Universitat Autònoma de Barcelona

Faculty of Political Science and Sociology

Bachelor's Dissertation

Title: Geopolitics of Innovation: U.S.-China Technology Competition and Implications for Technology Governance

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Dissertation submitted for the Degree of Political Science and Public Administration

Barcelona, May 20th, 2022

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INTRODUCTION

Emerging technologies have increasingly become a key point of contention in U.S.-China relations. The United States regards technological leadership as an imperative prerequisite for economic and military capabilities, and subsequently, its respective position in world politics as a Great Power (SWP, 2020). China has gone from being the hub for assembling high-tech products, to becoming a key player in cutting-edge technological innovation, rapidly catching up with the United States in R&D spending. The *Made in China 2025* plan became China's technological blueprint which seeks to dominate key technology sectors such as artificial intelligence, robotics, and ITC by reducing the country's dependence on foreign technology (Sun, 2019).

The relevance of focusing on the technological dimension of U.S.-China relations is twofold. First, although IR scholarship recognizes that innovation is important in international politics, the field lacks a framework to analyze how dominant and rising states interact in this realm. The theorization of the technological dimension in U.S.-China relations offers new insights into current dynamics, moving beyond the traditional focus of military conflict in power transitions (Kennedy *et al.*, 2018). Therefore, the aim of this paper is to further analyze how technology has become a locus of Great Power interaction between the United States and China, as negative externalities that arise from the rising state's activities form the link between technology and strategic competition.

Second, emerging technologies not only shape states' interests but also signals profound transformations in systems of governance. The disruptive characteristics of emerging technologies today create new challenges especially because of their applications to military capabilities. The unprecedented scale and velocity of new convergences of technologies and their yet-to-be-discovered impacts have the potential to affect deterrence, disrupt strategic balances fueling arms races, and challenge traditional arms control frameworks (Sun, 2019; Wu, 2020; Wong *et al.*, 2020). This can be reflected in the rising concerns of autonomy in weapon systems as they pose questions about their ethical, legal, and safe development and use. In a globalized world where technologies permeate national boundaries, cross-border collaboration has a vital role in setting global standards in order to avoid regulatory discrepancies (Word Economic Forum, 2020). From this perspective, there seems to be a need to better understand the role of technology in state interactions, and in turn, the interplay of these interactions in global governance dynamics. Thus, this paper seeks to explore how the United States and China's

technological rivalry can hinder cross-border cooperation in the area of governance by analyzing the case of Lethal Autonomous Weapon Systems (LAWS).

This paper explores how China's innovation imperative gave leeway to negative security and order externalities for the United States, which since 2017, has adopted a whole-of-government approach to target Chinese technological progress. The first section of the analysis focuses on a document review of U.S. foreign policy toward China from the year 2017 to 2022 and explores how China's pursuit of technological innovation has threatened the United States' strategic interests. Subsequently, by studying the technological dimension of U.S.-China relations, the second part of the analysis explores how competition for leadership in harnessing emerging technologies could hinder cooperation in technology governance. This section focuses on the case study of Lethal Autonomous Weapon Systems.

LITERATURE REVIEW

Most of the literature surrounding the topic of the strategic rivalry between the United States and China has focused on diplomatic and territorial aspects. In this way, the focal point of different studies has been the issues surrounding the South and East China Seas (see Gill, 2015; Zhao, 2015; Buszynski, 2012). However, with the current rapid advance of emerging technologies, competition for technological innovation became one of the most complex and central challenges in U.S.-China relations.

In light of this, several academics have become increasingly interested in how emerging technologies further competition between the United States and China as it has implications for military, political, and economic power. Some researchers argue that the ability to acquire cutting-edge technologies to increase military capacities has an important effect on the balance of military power and secures the basis for military superiority (Center *et al*., 2019; SWP, 2020; Wu, 2020). Also, technological leadership creates global competitive advantages for states as innovation drives the modern economy and provides metrics of progress that are later seen as symbols of national vitality (Center *et al*., 2019). Similarly, Schulze and Voelsen (SWP, 2019) study in more depth the technological dimension of U.S.-China relations arguing that both states regard technological superiority as a prerequisite for economic and military strength, and consequently, their respective place in world politics. They introduce the concept of

technopolitical spheres of influence to reflect how both states are using digital spaces as a means to project power.

Additionally, several studies show how there has been a shift in U.S. policy toward China and argue how the United States went from an integrative approach to a decoupling one. Although the U.S. exercised tight technology export controls, it has in general facilitated China's access to the global economic system and industrial value chains. Nonetheless, U.S.-China relations became tenser in 2017 when the start of a trade war was followed by technological contests as the U.S. increasingly accused China of forced technology transfer and intellectual property theft (Sun, 2019). In this sense, Gros (2019) has also argued that a key issue in the trade war between the U.S. and China has been Foreign Direct Investment as Washington's main complaints referred to U.S. high-tech firms being forced to reveal their technology and trade secrets as a result of unfair practices and informal pressures from China. Similarly, Campbell & Ratner (2018) argue that the assumption that deepening commercial, diplomatic, and cultural ties would transform China's internal development and external behavior has been the foundation of U.S. strategy toward China, however, the liberal international order failed to bind China as Washington expected.

Additionally, Kennedy & Lim (2018) sought to analyze how technology and innovation generate rivalry within power transitions. According to the authors, it is not sufficient for rising states to rely on financial returns from dominant states, but rather become more self-efficient through innovation. This can be done by acquiring and creating new technologies. In this way, middle-income economies[1] will seek to upgrade the technological capacity of their economies to generate long-term growth. The authors have labeled this condition the 'innovation imperative'. They argue that in the 1990s China became a hub for assembling several high-tech products, but in the past decade, its national priorities shifted and emerged as an important player in high-tech innovation (Kennedy *et al.*, 2018). In 2006, the *National Medium- and Long-term Science and Technology Development Plan (2006-2020)* established the main guidelines for its scientific and technological innovation, with a focus on emerging technology, emphasizing *independent innovation, key leaps, support development, and lead the future* and become a world power in science and technology by the middle of the 21st century

[1] Countries that passed the first stage of industrialization (see Kennedy & Lim, 2018: 554).

(Chinese Government Portal, 2006). In 2009, the State Council approved 4 trillion RMB for the *Industrial Revitalization and Economic Stimulation Plan* from which 9% would be invested in technology advancement. This mainly entailed upgrading the Chinese industrial sector, gearing towards high-end production in order to move away from export-oriented and labor-intensive modes of economic growth (The Economic Observer, 2009). By 2015, the State Council reviewed and passed the *Made in China 2025* plan.

Thus, several authors have argued how the *Made in China 2025* plan -China's technological blueprint- gave leeway to concerns from the United States' authorities, making the White House and U.S. agencies such as the Department of Commerce, target the Chinese technology industry sector over security concerns and trade agreements (Sun, 2019; Wu, 2020; Gros, 2019). Through this plan, China seeks to transition from a low-end manufacturer to a high-end producer of goods. For this transition to happen, the country has highly targeted investments in R&D, especially in key technological areas such as AI, robotics, ITCs, and clean energy, among other sectors (Cyrill, 2018). The document emphasizes its goal of reducing the country's dependence on foreign technology, seeking an *indigenous innovation* approach. China has been catching up with the R&D spending levels of the United States (see Appendix: figure 2). Also, Chinese FDI in U.S. ICT went from $1.86bn in 2005 to $9.07bn in 2016. The desire of Chinese investors to access U.S. innovation goes in tandem with technology acquisitions. Chinese companies are building R&D centers such as Huawei's R&D center in Seattle, LeEco's in California, Baidu's in Silicon Valley, and Didi Chuxing's AI center in California (The US-China Investment Hub, 2022).

Furthermore, Mazzar (2022) argues that the reach of new technologies will shape the nature of new rivalries such as the one between the U.S. and China, and thus, they are not easily comparable with previous ones. New technologies can make rivalries more conflictual and threatening to homelands, with more risks of crises and escalation. In this way, he argues that technology serves as a tool of statecraft that involves a whole competition continuum and these tools are used to gain advantage below the threshold of major war. Therefore, competition in this sense means *other than war*. Of equal importance, Sun (2020) asserts that the securitization of China's technological progress since the Trump administration has undermined U.S.-China security relations by increasing investments in national defense and arms building. By explicitly making it a priority for the United States to compete with China to sustain U.S. leadership in key

emerging technologies, it approaches an arms race environment in the name of safeguarding national security. Lastly, he makes an important emphasis on global technology governance arguing that a tech war between the two countries may lead to a delay in establishing common norms as a way to minimize risks that can spur from the use of new technologies.

In this sense, Kalenzi (2022) states that emerging technologies such as artificial intelligence represent the present and future of economic growth, but also pose significant risks to society. Similarly, some researchers have argued that in terms of technological innovation, there is a stark contrast between new technologies and the ones developed in the three preceding Industrial Revolutions. Now, there are *"…multiple, overlapping and converging technical revolutions in various domains"* (Calcara *et al.*, 2020: 01) due to the unprecedented scale and speed of convergence of new technologies in several areas and their undiscovered impact. Several questions arise from the issue of compliance of emerging technologies with democratic and legal requirements, social norms, and ethical values. Of equal importance, evolutions in military affairs combined with an accelerated pace of technological innovation can pose challenges to security and compliance with international humanitarian law. In this way, emerging technologies across different fields add layers of uncertainty and urgency to understand and manage their development and different applications (SIPRI, 2022).

Across these studies, there is consistent literature analyzing U.S.-China relations taking into account the increasing importance of emerging technologies for the geoeconomics landscape and military balance of power. Also, given the fast pace of innovation, several studies (see Brockmann *et al.*, 2019; Calcara *et al.*, 2020; Boulanin *et al.*, 2021; Kalenzi, 2022) started to focus on the governance of emergent technologies as there is a broad consensus that these have the potential to generate both benefits and risks to society, but no consensus on the optimal way to govern them.

Technology plays a key role in global politics, however, as Calcara *et al.* (2020) argue, IR theory and Security Studies have generally sidelined the role of technology to epiphenomenal or deterministic characteristics. Similarly, Kennedy & Lim (2018) noted that, although IR scholarship recognizes that innovation is important in international politics, the field lacks a framework to analyze how dominant and rising states interact in this realm. Therefore, they developed a model that illustrates how the rising state's innovation activities have the potential to challenge the dominant state's strategic

interests. In this way, they argue that two characteristics of such activities form the link between technology and strategic competition. These external effects are, first, *security externalities*, and second, *order externalities*. This model is the most relevant to the aims of this study, given its unique approach to how dominant states react to the innovation activities of rising states. Thus, to further understand the role that technology plays in U.S.-China relations, this paper will focus on the following research question:

1. *How has the United States responded to China's technological progress?*

Furthermore, there is still a lack of literature linking competition for technological innovation to technology governance issues. Therefore, it is the aim of the following pages to explore how the current competition between the United States and China to harness emerging technology can shape the current and future landscapes of technology governance. From the literature review and identified gaps thereof, the following sub-question is formulated:

2. *Can technology competition hinder cooperation in the governance of emerging technologies?*

THEORETICAL FRAMEWORK

The analysis of the technological dimension of U.S.-China relations can be approached with Kennedy & Lim's theoretical model. The model represents what they coined as the 'innovation imperative' -the need to acquire and develop new technologies to overcome structural challenges facing middle-income states and continue its international ascent-. How the rising state pursues this imperative will shape its interactions with the dominant state. These innovation activities can translate into two strategic effects, first, a *negative security externality*, and second, a *negative order externality*. In turn, each can motivate a response from the dominant state. In the first scenario, the dominant state experiences a risk to its security environment as a result of the rising state's activities. In the second scenario, the dominant state experiences a threat to its preferred international order as a result of the rising state's activities (Kennedy *et al.* 2018).

First, security externalities can arise as a by-product of economic interaction as the gains and wealth accumulation through trade with potential adversaries may be used to increase

military capabilities. Also, trade of dual-use technologies[2] is particularly relevant for security externalities since the acquisition of technologies with military applications is most likely to generate Great Power tension (Kennedy *et al.* 2018).

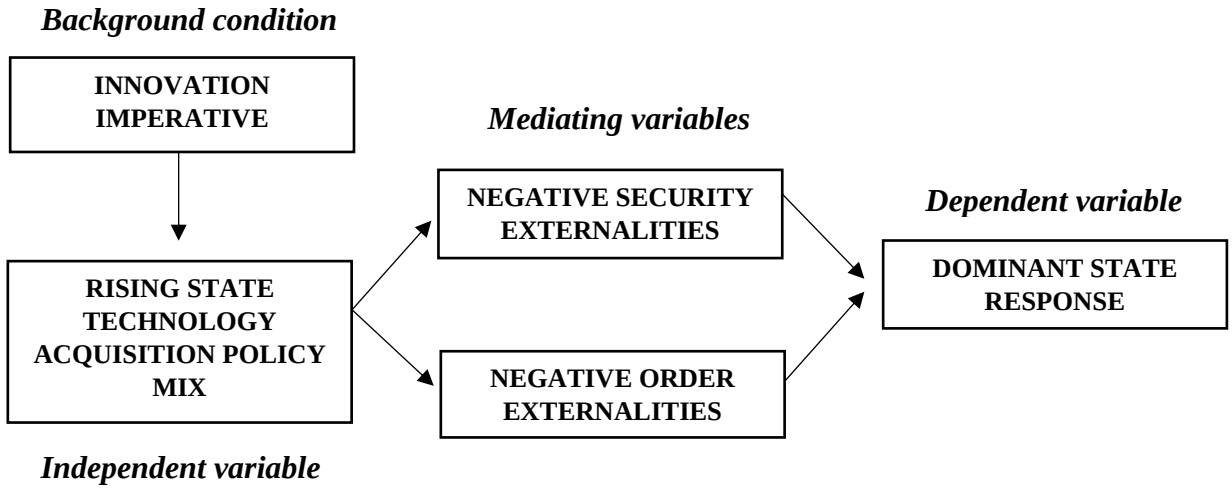
Hypothesis 1. China's innovation imperative generated negative security externalities for the United States.

Second, the dominant state will seek to preserve the rules, practices, and institutional arrangements that emerged under its leadership and that reflect its interests. In the area of technology, the dominant state will prefer a regime that allows it to extract profits from its position as a global technology leader in a rules-based order with strong protection of its intellectual property. Therefore, order externalities will arise if the dominant state sees this rules-based order challenged (Kennedy *et al.* 2018).

Hypothesis 2. China's innovation imperative generated negative order externalities for the United States.

The theory is laid out in the following model:

Figure 1. Theoretical model of Kennedy & Lim.



Note. Theoretical model from Kennedy & Lim. *International Affairs* 94: 3 (2018) 553–572.

[2] Dual-use technologies are technologies that may be used for both civilian and military purposes (SIPRI, 2022).

RESEARCH DESIGN

After a review of the relevant literature and the identification of the gaps in the scholarship regarding the topic, a research question and sub-question were developed; first, *how has the United States responded to China's technological progress?* and second, *can technology competition hinder cooperation in the governance of emerging technologies?*. In order to answer these questions, a set of hypotheses were formulated using the model of Kennedy & Lim (2018) presented in the theoretical framework, which reflects the independent, mediating, and dependent variables. Given that the aim of the study is to explore how technology can become a locus of Great Power interaction between the United States and China, this model is the most suitable to analyze this topic considering its approach to how dominant states react to the innovation activities of rising states.

In order to test the hypotheses, the paper followed a qualitative research approach through a review of primary sources, specifically, official U.S. government documents from the year 2017 to 2022. The document review covered, first, commercial practices in the area of technology concerning China such as trade sanctions, investment control, and export control. Second, domestic measures such as reports, acts, and strategies issued through executive and legislative orders and other measures adopted by government agencies. Third, alliances formed by the United States government with third-party states. These documents were selected as they reflect U.S. foreign policy on China in the area of technology.

The sub-question was approached by focusing the analysis on a case study of LAWS. Because of length and resource limitations, a qualitative case study reflected the best option for keeping the research focused and manageable, while still being able to shed light on the topic of technology governance. The topic of LAWS was chosen as a representative case of a currently disputed subject in the area of governance, specifically of how emerging security technologies are governed in practice within intergovernmental institutions, and of equal importance, a technology that the U.S. has regarded as highly important for its national security relative to its relations with China. Therefore, it is a representative case of how states perceive this technology for military use and their intentions in regulating them.

ANALYSIS

1. TECHNOLOGY: A NATIONAL INTEREST TO THE UNITED STATES

Emerging technologies are highly important for the United States as it regards technological superiority as a prerequisite for economic and military capabilities, and consequently, its respective position in world politics as a Great Power (SWP, 2020). This has been reflected in the 2017 *National Security Strategy* of the Trump administration (see Appendix A).

The second pillar of the strategy document emphasizes the United States' *lead in research, technology, invention, and innovation*, seeking to maintain its competitive advantage by prioritizing emerging technologies critical to economic growth and security such as data science, autonomous technologies, and artificial intelligence, among others. It especially mentions AI and its application in autonomous weapons as the field is rapidly progressing. Also, as these technologies 'originate in businesses and universities in the country', the document states that protection over the National Security Innovation Base will require domestic and international responses beyond the scope of any individual company or university in order to avoid losing the technological edge. In the same section, China is labeled as a 'competitor' and a 'rival', accused of stealing U.S. intellectual property, allowing it to unfairly tap into the innovation of 'free societies'. Moreover, it states that one of its priority actions is the improvement of U.S. government agencies in the understanding of worldwide S&T trends to retain 'U.S. advantages over competitors' (President of the United States, 2017: 04-20).

Throughout the document, China is labeled either as a 'revisionist power', one of the United States' main 'challengers', or a 'rival'. In the introduction, China is regarded as a source of challenge for "American power, influence, and interests, attempting to erode American security and prosperity" as it is determined to make economies less free and fair, grow its military capacities, and control information and data to repress their societies and expand their influence. China's use of technology and information is directly linked to the label of 'rival', as it uses these technologies to accelerate political, economic, and military contests in order to shift regional balances of power. Although there are mentions of cooperation efforts with China across areas of mutual interest, it argues that China seeks to shape a world antithetical to U.S. values and interests (see Appendix B).

The *Interim National Security Strategic Guidance* of the Biden administration does not differ greatly from the one of the Trump administration on the topic of China and emerging technologies. Although it does not use the same rhetoric, it follows a similar line of ideas. It begins by stating:

"…we face a world of rising nationalism, receding democracy, growing rivalry with China, Russia, and other authoritarian states, and a technological revolution that is reshaping every aspect of our lives…" (The White House, 2021a: 06).

The document recognizes the existence of a revolution in technology that generates both benefits and threats, and that leading powers are racing to develop and deploy emerging technologies such as AI, which have the ability to shape economic and military balances among states. It argues that rapid changes in technology innovation will shape every aspect of human life and the U.S. national interest, but the direction and consequences of these innovations remain unsettled, as they are not yet properly governed.

On one hand, it recognizes that the U.S. strategic competition with China should not impair the possibilities of working together when it is the national interest of the U.S. to do so, and it will engage China from a position of 'confidence and strength', conducting practical diplomacy. It also mentions the United States' will to engage in meaningful dialogue with China on a range of emerging military technological developments that concern strategic stability. On the other hand, it mentions the will to sustain the readiness of the U.S. Armed Forces so that it will remain the 'best trained and equipped force in the world', and in the face of challenges from 'an increasingly assertive China', the U.S. will assess the capabilities and sizing of the Force to shift its emphasis from 'unneeded legacy platforms and weapons systems' to free up resources for investments in cutting-edge technologies that will determine its military and national security advantage (The White House, 2021a: 14-21).

In this sense, it also mentions the United States' intention of positioning itself, diplomatically and militarily, to protect its allies and commercial partners, and support China's neighbors. Also, it emphasizes its support for Taiwan as a leading 'democracy and critical economic and security partner' and its will to work with 'like-minded countries' on the issues surrounding democracy and human rights in Hong Kong, Xinjiang, and Tibet. In order to present a common front and 'hold countries like China to account', it reaffirms the investment and modernization of NATO and other alliances with

Australia, Japan, and the Republic of Korea to encourage these countries to invest in their 'comparative advantages against current and future threats' (The White House, 2021a: 10).

The document also mentions that Chinese leaders' seeking 'unfair advantages, aggressive behavior, and coercion' undermines the rules and values of the international system. Therefore, when the Chinese government 'directly threatens' the interests of the U.S., Washington will counter, confronting the *'*unfair and illegal trade practices, cyber theft, and coercive economic practices*'* that undercut U.S. emerging technologies. Finally, it argues that the agenda described in the document will allow the U.S. to prevail in strategic competition with China (see Appendix C).

2. THE UNITED STATES' RESPONSE TO CHINA'S PROGRESS

In August 2017, President Trump issued a Memorandum to the United States Trade Representative (USTR) stating that China has implemented certain actions related to intellectual property, innovation, and technology that may negatively affect American interests (see Appendix D), and directed the USTR to determine whether to investigate China's actions which can be discriminatory to U.S. intellectual property rights, innovation, or technology development. Following this directive, in March of 2018, the USTR issued the investigation under section 301 of the Trade Act of 1974.

The investigation concluded that China uses various methods to require or pressure technology transfer from U.S. companies to Chinese entities, imposes restrictions on U.S. firms' investments and activities through restrictions on technology licensing terms, directs and facilitates systematic investments in and acquisition of U.S. companies and assets by Chinese companies to obtain cutting-edge technologies important for the Chinese government's industrial plans, and finally, it conducts unauthorized intrusions into computer networks of U.S. companies to obtain intellectual property and trade secrets (see Appendix S). In response to these findings, President Trump issued a memorandum directing to file a WTO case against China, restrict investment in key technology sectors, and impose tariffs on Chinese products such as aerospace and communication technology (see Appendix T). A few months later, in August 2018, The United States Congress passed the *John S. McCain National Defense Authorization Act* for Fiscal Year 2019 (NDAA), requiring the Ministry of Defense to develop a *"whole-of-government strategy*

on China" by designing a complex of policies toward China among all government departments (see Appendix E).

Also under congressional legislation, U.S. agencies on foreign investment review and export control were directed to increase their regulatory processes in order to block China's access to advanced technologies from the United States. The review mechanism of the Committee on Foreign Investment (CFIUS), which mainly targeted Chinese companies investing in the U.S., was reformed by the *Foreign Investment Risk Review Modernization Act of 2018* (FIRRMA) as part of the NDAA 2019, in order to protect national security from risks posed by certain types of foreign investment, especially those emanating from China (S.2098 - 115th Congress 2017–2018). Also, the measures taken under the *Export Control Reform Act of 2018* (ECRA) led to an upgrade of the export control of technological products to China (see Appendix F).

The Bureau of Industry and Security (BIS), which controls the export of dual-use military items, released a list of proposed export controls on emerging technologies in November of 2018, identifying 14 representative technology categories essential to U.S. national security. According to the proposed rules, since emerging technologies such as AI, robotics, and quantum computing are not yet listed in the *Commerce Control List* or controlled multilaterally, they would be subject to export controls as dual-use technologies may be used for military purposes (Bureau of Industry and Security, 2018). The BIS also amended the Export Administration Regulations (EAR) by adding Huawei to the Entity List in order to cut off trade of key components between the Chinese company and its U.S. suppliers. The Entity List was again amended in June of 2019 by adding five Chinese tech companies including a state-owned enterprise, barring them from buying U.S. parts and components without prior government approval (Bureau of Industry and Security, 2019).

In February of 2019, the Trump administration established the *Department of Defense American AI Initiative* via executive order to maintain AI leadership (Executive Office of the President, 2019). The strategy mentions China's increasing investments in AI for military purposes which *threatens to erode* U.S. technological and operational advantages and *destabilize the free and open international order*. Thus, it encourages the adoption of AI to maintain the U.S. strategic position and prevail on future battlefields (Department of Defense, 2018: 05).

Furthermore, the U.S. Congress passed the *Holding Foreign Companies Accountable Act* bill in August of 2020, requiring certain issuers of securities to establish that they are not owned or controlled by a foreign government. Among other measures, the bill required the disclosure of information related to any board members who were officials of the Chinese Communist Party and whether the articles of incorporation of the issuer contained any charter of the Chinese Communist Party (S.945 - 116th Congress 2019-2020). For alleged noncompliance with HFAA, the SEC added Weibo and Baidu, among other Chinese tech companies, for possible delisting from U.S. stock exchanges (U.S. Securities and Exchange Commission, 2022).

During the Biden administration, under section II of the *Secure Networks Act*, five Chinese tech companies including Huawei were blacklisted by the U.S. Federal Communications Commission (FCC) as they were deemed to pose a risk to national security. Later in 2022 the list was updated and two more Chinese companies were included, China Mobile International USA Inc. and China Telecom (Americas) Corp. (Federal Communications Commission, 2022). In addition, the U.S. Commerce Department added seven Chinese supercomputing entities to its Entity List (see Appendix G) which was later updated with another 8 new Chinese technology entities for alleged quantum computing efforts that supported military applications of the PRC.

To sustain the United States' global leadership role relative to China, the U.S. Congress introduced the *Strategic Competition Act of 2021* bill which asserted that the Chinese government had been leveraging its political, diplomatic, economic, military, technological, and ideological power to compete with the U.S. on the global stage. It also stated that the PRC was close to its goal of becoming 'the global leader in science and technology', and set out different measures to counter China such as the U.S.-ASEAN partnership. The U.S. Senate Foreign Relations Committee approved the Act, signaling bipartisan consensus in orienting U.S. policy toward being more aggressive to counter China. The Act was amended to provide, among other measures, more funding to U.S. technology industries, and to bolster U.S. foreign policy and the R&D environment to compete with China (S.1169 - 117th Congress 2021-2022).

Following previous policy from the Trump administration, President Biden expanded the ban on American investments in Chinese firms with purported ties to defense or surveillance technology sectors. Many of the targeted companies were subsidiaries and affiliates of state-owned companies and businesses named on earlier blacklists (see

Appendix H). Similarly, the U.S. Department of Commerce added 23 more Chinese companies to the economic blacklist, accused of enabling the PRC to repress and use high-technology surveillance against Uyghurs, Kazakhs, and other minorities in the XUAR. Also, it added 5 entities that were accused of directly supporting the PCR's military modernization. Moreover, U.S. intelligence officials warned companies and research institutions about the risks of interacting with China in five key technology sectors such as AI, quantum computing, biotechnology, semiconductors, and autonomous systems (see Appendix J). Although they did not advocate for decoupling, they seek to advise on the Chinese government's national plan to dominate in these fields.

Artificial intelligence is also high on the U.S. priority list. During the Trump administration, the White House introduced the *Maintaining American Leadership in Artificial Intelligence* initiative arguing that the Federal Government plays an important role in facilitating AI R&D and protecting the American AI technology base from acquisition by *strategic competitors and adversarial nations* (Executive Office of the President, 2019). During the Biden administration, the OFAC improved investment restrictions on SenseTime Group Limited, a top AI company specialized in facial recognition software for alleged human rights abuses (U.S. Department of the Treasury, 2021a). The OFAC increased its measures by adding 8 Chinese tech firms to the investment blacklist for their alleged relation to the Chinese Military-Industrial Complex (U.S. Department of the Treasury, 2021b).

Another U.S. agency that refocused its efforts on China was the C.I.A. The new agency director[3] stated that China was an adversarial power and the intelligence community's greatest challenge. In October of 2021, the agency announced two new mission centers in a way to restructure the agency, the *Transnational and Technology Mission Center* and the *China Mission Center*. The first one was created with the aim of identifying new technologies that could be used by the agency to help collect intelligence, while the latter is intended to bring resources to study and gather information on China's activities[4].

[3] William Burns gave his first sit-down interview in July 2021 since assuming the role of Central Intelligence Agency director in March and stated: "*We're no longer the only big kid on the geopolitical block, especially with the rise of China. And as you know very well, there's a revolution in technology which is transforming the way we live, work, compete and fight."* (NPR, 2021).

[4] CIA Director William Burns stated that the new mission *"…will further strengthen our collective work on the most important geopolitical threat we face in the 21st Century, an increasingly adversarial Chinese government."* (Barnes, 2021)

Following more concerns about the use of emerging technology for military applications, the BIS added 34 more Chinese entities and research institutes to the Entity List, citing national security threats presented by the PRC's efforts to develop and deploy biotechnology for military applications and human rights abuses (U.S. Department of Commerce, 2021b). Following this, the BIS proceeded to add 33 entities based in the PRC to the *Unverified List* in a move to tighten exports to China (Bureau of Industry and Security, 2022). Most entities listed on the UVL were high-tech manufacturers, including producers of laser components, government research labs, and universities.

In March of 2022, the USTR issued the *2022 Trade Policy Agenda & 2021 Annual Report* with the intent of realigning its trade policies toward China. The document stated that China's non-market economy has distorted global trade through economic policies and practices, often illicit, as a means to secure foreign intellectual property and technology to pursue its industrial policy objectives. Thus, it reasserts the efforts of the Biden administration to counter China's *unfair economic practices* (see Appendix K).

The U.S. also doubled down on new alliances either to counter China's influence in the Indo-Pacific or create partnerships in key emerging technology sectors (see Appendix L, M, N, O, P, Q, U). The *U.S.-Japan Competitiveness and Resilience Partnership* was created to counter China's rise by investing together in areas such as 5G, AI, quantum computing, and semiconductor supply chains. The *G7 Build Back Better World* initiative will provide infrastructure financing to developing countries as an alternative to China's Belt and Road initiative. Furthermore, the *U.S.-EU Trade and Technology Council* will create common transatlantic standards for screening exports to China and investment in AI and other technologies. Similarly, the *Export Controls and Human Rights Initiative* between the U.S., Australia, Canada, Denmark, France, Netherlands, UK, and Norway, will create standards for screening exports to China for technologies that could support 'digital authoritarianism' like speech and facial recognition tools. Additionally, the U.S. reinforced commitments with the QUAD and established the AUKUS partnership to contain Chinese influence in the Indo-Pacific. The QUAD's core objective is to secure a rules-based global order with a key focus on emerging technologies. AUKUS aims to modernize Australia over the coming decades to take up security challenges in the region by giving access to cutting-edge military technology.

2.1. Negative security externalities

The theoretical model of Kennedy & Lim (2018) reflects that *negative security externalities* can motivate a response of the dominant state when two conditions apply. First, if there is concern on the part of the dominant state about the possibility of military conflict with the rising state, and second, if the rising state's acquisition of a given technology has the potential to improve its relative warfighting capability or degrade that of the dominant state.

Based on the document review, it is reflected that China's innovation activities generated negative security externalities which prompted a response from the United States. Regarding the first condition, during both Trump's and Biden's administrations, Chinese technological progress has been increasingly targeted as it challenges U.S. military leadership. Also, during both administrations, investments in emerging technologies were a high priority to secure military advantages. Moreover, the Biden administration, concerned about Chinese military modernization and influence in the Indo-Pacific, increased or formed new partnerships and alliances with a key focus on emerging technologies in order to contain China and further U.S. influence in the region, securing a preferred technology ecosystem. This can be interpreted as a way for the U.S. to achieve a preferred balance of power and increase security through external balancing (see Appendix C). Despite this, the analysis cannot conclude, based on this information, that the U.S. is necessarily concerned about the possibility of military conflict with China[5].

As for the second condition, the analysis shows how there have been increasing concerns on the part of the U.S. about the possibility of China acquiring technology that can improve its relative military capabilities, especially through dual-use technologies. By accusing China of intellectual property theft and unfair commercial practices for the sake of forced technology transfers, the U.S. restricted investment in key technology sectors, imposed tariffs on Chinese technology products, and tightened export controls to block access to advanced technologies under regulations such as CFIUS and FIRRMA. Agencies like the BIS, SEC, OFAC, and FCC increasingly targeted Chinese technology companies by blacklisting them. Also, under the HFAA bill from Congress and the *Secure*

[5] A deeper analysis of the regional context in the Indo-Pacific will provide more details about a military confrontation as potential flashpoints may include the East China Sea, South China Sea, Taiwan Strait, and Korean Peninsula (see SWP, 2020: 20).

Networks Act, several tech companies from China were targeted as they were accused of supporting military advances for the PRC.

In order to address security externalities, the dominant state will likely intervene to cut off the supply of the relevant technology where it can through the marketplace (Kennedy *et al*., 2018). Certainly, the U.S. has consistently taken commercial and trade measures to restrict China's access to intellectual property and know-how of emerging technologies. Therefore, hypothesis 1 can be confirmed with the caveat that the U.S. move to form alliances can be interpreted as a way to increase security in the Indo-Pacific -i.e. external balancing- but not as a hint that the U.S. is concerned about a military confrontation with China.

2.2. Negative order externalities

Negative order externalities will arise when first, the rising state's behavior contradicts the existing order, and second, these contradictory actions threaten the integrity or legitimacy of the dominant state's preferred order (Kennedy *et al*., 2018).

Both Trump's and Biden's National Security Strategy documents reflect how China is regarded as an 'authoritarian state' that challenges U.S. interests and position on the global stage by using technology to accelerate its economic and military capabilities in order to extend its influence in the world. Since the Trump administration, China has been increasingly accused of using measures that go against the rules-based order that the U.S. prefers, such as illegal trade practices, cyber theft, and coercive economic practices to acquire U.S. technology and intellectual property.

In this sense, as China goes against the rules, practices, and institutional arrangements set by the preferred order of the U.S., it challenges the authority of the status quo. The United States' efforts to contain China highly reflect its motivation to restrict the emergence of an order that would otherwise be at odds with the one that advances U.S. interests. When the order is well established, the dominant state will use the enforcement tools at its disposal (Kennedy *et al*., 2018). The U.S. has mainly sought to contain China bilaterally through its different governmental agencies and the Special 301 review, and multilaterally, seeking to increase Chinese compliance through the WTO dispute settlement process (see Appendix R). Therefore, hypothesis 2 can be confirmed.

3. EMERGING TECHNOLOGY GOVERNANCE

The development of emerging technologies not only impacts states' economic and military interests but also signals profound transformations in systems of governance. Advancements in autonomous technologies have triggered an array of complex debates about their legal, ethical, and dual-use applications. Regulation requires collaboration among agencies within a country and samples of governance frameworks have already been put into place in several countries for emergent technologies such as AI[6]. However, in a globalized world where technologies permeate national boundaries, further complicating regulation processes, international bodies and cross-border collaboration have a vital role in setting global standards in order to avoid regulatory discrepancies (World Economic Forum, 2020).

China's determination to achieve several specific goals in the area of technology, and the United States' determination to resist that path, are further increasing rivalry between the two countries. This section seeks to explore how technological rivalry can hinder cross-border cooperation in the area of governance by analyzing the case of Lethal Autonomous Weapon Systems (LAWS).

3.1. Case study: Lethal Autonomous Weapon Systems

The development of autonomy in weapon systems has been an increasingly key point of concern for many states since the topic of LAWS was first discussed at the Human Rights Council in 2013. As a report by the Human Rights Watch (2020) shows, 97 countries have already stated their position on the issue. The question of whether LAWS should be regulated has been a focal point of arms control talks at the UN Convention on Certain Conventional Weapons (CCW) since the first informal Meeting of Experts was held in 2014. Since then, no other measure has been taken aside from the *11 guiding principles* that were adopted by the 2019 Meeting of the High Contracting Parties to the CCW.

LAWS are weapon systems that use artificial intelligence to identify, select, and kill human targets without human intervention (Lethal Autonomous Weapons, 2022). Unlike military drones that are remotely controlled by a human operator, LAWS use algorithms to make decisions. Reliably operational LAWS are still future prospects. Loitering weapons are the only offensive type of weapon system known to be capable of acquiring

[6] see Global Technology Governance Report 2021 (World Economic Forum, 2020).

and engaging targets autonomously within the advance determination of certain factors of deployment and attack. Moreover, there are certain obstacles to the development of autonomy in weapon systems such as technological, legal, normative, economic, and institutional resistance (Boulanin *et al*., 2017). Nevertheless, a 2021 report by the UN Panel of Experts on Libya has documented the use of a lethal autonomous weapon system, *STM Kargu-2*, which hunted down and engaged logistics convoys and retreating HAF forces (UNSC, 2021).

The concern about AWS lies in the lack of a global consensus on the definition and regulation of autonomy in weapon systems. International Humanitarian Law places limits on the development and use of AWS through the *specific and general rules on weapons, means, and methods of warfare,* but it does not provide an answer to what type and degree of human-machine interaction are required for compliance (Boulanin *et al*., 2021). The unregulated use of LAWS could trigger a low-barrier arms race which would challenge international stability. Because of the consensual *modus operandi* of the CCW, the chances of reaching an agreement are relatively low (Heinemann, 2022).

The technology that allows weapon systems to acquire targets autonomously -automated target recognition (ATR) systems- has been developed since the 1970s (Boulanin *et al*., 2017), but the interest and spending for the integration of AI in weapon systems have been increasing. The United States considers autonomy a cornerstone of its military modernization plans[7], and key to its national security and strategic competition with China. At the same time, China also has an important desire to dominate key technology sectors such as AI and autonomous technologies, as is laid out in its *Made in China 2025* strategy. While the CCW operates by consensus, leading countries in innovation and military capabilities are most likely going to influence the trajectory of international discussions on LAWS (Congressional Research Service, 2021).

The United States and China's positions on the use and development of LAWS are currently similar, although they have differing definitions[8] for them. The U.S. recommended further discussions in an international humanitarian law forum but in the CCW fourth session on LAWS, a representative warned against stigmatizing LAWS

[7] The National Defense Authorization Act for Fiscal Year 2022 authorized spending on several AI-related technologies.

[8] China defines LAWS as indiscriminate, lethal systems that do not have any human oversight and cannot be terminated (see Congressional Research Service (2021): *International Discussions Concerning Lethal Autonomous Weapon Systems.*

because of their military and humanitarian benefits (Division of Conference Management UN Geneva, 2019). The U.S. considers proposals for negotiations of a new international treaty on such weapon systems as premature given that existing international humanitarian law is already adequate. Similarly, in 2018 China has called for a ban on fully autonomous weapons but later clarified it would be limited to *use only* and not development and production, and since then it has not explicitly repeated its call for a new international treaty (Human Rights Watch, 2022).

Competition for AI leadership can make states and their enterprises put aside safety and reliability measures and the development of cutting-edge technologies with military applications can aggravate non-traditional security risks. As autonomous weapons become cheaper and more accessible and more countries obtain AI-driven drones at lower prices, terrorist organizations, criminal networks, and rogue states could get easier access to such technologies (Sun, 2019). Applications of AI for national security require only modest resources and no great expertise for its use, therefore, it can introduce threats of proliferation and unpredictability. Moreover, AI algorithms are often accessible and the hardware is "off-the-shelf", generating more concern about inadvertent conflict escalation and the potential of unintended military engagements (NSCAI, 2021). Indeed, a 2020 RAND report argued that the speed of autonomous systems led to inadvertent escalation in the wargame because of the speed that machine decision-making has on deterrence dynamics. In this sense, defining the overall grade of autonomy in weapon systems and its compliance with IHL along with ethical and security considerations (Boulanin *et al*., 2021), are critical in assessing their acceptability and a prerequisite for a potential adaptive arms control.

CONCLUSIONS

This paper explored two research questions, first, how has the United States responded to China's technological progress, and second, if technological competition could hinder cooperation in the governance of emerging technologies. The analysis found that China's pursuit of technological innovation has threatened the United States' strategic interests as its activities generated both negative *security* and *order externalities*. These externalities form the link between technology and strategic competition. The U.S. responded to China's innovation imperative by implementing a whole-of-government approach to slow

down its progress in technological innovation. In sum, the U.S. regards technology as one of the main arenas for competition with China. The theoretical model of Kennedy & Lim (2018) reflects how technology can be considered a locus of Great Power interaction, as the rising state's innovation activities could directly influence the strategic interests of the dominant state.

By addressing the case of LAWS, the analysis was able to reflect the current and potential gaps that exist in the area of technology governance, and how the development of international standards and regulations can be hindered by states competing to harness emerging technologies for military and security uses. Autonomous weapons systems generate two main challenges, first, the conceptualization of autonomy and human control in weapon systems is rather elusive and has raised questions regarding whether these systems are lawful, ethical, and safe, and second, their perceived military value is exceptionally high, making it a priority for states to develop or acquire them. If competition and short-term military interests define the geopolitical landscape, this may represent a setback in the achievement of an international consensus on the development and use of autonomy in weapon systems, their compliance with current IHL, and a potential arms control breakthrough. If further negative security and order externalities arise, relations between the United States and China will increasingly exhibit characteristics of a classical security dilemma where each side's striving for greater security will ultimately generate more insecurity on both sides. If emerging technologies are seen primarily as a source of military capabilities and central to national security, regulation of such technologies can be to a great extent hindered.

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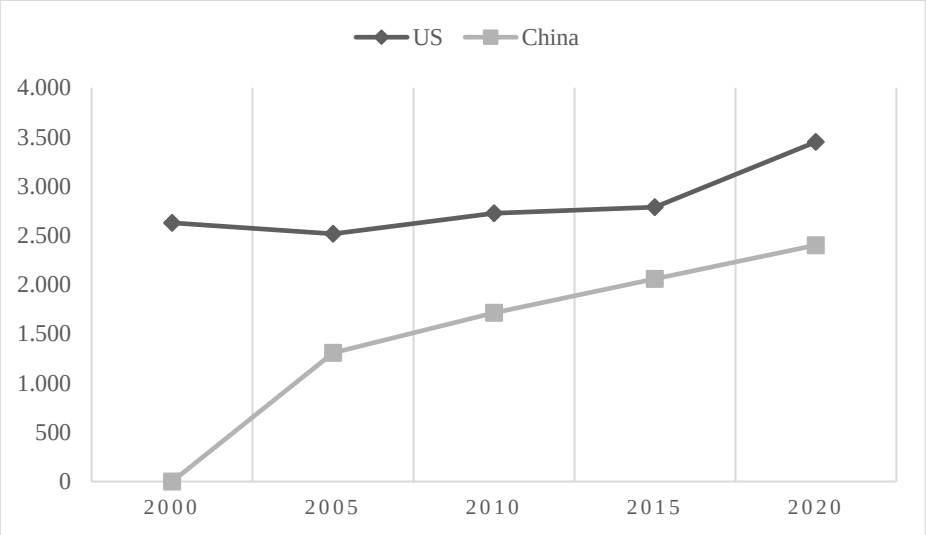
APPENDIX

FIGURES

Figure 2

Gross domestic spending on R&D of the United States and China, 2000-2020.



Note. The graph shows R&D spending in the U.S. and China, measured in USD constant prices using 2015 base year and Purchasing Power Parities (PPPs) and as percentage of GDP. OECD (2022), Gross domestic spending on R&D (indicator).

DOCUMENTS

2017 National Security Strategy

Appendix A. *"The contest over information accelerates [these] political, economic, and military competitions. Data, like energy, will shape U.S. economic prosperity and our future strategic position in the world. The ability to harness the power of data is fundamental to the continuing growth of America's economy, prevailing against hostile ideologies, and building and deploying the most effective military in the world."* (President of the United States, 2017: 03).

Appendix B. "*For decades, U.S. policy was rooted in the belief that support for China's rise and for its integration into the post-war international order would liberalize China. Contrary to our hopes, China expanded its power at the expense of the sovereignty of others. China gathers and exploits data on an unrivaled scale and spreads features of its authoritarian system, including corruption and the use of surveillance. It is building the*

most capable and well-funded military in the world, after our own." (President of the United States, 2017: 25).

2021 Interim National Security Guidance

Appendix C. *"The most effective way for America to out-compete a more assertive and authoritarian China over the long-term is to invest in our people, our economy, and our democracy. By restoring U.S. credibility and reasserting forward-looking global leadership, we will ensure that America, not China, sets the international agenda, working alongside others to shape new global norms and agreements that advance our interests and reflect our values. By bolstering and defending our unparalleled network of allies and partners, and making smart defense investments, we will also deter Chinese aggression and counter threats to our collective security, prosperity, and democratic way of life."* (The White House, 2021a: 20).

Memorandum of August 14, 2017: Addressing China's Laws, Policies, Practices, and Actions Related to Intellectual Property, Innovation, and Technology

Appendix D. *"…China has implemented laws, policies, and practices and has taken actions related to intellectual property, innovation, and technology that may encourage or require the transfer of American technology and intellectual property to enterprises in China or that may otherwise negatively affect American economic interests."* (Executive Office of the President, 2017: 01).

John S. McCain National Defense Authorization Act for Fiscal Year 2019

Appendix E. *"Congress declares that long-term strategic competition with China is a principal priority for the United States that requires the integration of multiple elements of national power, including diplomatic, economic, intelligence, law enforcement, and military elements, to protect and strengthen national security."* (H.R.5515 - 115th Congress 2017–2018: 132 STAT. 2060).

Export Control Reform Act of 2018 (ECRA)

Appendix F. "*This bill grants the President authority to control: (1) the export, reexport, and transfer of items (commodities, software, or technology), whether by U.S. persons (including corporations) or by foreign persons, wherever located to protect national security; and (2) the activities of U.S. persons, wherever located, relating to specific nuclear explosive devices, missiles, chemical or biological weapons, whole plants for*

chemical weapons precursors, foreign maritime nuclear projects, and foreign intelligence services." (H.R.5040 — 115th Congress 2017-2018: 01).

Press release: Commerce Adds Seven Chinese Supercomputing Entities to Entity List for their Support to China's Military Modernization, and Other Destabilizing Efforts

Appendix G. *"Supercomputing capabilities are vital for the development of many – perhaps almost all – modern weapons and national security systems, such as nuclear weapons and hypersonic weapons. The Department of Commerce will use the full extent of its authorities to prevent China from leveraging U.S. technologies to support these destabilizing military modernization efforts."* (U.S. Department of Commerce, 2021a: 01).

FACT SHEET: Executive Order Addressing the Threat from Securities Investments that Finance Certain Companies of the People's Republic of China

Appendix H. "*Solidify and strengthen a previous E.O to prohibit U.S. investments in the military-industrial complex of the People's Republic of China: This E.O. will amend E.O. 13959 by creating a sustainable and strengthened framework for imposing prohibitions on investments in Chinese defense and surveillance technology firms. The E.O. prohibits United States persons from engaging in the purchase or sale of any publicly traded securities of any person listed in the Annex to the E.O. or determined by the Secretary of the Treasury, in consultation with the Secretary of State, and, as the Secretary of the Treasury deems appropriate, the Secretary of Defense."* (The White House, 2021c: 01).

Protecting Critical and Emerging Technologies from Foreign Threats

Appendix J. "*U.S. leadership in emerging technology sectors faces growing challenges from strategic competitors who recognize the economic and military benefits of these technologies and have enacted comprehensive national strategies to achieve leadership in these areas. According to the 2021 Annual Threat Assessment of the U.S. Intelligence Community, with a more level technology playing field anticipated in the future, new technological developments will increasingly emerge from multiple countries and with less warning. While the democratization of such technologies can be beneficial, it can also be economically, militarily, and socially destabilizing. For this reason, advances in technologies such as computing, biotechnology, artificial intelligence, and manufacturing warrant extra attention to anticipate the trajectories of emerging*

technologies and understand their implications for security." (National Counterintelligence and Security Center, 2021: 01).

Fact Sheet: USTR Releases 2022 Trade Policy Agenda and 2021 Annual Report

Appendix K. "*The Biden Administration acknowledges that this relationship is complex and competitive. With respect to trade, we can be both partners and competitors, but any competition must be fair. China's approach to trade drives frictions in many of China's trade relationships – not just ours. China, as a large, non-market economy, is uniquely able to engage in unfair, anticompetitive practices, which harm workers and businesses in the United States and in other countries, including some of our closest allies and partners. By unduly concentrating production of certain goods in China, these non-market practices also undermine supply chain resilience and harm consumers that, in the long run, are deprived of the innovation and choice that fair competition would produce."* (United States Trade Representative, 2022: 01).

Fact Sheet: U.S.-Japan Competitiveness and Resilience (CoRe) Partnership

Appendix L. "*Throughout our individual and shared histories, the United States and Japan have been global leaders in innovation. Our new partnership for competitiveness and innovation carries on that tradition, focusing on scientific and technological advances. Together, we will lead a sustainable, green global economic growth, guided by the principles of openness and democracy. This includes our cooperation on research and technology development across diverse fields: Cancer Moonshot, biotechnology, artificial intelligence, quantum information science and technology, civil space cooperation (including the Artemis program and asteroid exploration), and secure information and communications technology (ICT), among others. With this partnership between two of the world's leading economies, we will lead the globe in building back better and promoting sustainable growth in the future."* (The White House, 2021b: 01).

FACT SHEET: President Biden and G7 Leaders Launch Build Back Better World (B3W) Partnership

Appendix M. "*The United States is rallying the world's democracies to deliver for our people, meet the world's biggest challenges, and demonstrate our shared values."*

"Today President Biden met with G7 leaders to discuss strategic competition with China and commit to concrete actions to help meet the tremendous infrastructure need in low- and middle-income countries." (The White House, 2021d: 01).

U.S.-EU Trade and Technology Council (TTC)

Appendix N. "*A key goal is to lead global, like-minded partners in promoting an open, interoperable, secure, and reliable digital space, and to remain leaders in developing and protecting tomorrow's technology. Through the TTC, the United States and the EU can work together toward a safer and more prosperous world with growth guided by principles of sustainable development, environmental protection, and urgent action to confront the climate crisis."* (U.S. Department of State, 2021: 01).

Fact Sheet: Export Controls and Human Rights Initiative Launched at the Summit for Democracy

Appendix O. *"As part of its commitment to put human rights at the center of U.S. foreign policy, the Biden-Harris Administration has taken meaningful action to curb the proliferation of technology that has been misused by governments for repression."* (The White House, 2021f: 01).

Joint Statement on Quad Cooperation in the Indo-Pacific

Appendix P. "*We, the Foreign Ministers of Australia, India and Japan and the Secretary of State of the United States met in Melbourne, Australia on 11 February 2022, for the fourth Quad Foreign Ministers' Meeting. In meeting, we reaffirm the Quad's commitment to supporting Indo Pacific countries' efforts to advance a free and open Indo-Pacific – a region which is inclusive and resilient, and in which states strive to protect the interests of their people, free from coercion."* (U.S. Department of State, 2022: 01).

FACT SHEET: Implementation of the Australia – United Kingdom – United States Partnership (AUKUS)

Appendix Q. "*Implementation of the AUKUS partnership has now begun. It has two related lines of effort. Submarines. AUKUS will provide Australia with a conventionally armed, nuclear powered submarine capability at the earliest possible date, while upholding the highest non-proliferation standards. Advanced capabilities. AUKUS will develop and provide joint advanced military capabilities to promote security and stability in the Indo-Pacific region."* (The White House, 2022: 01).

Findings of the Investigation into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation Under Section 301 of the Trade Act of 1974

Appendix R. *"Concerns about a wide range of unfair practices of the Chinese government (and the Chinese Communist Party (CCP)) related to technology transfer, intellectual property, and innovation are longstanding. USTR has pursued these issues multilaterally, for example, through the WTO dispute settlement process and in WTO committees, and bilaterally through the annual Special 301 review. These issues also have been raised in bilateral dialogues with China, including the U.S.-China Joint Commission on Commerce and Trade (JCCT) and U.S.-China Strategic & Economic Dialogue (S&ED), to attempt to address some of the U.S. concerns."* (United States Trade Representative, 2018: 04).

Appendix S. *"The US Chamber of Commerce has highlighted how the Chinese government uses its discretion in the review process to apply vague and unwritten rules in a selective and non-transparent manner: The relatively opaque nature of the inbound FDI approval processes enables China's investment approval authorities to favor domestic competitors over foreign investors, should they so desire, without leaving a paper trail of discriminatory written regulations that could clearly offend WTO obligations. Foreign investors have reported this favoritism occurring in two ways: (i) through the application of vaguely worded or unpublished rules or requirements in ways that discriminate against foreign investors; and (ii) through the imposition of deal-specific conditions that go beyond any written legal requirements."* (United States Trade Representative, 2018: 37).

Memorandum on Actions by the United States Related to the Section 301 Investigation of China's Laws, Policies, Practices, or Actions Related to Technology Transfer, Intellectual Property, and Innovation

Appendix T. *"Sec. 2. WTO Dispute Settlement. (a) The Trade Representative shall, as appropriate and consistent with law, pursue dispute settlement in the World Trade Organization (WTO) to address China's discriminatory licensing practices. Where appropriate and consistent with law, the Trade Representative should pursue this action in cooperation with other WTO members to address China's unfair trade practices."* (Administration of Donald J. Trump, 2018: 02).

Fact Sheet: Quad Leaders' Summit

Appendix U. *"Quad leaders are committed to working together to foster an open, accessible, and secure technology ecosystem. Since establishing a new critical and emerging technologies working group in March, we have organized our work around four efforts: technical standards, 5G diversification and deployment, horizon-scanning, and technology supply chains. Today, the Quad leaders launch a statement of principles on technology, along with new efforts that together will advance critical and emerging technologies shaped by our shared democratic values and respect for universal human rights."* (The White House, 2021e: 01).