-coercion-lessons-lithuania.

15 Federal Government of Germany, *Strategy on China*.

16 "A restrictive, responsible policy on the export of military equipment," Federal Ministry of Economic Affairs and Climate Action, January 1, 2019, https://www.bmwk.de/Redaktion/EN/Dossier/export-controls-for-military-equipment.html.

17 The Wassenaar Arrangement, the Nuclear Suppliers Group, the Australia Group, and the Missile Technology Control Regime are the four multilateral regimes in which Germany has pushed for new listing and broadened membership.

18 "EU arms embargo on China," Stockholm International Peace Research Institute, November 20, 2012, https://www.sipri.org/databases/embargoes/eu_arms_embargoes/china.

19 "Information note Regulation (EU) 2021/821 of the European Parliament and of the Council setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items (OJ L 206, 11.6.2021, p. 1.): Information on measures adopted by Member States in conformity with Articles 4, 6, 7, 9, 11, 12, 22 and 23 2022/C 66/04," Official Journal of the European Union, February 2, 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022XC0208%2802%29.

20 "First Committee Considers Constraints on Dual-Use Technology Exports, Divergent Proposals for Countering Cyberspace Threats," United Nations, November 2, 2022, https://press.un.org/en/2022/gadis3704.doc.htm.

21 Joe Miller, "Silicon Saxony aims to be EU chipmaking hub," *Financial Times*, December 15, 2021, https://www.ft.com/content/75841b94-196e-466f-ad1b-72d3809c33fc.

22 Jan-Peter Kleinhans et al., "Running on Ice: China's Chipmakers in a Post-October 7 World," Rhodium Group, April 4, 2023, https://rhg.com/research/running-on-ice/.

23 Micro-electromechanical systems (MEMS) are small integrated devices or systems that combine mechanical and electrical components.

24 "About Us," Elmos, n.d., https://www.elmos.com/english/about-elmos/company/about-us.html; and "About Semikron Danfoss," Semikron Danfross, n.d., https://www.semikron-danfoss.com/about-semikron-danfoss/semikron-danfoss-at-a-glance.html.

25 Jan-Peter Kleinhans, *The Lack of Semiconductor Manufacturing in Europe: Why the 2nm fab is a bad investment* (Berlin: Stiftung Neue Verantwortung, April 2021), https://www.stiftung-nv.de/sites/default/files/eu-semiconductor-manufacturing.april_.2021.pdf.

26 "TSMC, Bosch, Infineon, and NXP Establish Joint Venture to Bring Advanced Semiconductor

Manufacturing to Europe," TSMC, August 8, 2023, https://pr.tsmc.com/english/news/3049.

27 "Our Technology Portfolio", X-Fab, n.d., https://www.xfab.com/technology; and "Foundry," United Monolithic Semiconductors, n.d., https://www.ums-rf.com/foundry/.

28 Felix Grawert and Christian Danniger, "Q2/2023 Investor Presentation," Aixtron, July 27, 2023, https://www.aixtron.com/investoren/publikationen/ir-praesentationen/2023/AIXA%20Q2-2023%20Results%20Presentation.pdf; "History of Zeiss Semiconductor Metrology Systems," Zeiss, n.d., https://www.zeiss.com/corporate/en/about-zeiss/past/history/technological-milestones/semiconductor-metrology-systems.html; and Andreas Rinke and Miranda Murray, "Germany blocks Chinese stake in two chipmakers over security concerns," Reuters, November 9, 2022, https://www.reuters.com/markets/deals/germany-block-chinese-takeover-semiconductor-firm-ers-electronic-handelsblatt-2022-11-09/.

29 Paul Gräupner et al., "High NA EUV optics: preparing lithography for the next big step," ASML and Zeiss, presentation, 2021, https://asset-downloads.zeiss.com/catalogs/download/smt/2f5250f6-00a1-4d8e-a468-6bf812335b10/high-na-euv-optics_preparing-lithography-for-the-next-big-step.pdf; and Johannes Kaschke "Beam Quality Of Pulsed High Power Co2-Lasers," (presentation, EUV Litho 2018 Source Workshop, June 11, 2018), https://www.euvlitho.com/2018/S36.pdf.

30 Eduardo Jaramillo, "China's semiconductor industry can't quit German optics," The China Project, May 1, 2023, https://thechinaproject.com/2023/05/01/chinas-semiconductor-industry-cant-quit-german-optics/.

31 "SEMI Comments to Risks in the Semiconductor Manufacturing and Advanced Packaging Supply Chain Notice of Request for Public Comments," SEMI, Docket Number BIS-2021-0011, April 2021, https://www.semi.org/sites/semi.org/files/2021-04/Apr%205%20Final%20SEMI%20Supply%20Chain%20Comments.pdf.

32 Jan-Peter Kleinhans and Nurzat Baisakova, *The Global Semiconductor Value Chain: A Technology Primer for Policy Makers* (Berlin: Stiftung Neue Verantwortung, October 2020), https://www.stiftung-nv.de/sites/default/files/the_global_semiconductor_value_chain.pdf.

33 Isabella-Alessa Bauer, "Siltronic und GlobalWafers – Chronologie eines Scheiterns" [Siltronic and GlobalWafers – Chronology of a Failure], M&A Review, March 1, 2022, https://ma-review.de/siltronic-und-globalwafers-chronologie-eines-scheiterns/.

34 "Infineon Technologies AG Q4 2022 Earnings Call Transcript," SeekingAlpha, November 16, 2022, https://seekingalpha.com/article/4558591-infineon-technologies-ag-ifnny-q4-2022-earnings-call-transcript.

35 Reva Goujon et al., *Freeze-in-Place: The Impact of US Tech Controls on China* (Washington, DC: Rhodium Group, October 2022), https://rhg.com/research/freeze-in-place/.

36 "Siltronic AG Q3 2022 Earnings Call Transcript," SeekingAlpha, October 28, 2022, https://seekingalpha.com/article/4550643-siltronic-ag-ssllf-q3-2022-earnings-call-transcript.

37 "ASM Updates Q4 Guidance," ASM International, November 28, 2022, https://www.asm.com/press-releases/2563389.

38 "Analyst Earnings Conference Call Q3/2022 & 9M/2022 Results," Aixtron, October 27, 2022, https://www.aixtron.com/investoren/events/telefonkonferenz/2022/Q3-2022_Results_Speech_QAs.pdf.

39 The U.S.-based Semiconductor Industry Association in a public comment to the new controls criticized that "the level of industry uncertainty about which new controls on otherwise commercial items might or might not be imposed in the future is also at an all-time high." See "Public comment 13 on Advanced computing IFR. Semiconductor Industry Association. 1-13-23," Regulations.gov, January 24, 2023, https://www.regulations.gov/comment/BIS-2022-0025-0018.

40 "Öffentliche Anhörung zum Thema 'Europäische Antwort auf den Inflation Reduction Act'" [Public

hearing on the topic 'European Response to the Inflation Reduction Act'], Deutscher Bundestag, May 10, 2023, https://www.bundestag.de/ausschuesse/a09_wirtschaft/Anhoerungen/945280-945280; "Inflation Reduction Act: Europa im Wettbewerb um die Grüne Transformation" [Inflation Reduction Act: Europe in competition for the Green Transformation], Federation of German Industries, February 17, 2023, https://bdi.eu/artikel/news/inflation-reduction-act-europa-im-wettbewerb-um-die-gruene-transformation; "Stellungnahme zum Entwurf 'Inflation Reduction Act' und der Förderung der Elektromobilität in den USA" [Regarding the draft 'Inflation Reduction Act' and the promotion of electromobility in the USA], German Association of the Automotive Industry (VDA), updated August 11, 2022, https://www.vda.de/dam/jcr:f7d02da5-bf8a-4e81-9aa7-f4f9592efa35/VDA-Stellungnahme_USA-Klimapaket_20220811.pdf; "The IRA and the EU's Response Strengthening Transatlantic Trade and Investment," Transatlantic Business Initiative, 2023, https://transatlanticbusiness.eu/wp-content/uploads/2023/05/TBI_The-IRA-and-the-EUs-Response.pdf; Kerstin Bernoth and Josefin Meyer, "US Inflation Reduction Act demands quick strategic action from the EU," DIW, 2023, https://www.diw.de/documents/publikationen/73/diw_01.c.865376.de/dwr-23-6-1.pdf; Veronika Grimm et al., "Der Inflation Reduction Act: Ist Die Neue Us-Industriepolitik Eine Gefahr Für Europa?" [The Inflation Reduction Act: Is the New U.S. Industrial Policy a Threat to Europe?], Sachverständigenrat Wirtschaft, July 2023, https://www.sachverstaendigenrat-wirtschaft.de/fileadmin/dateiablage/PolicyBrief/Policy_Brief_2023_01.pdf; and Janek Steitz and Philippa Sigl-Glöckner, "US Inflation Reduction Act: Der Wolf im Schafspelz [U.S. Inflation Reduction Act: The Wolf in Sheep's Clothing]," Dezernat Zukunft, October 27, 2022, https://www.dezernatzukunft.org/us-inflation-reduction-act-der-wolf-im-schafspelz/.

41 Martin Chorzempa and Laura von Daniels, "New US Export Controls: Key Policy Choices for Europe," Stiftung Wissenschaft und Politik, March 24, 2023, https://www.swp-berlin.org/10.18449/2023C20/; Tobias Gehrke and Julian Ringhof, "The power of control: How the EU can shape the new era of strategic export restrictions," European Council on Foreign Relations, May 17, 2023, https://ecfr.eu/publication/the-power-of-control-how-the-eu-can-shape-the-new-era-of-strategic-export-restrictions/; and Jan-Peter Kleinhans and John Lee, "China Semiconductor Observatory – Baseline Report 2022," China Semiconductor Observatory, 2022, https://www.stiftung-nv.de/sites/default/files/cso_baseline_report_2022.pdf.

42 "Public comment 13 on Advanced computing IFR. Semiconductor Industry Association. 1-13-23," Regulations.gov.

43 "Merck KGaA aims to build domestic supply chains in China," Reuters, May 11, 2023, https://www.reuters.com/business/healthcare-pharmaceuticals/merck-kgaa-aims-build-domestic-supply-chains-china-2023-05-11/.

44 "7 Hiroshima Leaders' Communiqué," G7 Hiroshima Summit, May 20, 2023, https://www.consilium.europa.eu/media/64497/g7-2023-hiroshima-leaders-communiqu%C3%A9.pdf; and "Joint Communication to the European Parliament, the European Council and the Council on 'European Economic Security Strategy'," European Commission, June 20, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023JC0020&qid=1687525961309.

45 Federal Government of Germany, *Strategy on China*.

46 Ibid.

47 Ibid.

48 "Regulation of the Minister for Foreign Trade and Development cooperation of June 23, 2023, no. MinBuza.2023.15246-27 containing introduction of a licensing obligation for the export of advanced semiconductor production equipment not listed in Annex I to Regulation 2021/821 (Advanced production equipment scheme for semiconductors)," Government Gazette of the Kingdom of the Netherlands, June 20, 2023, https://zoek.officielebekendmakingen.nl/stcrt-2023-18212.html.

49 Federal Government of Germany, *Strategy on China*.

JAPANESE PERSPECTIVE

1 Society of Semiconductor Industry Specialists, "Trends in the Semiconductor Industry," Semiconductor History Museum of Japan, 2011, https://www.shmj.or.jp/english/trends/trd80s.html.

2 Douglas A. Irwin, *The U.S.-Japan Semiconductor Trade Conflict* (Chicago: University of Chicago Press, 1996), 5-14, https://www.nber.org/system/files/chapters/c8717/c8717.pdf.

3 Ministry of Economy, Trade and Industry (METI), *The Strategy for Semiconductors and the Digital Industry (Summary)* (Tokyo, Japan: 2023), https://www.meti.go.jp/english/press/2021/pdf/0604_005a.pdf. This document has been recently revised with the original Japanese version available here: https://www.meti.go.jp/press/2023/06/20230606003/20230606003.html. https://www.meti.go.jp/policy/mono_info_service/joho/conference/semicon_digital/kaitei_senryaku.pdf.

4 防衛白書 [Ministry of Defense], 解説：最先端技術と中国の軍事 [*Cutting-Edge Technologies and Chinese Military*] (Tokyo, Japan: 2018), https://www.mod.go.jp/j/publication/wp/wp2018/html/nc004000.html.

5 Takahide Kiuchi, "Does Sanctions against China by US move from 'De-risking' to 'De-coupling'?" [木内登英「日本の先端半導体製造装置の輸出規制：米国の対中制裁は「デリスキング」から「デカップリング」に進むか」], Nomura Research Institute, July 25, 2023, https://www.nri.com/jp/knowledge/blog/lst/2023/fis/kiuchi/0725.

6 Kazuto Suzuki, "Semiconductor as a Geoeconomics Problem" [「地経学の問題としての半導体」], Voice, July 2023, 66-73.

7 Riho Nagao, "Japan to Give Chipmaker Rapidus Nearly $2bn More in Aid," Nikkei Asia, April 26, 2023, https://asia.nikkei.com/Business/Tech/Semiconductors/Japan-to-give-chipmaker-Rapidus-nearly-2bn-more-in-aid.

8 "New Strategy for US Export Control: Giving Consideration to Global Companies" [「米国の輸出管理に新戦略、グローバル企業に配慮」], JETRO, May 17, 2023, https://www.jetro.go.jp/biz/areareports/special/2023/0501/d446713f61c3fa47.html.

9 Kazuto Suzuki, "Analyzing Export Control and GSOMIA Problem with South Korea by the Concept of Economic Statecraft" [「「エコノミック・ステイトクラフト」論で斬る　輸出管理とGSOMIA問題の核心にある韓国の「自尊心」」], *Chu-o Koron*, September 2019, 48-55.

10 "Complementary Commentary on Extended Export Control against China by the US" [「米国が著しく強化した対中輸出規制についての補足的 QA 風解説」], CISTEC, November 11, 2023, https://www.cistec.or.jp/service/uschina/53-20221021.pdf.

11 Rintaro Tobita, "U.S. Pushes Japan and Other Allies to Join China Chip Curbs," Nikkei Asia, November 1, 2022, https://asia.nikkei.com/Politics/International-relations/U.S.-pushes-Japan-and-other-allies-to-join-China-chip-curbs.

12 "CSIS Translation: Updated Japanese Export Controls on High-Performance Semiconductor Manufacturing Equipment," CSIS, July 18, 2023, https://www.csis.org/analysis/csis-translation-updated-japanese-export-controls-high-performance-semiconductor.

13 Henry Ridgwell, "Japan Imposes Microchip Export Ban, Angering China," Voice of America, July 27, 2023, https://www.voanews.com/a/japan-imposes-microchip-export-ban-angering-china-/7200142.html.

14 Daleep Singh, "Daleep Singh on America's Economic Statecraft," *The Economist*, January 11, 2023, https://www.economist.com/by-invitation/2023/01/11/daleep-singh-on-americas-economic-statecraft.

15 Christopher Cytera, "Gallium, Germanium, and China – The Minerals Inflaming the Global Chip War," Center for European Policy Analysis, *Commentary*, August 8, 2023, https://cepa.org/article/china-gallium-and-germanium-the-minerals-inflaming-the-global-chip-war/.

16 Sam Nussey, "Japan-backed Fund to Buy Chip Materials Maker JSR for $6.4 Billion," Reuters, June 23, 2023, https://www.reuters.com/markets/deals/shares-japans-jsr-untraded-surprise-possible-buyout-2023-06-26/.

17 Takashi Mochizuki and Yuki Furukawa, "Chip Titan TSMC's First Factory in Japan Has to Contend With Horrible Traffic," *Bloomberg*, June 8, 2023, https://www.bloomberg.com/news/features/2023-06-08/chip-titan-tsmc-s-first-factory-in-japan-has-to-contend-with-horrible-traffic.

18 Satoko Ohnuki, "Pay Planned for Kumamoto Master's Students Studying Chips," *Asahi Shimbun*, February 16, 2023, https://www.asahi.com/ajw/articles/14835000.

DUTCH PERSPECTIVE

1 "Designing the future of semiconductors in the Netherlands," High Tech NL Semiconductors, June 2023, https://www.hightechnl.nl/hightechnl/nieuws/designing-the-future-of-semiconductors-in-the-netherlands/.

2 "Chip manufacturers largest among Dutch listed companies," DeNederlandscheBank, December 1, 2022, https://www.dnb.nl/en/statistical-news/snb-2022/chip-manufacturers-largest-among-dutch-listed-companies/?trk=organization_guest_main-feed-card_feed-article-content.

3 "Let's drive innovation towards a new era," HighTech NL, July 2022, https://nlplatform.com/sites/default/files/downloads/NLB%20Branding%20brochure%20A5%20-%20Semicom%20-%20v8b2%20spread_0.pdf.

4 Dutch Ministry of Foreign Affairs, *The Netherlands and China: A new balance* (The Hague: Government of the Netherlands, May 2019), https://www.government.nl/documents/policy-notes/2019/05/15/china-strategy-the-netherlands--china-a-new-balance. For a good overview of the Netherlands' evolving approach to China, see Vera Kranenburg, "Netherlands: Securitization of China and protection of technology," in Bernhard Bartsch et al., *From a China strategy to no strategy at all: Exploring the diversity of European approaches* (European Think-tank Network on China, July 2023), https://www.clingendael.org/publication/china-strategy-no-strategy-all-0.

5 Dutch Ministry of Foreign Affairs, *The Netherlands and China*, 92.

6 Stephen Swai, "China imposes sanctions on Dutch MP Sjoerd Sjoerdsma," *The Holland Times*, April 3, 2021, https://www.hollandtimes.nl/earliereditions/2021/2021-edition-3-april-may/china-imposes-sanctions-on-dutch-mp-sjoerd-sjoerdsma/.

7 "Statement on the Netherlands Trade and Investment Office's name change," Government of the Netherlands, April 28, 2020, https://www.government.nl/documents/diplomatic-statements/2020/04/28/statement-on-the-netherlands-trade-and-investment-office's-name-change.

8 Liu Caiyu, "Change in Netherlands' office name in Taiwan is 'playing with fire,' poses risk to ties with Chinese mainland: experts," *Global Times China*, May 1, 2020, https://www.globaltimes.cn/content/1187254.shtml.

9 "Brief van de Staatssecretaris van Economische Zaken en Klimaat [Letter from the State Secretary of Economic Affairs and Climate]," Kamerstuk, June 29, 2020, https://zoek.officielebekendmakingen.nl/kst-33009-92.html.

10 "Besluit veiligheid en integriteit telecommunicatie" [Telecommunications Security and Integrity Decree], Dutch Ministry of Economic Affairs and Climate, December 5, 2019, https://zoek.officielebekendmakingen.nl/stb-2019-457.html.

11 "Huawei blocked from core 5G networks of major Dutch providers," NL Times, May 21, 2021, https://nltimes.nl/2021/05/21/huawei-blocked-core-5g-networks-major-dutch-providers.

12 "Kamerbrief Ontwikkelingen Chinabeleid: een verschuiving van de balans" [Letter to parliament on developments in China policy: A shift in balance], Dutch Ministry of Foreign Affairs, January 13, 2023,

https://www.rijksoverheid.nl/documenten/kamerstukken/2023/01/13/kamerbrief-inzake-ontwikkelingen-chinabeleid-een-verschuiving-van-de-balans.

13 "Motie van het lid Brekelmans over mensenrechten in het buitenlands beleid" [Motion by Mr Brekelmans on human rights in foreign policy], Tweede Kamer der Staten-Generaal, October 4, 2021, https://zoek.officielebekendmakingen.nl/kst-32735-324.html.

14 Author's translation. See "Motie van het lid Kuzu over China" [Motion by member Kuzu on China], Tweede Kamer der Staten-Generaal, November 24, 2021, https://zoek.officielebekendmakingen.nl/kst-35207-47.html.

15 "Gewijzigde motie van het lid Klink c.s. t.v.v. 21501-02-2654 over zo concreet mogelijk de afhankelijkheid van kritieke grondstoffen, chips, halfgeleiders en hightechproducten met afbouwpad in kaart brengen [Modified motion by member Klink c.s. t.v.v. 21501-02-2654 on mapping the dependence of critical raw materials, chips, semiconductors, and high-tech products with a phase-out path as concretely as possible]", Tweede Kamer der Staten-Generaal, May 24, 2023, https://www.tweedekamer.nl/kamerstukken/moties/detail?id=2023Z09128&did=2023D21918.

16 Gregory C. Allen, *Choking off China's Access to the Future of AI* (Washington, DC: CSIS, October 2022), https://www.csis.org/analysis/choking-chinas-access-future-ai.

17 Arjun Kharpal, "Semiconductor giant ASML sees 2023 sales surge; says China revenue to be steady despite U.S. chip restrictions," CNBC, January 25, 2023, https://www.cnbc.com/2023/01/25/asml-forecasts-25percent-rise-in-2023-revenue-as-chip-industry-recovers.html.

18 Marc Hijink, "ASML-topman over export naar China: 'Wij hebben al genoeg ingeleverd'" [ASML CEO about export to China: 'We have already given up enough'] *NRC Handelsblad*, December 13, 2022, https://www.nrc.nl/nieuws/2022/12/13/asml-topman-over-export-naar-china-wij-hebben-al-ingeleverd-a4151373.

19 Author's translation. This source is a parliamentary question ("kamervraag") for Dutch parliament, a question-and-answer between a Dutch House of Representatives member and government ministers. See Laurens Dassen, "Antwoord op vragen van het lid Dassen over de nieuwe Amerikaanse wet die de export van geavanceerde chips en machines naar China verder aan banden wil leggen" [The new U.S. law that aims to further restrict the export of advanced chips and machines to China], November 8, 2022, https://www.openkamer.org/kamervraag/2022Z17158/.

20 "ASML moet wijken, maar met welk doel?" [ASML must give way, but for what purpose?], Volt, March 10, 2023, https://voltnederland.org/blog/asml-moet-wijken-maar-met-welk-doel .

21 Cedric Ryngaert, "De impact van Amerikaanse extraterritoriale regelgeving op Nederlandse belangen" [The impact of American extraterritorial regulations on Dutch interests], *Nederlands juristenblad* 24 (2021): 1942–1951, https://dspace.library.uu.nl/handle/1874/422065.

22 Marc Hijink, "ASML CEO about exports to China."

23 Alexandra Alper, Toby Sterling, and Stephen Nellis, "Trump administration pressed Dutch hard to cancel China chip-equipment sale: sources", Reuters, January 6, 2020, https://www.reuters.com/article/us-asml-holding-usa-china-insight-idUSKBN1Z50HN.

24 Ibid.

25 Ibid.

26 The Ministry of Defence document is accessible through the Dutch Open Government Act, which contains the semiconductor strategy document. See "Semiconductor Strategy," Netherlands Ministry of Defence, October 9, 2020, https://open.overheid.nl/documenten/ronl-439fd001c31e0f25670c025e03e81fd1ff0b928c/pdf.

27 Author's translation. See "Semiconductor Strategy," Netherlands Ministry of Defence.

28 Ibid.

29 "Comments of ASML U.S. LLC on Advance Notice Regarding the Identification and Review of Controls for Certain Foundational Technologies," ASML, November 9, 2020, https://downloads.regulations.gov/BIS-2020-0029-0049/attachment_1.pdf.

30 U.S. Department of Commerce, "Deputy Secretary Graves Emphasizes Priorities for Enhanced U.S.-EU Transatlantic Trade with Leaders, Industry Representatives in Netherlands and Belgium," Press release, June 3, 2022, https://www.commerce.gov/news/press-releases/2022/06/deputy-secretary-graves-emphasizes-priorities-enhanced-us-eu.

31 Office of Senator Chris Coons, "Senators Coons and Portman statement on congressional delegation to The Hague," Press release, November 5, 2022, https://www.coons.senate.gov/news/press-releases/senators-coons-and-portman-statement-on-congressional-delegation-to-the-hague.

32 Author's translation. See Mark Rutte (@MinPres), "NL en de VS hebben een lange, historische vriendschap" [Netherlands and the U.S. have a long, historic friendship]," X (Twitter), November 4, 2022, 1:33 p.m., https://twitter.com/MinPres/status/1588585144742735873.

33 Doug Fuller, "As the Fog Lifts: Reflections on the Chip War's Impact after One Month–Chip Fabrication," China Tech Tales, November 6, 2022, https://chinatechtales.wordpress.com/2022/11/06/as-the-fog-lifts-reflections-on-the-chip-wars-impact-after-one-month-chip-fabrication/.

34 "Netherlands plans new curbs on chip-making equipment sales to China," Reuters, December 8, 2022, https://www.reuters.com/technology/netherlands-plans-curbs-china-chip-exports-deal-with-us-bloomberg-news-2022-12-08/.

35 "Exportcontrolebeleid voor halfgeleidertechnologie" [Export Control Policy for Semiconductor Technology], Dutch Ministry of Foreign Affairs, December 1, 2022, https://open.overheid.nl/documenten/ronl-f749085585e99c1f61a001dc97680a91956f883d/pdf.

36 "U.S. secures deal with Netherlands, Japan on China chip export limit, Bloomberg reports," Reuters, January 28, 2023, https://www.reuters.com/world/officials-netherlands-japan-washington-chip-talks-2023-01-27/.

37 "Aankondiging aankomende exportcontrolemaatregelen voor geavanceerde productieapparatuur voor halfgeleiders" [Announcing upcoming export control measures for advanced semiconductor manufacturing equipment], Dutch Ministry of Foreign Affairs, March 8, 2023, https://www.rijksoverheid.nl/documenten/kamerstukken/2023/03/08/kamerbrief-inzake-aankondiging-aankomende-exportcontrolemaatregelen-voor-geavanceerde-productieapparatuur-voor-halfgeleiders.

38 Ibid.

39 Ibid.

40 Author's translation. See "Regeling van de Minister voor Buitenlandse Handel en Ontwikkelingssamenwerking van 23 juni 2023, nr. MinBuza.2023.15246-27 houdende invoering van een vergunningplicht voor de uitvoer van geavanceerde productieapparatuur voor halfgeleiders die niet zijn genoemd in bijlage I van Verordening 2021/821 (Regeling geavanceerde productieapparatuur voor halfgeleiders)" [Regulation of the Minister for Foreign Trade and Development Cooperation of June 23, 2023, no. MinBuza.2023.15246-27 introducing a license obligation for the export of advanced production equipment for semiconductors that are not mentioned in Annex I of Regulation 2021/821 (Regulation on advanced production equipment for semiconductors)], Official Gazette of the Kingdom of the Netherlands, June 30, 2023, https://zoek.officielebekendmakingen.nl/stcrt-2023-18212.html.

41 Ibid.

42 Xinmei Shen, "Chinese imports of ASML lithography chip-making machines have surged past the Dutch company's 2023 estimates," *South China Morning Post*, August 26, 2023, https://www.scmp.com/tech/tech-war/article/3232401/chinese-imports-asml-lithography-chip-making-machines-have-surged-past-dutch-companys-2023-estimates

43 Shen Weiduo and Ma Jingjing, "Dutch export controls come into effect; following Washington 'will only lead to backlash' as China's tech progress continues despite US sanctions: observer," *Global Times*, September 1, 2023, https://www.globaltimes.cn/page/202309/1297419.shtml.

44 Marc Hijink, "Schreinemacher: Chinese exportbeperking voor ASML alleen op eigen voorwaarden" *NRC Handelsblad*, November 18, 2022, https://www.nrc.nl/nieuws/2022/11/18/schreinemacher-chinese-exportbeperking-voor-asml-alleen-op-eigen-voorwaarden-a4148738.

45 Philip Blenkinsop, "Dutch trade minister: China protest over export rules is 'understandable'," Reuters, March 9 2023, https://www.reuters.com/world/dutch-trade-minister-china-protest-over-export-rules-is-understandable-2023-03-09/.

46 Author's translation. See "Regeling van de Minister voor Buitenlandse Handel en Ontwikkelingssamenwerking van 23 juni 2023, nr. MinBuza.2023.15246-27 houdende invoering van een vergunningplicht voor de uitvoer van geavanceerde productieapparatuur voor halfgeleiders die niet zijn genoemd in bijlage I van Verordening 2021/821 (Regeling geavanceerde productieapparatuur voor halfgeleiders) [Regulation of the Minister for Foreign Trade and Development Cooperation of 23 June 2023, no. MinBuza.2023.15246-27 introducing a license obligation for the export of advanced production equipment for semiconductors that are not mentioned in Annex I of Regulation 2021/821 (Regulation on advanced production equipment for semiconductors)]", Official Gazette of the Kingdom of the Netherlands, June 30, 2023, https://zoek.officielebekendmakingen.nl/stcrt-2023-18212.html.

47 Ministry of Defense, *Militaire Inlichtingen- en Veiligheidsdienst (MIVD)* [Military Intelligence and Security Service (MIVD)], (Den Haag: Government of the Netherlands, April 2022), .

48 "Wet veiligheidstoets investeringen, fusies en overnames" [Investments, Mergers and Acquisitions Security Test Act], Overheid Wettenbank, June 1, 2023, https://wetten.overheid.nl/BWBR0046747/2023-06-01.

49 Ibid.

50 "Staatsblad van het Koninkrijk der Nederlanden" [Official Gazette of the Kingdom of the Netherlands], Dutch Ministry of Economic Affairs and Climate, May 31, 2023, https://zoek.officielebekendmakingen.nl/stb-2023-172.html.

51 "Executive Order on Addressing United States Investments in Certain National Security Technologies and Products in Countries of Concern," The White House, August 9, 2023, https://www.whitehouse.gov/briefing-room/presidential-actions/2023/08/09/executive-order-on-addressing-united-states-investments-in-certain-national-security-technologies-and-products-in-countries-of-concern/.

52 See also Brigitte Dekker & Maaike Okano-Heijmans, "The US-China trade-tech stand-off and the need for EU action on export control," Clingendael Institute, August 2019, https://www.clingendael.org/publication/us-china-trade-tech-stand.

TAIWANESE PERSPECTIVE

1 Office of the U.S. Trade Representative, "President Trump Approves Relief for U.S. Washing Machine and Solar Cell Manufacturers," Press release, January 22, 2018, https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/january/president-trump-approves-relief-us.

2 Jake Sullivan, "Remarks on the Biden-Harris Administration's National Security Strategy," The White House, October 12, 2022, https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/10/13/remarks-by-national-security-advisor-jake-sullivan-on-the-biden-harris-administrations-national-security-strategy/.

3 "TSIA Q2 2023," Taiwan Semiconductor Industry Association, https://www.tsia.org.tw/EN/index.

4 "Taiwan's dominance of the chip industry makes it more important," *The Economist*, March 6, 2023, https://www.economist.com/special-report/2023/03/06/taiwans-dominance-of-the-chip-industry-makes-it-more-important.

5 Katherin Hille, "Trade war forces Chinese chipmaker Fujian Jinhua to halt output," *Financial Times*, January 28, 2019, https://www.ft.com/content/87b5580c-22bf-11e9-8ce6-5db4543da632; "Addition of Huawei Non-U.S. Affiliates to the Entity List, the Removal of Temporary General License, and Amendments to General Prohibition Three (Foreign-Produced Direct Product Rule)," *Federal Register* 84, no. 51596, August 8, 2020, https://www.federalregister.gov/d/2020-18213; and U.S. Department of Commerce, "Commerce Adds China's SMIC to the Entity List, Restricting Access to Key Enabling U.S. Technology," Press release, December 18, 2020, https://2017-2021.commerce.gov/news/press-releases/2020/12/commerce-adds-chinas-smic-entity-list-restricting-access-key-enabling.html.

6 "Addition of Huawei Non-U.S. Affiliates to the Entity List," *Federal Register*.

7 "Nvidia Form 8-K Filing," U.S. Securities and Exchange Commission, August 26, 2022, https://www.sec.gov/Archives/edgar/data/1045810/000104581022000146/nvda-20220826.htm.

8 Debby Wu, Ian King, and Jenny Leonard, "US Quietly Tightens Grip on Exports of Chipmaking Gear to China," Bloomberg, July 29, 2022, https://www.bloomberg.com/news/articles/2022-07-29/us-pushes-expansion-of-china-chip-ban-key-suppliers-say.

9 Bureau of Industry and Security, U.S. Department of Commerce, "Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)," Press release, October 7, 2022, https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file.

10 Gregory C. Allen, *Choking off China's Access to the Future of AI* (Washington, DC: CSIS, October 2022), https://www.csis.org/analysis/choking-chinas-access-future-ai.

11 Gregory C. Allen, Emily Benson, and Margot Putnam, "Japan and the Netherlands Announce Plans for New Export Controls on Semiconductor Equipment," CSIS, *Commentary*, April 2023, https://www.csis.org/analysis/japan-and-netherlands-announce-plans-new-export-controls-semiconductor-equipment.

12 "FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China," The White House, August 9, 2022, https://www.whitehouse.gov/briefing- room/statements-releases/2022/08/09/fact-sheet-chips-and- science-act-will-lower-costs-create-jobs-strengthen-supply-chains- and-counter-china/.

13 Chips and Science Act, Pub. L. No. 117-167, 136 Stat. 1366 (2022), https://www.congress.gov/bill/117th-congress/house-bill/4346.

14 CHIPS Incentives Program, *Vision for Success: Commercial Fabrication Facilities* (Washington, DC: U.S. Department of Commerce), https://www.nist.gov/system/files/documents/2023/02/28/Vision_for_Success-Commercial_Fabrication_Facilities.pdf; and "Preventing the Improper Use of CHIPS Act Funding," *Federal Register* 88, no. 17439 (March 23, 2023): 17439, https://www.federalregister.gov/documents/2023/03/23/2023-05869/preventing-the-improper-use-of-chips-act-funding.

15 "Comments of the Semiconductor Industry Association (SIA) On the CHIPS Program Office (CPO) National Institute of Standards and Technology (NIST) Proposed Rule On Preventing the Improper Use of CHIPS Act Funding RIN 0693-AB070, NIST-2023-0001 88 Fed. Reg. 17439 (March 23, 2023)," Semiconductor Industry Association, May 22, 2023, https://www.semiconductors.org/wp-content/uploads/2023/05/SIA-Comments-to-CPO-on-Preventing-the-Improper-Use-of-CHIPS-Act-Funding-5_22_23.pdf.

16 Soo-Hyang Choi, "South Korea asks US to review China rule for chip subsidies," Reuters, May 24, 2023, https://www.reuters.com/technology/south-korea-asks-us-review-china-rule-chip-subsidies-2023-05-24/.

17 "TSMC talking to US about CHIPS Act 'guidance' amid subsidy concerns," Reuters, April 10, 2023, https://www.reuters.com/technology/tsmc-talking-us-about-chips-act-guidance-amid-subsidy-concerns-2023-04-10/.

18 Yuka Hayashi, "U.S. to Allow South Korean, Taiwan Chip Makers to Keep Operations in China," *Wall Street Journal*, June 12, 2023, https://www.wsj.com/articles/u-s-to-allow-south-korean-taiwan-chip-makers-to-keep-operations-in-china-5d7d72cc.

19 World Bank, *Reviving Growth*, East Asia and the Pacific Region Economic Outlook (Washington, DC: World Bank, April 2023), https://openknowledge.worldbank.org/server/api/core/bitstreams/7065093c-6b71-4037-ac32-9adb7f2fd85a/content.

20 Allen, *Choking Off China's Access*.

21 Anton Shilov, "Chinese Chip Industry to Focus on Perfecting Mature Nodes," Tom's Hardware, May 10, 2023, https://www.tomshardware.com/news/chinese-chip-industry-to-focus-on-perfecting-mature-nodes.

22 Jane Lee and Stephen Nellis, "Explainer: What is 'FDPR' and why is the U.S. using it to cripple China's tech sector?," Reuters, October 8, 2022, https://www.reuters.com/technology/what-is-fdpr-why-is-us-using-it-cripple-chinas-tech-sector-2022-10-07/.

23 Emma Kinery, "TSMC to up Arizona investment to $40 billion with second semiconductor chip plant," CNBC, December 6, 2022, https://www.cnbc.com/2022/12/06/tsmc-to-up-arizona-investment-to-40-billion-with-second-semiconductor-chip-plant.html.

24 Anton Shilov, "U.S. Govt Outlines Requirements for CHIPS Act Subsidies," Tom's Hardware, February 28, 2023, https://www.tomshardware.com/news/us-govt-outlines-requirements-for-chips-act-subsidies.

25 Yimou Lee and Sarah Wu, "TSMC expects Q2 sales drop as clients struggle to clear inventory," Reuters, April 20, 2023, https://www.reuters.com/technology/tsmc-q1-profit-rises-2-yy-beats-market-expectations-2023-04-20/.

26 Mitchell Clark, "Nvidia's selling a nerfed GPU in China to get around export restrictions," The Verge, November 8, 2022, https://www.theverge.com/2022/11/8/23447886/nvidia-a800-china-chip-ai-research-slowed-down-restrictions.

27 Anton Shilov, "TSMC to Expand Capacity for Mature and Specialty Nodes by 50%," AnandTech, June 16, 2022, https://www.anandtech.com/show/17456/tsmc-to-expand-capacity-for-mature-and-specialty-nodes-by-50.

28 TSMC, "TSMC to Build Specialty Technology Fab in Japan with Sony Semiconductor Solutions as Minority Shareholder," Press release, November 9, 2021, https://pr.tsmc.com/english/news/2880.

29 TSMC, "TSMC, Bosch, Infineon, and NXP Establish Joint Venture to Bring Advanced Semiconductor Manufacturing to Europe," Press release, August 8, 2023, https://pr.tsmc.com/english/news/3049.

30 Monica Chen and Jessie Shen, "TSMC to expand capacity for 28nm process at China fab," DigiTimes Asia, April 23, 2021, https://www.digitimes.com/news/a20210423PD202.html.

31 Matthew Fulco, "Amid Geopolitical Gale, Taiwan's Chipmakers Chart New Course," AmCham Taiwan: Taiwan Business Topics, February 16, 2023, https://topics.amcham.com.tw/2023/02/amid-geopolitical-gale-taiwans-chipmakers-chart-new-course/.

32 "Future R&D Plans," Taiwan Semiconductor Manufacturing Corporation, n.d., https://www.tsmc.com/english/dedicatedFoundry/technology/future_rd/.

33 The N3E nanometer node, or the "Enhanced N3 node," falls under TSMC's N3 family despite key design differences, lower process complexity, and higher production yield rates than the previously released N3. See "TSMC Showcases New Technology Developments at 2023 Technology Symposium," Press release, April 27, 2023, https://pr.tsmc.com/english/news/3021; and "Chapter 5: Operational Highlights" in TSMC, *TSMC Annual Report 2022* (Hsinchu, Taiwan: TSMC, 2022), https://investor.tsmc.com/sites/ir/annual-report/2022/2022%20Annual%20Report-E.pdf.

34 Keoni Everington, "TSMC to start building 1.4nm fabs in Taiwan in 2026," TaiwanNews, June 27, 2023, https://www.taiwannews.com.tw/en/news/4929623.

35 "Transcript: Q1 2023 Taiwan Semiconductor Manufacturing Co Ltd Earnings Call (April 20, 2023)," TSMC, April 20, 2023, https://investor.tsmc.com/english/encrypt/files/encrypt_file/reports/2023-04/882aa7c981570fe00c0bba76648983b02b54cbf4/TSMC%201Q23%20Transcript.pdf.

36 "Regulations Governing Export and Import Of Strategic High-tech Commodities," Taiwan Ministry of Economic Affairs, last amended October 20, 2017, https://law.moj.gov.tw/ENG/LawClass/LawHistory.aspx?pcode=J0090013.

37 "Export Control Laws (SHTC)," Bureau of Foreign Trade, Taiwan Ministry of Economic Affairs, https://www.trade.gov.tw/english/Pages/List.aspx?nodeID=298.

38 "Operational Guidelines for Key Technology Review and Supervision of Investment in Foundry, Integrated Circuit Design, Integrated Circuit Packaging, Integrated Circuit Testing, and LCD Panel Plants in Mainland China," Taiwan Ministry of Economic Affairs, https://law.moea.gov.tw/LawContent.aspx?id=FL021027.

39 "Statute for Industrial Innovation," Taiwan Ministry of Economic Affairs, last amended January 19, 2023, https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=J0040051.

40 Ibid.

41 "National Security Act," Taiwan Executive Yuan, last updated June 8, 2022, https://law.moj.gov.tw/ENG/LawClass/LawHistory.aspx?pcode=A0030028.

42 "Act Governing Relations between the People of the Taiwan Area and the Mainland Area," Taiwan Mainland Affairs Council, last amended June 8, 2022, https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=Q0010001; and "National Security Act," Taiwan Executive Yuan.

43 "The Chip 4 alliance will struggle to find cohesion in 2023," Economist Intelligence Unit, December 8, 2022, https://country.eiu.com/article.aspx?articleid=1182633901.

44 Kim Yoo-chul, "Chip 4 aims to control Samsung-TSMC rivalry for Intel," *Korea Times*, September 5, 2022, https://www.koreatimes.co.kr/www/tech/2023/06/129_335586.html.

45 Wang Yushu, "Chip 4 The United States and South Korea first talk about Wang Meihua: Alliance and cooperation can be made on two issues," *China Times*, August 20, 2022, https://www.chinatimes.com/newspapers/20220820000403-260110?chdtv.

46 "The Chip 4 alliance will struggle," Economist Intelligence Unit.

47 Alicia Garcia Herrero, "What is Behind China's Dual Circulation Strategy," *China Leadership Monitor*, September 1, 2021, https://www.prcleader.org/post/what-is-behind-china-s-dual-circulation-strategy.

48 Arjun Kharpal, "How Asia came to dominate chipmaking and what the U.S. wants to do about it," CNBC, April 11, 2021, https://www.cnbc.com/2021/04/12/us-semiconductor-policy-looks-to-cut-out-china-secure-supply-chain.html.

49 Sheila Chiang, "Don't underestimate China's ability to build its own advanced chips despite U.S. curbs, tech analysts say," CNBC, June 6, 2023, https://www.cnbc.com/2023/06/06/dont-underestimate-chinas-ability-to-build-advanced-chips-analysts-say.html.

50 Che Pan, "China's semiconductor developers eye shift to RISC-V architecture amid growing chip demand in cars, data centres and AI, executive says," *South China Morning Post*, May 18, 2023, https://www.scmp.com/tech/tech-trends/article/3221027/chinas-semiconductor-developers-eye-shift-risc-v-architecture-amid-growing-chip-demand-cars-data.

51 "RISC-V International Members," RISC-V, n.d., https://riscv.org/members/.

52 Assaf Orion, "Illusion, Awakening, Rage, and Response: The United States Strategic Approach to China," Institute for National Security Studies, *INSS Insight* no. 1338, June 21, 2020, https://www.inss.org.il/publication/usa-strategy-towards-china/.

53 "China Stockpiles U.S. Chips as 'Silicon Curtain' Descends," Bloomberg, December 3, 2019, https://www.bloomberg.com/news/articles/2019-12-03/china-stockpiles-foreign-tech-as-silicon-curtain-descends.

54 TSMC, "TSMC Announces Intention to Build and Operate an Advanced Semiconductor Fab in the United States," Press release, May 15, 2020, https://pr.tsmc.com/english/news/2033; TSMC, "TSMC to Build Specialty Technology Fab in Japan with Sony Semiconductor Solutions as Minority Shareholder," Press release, November 9, 2021, https://pr.tsmc.com/english/news/2880; and "Germany spends big to win $11 billion TSMC chip plant," Reuters, August 8, 2023, https://www.reuters.com/technology/taiwan-chipmaker-tsmc-approves-38-bln-germany-factory-plan-2023-08-08/.

55 Monica Chen and Willis Ke, "TSMC new US fab to dent profits, hard to transfer costs to customers," *DigiTimes Asia*, March 13, 2023, https://www.digitimes.com/news/a20230313PD200/arizona-ic-manufacturing-morris-chang-tsmc-wafer-fab.html.

56 Senate Foreign Relations Committee, "Menendez, Risch, Van Hollen, Romney Unveil Taiwan Tax Agreement Act of 2023," Press release, May 4, 2023, https://www.foreign.senate.gov/press/dem/release/menendez-risch-van-hollen-romney-unveil-taiwan-tax-agreement-act-of-2023.

EUROPEAN UNION PERSPECTIVE

1 "Regeling van de Minister voor Buitenlandse Handel en Ontwikkelingssamenwerking van 23 juni 2023, nr. MinBuza.2023.15246-27 houdende invoering van een vergunningplicht voor de uitvoer van geavanceerde productieapparatuur voor halfgeleiders die niet zijn genoemd in bijlage I van Verordening 2021/821 (Regeling geavanceerde productieapparatuur voor halfgeleiders)" [Regulation of the Minister for Foreign Trade and Development Cooperation of 23 June 2023, no. MinBuza.2023.15246-27 introducing a license obligation for the export of advanced production equipment for semiconductors that are not mentioned in Annex I of Regulation 2021/821 (Regulation on advanced production equipment for semiconductors)], Dutch Ministry of Foreign Affairs, June 30, 2023, https://zoek.officielebekendmakingen.nl/stcrt-2023-18212.html; and "Dual-use export controls," European Union, January 12, 2023, https://eur-lex.europa.eu/EN/legal-content/summary/dual-use-export-controls.html.

2 "EU and US agree to start discussions on a Global Arrangement on Sustainable Steel and Aluminium and suspend steel and aluminium trade disputes," European Commission, Press release, October 31, 2021, https://ec.europa.eu/commission/presscorner/detail/en/ip_21_5721.

3 "EU-China Strategic Outlook: Commission and HR/VP contribution to the European Council (21-22 March 2019)," European Commission, March 12, 2019, https://commission.europa.eu/publications/eu-china-strategic-outlook-commission-and-hrvp-contribution-european-council-21-22-march-2019_en.

4 "European Council conclusions on China, 30 June 2023," European Council, Council of the European Union, Press release, June 30, 2023, https://www.consilium.europa.eu/en/press/press-releases/2023/06/30/european-council-conclusions-on-china-30-june-2023/.

5 "An EU approach to enhance economic security," European Commission, Press release, June 20, 2023, https://ec.europa.eu/commission/presscorner/detail/en/IP_23_3358.

6 Ibid.

7 Ibid.

8 "'Dual-use' items means items, including software and technology, which can be used for both civilian and military applications." See "Regulation (EU) 2021/821 of the European Parliament and of the Council of 20 May 2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items (recast)," *Official Journal of the European Union*, May 20, 2021, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R0821.

9 Martin Chorzempa and Laura von Daniels, *New U.S. Export Controls: Key Policy Choices for Europe* (Netherland: Stiftung Wissenschaft und Politik, March 20, 2023), 1, https://www.swp-berlin.org/publications/products/comments/2023C20_USExportControls.pdf.

10 Gregory C. Allen, "Across Drones, AI, and Space, Commercial Tech Is Flexing Military Muscle in Ukraine," CSIS, *Commentary*, May 13, 2022, https://www.csis.org/analysis/across-drones-ai-and-space-commercial-tech-flexing-military-muscle-ukraine.

11 Andrea Ciani and Michela Nardo, *The position of the EU in the semiconductor value chain: evidence on trade, foreign acquisitions, and ownership* (Brussels: European Commission, March 2023), 1, https://joint-research-centre.ec.europa.eu/system/files/2022-04/JRC129035.pdf.

12 Pradeep Chakraborty, "Big four – Cadence, Synopsys, Ansys, and Siemens EDA – account for over 90 percent of EDA industry revenues," Dataquest, April 11, 2023, https://www.dqindia.com/big-four-cadence-synopsys-ansys-and-siemens-eda-account-for-over-90-of-eda-industry-revenues/.

13 OECD, *Measuring distortions in international markets: The semiconductor value chain* (Paris, France: December 2019), https://www.oecd-ilibrary.org/trade/measuring-distortions-in-international-markets_8fe4491d-en.

14 European Commission, *European Chips Act: Staff Working Document* (Brussels: May 2022), https://digital-strategy.ec.europa.eu/en/library/european-chips-act-staff-working-document.

15 Ibid.

16 European Parliament, *Strengthening EU chip capabilities How will the chips act reinforce Europe's semiconductor sector by 2030?* (Brussels: July 2022), https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733585/EPRS_BRI(2022)733585_EN.pdf.

17 Kritika Bhaskar, "Top 10 Best Semiconductor Companies in Europe 2023," Inventiva, April 23, 2023, https://www.inventiva.co.in/trends/semiconductor-companies-in-europe-2023/.

18 European Commission, *European Chips Act*.

19 Hagen Mikulas, "Chipfabrik in Magdeburg: Bund gibt 10 Milliarden für Intel-Ansiedelung" [Chip factory in

Magdeburg: Federal government gives 10 billion for Intel settlement], ZDF, June 19, 2023, https://www.zdf.de/nachrichten/politik/intel-staatsmittel-subvention-chip-fabrik-magdeburg-100.html.

20 Agathe Demarais, *Backfire: How Sanctions Reshape the World Against U.S. Interests* (New York: Columbia University Press, November 2022).

21 Hannelore Crolly, "Mit dem Tausch-Trick zieht Europa den Zorn Washingtons auf sich" [With the exchange trick, Europe draws the wrath of Washington], WELT, January 28, 2019, https://www.welt.de/wirtschaft/article187837916/Iran-EU-bietet-Trump-bei-Sanktionen-die-Stirn.html.

22 Bureau of Industry and Security, "Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)," U.S. Department of Commerce, Press Release, October 7, 2022, https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file.

23 Jan-Peter Kleinhans, Reva Goujon, Julia Hess, and Lauren Dudley, "Running on Ice: China's Chipmakers in a Post-October 7 World," Rhodium Group, April 4, 2023, https://rhg.com/research/running-on-ice/.

24 "U.S.-EU Joint Statement of the Trade and Technology Council," Office of the United States Trade Representative, Executive Office of the President, Press release, May 31, 2023, https://ustr.gov/about-us/policy-offices/press-office/press-releases/2023/may/us-eu-joint-statement-trade-and-technology-council.

25 Chorzempa and von Daniels, *New U.S. Export Controls*.

26 Pieter Haeck, "EU sidelined in US-Dutch deal to block chips exports to China," *Politico*, January 31, 2023, https://www.politico.eu/article/eu-sidelined-in-us-dutch-deal-to-block-chips-exports-to-china/.

27 Andy Bounds, "Belgium accuses US of 'aggressive' push to lure European business," *Financial Times*, January 10, 2023, https://www.ft.com/content/16816444-1694-4530-84bb-ac289d6776dd.

28 Bernhard Bartsch and Claudia Wessling, *From a China strategy to no strategy at all: Exploring the diversity of European approaches* (Berlin: MERICS, July 2023), https://www.merics.org/en/report/china-strategy-no-strategy-all-exploring-diversity-european-approaches.

UNITED STATES PERSPECTIVE

1 "U.S. Export Controls," International Trade Administration, U.S. Department of Commerce, n.d., https://www.trade.gov/us-export-controls.

2 William Alan Reinsch and Emily Benson, *Digitizing Export Controls: A Trade Compliance Technology Stack?* (Washington, DC: CSIS, December 2021), 1, https://www.csis.org/analysis/digitizing-export-controls-trade-compliance-technology-stack.

3 "TOPN: Export Control Act of 1949," Legal Information Institute, Cornell Law School, n.d., https://www.law.cornell.edu/topn/export_control_act_of_1949; and John Gibbons, *Technology and East-West Trade* (Washington, DC: U.S. Congress Office of Technology Assessment, 1979), https://www.princeton.edu/~ota/disk3/1979/7918/7918.PDF.

4 John Henshaw, *The Origins of COCOM: Lessons for Contemporary Proliferation Control Regimes* (Washington, DC: Stimson Center, May 1993), 7, https://www.stimson.org/wp-content/files/file-attachments/Report7_1.pdf.

5 "The Wassenaar Arrangement at a Glance," Arms Control Association, February 2022, https://www.armscontrol.org/factsheets/wassenaar.

6 Bureau of Industry and Security, *BIS 2018 Annual Conference on Export Controls and Policy* (Washington, DC: U.S. Department of Commerce, 2018), https://www.bis.doc.gov/documents/bis-annual-conference-

2018/2212-multilateral-regime-control-lists-wassenaar-nsg-ag-mtcr-rev-13may2018/file.

7 James Andrew Lewis, "Notes on Creating an Export Control Regime," CSIS, *Commentary*, December 15, 2022, https://www.csis.org/analysis/notes-creating-export-control-regime.

8 Gina Raimondo, "A Conversation with US Commerce Secretary Gina M. Raimondo an Sen. Todd young (R-IN) on the Future of US Semiconductor Policy" (Speech, American Enterprise Institute, Washington, DC, July 26, 2023), https://www.aei.org/events/a-conversation-with-us-commerce-secretary-gina-m-raimondo-on-the-future-of-us-semiconductor-policy/.

9 Kevin Wolf and Emily S. Weinstein, "COCOM's Daughter?," Center for Security and Emerging Technology, *Commentary*, May 2022, https://cset.georgetown.edu/wp-content/uploads/WorldECR-109-pp24-28-Article1-Wolf-Weinstein.pdf.

10 "FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China," The White House, August 9, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/.

11 "European Chips Act," European Commission, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-chips-act_en; Jeong-Ho Lee and Sohee Kim, "South Korea Passes Its 'Chips Act' Amid US-China Friction," Bloomberg, March 29, 2023, https:// www.bloomberg.com/news/articles/2023-03-29/south-korea-to- pass-its-own-chips-act-amid-us-china-friction; and "Act on Restriction of Special Cases Concerning Taxation," Republic of Korea, April 18, 2017, https://elaw.klri.re.kr/eng_service/lawView.do?hseq=43262&lang=ENG.

12 Miriam Rozen, "Appetite for geopolitical risk management is growing," *Financial Times*, May 15, 2023, https://www.ft.com/content/3989290b-c4d1-48dc-88f1-ca80e61c186f.

13 "Remarks by National Security Advisor Jake Sullivan at the Special Competitive Studies Project Global Emerging Technologies Summit," The White House, Speech Transcript, September 16, 2022, https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/09/16/remarks-by-national-security-advisor-jake-sullivan-at-the-special-competitive-studies-project-global-emerging-technologies-summit/.

14 Ibid.

15 Ryan Fedasiuk, Karson Elmgren, and Ellen Lu, *Silicon Twist: Managing the Chinese Military's Access to AI Chips* (Washington, DC: Center for Security and Emerging Technology, June 2022), 1, https://cset.georgetown.edu/publication/silicon-twist/; Gregory C. Allen, "Blocking China's Access to AI Chips Matters to U.S. National Security," CSIS, *Commentary*, June 31, 2023, https://www.csis.org/analysis/blocking-chinas-access-ai-chips-matters-us-national-security.

16 Bureau of Industry and Security, "Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)," U.S. Department of Commerce, Press release, October 7, 2022, https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file.

17 "Commerce Control List (CCL)," U.S Department of Commerce, n.d., https://www.bis.doc.gov/index.php/regulations/commerce-control-list-ccl.

18 "Export Administration Regulations Files," U.S. Department of Commerce, n.d., https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear.

19 "Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items; Supercomputer and Semiconductor End Use; Entity List Modification; Updates

to the Controls To Add Macau," *Federal Register* 88, no. 11 (January 18, 2013): 2821, https://www.federalregister.gov/documents/2023/01/18/2023-00888/implementation-of-additional-export-controls-certain-advanced-computing-and-semiconductor.

20 "Remarks by National Security Advisor Jake Sullivan," The White House.

21 Sujai Shivakumar and Charles Wessner, *The Strategic Importance of Legacy Chips* (Washington, DC: CSIS, March 2023), 1, https://www.csis.org/analysis/strategic-importance-legacy-chips.

22 Christopher Timura et al., "United States Creates New Export Controls on China for Semi-Conductor Manufacturing Technology, Advanced Semiconductors, and Supercomputers in New Phase of Strategic Tech Competition," Gibson Dunn, October 13, 2022, https://www.gibsondunn.com/us-new-export-controls-on-china-for-semi-conductor-manufacturing-technology-advanced-semiconductors-in-new-phase-strategic-tech-competition/.

23 William Alan Reinsch, "Export Control: Too Much or Too Little?," CSIS, *Commentary*, October 17, 2022, https://www.csis.org/analysis/export-control-too-much-or-too-little.

24 "Foreign-Direct Product (FDP) Rules," *Code of Federal Regulations* title 15 (2023): Part 734, https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-734/section-734.9#p-734.9(h).

25 "Foreign-Direct Product Rules: Organization, Clarification, and Correction," *Federal Register* 87, no. 23 (February 3, 2022): 6022, https://www.govinfo.gov/content/pkg/FR-2022-02-03/pdf/2022-02302.pdf.

26 "H.R. 5040, Export Control Reform Act of 2018," House Committee on Foreign Affairs, U.S. House of Representatives, Press release, 2018, https://foreignaffairs.house.gov/legislation/h-r-5040-export-control-reform-act-of-2018/.

27 "Addition of Huawei Non-U.S. Affiliates to the Entity List, the Removal of Temporary General License, and Amendments to General Prohibition Three (Foreign-Produced Direct Product Rule)," *Federal Register* 85, no. 162 (August 20, 2020): 51596, https://www.govinfo.gov/content/pkg/FR-2020-08-20/pdf/2020-18213.pdf.

28 Annie Froehlich, "Foreign Direct Product Rule: Is Russia the next Huawei?," Atlantic Council, Commentary, February 3, 2022, https://www.atlanticcouncil.org/blogs/econographics/foreign-direct-product-rule-is-russia-the-next-huawei/.

29 "Foreign-Direct Product (FDP) Rules," *Code of Federal Regulations* title 15 (2023): Part 734.9 section (h), Part 734.9 section (i), https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-734/section-734.9#p-734.9(h).

30 "Understanding the Foreign Direct Product Rule," Export Compliance Training Institute, December 20, 2022, https://www.learnexportcompliance.com/understanding-the-foreign-direct-product-rule/.

31 Michaela Platzer et al., Semiconductors: *U.S. Industry, Global Competition, and Federal Policy*, CRS Report No. R46581 (Washington, DC: Congressional Research Service, October 2020), https://crsreports.congress.gov/product/pdf/R/R46581.

32 Saif M. Khan, *The Semiconductor Supply Chain: Assessing National Competitiveness* (Washington, DC: Center for Security and Emerging Technology, January 2021), https://cset.georgetown.edu/ publication/the-semiconductor-supply-chain/.

33 "What is EDA (Electronic Design Automation)," Synopsys, n.d., https://www.synopsys.com/glossary/what-is-electronic-design-automation.html.

34 Gregory C. Allen and Emily Benson, "Clues to the U.S.-Dutch-Japanese Semiconductor Export Controls Deal Are Hiding in Plain Sight," CSIS, *Commentary*, March 1, 2023, https://www.csis.org/analysis/clues-us-

dutch-japanese-semiconductor-export-controls-deal-are-hiding-plain-sight.

35 Manpreet Singh et al., *Semiconductors and the Semiconductor Industry*, CRS Report No. R47508 (Washington, DC: Congressional Research Service, April 2023), https://crsreports.congress.gov/product/pdf/R/R47508.

36 Khan, *The Semiconductor Supply Chain*.

37 "How ASML became chipmaking's biggest monopoly," *The Economist*, February 29, 2020, https://www.economist.com/business/2020/02/29/how-asml-became-chipmakings-biggest-monopoly.

38 Allen and Benson, "Clues to the U.S.-Dutch-Japanese Semiconductor Export Controls."

39 Gregory C. Allen, Emily Benson, and Margot Putnam, "Japan and the Netherlands Announce Plans for New Export Controls on Semiconductor Equipment," CSIS, *Commentary*, April 10, 2023, https://www.csis.org/analysis/japan-and-netherlands-announce-plans-new-export-controls-semiconductor-equipment; and "CSIS Translation: Updated Japanese Export Controls on High-Performance Semiconductor Manufacturing Equipment," CSIS, July 18, 2023, https://www.csis.org/analysis/csis-translation-updated-japanese-export-controls-high-performance-semiconductor.

40 Hideki Tomoshige, "Key Differences Remain between U.S. and Japanese Advanced Semiconductor Export Controls on China," CSIS, Blog Post, May 25, 2023, https://www.csis.org/blogs/perspectives-innovation/key-differences-remain-between-us-and-japanese-advanced-semiconductor.

41 "CSIS Translation: Updated Japanese Export Controls," CSIS.

42 Pieter Haeck, "The Netherlands to block export of advanced chips printers to China," *Politico*, March 8, 2023, https://www.politico.eu/article/netherlands-impose-restrictions-chips-export-to-china-asml/.

43 "Government publishes additional export measures for advanced semiconductor manufacturing equipment," Government of the Netherlands, Press release, June 30, 2023, https://www.government.nl/latest/news/2023/06/30/government-publishes-additional-export-measures-for-advanced-semiconductor-manufacturing-equipment.

44 "Principles of the trading system," World Trade Organization, n.d., https://www.wto.org/english/thewto_e/whatis_e/tif_e/fact2_e.htm.

45 Gregory C. Allen, "Blocking China's Access to AI Chips Matters to U.S. National Security," CSIS, *Commentary*, July 31, 2023, https://www.csis.org/analysis/blocking-chinas-access-ai-chips-matters-us-national-security.

46 "Lam Research warns of up to $2.5 bln revenue hit from U.S. curbs on China exports," Reuters, October 19, 2022, https://www.reuters.com/technology/lam-research-warns-up-25-bln-revenue-hit-us-curbs-china-exports-2022-10-19/; Yifan Yu, "KLA estimates up to $900m revenue hit in 2023 from China chip ban," Nikkei Asia, October 27, 2022, https://asia.nikkei.com/Business/Tech/Semiconductors/KLA-estimates-up-to-900m-revenue-hit-in-2023-from-China-chip-ban.

47 "Applied Materials Revises Fourth Quarter of Fiscal 2022 Business Outlook," Applied Materials, Press release, October 12, 2022, https://ir.appliedmaterials.com/news-releases/news-release-details/applied-materials-revises-fourth-quarter-fiscal-2022-business.

48 "China Bars Micron Chips in Escalation of US Tech Clash," Bloomberg, May 21, 2022, https://www.bloomberg.com/news/articles/2023-05-21/china-says-micron-products-failed-in-its-cybersecurity-review.

49 "China restricts exports of high-tech metals in a slap at Washington ahead of Yellen's visit," AP News, July 4, 2023, https://apnews.com/article/china-united-states-technology-germanium-gallium-aa6bffcb62ff95

d7ae562da58139fe71; Matthew Funaiole, Brian Hart, and Aidan Powers-Riggs, *Mineral Monopoly: China's Control over Gallium Is a National Security Threat* (Washington, DC: CSIS, July 2023), 1, https://features.csis.org/hiddenreach/china-critical-mineral-gallium/.

50 "Gallium," U.S. Geological Survey, n.d., https://pubs.usgs.gov/periodicals/mcs2023/mcs2023-gallium.pdf; and "Germanium," U.S. Geological Survey, n.d., https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-germanium.pdf.

51 Keith Bradsher, "Amid Tension, China Blocks Vital Exports to Japan," New York Times, September 22, 2010, https://www.nytimes.com/2010/09/23/business/global/23rare.html.

52 Maria Demertzis, "De-risking as an economic strategy," Bruegel, *Commentary*, June 6, 2023, https://www.bruegel.org/comment/de-risking-economic-strategy.

53 Matthew Reynolds and Matthew Goodman, *Deny, Deflect, Deter: Countering China's Economic Coercion* (Washington, DC: CSIS, March 21, 2023), 1, https://www.csis.org/analysis/deny-deflect-deter-countering-chinas-economic-coercion.

54 William Reinsch and Emily Benson, "US Chipping Away at Semiconductor Supply Chains," *Asia Times*, June 15, 2023, https://asiatimes.com/2023/06/us-chipping-away-at-semiconductor-supply-chains/.

55 Carlos Cordon, "The end of 'made in China'? Five ways to cut supply chain risks," IMD, January 23, 2023, https://www.imd.org/ibyimd/supply-chain/the-end-of-made-in-china-five-ways-to-cut-supply-chain-risks/.

56 Sarah Bauerle Danzman and Emily Kilcrease, "The Illusion of Controls Unilateral Attempts to Contain China's Technology Ambitions Will Fail," *Foreign Affairs*, December 30, 2022, https://www.foreignaffairs.com/united-states/illusion-controls.

57 "Huawei makes breakthroughs in design tools for 14nm chips -media," Reuters, March 24, 2023, https://www.reuters.com/technology/huawei-makes-breakthrough-design-tools-14nm-chips-media-2023-03-24/.

58 Jack Wu, "China boosts silicon wafer production to strengthen resilience," *DigiTimes Asia*, July 31, 2023, https://www.digitimes.com/news/a20230727PD202/china-nsig-silicon-wafer.html.

59 Kevin Yao, "Explainer: What we know about China's 'dual circulation' economic strategy," World Economic Forum, *Commentary*, September 14, 2020, https://www.weforum.org/agenda/2020/09/chinas-dual-circulation-economic-strategy/.

60 Asa Fitch et al., "U.S. Considers New Curbs on AI Chip Exports to China," *Wall Street Journal*, June 27, 2023, https://www.wsj.com/articles/u-s-considers-new-curbs-on-ai-chip-exports-to-china-56b17feb; and Ian Talley et al., "Loophole Allows U.S. Tech Exports to Banned Chinese Firms," *Wall Street Journal*, March 24, 2023, https://www.wsj.com/articles/loophole-allows-u-s-tech-exports-to-banned-chinese-firms-b4800164.

61 Josh Ye, David Kirton, and Chen Lin, "Focus: Inside China's underground market for high-end Nvidia AI chip," Reuters, June 20, 2023, https://www.reuters.com/technology/inside-chinas-underground-market-high-end-nvidia-ai-chips-2023-06-19/.

62 William Alan Reinsch, "China Whack-a-Mole," CSIS, *Commentary*, April 24, 2023, https://www.csis.org/analysis/china-whack-mole.

63 Manpreet Singh et al., *Semiconductors and the Semiconductor Industry*.

64 Sheila Chiang, "South Korea wants to be a top A.I. hub – its memory chip dominance could be an advantage," CNBC, July 5, 2023, https://www.cnbc.com/2023/07/06/south-koreas-dominance-in-memory-chips-an-advantage-in-ai-race.html.

65 Martin Chorzempa, "How US chip controls on China benefit and cost Korean firms," Peterson Institute for Internatinoal Economics, *Brief*, July 5, 2023, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4501484.

66 Sohee Kim, "Seoul Sees US Extending China Export Waivers for its Chipmakers," Bloomberg, May 9, 2023, https://www.bloomberg.com/news/articles/2023-05-09/seoul-sees-us-extending-china-export-waivers-for-its-chipmakers.

67 Yuka Hayashi, "U.S. to Allow South Korean, Taiwan Chip Makers to Keep Operations in China," *Wall Street Journal*, June 12, 2023, https://www.wsj.com/articles/u-s-to-allow-south-korean-taiwan-chip-makers-to-keep-operations-in-china-5d7d72cc.

68 "US urges South Korea not to fill chip shortfalls in China if Micron banned, Financial Times reports" *Financial Times*, https://www.reuters.com/technology/us-urges-south-korea-not-fill-china-shortfalls-if-beijing-bans-micron-chips-ft-2023-04-23/.

69 Ryan McMorrow et al., "South Korea signals its chipmakers can fill gap after China's ban on Micron," *Financial Times*, May 22, 2023, https://www.ft.com/content/93ba7f32-35df-4b5f-a14f-263b26b1f854.

70 William Alan Reinsch and Emily Benson, *Optimizing Export Controls for Critical and Emerging Technologies* (Washington, DC: CSIS, May 2023), 1, https://www.csis.org/analysis/optimizing-export-controls-critical-and-emerging-technologies.

71 William R. Spiegelberger, *Anatomy of a Muddle: U.S. Sanctions against Rusal and Oleg Deripaska* (Washington, DC: Foreign Policy Research Institute, April 2019), 1, https://www.fpri.org/article/2019/04/anatomy-of-a-muddle-u-s-sanctions-against-rusal-and-oleg-deripaska/.

72 Philip Blenkinsop and Rachelle Younglai, "Banking's SWIFT says ready to block Iran transactions," Reuters, February 17, 2012, https://www.reuters.com/article/us-iran-sanctions-swift/bankings-swift-says-ready-to-block-iran-transactions-idUSTRE81G26820120217.

73 "G7 Hiroshima Leaders' Communiqué," The White House, Statements and Releases, May 20, 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/20/g7-hiroshima-leaders-communique/; "An EU approach to enhance economic security," European Commission, Press Release, June 20, 2023, https://ec.europa.eu/commission/presscorner/detail/en/IP_23_3358; and Government of the Federal Republic of Germany, *Strategy on China* (Berlin: July 2023), https://www.auswaertiges-amt.de/blob/2608580/49d50fecc479304c3da2e2079c55e106/china-strategie-en-data.pdf.

COVER PHOTO NMEDIA/ADOBE STOCK

CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

1616 Rhode Island Avenue NW
Washington, DC 20036
202 887 0200 | **www.csis.org**