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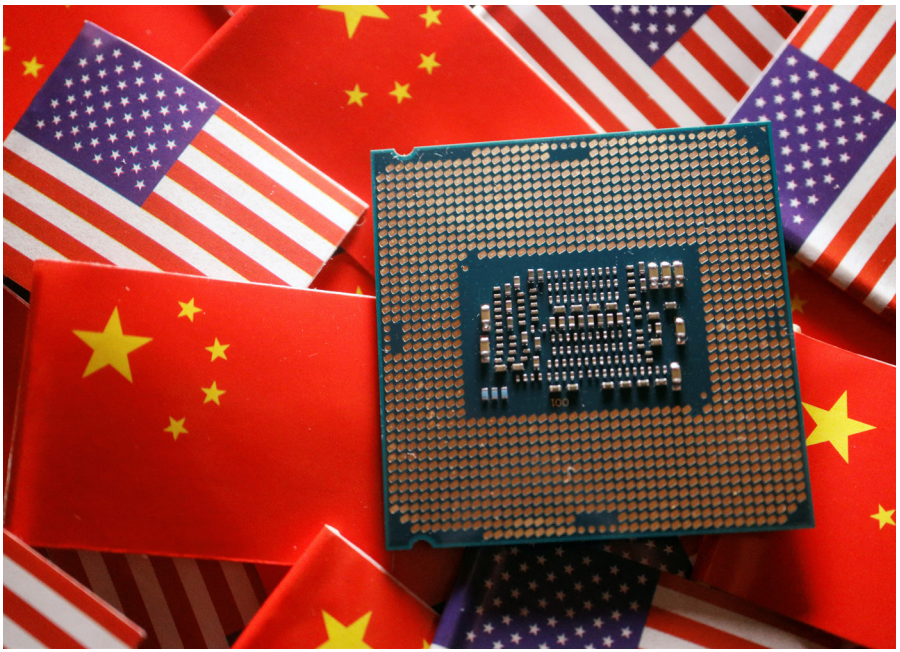
CHAPTER 2

Silicon Curtain: America's Quest for Allied Export Controls against China

Sophie-Charlotte Fischer

Export controls are playing an increasingly important role in the US government's efforts to deny China access to critical technologies, and their far-reaching effects have already begun to reshape the global technology landscape. However, the Biden administration's recently imposed export controls on China's semiconductor sector have highlighted the challenges the US faces in securing the buy-in from allies that it needs to ensure their long-term effectiveness. The episode has also underscored some critical issues that allies have to confront in dealing with Washington as it pursues its sharpened technological goals vis-à-vis Beijing.



Central processing unit (CPU) semiconductor chip, 17 February 2023. *Florence Lo / Reuters*

Technology has become a central arena in the intensifying great-power competition between the United States and China. As the power asymmetry between the two countries narrowed and mutual trust waned, Washington increasingly perceived Beijing's technological ambitions as a threat. The US government is concerned that China's continued domestic advances in areas such as Artificial Intelligence (AI), combined with technology and know-how acquired from abroad, could erode its long-standing technological advantage and thereby undermine both US military and economic competitiveness. In addition, China's use and export of technology for purposes such as surveillance have raised concerns about systemic threats to democratic values and human rights.

The return of great-power competition and its crystallization in the field of technology have led to a renewed focus in Washington on how to maintain US technological superiority. Beyond the question of how the US can strengthen its own capabilities to remain competitive, the element of denial has received increasing attention in both the administrations of former President Donald Trump and his successor Joe Biden. However, under Biden, the US has shifted its aim from simply keeping China a few generations behind to freezing its progress by denying Beijing access to certain critical technologies and the related know-how. Washington is turning to an old instrument in its toolbox – export controls coordinated with allies – to realize this objective.

The strategy of denying a great-power competitor access to critical technologies with allied support played an important role in America's efforts to contain the Soviet Union during the Cold War. However, in contrast to that era, the international technology landscape is significantly more complex today. Technology supply chains are highly globalized, commercial companies spearhead the development of cutting-edge dual-use technologies, and the US can no longer rely on overwhelming technological dominance. In this environment, the success of US export controls requires, more than ever, close cooperation with technologically capable allies and partners. However, the US government's ability to secure the full support of allies in Europe and the Asia-Pacific is uncertain. US allies have their own interests towards China, which are not fully congruent with those of Washington. If Biden fails to bring key high-tech-producing allies on board, then export controls are unlikely to be effective in the long run, will impose significant costs on American companies, and may

undermine rather than enhance US competitiveness.

This complex balancing act is illustrated by the Biden administration's recent attempts to persuade allies to match their domestic regulations with comprehensive US export controls on advanced computing and semiconductor manufacturing equipment. Washington identified semiconductors as a target because of the enabling nature of the technology and because China has so far failed to catch up with market leaders in some critical segments of the industry. However, in addition to the US, some of its allies in Europe and the Asia-Pacific also play a crucial role in important segments of semiconductor supply chains. Japan and the Netherlands, for example, are key suppliers of equipment required to manufacture advanced semiconductors. Yet, The Hague and Tokyo have been reluctant simply to succumb to US pressure to introduce national export controls that mirror Washington's, and uncertainties remain as to their support for the far-reaching measures.

This chapter explores the challenges that the US faces in managing the escalating great-power competition in technology with China and the strategic importance of allied export controls in this endeavor. It is divided into four sections. The first section provides a brief overview of the history of multilateral export controls, highlighting their rationale and evolution over time. The second section explains the importance of technology in the US-China relationship and why it has become a central area of competition. The third section then highlights the critical role of export controls in maintaining US technological superiority and the need for allied cooperation to enforce them effectively in the long run. The fourth section illustrates the challenges the US faces in extending the reach of its export controls, using the recently implemented export controls on semiconductor manufacturing equipment against China and attempts to coordinate them with the Netherlands and Japan as a case study. The fifth and final section offers conclusions and an outlook for the further development of this strategic trend.

Multilateral Export Controls: A Brief History

The origins of multilateral export controls go back to the early stages of the Cold War. During the Cold War, the United States developed a strategy of military-technological superiority to counter its main competitor, the Soviet Union (USSR). The US had established a government-led innovation system during the Second World War that laid the foundation for its

enduring technological strength and breakthrough inventions such as the atomic bomb. In the ensuing competition with the Soviet Union, US national security was closely tied to its ability to lead in technology, given the USSR's vast superiority in manpower and its at least temporary successes in challenging Washington in areas such as missile technology and space. Thus, throughout the Cold War, deterrence became a function of the US ability to continually create and maintain a technological gap between itself and the Soviet Union.[1]

The approach of the US government to implement its strategy of military-technological superiority was essentially twofold. First, the government significantly invested in research and development (R&D) to achieve and maintain a leading position in cutting-edge technology. Second, it sought to deny its competitors access to US technology. In this context, export controls emerged as a key instrument in the US government's toolbox, complementary to others such as secrecy orders on inventions and visa denials that aim to restrict cross-border flows of technology and related know-how in pursuit of national security and foreign policy objectives.[2] Before the Cold War era, Washington did not apply export controls strategically during peacetime. This changed, however, with the passage of the Export Control Act of 1949, which gave the US president substantial power to control the flow of goods and information across borders for foreign policy objectives.[3]

To amplify its national efforts, the US government convinced its NATO allies to establish a multilateral export control regime in 1949–1950. The aim of the Coordinating Committee for Multilateral Export Controls (CoCom) was to cut off the Eastern bloc from advanced technology and to coordinate export controls among allies, thereby ensuring that US allies gave national security concerns the same weight as Washington in their trade with the Soviets. Interestingly, in the wake of the Korean War, the US government also promoted the creation of a separate sub-committee to target China. The so-called CHINCOM was set up in 1952 and administered even more extensive export controls than CoCom on the Eastern Bloc. However, CHINCOM was disbanded in 1957 and integrated into CoCom because its members – notably Britain, France, and the United States – had different preferences about how strict export controls against China should be. The US unilaterally maintained particularly tough restrictions, and only began to relax them slightly during the Sino-American rapprochement of the 1970s.[4]

CoCom significantly shaped the global technology landscape during the Cold War. The conditions for enforcing export controls successfully were relatively favorable at the time. The world economy was characterized by a low degree of globalization of production, and the US had a strong position at the forefront of technological development. One estimate held that in the 1970s, US companies and government agencies were the source of about 70 per cent of the world's cutting-edge technology.[5] In addition, a much higher proportion of R&D was driven by the US government and especially defense spending than is the case today. The US also had considerable leverage over its allies because of their dependence on economic, financial, and military aid after the Second World War. Finally, there was a clear ideological alignment between the US and its allies and partners.

Despite the favorable environment, however, CoCom also faced several challenges during its years of operation. While the United States routinely emphasized national security concerns and pushed for tighter controls, European states such as West Germany and the United Kingdom argued for increased trade with the Eastern bloc and stressed the political leverage that it could provide. The different weighing of these priorities contributed to the evolution of different national export control systems across CoCom member states. In addition, companies that developed export-controlled goods resented these regulatory barriers to their pursuit of new market opportunities and pushed back, especially by the 1970s.[6] Finally, even during the Cold War, the export control system of the US and its allies was not ironclad, and some technology did slip through. In the 1970s and 1980s, for example, the Soviets were able to acquire sensitive Western technology in areas such as computers, semiconductors, lasers, and optics.[7]

During the last two decades of the Cold War, multilateral export control regimes other than CoCom were established with a focus on specific technologies. After India conducted its first nuclear test, based in part on technology provided by Canada for peaceful purposes, seven countries, including the Soviet Union, formed the Nuclear Suppliers Group (NSG) in 1974. The NSG focuses on the non-proliferation of materials, equipment, and technology that can be used to develop nuclear weapons. Another example is the Australia Group, established in 1985 following Iraq's use of chemical weapons during the Iran-Iraq War. Material exports and technical assistance from several Western

and particularly German companies had aided the development of the Iraqi chemical weapons program. The objective of the Australia Group is to contribute to the non-proliferation of chemical and biological weapons by harmonizing national controls of related exports and acting as an information sharing mechanism. Lastly, the G7 states established the Missile Technology Control Regime (MTCR) in 1987 to curb the spread of missile technology that could be used as delivery systems for weapons of mass destruction (WMD). These regimes continue to exist and remain highly relevant to ongoing global non-proliferation efforts today.

CoCom, however, was dissolved after the end of the Cold War in 1994. A successor regime, the Wassenaar Arrangement (WA), which also grew out of consultations among the G7, was established in 1996 to control the flow of conventional arms and sensitive dual-use technologies and thereby to prevent the build-up of destabilizing capabilities by "states of concern." The WA serves primarily as a mechanism for its member states to share information, coordinate a joint list of export-controlled items, and promote responsible behavior among its members. Former Warsaw Pact states, including Russia, have also been admitted as members of the WA.[8]

The end of the Cold War also marked a shift in the strategic significance of export controls. From the US perspective, export controls were no longer used as a tool to manage great-power competition, but rather to prevent the spread of weapons of mass destruction (WMDs) and their delivery systems to "rogue states" and non-state actors, a goal that became more urgent following the terrorist attacks on September 11, 2001. Moving away from the era of great-power competition, the administrations of President George H.W. Bush and especially his successor Bill Clinton sought to integrate both Russia and China into a US-led international order. The decision to include Russia in the WA and the further relaxation of US Cold War export controls toward China reflected this objective.

China's Tech Challenge to the US

The US-led push for trade liberalization, accompanied by a drive for specialization and efficiency gains, led to the evolution of a highly interconnected global economy, including in the tech sector. The emergence of complex technology supply chains that span multiple countries and the domination of a few specialized firms in specific market segments that are concentrated in certain geographical areas are exemplary of this trend. Despite sporadic national security concerns[9], the

US also fostered close ties with China on technology, including in R&D, manufacturing, and trade. Especially after Beijing's accession to the WTO in 2000, these ties grew increasingly close and were part of the broader US strategy of engagement vis-à-vis China.[10]

However, by the end of the 2000s, the tide turned. Starting with the Bush administration and continuing during the Obama administration, the US increasingly perceived China as a competitor, casting doubts on the mutual benefits of interdependence. China had been rapidly modernizing its military, eroding US power projection capabilities in the Asia-Pacific region, and expanding its global reach. Beijing had also begun to backtrack on economic reforms and trade liberalization. Especially since Xi Jinping came into power in 2012, the increasingly assertive regime in Beijing also routinely used its growing economic clout to exert pressure on other countries, all while seeking to reduce its own dependencies. In its 2022 National Security Strategy, the Biden administration concluded that China is America's "only competitor with both the intent to reshape the international order and, increasingly, the economic, diplomatic, military, and technological power" to do it.[11]

As the perceived power asymmetry between the US and China has diminished and mutual trust has deteriorated, Beijing's technological advances have become a central source of US concern. Washington fears that China's domestic advances in promising areas such as Artificial Intelligence (AI) and quantum technology, combined with legally and illegally acquired technology and know-how from abroad, could erode its long-standing technological advantage and thereby undermine both US military and economic strength. In this regard, US policymakers are particularly concerned about China's military-civil fusion strategy, which blurs the lines between commercial and military technology and exploits the dual-use character of many emerging technologies.[12] In addition, Washington has expressed worries that Beijing is seeking to shape emerging technologies and the standards, norms, and regulations that govern them to reflect its own interests and values, while countering those of the US and its allies.

The Renaissance of Export Controls

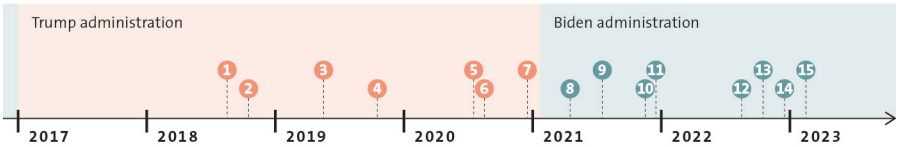
The return of great-power competition and its manifestation in the field of technology have led to a renewed focus in Washington on maintaining US technological superiority. Beyond the question of how the United States can strengthen its own technological

capabilities to remain competitive, the element of denial has received increasing attention. In this context, export controls have once again emerged as a key tool, alongside others, such as foreign direct investment screening and visa denials.[13] However, given today's interconnected global economy, in which commercial companies spearhead the development of cutting-edge technology, and the fact that the US no longer has a virtual monopoly on advanced technology, it cannot simply cut Beijing off.[14] More than ever, to be effective, the US must work with allies and partners to control bottlenecks in relevant technology supply chains and shape those networks to its advantage.

While the Bush and Obama administrations were already concerned about China's growing ambitions and took certain targeted actions to counter them, the Trump administration was the first to take on China's technology sector broadly. It took a multi-pronged approach to restricting technology transfers to China, with export controls playing a prominent role. For example, the Trump administration began to make extensive use of the Commerce Department's Bureau of Industry and Security's Entity List (EL), which specifies licensing requirements for the transfer of some or all items covered by the US Export Administration Regulations (EAR) to listed companies, persons, or further entities. During its tenure, the Trump administration blacklisted a range of Chinese entities linked to China's technology sector. A prominent addition to the list was the telecoms giant Huawei with the goal of denying it access to US semiconductor technology.[15] During Trump's time in the White House, Congress also passed the 2018 Export Control Reform Act (ECRA) with an eye to China, which required the Commerce Department to adapt US export controls to the new challenges posed by "emerging and foundational technologies." ECRA also highlighted that "export controls that are multilateral, are most effective."[16]

However, Trump's "go-it-alone" approach was widely characterized by a disregard for traditional American allies and partners.[17] The Trump administration doubled down on unilateral export controls and exploiting their extraterritorial effects, as in the case of Huawei. There, the Trump administration used the Foreign Direct Product Rule (FDPR), which extended restrictions on the export of semiconductors to Huawei to any supplier outside of the United States that uses US-controlled equipment or software. The Trump administration also exerted political pressure on its ally the Netherlands to halt exports

Selected US Export Control Measures, 2017–2023



1. **August 2018** President Trump Signs the Export Control Reform Act of 2018 into law.
2. **October 2018** The BIS adds Fujian Jinhua Integrated Circuit Company to the entity list due to "a significant risk" that it may engage in activities that could adversely affect US national security interests.
3. **May 2019** The BIS issues a final rule adding the Chinese telecoms giant Huawei and 68 non-US affiliates of the company to the entity list.
4. **October 2019** The BIS adds 28 Chinese entities, including Hikvision, IFLYTEK, and Sense Time, to the entity list for acting contrary to the foreign policy interests of the US.
5. **July 2020** The BIS adds 11 Chinese companies to the entity list for their involvement in human rights abuses in Xinjiang.
6. **August 2020:** The BIS adds 38 additional Huawei affiliates to the Entity List and modifies the application of the Foreign Direct Product Rule with respect to Huawei.
7. **December 2020** The BIS adds 77 entities – most of them Chinese – to the entity list. These include, for example, the Semiconductor Manufacturing International Corporation.
8. **April 2021** The BIS adds seven Chinese supercomputing entities to the entity list, due to their involvement with military actors, destabilizing military modernization efforts, and/or WMD programs.
9. **July 2021** The BIS adds 23 Chinese companies and entities due to their role in alleged human rights abuses in Xinjiang, for their ties to China's military modernization efforts, or for doing business with already sanctioned firms.
10. **November 2021** The BIS adds eight Chinese technology entities to the entity list for "quantum computing efforts that support military applications."
11. **December 2021** The BIS adds 34 Chinese entities and research institutes to the entity list for supporting China's military modernization efforts or being "a part of a network used to supply or attempt to supply Iran with US-origin items."
12. **August 2022** The BIS adds seven Chinese space, aerospace, and related technology entities to the entity list for their involvement in PRC military modernization efforts.
13. **October 2022** The BIS implements new sweeping restrictions on the export of advanced computing and semiconductor manufacturing items to China.
14. **December 2022** The BIS announces that it is adding 36 primarily Chinese entities, including memory chip maker YMTC and the AI company Cambricon Technologies Corp, to the entity list.
15. **February 2023** This BIS adds six Chinese entities related to the PRC's suspected balloon surveillance program to the entity list for supporting China's military modernization efforts.

Sources: US Department of Commerce, Bureau of Industry and Security (BIS)

of cutting-edge chip manufacturing equipment developed by the Dutch company ASML – so-called "Extreme Ultraviolet Lithography" (EUV) machines – to Chinese Semiconductor Manufacturing International Corporation (SMIC).[18] While this unilateralist approach was effective in achieving certain goals, it also contributed to severely strained relations with key US allies.

The Biden administration's approach to China's technology ambitions differs from Trump's in two ways. First, Biden has not only revised, but also notably expanded, the goals of US technology policy towards China. As US National Security Advisor Jake Sullivan explained in the fall of 2022, in contrast to previous administrations that tried to protect US "relative advantages" and "to stay only a couple of generations ahead" through a "sliding scale approach," the Biden administration seeks to "maintain as large of a lead as possible" in key technologies.[19] What this means in essence is that in certain technology areas deemed critical, the US seeks to freeze China's further development and thereby to contain its technological rise. This shift is reflected in sweeping export controls on advanced computing and semiconductor manufacturing equipment to China that the Biden administration imposed in the fall of 2022.

The second difference from the Trump administration's approach is that Biden seeks to combine the US government's tougher stance on China's technology ambitions with elements of multilateralism, focusing on expanding collaboration with technologically advanced democracies. The Biden administration recognizes that it cannot effectively deny China access to advanced technology in the long term without the support of its allies and partners. As US Commerce Secretary Gina Raimondo remarked in a recent speech: "…from export controls to new investment parameters to supply chains—require not only a partnership between the US government and private sector but also between the US and our allies and partners. In our competition with China to shape the 21st-century global economy, we cannot go at it alone."[20] The Biden administration, however, faces a range of challenges in coordinating export controls with its allies because it has no central platform for doing so.

Existing multilateral regimes do not provide an appropriate platform for the US government to coordinate export controls against China. The Nuclear Suppliers Group, the Australia Group, and the Missile Technology Control Regime have a limited focus on specific technologies and do not

cover those that the US considers most critical in its competition with China. The Wassenaar Arrangement, which also covers dual-use technologies, is not an effective forum to pursue US objectives towards China either. Decisions by its member states are made by consensus, and coordination is complicated by Russia's membership and its close relationship with Beijing. Additionally, membership in the WA is by voluntary association, and there is no enforcement mechanism to ensure compliance. Furthermore, important players with technological capabilities, such as Taiwan and Singapore, are not part of the WA.[21]

Given these limitations, export controls experts Emily Weinstein and Kevin Wolf have proposed the idea of creating a "CoCom 2.0" – a new multilateral export control regime with a core group composed of "techno-democracies" aimed, for example, at addressing "China's strategic economic dominance objectives" that could have national security implications and "responding to China's and Russia's civil-military fusion policies."[22] In the 2021 United States Innovation and Competition Act (which was in part absorbed by the CHIPS and Science Act of 2022), the US Senate even suggested that "the United States should explore the value of establishing a body akin to the Coordinating Committee for Multilateral Export Controls (CoCom)" albeit with a focus on coordinating specifically "United States and European Union export control policies with respect to limiting exports of sensitive technologies to the People's Republic of China."[23] Yet, so far, these suggestions do not seem to have borne fruit.

The US has, however, established several new initiatives to align with allies and partners on technology issues, but which have so far proved limited in their potential to coordinate export controls. One such initiative is the EU-US Trade and Technology Council (TTC), proposed by the EU and inaugurated in 2021, which provides a platform for the transatlantic partners to address different topics and concerns in ten working groups, including one on export controls. While the TTC proved very valuable in coordinating US and EU export controls against Russia following the invasion of Ukraine in early 2022, EU member states have been reluctant, so far, to use the TTC as a body explicitly targeting China.[24] In 2021, the US also proposed the Chip 4 Alliance, aimed at allies and partners in the Asia-Pacific region, including Japan, South Korea, and Taiwan, with significant semiconductor capabilities. The goal of this initiative is to restructure global semiconductor supply chains to

reduce reliance on China, protect relevant companies' IP, and coordinate export controls. However, the alliance has been off to a rocky start, with members hesitant to buy in for fear of retribution from Beijing and industry backlash.[25]

Lacking a reliable multilateral mechanism, but wanting to move quickly, the Biden administration unilaterally imposed sweeping export restrictions on advanced computing and semiconductor manufacturing items targeting China in October 2022. Since announcing the controls, the administration has intensified efforts to persuade allies in Europe and East Asia to impose similar restrictions and thereby amplify those of the US.[26] But US attempts to bring even a few countries on board have proved cumbersome, providing a case study in some of the major challenges the US faces in trying to act multilaterally and coordinate export controls with allies in the current global economic, political, and security environment. At the same time, it foreshadows some of the challenges that US allies may face in dealing with Washington and the pursuit of its strategic objectives towards Beijing in the future.

Reluctant Allies

In October 2022, the US government announced sweeping export controls on semiconductor exports to China. Semiconductors are considered an enabling technology because they are part of virtually every electronic device and are essential to critical functions such as data processing, transmission, and storage. There are three broad types of semiconductors: memory; logic; and discrete, analog, and other (DAO). Those semiconductors that are integrated circuits (as most of them are) are also called chips. Over time, chips have become increasingly powerful. According to Moore's Law, named after Intel co-founder Gordon Moore, the number of transistors that can fit on a chip roughly doubles about every two years, leading to new and more potent generations of chips. While this process has slowed in recent years, the most advanced technology available today is the 3 nanometer (nm) process node. Innovation in the semiconductor industry is continuously pushed by the drive for more powerful, specialized, smaller, and efficient chips.[27]

However, while semiconductors were originally invented in the United States, semiconductor supply chains are highly globalized and multi-layered today. The first layer can be roughly divided into three main steps: (1) the design, (2) front-end manufacturing (wafer fabrication), and (3) back-end manufacturing (assembly and testing). There are very

few companies – so-called integrated device manufacturers (IDM) – that complete all three steps in-house. These include, for example, Texas Instruments and Intel in the US and the South Korean company Samsung. The dominant model today is one in which the three steps are distributed over different companies and countries. There is an increasing number of companies, such as Apple, (1) that design chips themselves for their specific purposes. However, all companies designing chips rely on design software, which is predominantly developed by US companies, including Cadence Design Systems, Mentor, and Synopsis. The front-end manufacturing (2) is usually outsourced to so-called foundries. The world's largest foundry by revenue is the Taiwan Semiconductor Manufacturing Corporation (TSMC), which also dominates the production of the currently most advanced chips.[28] The third step is then outsourced again (3), including to China, which holds the largest market share in assembly, testing, and packaging.

It is also worth taking a brief look at what lies below this first layer. The (2) complex front-end manufacturing process requires not only specialized expertise but also very sophisticated machinery, especially to produce the latest generations of semiconductors. Over 50 different types of equipment are used in the highly complex manufacturing process. The necessary cutting-edge equipment is produced by only a few companies globally, including, for example, the US firms Lam Research, KLA, and Applied Materials, Japan's Nikon and Tokyo Electron, as well as the Dutch company ASML.[29] While the scope of this chapter is too limited to delve further into the complexities of semiconductor supply chains, it should at least be noted that there are other important sub-segments of the second layer, such as the chemicals and gases required for the manufacturing process. There are also additional layers, such as the many inputs required by equipment manufacturers to develop the machines they sell. Thus, government intervention in the extremely complex semiconductor supply chains is likely to have ripple effects across countries, if not continents.[30]

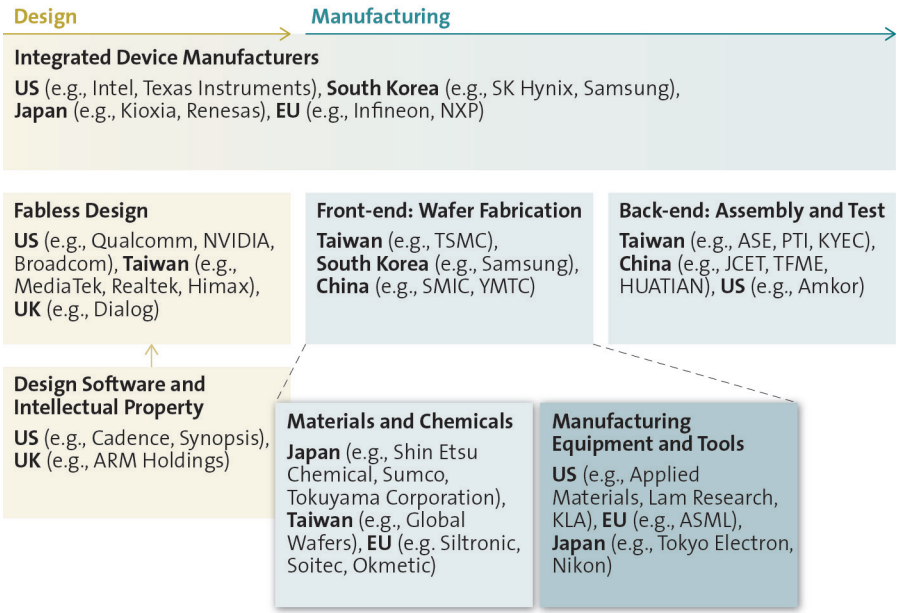
With the far-reaching export controls announced in October 2022, the US government seeks to deny China access to advanced semiconductors, related manufacturing equipment, as well as the know-how and inputs that could help China develop its own equipment.[31] Losing access to these assets, which China is still unable to develop on its own despite decades of effort and significant investment, could have serious implications for Beijing's

ability to advance its ambitions in strategically prioritized technology sectors such as AI.[32] In doing so, the US government hopes to prevent China from developing some sophisticated military equipment as well as technology that could enable human rights violations and thus harm US national security and foreign policy interests.

The Biden administration took great risks by unilaterally imposing export controls on advanced semiconductor manufacturing items targeting China. While the US maintains the strongest position in the semiconductor industry globally, it is unable to control and exploit choke points of the relevant supply chains on its own, at least in the long term. Without the support of other key supplier countries, the controls might not only be less effective by continuing to provide Chinese entities with certain critical equipment and know-how. They also might provide an incentive for companies from allied countries, at a time when US companies are forced to incur the high cost of reducing their exposure to the Chinese market, to try to capture additional market niches that were previously covered exclusively or predominantly by American firms. Moreover, by depriving affected US companies of revenue to reinvest in R&D, the controls could also backfire and hurt America's future competitiveness. The Biden administration asserted that it would work with allies and partners and persuade them to adopt similar controls. However, US Commerce Secretary Gina Raimondo also warned that it could take up to nine months to get allies on board and thus to ease the pain for the affected American semiconductor businesses.[33]

Two allies that have come under particular scrutiny in Washington's efforts to extend the reach of its control are the Netherlands and Japan. This is because of their strong positions in a sub-segment of the semiconductor supply chain – advanced semiconductor manufacturing equipment – access to which is important for China to enable its industry to produce more powerful chips domestically and ultimately to reduce its reliance on imports. However, there are two distinct challenges from the US perspective regarding Dutch and Japanese semiconductor manufacturing equipment suppliers and why it is important to have their government's support for export controls. First, Dutch and Japanese companies have a dominant position in a particular niche of equipment, so-called advanced photolithography equipment. The most advanced types are the above-mentioned extreme ultraviolet (EUV) lithography – already restricted equipment which is exclusively provided by

Key Countries and Companies Along the Semiconductor Value Chain



Sources: Semiconductor Industry Association; Boston Consulting Group; Stiftung Neue Verantwortung; CSIS; Finance Charts; Electronics Weekly

the Dutch company ASML – followed by different kinds of deep ultraviolet (DUV) lithography, and finally i-line lithography. Second, the export controls on US companies could incentivize Dutch and Japanese firms to invest as well in the development of additional equipment types that have so far been dominated by American companies.[34]

The Hague and Tokyo have been reluctant to yield to Washington's request to introduce national restrictions that mirror US export controls. Broadly, their reluctance has been for a variety of reasons, including divergences in their threat assessment of China and, therefore, a different weighing of economic and national security concerns.

A major challenge for the US in bringing its European and East Asian allies on board is a persistent difference in threat perceptions regarding China. While the US sees China as its main

competitor and a threat to its security and economic interests and values, the perceptions of Washington's European and East Asian allies still differ. In recent years, the European Union and many of its member states, including the Netherlands, have become more sober in their assessment of China, seeing it simultaneously as a partner, economic competitor, and systemic rival. But from a European perspective, the security threat from Moscow is far greater than that from Beijing, as the Russian invasion of Ukraine has underlined, and Europe's economic reliance on China remains significant. Due to the geographic proximity, the potential threat from Beijing looms larger for Japan than for the European Union. Tokyo has also begun to adjust its view of China, particularly in light of disputes over the Senkaku islands, Beijing's rapid military build-up, and growing tensions in the region over Taiwan, and has recently significantly increased its defense spending.[35] At the same time, China has become Japan's largest trading partner over time and remains an important market for Japanese companies despite rising political tensions.[36]

Against this backdrop, there still is a nuanced difference in the objectives of the US and its allies when it comes to China. While the US government is once again putting national security front and center in the design of its export controls and is seemingly willing to accept high economic costs for their application, its allies, despite slowly shifting perceptions of China, still appear to weigh these elements slightly differently. Next to the US, China is the largest market for semiconductor consumption globally, with its volume expected to expand further in the future.[37] For Japanese and Dutch equipment suppliers, revenues from the Chinese market play an important role. Tokyo Electron, Japan's leading producer of semiconductor manufacturing equipment, for example, reportedly derives about a quarter of its revenues from its China business. This comes at a time when countries around the globe are seeking to expand their domestic semiconductor industries and face increasing competition. Given these economic interests, it comes as no surprise that the Japanese government, for example, reportedly preferred controls that are tough enough to send a clear message to Beijing while still allowing its businesses to pursue their interests in the Chinese market.[38]

The Dutch and Japanese have also been uneasy over pressure from the US government to mirror its export controls. Although Biden administration officials have emphasized that they are seeking dialogue rather than

pushing governments to align with their position, The Hague and Tokyo have made it clear that Washington cannot dictate the design of their domestic regulatory regimes. As Dutch Minister of Foreign Trade Liesje Schreinemacher said: "(…) the US cannot simply impose such changes on us. We participate in those conversations in a sovereign way. (…) The Netherlands will not copy the American measures one-to-one."[39] This element of the negotiations illustrates the challenge that the Biden administration faces in distancing itself from Trump's approach. It highlights the delicate balance that Biden must strike in persuading allies to support US policy toward China without alienating them by applying too much pressure or simply exploiting its extraterritorial powers. Such overreach could also ultimately motivate allied governments and tech companies to deliberately reduce American inputs, thereby diminishing the ability of the US government to deploy coercive measures against them in the future.

However, Russia's invasion of Ukraine and rising tensions over Taiwan have also once again underscored that the United States' European and East Asian allies are highly dependent on Washington as a security provider. This gives the US considerable leverage to align the policies of its technologically capable allies with its policies toward Beijing. It is unclear, however, whether and how the United States has used this leverage in its consultations with The Hague and Tokyo to date and what role it might play in discussions with allies about further coercive economic measures against China in the future.

In January 2023, it was reported that the US had reached an agreement "in principle" with Tokyo and The Hague on semiconductor export controls. On the one hand, this can be seen as a great success for the Biden administration. It seemingly persuaded allies to implement export controls on technologies of concern to Washington just a few months after the initial announcement of the unilateral US controls. On the other hand, however, the devil is still in the details. The governments involved have been careful not to be too explicit about what exactly they have agreed and have avoided mentioning China as a target of their controls, reflecting US allies' concerns about possible retaliation from Beijing. Moreover, several issues seem to require further clarification and compromise. These likely include specifications for what types of equipment will eventually be restricted and whether the agreements will include US-style controls on Dutch and Japanese nationals working in positions in

China that support the design or manufacture of advanced semiconductors.[40] From what is known at the time of writing, the Dutch export controls may ultimately be less stringent than those of the US, and as a Japanese lawmaker has indicated, the same may be true of Tokyo's controls.[41] Moreover, given the differences between the national export control regimes of the US, Japan, and the Netherlands, it is unclear when The Hague and Tokyo would be able to implement theirs.

Outlook and Conclusion

In the intensifying competition between the United States and China, export controls have once again become a strategic tool for the US government to deny its key competitor access to cutting-edge technology. While the Trump administration had already ushered in the renaissance of export controls, the Biden administration has significantly expanded the breadth and depth of their use against China. It has made clear that the goal of US policy is no longer simply to keep China's industries a few generations behind, but to prevent further progress in core technologies and the development of capabilities that could threaten US national security and foreign policy interests. In this way, US export controls are contributing to reshaping the global technology landscape, and ultimately to consolidating an American, as opposed to a Chinese-led, "technology sphere," with at least partially separate supply chains and significantly reduced exchanges of know-how.

Given current trends in US-China relations, which point to a further escalation rather than an easing of tensions as the recent spat over alleged Chinese spy balloons has underscored, it is likely that the far-reaching US export controls on semiconductors are just the beginning. In the future, as has already been indicated, the Biden administration may decide to impose controls on additional technologies it deems strategically valuable, such as quantum technology, biotechnology, and clean energy technology.[42] Last November, for example, Biden met with representatives from IBM, one of the leaders in quantum computing, and discussed the design of potential export controls in this area and the challenges that they may pose.[43]

However, as the example of US export controls on semiconductors shows, it is essential for the American government to coordinate with allies for them to be effective, and to reduce the economic costs involved. In the absence of an appropriate multilateral forum, export controls are likely to become a more prominent topic of discussion between the United States

and its allies in other fora, as has already been seen in the context of the TTC or the Chip 4 Alliance, as well as in bilateral consultations. Thus, for the foreseeable future, the United States is in a delicate position in which it must skillfully use both sticks and carrots to bring allies in line with its objectives without alienating them. This will require a deep understanding of each ally's strategic interests and technological capabilities, a judicious use of the leverage that it has over allies, a willingness to tailor its approach to the unique circumstances of each relationship, and possibly a great deal of patience and diplomatic resources.

Taken together, the likely US appetite for further export controls, the need for joint controls, and Washington's increased leverage over allies due to its renewed significance as security provider, will increase the pressure on technologically capable allies and partners in Europe and East Asia to pick sides. While the constellation of relevant states may vary depending on the technology area in focus, it means that national governments will need to be prepared to engage in more such discussions with the US administration in the future. For the European Union, which has been on the sidelines of the Dutch-US discussions, this requires a clearer assessment of its position on strategic export controls vis-à-vis the US and China, including a forward-looking analysis of technology areas that may be affected next and their implications for the EU. At present, senior EU officials – European Commission president Ursula von der Leyen and European Council president Charles Michel – appear to favor different approaches to Beijing with the former seeking a harder line than the latter.[44] However, if Brussels does not wake up to the new geopolitical realities, it risks being sidelined, and a potential new patchwork of bilateral agreements between EU countries and Washington could emerge, with likely repercussions for other member states.[45]

Looking further ahead, there are several uncertainties about how the dynamics of allied export controls against China will evolve. One uncertainty is the evolution of China's position on the war in Ukraine. While Beijing has developed an increasingly close relationship with Moscow in recent years, its position on the war has been ambiguous. At the time of writing, Beijing had not provided Russia with military assistance and had publicly expressed its opposition to the use or threat of use of nuclear weapons. At the same time, it has increased purchases of Russian oil and gas and provided rhetorical support by criticizing and blaming the US

and NATO for the war. While it still seems unlikely given China's broader economic interests, US intelligence continues to warn that China may decide to supply Russia with weapons such as drones after all.[46] Such a move would directly and significantly harm European security interests. Following the Russian invasion in February 2022, the US, in coordination with its allies, quickly implemented extensive export controls against Russia. To be sure, similar controls against China would be much more difficult and costly to implement, given Beijing's deeper technological ties to Washington and its allies and greater economic interdependence across sectors. Nevertheless, military support for Moscow could significantly raise the price that the US and its allies are willing to pay to isolate China.

Another uncertainty that could have a profound impact on the support of US allies for extensive export controls targeting China is the development of rising international tensions over Taiwan. A Chinese invasion of Taiwan, or even a more acute threat to do so, could lead to closer US and allied coordination on export controls, including those targeting China's technology sector, which remains highly dependent on imports despite decades of efforts to reduce its reliance on foreign technology. Similar to a scenario in which China becomes more involved in the war in Ukraine, a contingency over Taiwan could significantly increase the willingness of the US and its allies in Europe and other regions of the world to pay a high price for China's technological isolation.

A third lingering uncertainty that could alter the current dynamic between the US government and its allies is the 2024 elections. It seems likely that whichever administration follows, Washington will continue to tighten the screws on China's technological ambitions. Neither a Democratic nor a Republican president is likely to change the current course, as a tougher stance on China has become one of very few bipartisan issues. What is uncertain, however, is the role that allies will play in Washington's calculus going forward. If a Republican president, possibly even Trump, is (re-)elected in 2024, it is possible that the US administration will again opt for a more coercive approach to bring allies in line with its technology policy toward China.

In conclusion, the increased use of export controls and the importance of international coordination for the United States is a strategic trend that deserves close attention and further analysis. Its ramifications will have a profound impact on the evolution

of the international technology landscape and the balance of power between the United States and China. It is therefore imperative that US allies and partners in Europe and the Asia-Pacific region not only monitor this trend, but proactively shape it to ensure their own future technological competitiveness, and by extension their prosperity and security.

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