

The Commercialization and Militarization of the Final Frontier: A Tragedy of the Commons  
with Dire Consequences for Global Security

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**ABSTRACT**

The increasing commercialization and militarization of outer space is creating both opportunities and challenges for states and private entities alike. This paper explores the question: what are the security implications of a tragedy of the commons in outer space? Previous literature examining activity in outer space has broadly fallen in two categories: Authors either view the final frontier as a security challenge—the source of a security dilemma and potential arms race—or as a legal challenge, the site of future battles over property rights and commercial activity that can only be regulated through the activity of lawyers and diplomats. Introducing a lens that has seldom been used in the outer space literature, this paper treats the final frontier as a tragedy of the commons. Viewing the empirical trends through the theoretical framework established by Garrett Hardin and Elinor Ostrom reveals new insights: states' national interest and commercial entities' profit-chasing until now has been constrained only by technological limitations and an increasingly weaker Outer Space Treaty. This paper, through the use of qualitative evidence from scholarly articles and government reports, argues that the individual interests of states and commercial players must be balanced against protection of the commons and international security, a balance that can be achieved by the United States by simultaneously pursuing limited capability-enhancement and endorsing new regulatory international institutions.

In the early hours before dawn on November 16, 2022, the largest and most powerful rocket ever—the Space Launch System (SLS), a project of the United States National Aeronautics and Space Administration’s (NASA)—launched into space.<sup>1</sup> After multiple delays, the mission—fittingly dubbed Artemis I after the Greek goddess of the moon and twin sister of Apollo—finally got underway.<sup>2</sup> Artemis I will be followed by Artemis II and III which will, if all goes to plan, return the United States to the moon by 2025.<sup>3</sup> The SLS cost \$23 billion alone, a striking figure given the cheaper alternatives that exist, such as SpaceX’s reusable Falcon-9 rocket that takes NASA astronauts to the International Space Station (ISS).<sup>4</sup> The heavy investment is the product of politics<sup>5</sup>—which prioritized well-paying manufacturing jobs instead of cost-efficiency—but also the incredible determination of the United States to solidify its position as the world’s preeminent spacefaring nation.

The figurative ascent to space superiority is as politically challenging as the physical ascent to outer space is technically challenging. Outer space remains a realm of fierce competition, one that—with the exception of the weakening Outer Space Treaty (OST) and its related conventions—is frighteningly unregulated. In this paper, I seek to answer the question: What are the security implications of a tragedy of the commons in outer space? Drawing from theoretical and scholarly literature, I posit that the current situation in outer space represents a classic tragedy of the commons, and drawing from empirical evidence documented by scholars, journalists, and government reports, I argue that the current situation will have a negative impact

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<sup>1</sup> “The world’s most pointless rocket has been launched at last,” *Economist*, November 16, 2022, <https://www.economist.com/science-and-technology/2022/11/16/the-worlds-most-pointless-rocket-has-been-launched-at-last>

<sup>2</sup> Ibid.

<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

<sup>5</sup> Ibid.

on global and extraterrestrial security by prompting an arms race, providing aggressive actors with advanced capabilities that can be integrated with ground operations, and creating pretexts for military conflict. I find that an inherent tension exists between the interests of states (and commercial entities) and the preservation of the commons, a tension that can only be reconciled if actors (in the spirit of common-pool resource management) pursue balanced policy approaches. In the following section, I provide the necessary context to illuminate the extent of current competition and risk in the final frontier. I then review the existing scholarly literature on outer space, before moving onto the theoretical literature covering the commons. After stating my hypothesis, I analyze in-depth the commercialization and militarization of outer space and its implications for policymakers. Finally, I offer policy recommendations for the United States government as well as concluding thoughts.

## **I. Overview of Developments in Outer Space**

While the United States looks to the stars, so do private companies. Commercial entities are increasingly looking to play an important role in low-Earth orbit (LEO). As of May 2022, 5,465 satellites orbited Earth, 4,700 of which were in LEO.<sup>6</sup> Of the just under 3,000 commercial satellites owned by United States companies, over 2,200 belonged to SpaceX's Starlink.<sup>7</sup> Between May and December, SpaceX increased its satellites to over 3,500 satellites in LEO.<sup>8</sup> On December 1, 2022, SpaceX received authorization to deploy 7,500 more of its second-generation satellites.<sup>9</sup> By launching a rocket a week, ten times the amount of its top competitors, SpaceX is

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<sup>6</sup> "UCS Satellite Database," *Union of Concerned Scientists*, May 1, 2022, <https://www.ucsusa.org/resources/satellite-database>

<sup>7</sup> Ibid.

<sup>8</sup> David Shepardson, "SpaceX gets U.S. approval to deploy up to 7,500 satellites," *Reuters*, December 1, 2022, <https://www.reuters.com/technology/us-fcc-partially-grants-spacexs-application-second-gen-satellite-system-2022-12-01/>

<sup>9</sup> Ibid.

a clear leader in the field.<sup>10</sup> Nevertheless, its owner Elon Musk is facing challenges from his fellow billionaires' initiatives, chiefly Jeff Bezos's Blue Origin and Richard Branson's Virgin Galactic, both of which are attempting to cement their position in the space tourism industry.<sup>11</sup> Overall, commercial activity in space is expected to grow in value from \$385 billion in 2017 to \$1.5 trillion by 2040.<sup>12</sup> Space mining—once thought to be a fantasy—could also become a reality. The allure of precious metals and minerals in the Asteroid Belt—collectively valued at \$700 quintillion—continues to spur innovation in the lucrative field of space technology.<sup>13</sup>

The situation in outer space today differs starkly with that of the past. During the Cold War, outer space exploration was confined to an American and Soviet endeavor, pursued for the most part to enhance national reputation. In 1966, the United States and the Soviet Union agreed to the Outer Space Treaty, which outlined space as the “province of all mankind.”<sup>14</sup> Unanimously supported by the General Assembly, the OST represented years of careful negotiations and a remarkable compromise between the two global superpowers and a host of other nations.<sup>15</sup> Entering into force in 1967, the OST prohibited nations from staking claims of sovereignty in outer space, outlawing the placement of military installations on celestial bodies.<sup>16</sup> The treaty also outlawed positioning nuclear weapons in outer space.<sup>17</sup> Today, 112 states—

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<sup>10</sup> Sarah Kreps, Avishai Melamed, and Ray Jayawardhana, “The promise and perils of the new space boom,” *Brookings*, November 2, 2022, <https://www.brookings.edu/techstream/the-promise-and-peril-of-the-new-space-boom-us-china-competition-spacex-international-law/>

<sup>11</sup> *Ibid.*

<sup>12</sup> Brian Higginbotham, “The Space Economy: An Industry Takes Off,” *US Chamber of Commerce*, October 11, 2018, <https://www.uschamber.com/technology/the-space-economy-industry-takes>

<sup>13</sup> “Asteroids contain metals worth quintillions of dollars — but mining them won’t necessarily make you richer than Bezos or Musk,” *Business Insider*, <https://www.businessinsider.in/science/space/news/asteroids-contain-metals-worth-quintillions-of-dollars-but-mining-them-wont-necessarily-make-you-richer-than-bezos-or-musk/articleshow/83989878.cms>

<sup>14</sup> Stephen Buono, “Merely a ‘Scrap of Paper’? The Outer Space Treaty in Historical Perspective,” *Diplomacy & Statecraft* 31, no. 2 (2020): 350-372.

<sup>15</sup> *Ibid.*

<sup>16</sup> *Ibid.*

<sup>17</sup> *Ibid.*

including all major spacefaring powers—are party to the OST, and 89 more have signed it.<sup>18</sup>

Despite its established position in international law, however, the principles enshrined into the OST face challenges as space exploration and exploitation are now enterprises pursued by more than 60 spacefaring nations and a number of commercial entities. The use of outer space for satellites, scientific exploration, and commercial purposes is increasingly accompanied by its militarization. Addressing the proliferation of counterspace weapons, for example, U.S. General John Raymond bluntly remarked: “Space... is no longer a benign environment.”<sup>19</sup>

Indeed, even as commercial activity booms, international cooperation in the outer space domain is at alarming risk. In 2024, Russia’s space agency—Roscosmos—will withdraw from the ISS.<sup>20</sup> After the station lost funding from the U.S. Congress and other international financiers, NASA outlined plans to decommission the ISS by 2030.<sup>21</sup> A year later, the station will splash down to Point Nemo, the remote part of the ocean furthest from land and the graveyard of spacecraft that return to Earth.<sup>22</sup> It is in the interest of the all relevant actors to ensure that hope for cooperation is not buried alongside the ISS, as cooperation is needed to mitigate issues such as space debris. Debris in LEO—which consists of 20,000 objects over 10cm—is of salient concern. Figure 1 depicts the increase in objects in LEO and GEO (Geosynchronous Orbit) between 1975 and 2019.<sup>23</sup>

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<sup>18</sup> “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies – Status of the Treaty,” United Nations Office of Disarmament Affairs, 2022, [https://treaties.unoda.org/t/outer\\_space](https://treaties.unoda.org/t/outer_space)

<sup>19</sup> Ed Adamczyk, “U.S. Space Command general briefs NATO to affirm deterrence mission,” *United Press International*, October 14, 2019, <https://www.upi.com/Defense-News/2019/10/14/US-Space-Command-general-briefs-NATO-to-affirm-deterrence-mission/7481571072966/>

<sup>20</sup> Ezzy Pearson, “How the ISS is being retired, and what will happen to it,” *Sky at Night*, *British Broadcasting Corporation*, March 21, 2022, <https://www.skyatnightmagazine.com/space-missions/international-space-station-retirement/>

<sup>21</sup> “International Space Station to crash down to Earth in 2031,” *British Broadcasting Corporation*, February 3, 2022, <https://www.bbc.com/news/science-environment-60246032>

<sup>22</sup> *Ibid.*

<sup>23</sup> Bruce McClintock, et al., “Responsible Space Behavior for the New Space Era,” 2021, *Rand Corporation*, <https://www.rand.org/pubs/perspectives/PEA887-2.html>.

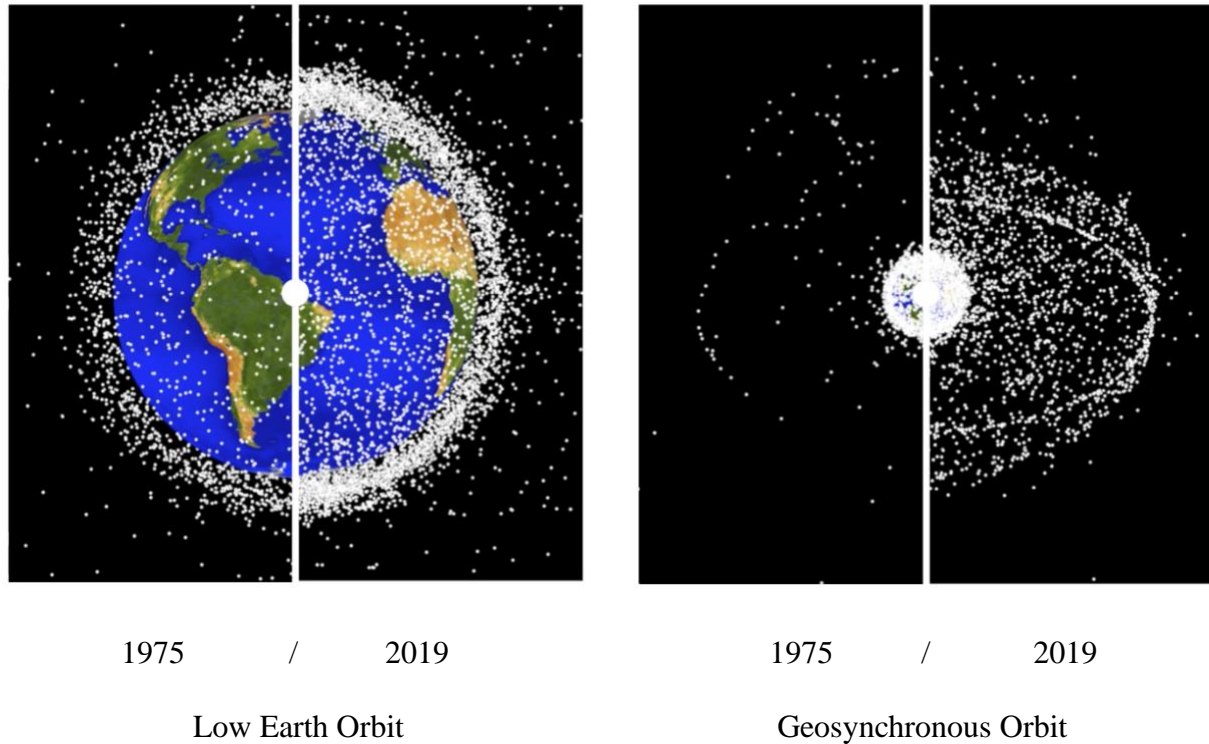


Figure 1. The growth in objects in Low Earth Orbit from 1975-2019 pictured on the left, and the growth of objects in Geosynchronous Orbit from 1975-2019 pictured on the right.<sup>24</sup>

Collisions in space—such as when debris crashed into a French government spacecraft in 1996 or when an inactive Russian satellite crashed into an active U.S. commercial satellite in 2009—destroy space assets and create more debris.<sup>25</sup> Scientists are concerned that newly-created debris will increasingly pollute LEO and collide with existing objects, creating even more debris in a vicious cycle.<sup>26</sup> This phenomenon—in which debris creation outpaces efforts to clean it up—is known as the Kessler Syndrome, named after the NASA scientist who first elucidated it

<sup>24</sup> Clementine G. Starling, et al., *The Future of Security in Space: A Thirty-Year US Strategy*, (Washington, D.C.: Atlantic Council, April 2021).

<sup>25</sup> Ibid.

<sup>26</sup> Ibid.

in 1978.<sup>27</sup> If left unchecked, the Kessler Syndrome would render all space operations impossible.<sup>28</sup> Thus, space debris and its potential effects constitute an existential threat to the future of all space operations—military, commercial, civilian, and scientific.<sup>29</sup>

The changing strategic landscape of outer space is challenging the efficacy of existing international law, threatening to render it outdated. Advancements in technology and the ambition of nations are currently outpacing the efforts of scientists and statesmen to craft new frameworks regulating activity in outer space, making debris one of many concerns in the final frontier. The inability of current institutional frameworks to regulate the potential exploitation of space for military and commercial purposes poses a grave threat to international security by creating the pretexts for conflict and allowing aggressive actors to arm themselves with advanced capabilities.

## II. Literature Review

This paper is nested in a broader literature examining the increasing commercialization and militarization of outer space. Space has been viewed through two principal lenses: a security lens and a legal lens. In the case of the former, scholars have treated policy toward outer space as a security dilemma. In the latter, scholars have treated outer space as a legal problem, in which the challenges posed by the current environment can be mitigated by regulating property rights in space and negotiating arms control agreements through international institutions. Although not a stark binary, the first lens is born out of realism, and the second out of liberalism.

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<sup>27</sup> Ibid.

<sup>28</sup> Ibid.

<sup>29</sup> Charles Powell, "Saving Space from 'Star Wars'-Style Misperceptions," *War on the Rocks*, July 14, 2020, <https://warontherocks.com/2020/07/saving-space-from-star-wars-style-misperceptions/>

The security dilemma lens presents a compelling view of outer space. The view dates back to the beginning of the Cold War, when many within the realist-dominated International Relations sphere applied it to increasing competition between the United States and the Soviet Union.<sup>30</sup> A security dilemma develops when opposing actors treats their own actions as defensive, and the other's as offensive—often leading to spiraling tensions and escalations, such as an arms race.<sup>31</sup> Security dilemmas are characterized by structural uncertainty, interdependent group identities, and a self-perpetuating dynamic.<sup>32</sup> They arise when the international system's structural anarchy is compounded by the inability to distinguish offensive and defensive weapons, in-group solidarity and rejection of the out-group, and a fatalist attitude toward insecurity that rationalizes escalation.<sup>33</sup> As Snyder and Jervis (1999) put it, the security dilemma “can take on a life of its own, trapping both predators and prey in rivalries.”<sup>34</sup>

Following from these conditions, it becomes apparent why some might view space as a security dilemma. As multiple authors have pointed out (Townsend 2020, Wolter 2006, Finch 2014), it is difficult—if not impossible—to differentiate between offensive and defensive space systems and weapons, causing actors to gauge the strategic environment in space as “offense-dominant.”<sup>35</sup> Multiple observers (Bergmann and Lohsen 2022, Townsend 2020) have pointed out, for example, that ostensibly peaceful technologies—such as robot arms designed to repair satellites after collisions or lasers that provide secure communication—can be repurposed to

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<sup>30</sup> David Mitchell, “The Cycle of Insecurity: Reassessing the Security Dilemma as a Conflict Analysis Tool,” *Peace and Conflict Studies* 26, no. 2 (2019): 1-23.

<sup>31</sup> *Ibid.*, 1.

<sup>32</sup> *Ibid.*, 2.

<sup>33</sup> *Ibid.*, 5.

<sup>34</sup> Jack Snyder and Robert Jervis, “Civil war and the security dilemma” In B. Walter & J. Snyder (Eds.). *Civil Wars, insecurity and intervention*, (New York, NY: Columbia University Press, 1999), 15-37.

<sup>35</sup> Brad Townsend, “Strategic Choice and the Orbital Security Dilemma,” *Strategic Studies Quarterly* 14, no. 1, (Spring 2020): 64-90; Detlev Wolter, *Common Security in Outer Space and International Law* (Geneva: UN Institute for Disarmament Research, 2006), 31, 188; James Finch, “Bringing Space Crisis Stability Down to Earth,” *Joint Force Quarterly* 76, no. 1 (January 2015): 15-20.



destroy space assets.<sup>36</sup> Other authors (Johnson-Freese 2016, Al-Rodhan 2018, Yates and Grimaila 2008) emphasize that the reliance on space assets for communication and intelligence and the consequent linkages between space and terrestrial security further heighten the stakes.<sup>37</sup> Scholars (Zhang 2011, Hitchens 2002, Anantatmula 2013, Townsend 2020) argue that the combination of ambiguity and high stakes prompts insecurity, and forces actors like the United States and China to compete by building their own capabilities, entrenching a security dilemma and prompting a potential arms race.<sup>38</sup> These factors—combined with the space industry’s reliance on government contracts and government’s reliance on private-sector technology—create a cycle of investment, innovation, and competition that contributes to the self-perpetuating nature of the orbital security dilemma.<sup>39</sup>

A second strand of literature views space as primarily a legal problem. Authors in this section of the literature (Mallick and Rajagopalan 2019, Buxton 2004, Coffey 2009) treat the vast economic and strategic boons to be found in space as the true motivation for competition and regard a regime of property rights and/or arms control as viable ways to regulate such competition.<sup>40</sup> Implicit in this view is that if states and private actors create institutional

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<sup>36</sup> Townsend 2020; Max Bergmann and Andrew Lohsen, “Understanding the Broader Transatlantic Security Implications of Greater Sino-Russian Military Alignment,” *Center for Strategic and International Studies*, 2022, <https://www.jstor.org/stable/resrep45513.8>

<sup>37</sup> Joan Johnson-Freese, *Space Warfare in the 21st Century: Arming the Heavens* (New York: Routledge, 2016), 1-25; Nayef Al-Rodhan, “The Interplay Between Outer Space Security and Terrestrial Global Security,” *Harvard International Review* 39, no. 3, (Summer 2018): 29-33; Heather Yates and Michael Grimaila, “A Systematic Approach to Securing our Space Assets,” *High Frontier* 4, no. 2 (2008): 48–53.

<sup>38</sup> Baohui Zhang, “The Security Dilemma in the U.S.-China Military Space Relationship: The Prospects for Arms Control,” *Asian Survey* 51, no. 2 (March/April 2011): 311-332; Theresa Hitchens, “Space Weapons: More Security or Less?” *James Martin Center for Nonproliferation Studies*, 2002, <http://www.jstor.com/stable/resrep09905.10>; Vishnu Anantatmula, “U.S. Initiative to Place Weapons in Space: The Catalyst for a Space-Based Arms Race with China and Russia,” *Astropolitics* 11, no. 3 (2013): 132-155; Townsend 2020.

<sup>39</sup> Johnson-Freese 2016; Pavel Frankowski, “Outer Space and Private Companies: Consequences for Global Security,” *Politeja* 50, no. 5 (2017): 131-148.

<sup>40</sup> Senjuti Mallick and Rajeswari Pillai Rajagopalan, “If Space is ‘the Province of Mankind’, Who Owns its Resources? An Examination of the Potential of space Mining and its Legal Implications,” *Observer Research Foundation*, January 2019, [https://www.orfonline.org/wpcontent/uploads/2019/01/ORF\\_Occasional\\_Paper\\_182\\_Space\\_Mining.pdf](https://www.orfonline.org/wpcontent/uploads/2019/01/ORF_Occasional_Paper_182_Space_Mining.pdf); Carol

frameworks to govern resources and arms, then a security dilemma can be averted. Currently, there is constant tension between two legal principles: the common heritage of mankind principle, outlined by the OST, and the “first in time, first in right” principle—a traditional rule of property; the first principle is needed to ensure sustainability in space, the latter needed to spur innovation and investment. As multiple authors have pointed out (Hertzfeld, et al., 2016; Bragg, et al. 2018; Mallick and Rajagopalan 2019), states and the private entities they represent are increasingly looking to exploit legal loopholes to further their claims in outer space in the pursuit of economic resources by advancing their technology and creating incentives for the private sector.<sup>41</sup> For example, U.S. legislation from 2015 and a similar law passed in Luxembourg in 2017 legalized and encouraged space mining, establishing a “finders-keepers” mentality vis-à-vis space resources.<sup>42</sup> Despite undermining the principle of *res communis* upon which the OST arose, Luxembourg argued that its law was in line with maritime law—if space resources are akin to fish, although a country cannot claim celestial bodies (or oceans) as its property, it can still harvest resources (Mallick and Rajagopalan 2019). Nearly every author from this section of literature concludes by emphasizing the need for an international regulatory framework and governing body to delineate property rights in space and to oversee their transfer.

In a similar vein, authors (Mutschler 2010, Chow 2018, Bourbonniere and Lee 2007, Garwin 2001, O’Hanlon 2004) have also proposed arms controls measures in space—from the

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Buxton, “Property in Outer Space: The Common Heritage of Mankind Principle vs. the First in Time, First in Right, Rule of Property,” *Journal of Air Law and Commerce* 69, no. 4 (2004): 689-707; Sarah Coffey, “Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space,” *Case Western Reserve Journal of International Law* 41, no. 6 (2009): 119-147.

<sup>41</sup> Henry R. Hertzfeld, Brian Weeden, and Christopher D. Johnson, “Outer Space: Ungoverned or Lacking Effective Governance? New Approaches to Managing Human Activities in Space,” *The SAIS Review of International Affairs* 36, no. 2, (Summer-Fall 2016): 15-28; Bragg, et al., “Governing in a Crowded Space: The OST and Development of the Legal Regime for Space,” National Security Institute, April, 2018, <https://apps.dtic.mil/sti/pdfs/AD1095009.pdf>; Mallick and Rajagopalan 2019.

<sup>42</sup> Jinyuan Su, “Legality of Unilateral Exploitation of Space Resources Under International Law,” *The International and Comparative Law Quarterly* 66, no. 4 (October 2017): 991-1008; Mallick and Rajagopalan 2019.

application of *jus ad bellum* principles to reductions in anti-satellite (ASAT) weapons testing.<sup>43</sup> Another principal challenge of the legal environment in outer space, however, is that traditional arms control measures—which simply limit the number of weapons or reduce their potency—are mostly ineffective in space, in which the smallest of weapons can deal enough damage to a satellite to cause catastrophic damage. Scholars (Chow 2018, McClintock, et al. 2021, Johnson 2020) have thus also posited the need for combining traditional arms control measures with strict guidelines for rendezvous and proximity operations (RPOs), which regulate the path space assets take to prevent collisions.<sup>44</sup> Finally, while the United States appears uniquely well situated to both prompt and benefit from enhanced global cooperation (Patrick and Evanoff 2018), there is intense competition over who should lead regional cooperation in areas like Asia, in which China, Japan, and India all possess capable space programs (Yoshimatsu 2021).<sup>45</sup>

The body of literature on outer space is rich with insightful analysis that this paper is indebted to. Nevertheless, perhaps in an effort to preserve brevity, there has not been sufficient debate on how we ought to conceive of outer space before jumping into how we analyze the policies and actions that occur in relation to outer space. At the heart of the different views on outer space militarization and commercialization summarized above is an unstated, underlying

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<sup>43</sup> Max M. Mutschler, “Keeping Space Safe: Towards a long-term strategy to arms control in space,” *Peace Institute Research Frankfurt* no. 10 (2010): 1-37; Brian G. Chow, “Space Arms Control: A Hybrid Approach,” *Strategic Studies Quarterly* 12, no. 2 (Summer 2018): 107-132; Michel Bourbonnière and Ricky J. Lee, “Legality of the Deployment of Conventional Weapons in Earth Orbit: Balancing Space Law and the Law of Armed Conflict,” *European Journal of International Law* 18, no. 5 (November 2007): 873-901; Richard L. Garwin, “Space Weapons or Space Arms Control?” *American Philosophical Society* 145, no. 3 (September 2001): 243-259; Michael E. O’Hanlon, *Neither Star Wars nor Sanctuary: Constraining the Military Uses of Space* (Washington, DC: Brookings Institution Press, 2004): 105-118.

<sup>44</sup> Chow 2018; McClintock, et al. 2021; Kaitlyn Johnson, “Key Governance Issues in Space: Rendezvous and Proximity Operations,” *Center for Strategic and International Studies*, 2020, <https://www.jstor.org/stable/resrep26047.7>.

<sup>45</sup> Stewart Patrick and Kyle L. Evanoff, “The Right Way to Achieve Security in Space: The U.S. Needs to Champion International Cooperation,” *Foreign Affairs* 97, no. 5, (September-October 2018); Hidetaka Yoshimatsu, “Exploring the China factor in Japan’s foreign and security policy in outer space,” *Australian Journal of International Affairs* 75, no. 3 (February 2021): 305-322.

difference on what space fundamentally is and what it should be—principally, whether or not it should be conceptualized as a commons, and if so, what is the level of regulation that accompanies (or should accompany) that commons? There exists some debate on this issue that should be acknowledged: some scholars (Hertzfeld, et. al. 2015, Goehring 2021) argue that space should not be conceptualized as a commons due to its boundless nature and the limited language of current legal frameworks, while others (Schauer 1977, Steer 2017, Silverstein and Panda 2021) offer more charitable interpretation of international law—viewing the spirit of the law in conjunction with some of the phrases as cementing space as a commons.<sup>46</sup> The following section will explore the theoretical literature on the commons and articulate the thesis of the argument this paper intends to make.

### III. Theory

Garrett Hardin’s 1968 article “The Tragedy of the Commons” and its titular idea have been extraordinarily influential in the social sciences since its publication. In the article, Hardin argued that competition between rational actors over an accessible, finite resource would ultimately lead to the depletion of that resource, even if its preservation contributed to the wellbeing of the competing actors. Hardin used his famous shepherd allegory to illustrate his point: the marginal benefit a herdsman can gain by adding a sheep to his flock outweighs the fraction of the cost of increasing overgrazing that is borne by the herdsman—eventually

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<sup>46</sup> Henry R. Hertzfeld, “How Simple Terms Mislead Us: The Pitfalls of Thinking about Outer Space as a Commons,” (2015) (unpublished paper, No. IAC-15 - E7.5.2 x 29369, presented at International Astronautical Conference); John Goehring, “Why Isn’t Outer Space a Global Commons,” *Journal of National Security Law & Policy* 11, no. 3 (2021): 573-590; William Schauer, “Outer Space: The Boundless Commons?” *Journal of International Affairs* 31, no. 1 (Spring 1977): 67-70; Cassandra Steer, “Global Commons, Cosmic Commons: Implications of Military and Security Uses of Outer Space,” *Georgetown Journal of International Affairs* 18, no. 1 (Winter/Spring 2017): 9-16; Benjamin Silverstein and Ankit Panda, “Space Is a Great Commons. It’s Time to Treat It as Such,” *Carnegie Endowment for International Peace*, March 9, 2021, <https://carnegieendowment.org/2021/03/09/space-is-great-commons.-it-s-time-to-treat-it-as-such-pub-84018>.

depleting the pasture entirely. “Therein is the tragedy,” Hardin writes... “Freedom in a commons brings ruin to all.”<sup>47</sup> Hardin extrapolated his theory to other “commons”—national parks, the oceans, and the air. Hardin proposed that alleviating the tragedy of commons requires either direct government regulation of the resource or the delineation of private property rights. While influential, Hardin’s theory was heavily criticized. The most notable contradiction (at least for the purpose of this paper) came from Elinor Ostrom, who argued in her 1990 book *Governing the Commons* that individuals can communicate and cooperate to effectively manage common pool resources (without either of Hardin’s two proposed remedies). Ostrom famously provided the example of a Swiss village that maintained (for centuries) a collective meadow for cow grazing by enforcing the rule that a herdsman could only send as many cows to the meadow as he could feed in the winter.<sup>48</sup> Indeed, Ostrom pulled from a vast array of empirical examples of common-pool resource management to critique the rational actor model Hardin relied on, positing a more complex view of human behavior—she argued that the observation of reciprocity, norm creation, and the imposition of institutions (rules) can and have effectively managed the commons.

Outer space and its resources share many of the characteristics of the commons identified by Hardin and Ostrom. Space is, in theory, accessible to all; its resources are simultaneously non-excludable but rivalrous (common pool). Despite the prevalent view of space as boundless, the resources we can access with current and near-futuristic technology are finite; moreover, LEO is geographically bounded. Hardin’s reference to pollution (the marginal cost to actors of polluting is lower than the profits that can be reaped by polluting) is near-perfectly applicable to

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<sup>47</sup> Garrett Hardin, “Tragedy of the Commons,” *Science*, New Series 162, no. 3859 (December 13, 1968): 1244.

<sup>48</sup> Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990), 64.

the problem of debris in outer space. Through the OST, states committed to outer space being a domain over which no one can claim sovereignty, but through which freedom of exploration should be upheld—defining features of the other commons identified by the International Relations field and international law (the High Seas, the Atmosphere, and the Antarctic). While it admittedly suffers from a scintilla of reductionism, the view of outer space as an arena of competition between self-interested rational actors (governments and private companies) best fits the empirical evidence. Thus, I argue that the current commercialization and militarization of outer space represents a classic tragedy of the commons, one that will have a negative impact on global and cosmic security. Nevertheless, drawing upon Ostrom, I argue that potential opportunities for regulation through institutions exist and will be expounded upon in later sections.

#### **IV. Analysis**

With the lens of space as a tragedy of the commons, the situation in space is framed more properly. In this section, I illustrate through qualitative evidence from scholarly work and government reports how the developments in space—from exploration and commercialization to militarization—support the hypothesis that space represents a tragedy of the commons. While the economic implications of a tragedy of the commons, mainly resource depletion, are evident without much elucidation needed, I also begin to illustrate the security implications of that tragedy—competition over resources that can create the power dynamics and pretexts that cause conflicts, an arms race that exacerbates tensions and makes cooperation less likely, and the enhancement of capabilities that can embolden aggressive actors in terrestrial conflicts.

### *Exploration and Commercialization*

With the Artemis missions, the United States has recommitted itself to lunar and deep space exploration. However, it faces stiff competition from other nations. Beijing is pursuing a number of missions that will, if successful, result in a permanent lunar base for China.<sup>49</sup> Construction of China's International Lunar Research Station (ILRS) is set to begin next decade and is scheduled to be habitable by 2035.<sup>50</sup> The three missions China has planned in the coming years—Chang'e-6, 7 and 8—are intended to provide the country's space program with the necessary samples and information to complete a crewed landing by the end of the decade and prepare for ILRS construction.<sup>51</sup> China, which was denied access to the ISS, has also launched its own Tiangong space station.<sup>52</sup> With these initiatives, China is positioning itself to be a leader in future lunar and deep space exploration.<sup>53</sup> China is also expanding its economic presence in outer space. In response to SpaceX's increased presence in LEO, China is planning on launching 10,000 additional satellites by 2025.<sup>54</sup> A critical part of China's landmark Belt and Road Initiative is the expansion of its satellite navigation system, Beidou.<sup>55</sup> The Beidou network consists of 45 satellites in orbit and 120 ground stations, including two in North America.<sup>56</sup> Beidou products and services are predicted to be worth \$156 billion by 2025, providing an

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<sup>49</sup> Andrew Jones, "China outlines pathway for lunar and deep space exploration," *Space News*, November 28, 2022, <https://spacenews.com/china-outlines-pathway-for-lunar-and-deep-space-exploration/>

<sup>50</sup> Ibid.

<sup>51</sup> Ibid.

<sup>52</sup> "Military and Security Developments Involving the People's Republic of China," *U.S. Department of Defense*, 2022, <https://media.defense.gov/2022/Nov/29/2003122279/-1/-1/1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF>

<sup>53</sup> Jones 2022.

<sup>54</sup> Chaudhary Smriti, "China Plans to Launch 10,000 Satellites To Compete With Elon Musk's SpaceX," *The Eurasian Times*, November 19, 2020, <https://eurasianimes.com/china-plans-to-launch-10000-satellites-to-compete-with-elon-musks-spacex/>

<sup>55</sup> Zhang Tong and Stephen Chen, "China's Beidou satellite navigation system gets a stronger foothold in the West," *South China Morning Post*, November 10, 2022, <https://www.scmp.com/news/china/science/article/3199160/chinas-beidou-satellite-navigation-system-gets-stronger-foothold-west>

<sup>56</sup> Ibid.

economic boon to China.<sup>57</sup> The growing value of the industries surrounding outer space pose a threat to the preservation of the commons. The increasing value raises the marginal benefit for a state of increasing its presence in outer space above the fraction of the collective cost borne by the state, thus triggering the condition of Hardin's tragedy of the commons. With China and the United States each feeling the pressure to match the other step for step, the common interest of mankind will take a backseat to national interest.

While China rises, however, Russia falls behind in the space race. The decline in Russia's space prowess is a surprising development given that the Soviet Union was the first to put a man in space, an object on Mars, and a satellite in orbit.<sup>58</sup> Russia possesses more than 20 satellites in its GLONASS navigation system, which it spent over \$430 million on in 2019.<sup>59</sup> However, Russia's focus on navigation technologies—coupled with an already weak business environment for its domestic satellite industry and sanctions that have hampered factories' production—has resulted in the country falling behind in military and intelligence technologies related to space.<sup>60</sup> By 2020, China possessed double Russia's satellites and also overtook the country in military spacecraft.<sup>61</sup> Consequently, Moscow has attempted to deepen its cooperation with Beijing. In 2017, the two countries agreed to a five-year partnership in space,<sup>62</sup> and in 2021, their space programs announced plans to collaborate on the ILRS.<sup>63</sup>

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<sup>57</sup> U.S. Department of Defense 2022.

<sup>58</sup> Elizabeth Hanes, "From Sputnik to Spacewalking: 7 Soviet Space Firsts," *History.com*, October 2, 2020, <https://www.history.com/news/from-sputnik-to-spacewalking-7-soviet-space-firsts>

<sup>59</sup> Pavel Lugin, "Russia is behind in military space capabilities, but that only drives its appetite," *Defense News*, April 2, 2020, <https://www.defensenews.com/opinion/commentary/2020/04/02/russia-is-behind-in-military-space-capabilities-but-that-only-drives-its-appetite/>

<sup>60</sup> *Ibid.*

<sup>61</sup> *Ibid.*

<sup>62</sup> Max Bergmann and Andrew Lohsen, "Understanding the Broader Transatlantic Security Implications of Greater Sino-Russian Military Alignment," *Center for Strategic and International Studies*, December 2022.

<sup>63</sup> Jeffrey Kluger, "China Wants New Partners For Its Moon Missions As Its Relationship With Russia Cools," *Time Magazine*, September 30, 2022, <https://time.com/6218389/china-russia-moon-missions/>



Russia's invasion of Ukraine, however, has rocked its relationship with other countries and damaged its efforts to make meaningful strides on its space program.<sup>64</sup> Just 16 months after China and Russia announced the ILRS, some reports indicate that behind closed doors, China's space program seems hesitant to continue pursuing full-fledged cooperation with the Russian space program.<sup>65</sup> Indeed, in early 2023, news outlets reported that China was seeking new partners for the ILRS.<sup>66</sup> The two countries are still expected to sign another five-year cooperation agreement sometime in 2023,<sup>67</sup> but the relationship is becoming increasingly lopsided: Russia needs China more than the reverse.

Russia possesses grand ambitions: before the ILRS becomes habitable in 2035, Roscosmos is aiming to land a crew on the Moon in 2030.<sup>68</sup> Nevertheless, they will need assistance. Mir Sadat—who served on the National Security Council and led interagency cooperation on space while Space Force was being implemented—notes that Russia's space station won't be fully operational until at least 2035.<sup>69</sup> He sums up the weakness of Russia's space program:

Their [Russia's] current Soyuz spacecraft does not have the capability to reach China's Tiangong space station; therefore, between 2024 and at least 2035, Russia cedes the capacity to put humans in low-Earth orbit. This vulnerability effectively undermines Russia as a space superpower because it seems increasingly likely that they would be a follower, rather than a leader, in space at least for the next decade.<sup>70</sup>

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<sup>64</sup> Ibid.

<sup>65</sup> Kluger 2022.

<sup>66</sup> "China-Russia Space Alliance Stumbles in Bid to Surpass US," *Bloomberg*, February 26, 2023, <https://www.bloomberg.com/news/articles/2023-02-26/china-russia-alliance-in-space-stumbles-in-bid-to-surpass-the-us#xj4y7vzkg>

<sup>67</sup> Bergmann and Lohsen 2022.

<sup>68</sup> Todd Harrison, et al., "Space Threat Assessment 2021," *Center for Strategic and International Studies*, 2021, <https://www.csis.org/analysis/space-threat-assessment-2021>

<sup>69</sup> Christopher Mulder and Mir Sadat, "Russia's pulling the plug on space cooperation. Should the world be worried?" *Atlantic Council*, July 27, 2022, <https://www.atlanticcouncil.org/blogs/new-atlanticist/russias-pulling-the-plug-on-space-cooperation-should-the-world-be-worried/>

<sup>70</sup> Ibid.

Russia's stumbles combined with the lack of current regulation in outer space leave room for the United States to press the advantage and shape norms to its interests. In the tragedy of the outer space commons, norms are created not by institutions, but by actors pursuing their individual interests.

Indeed, as nations jostle over positioning in space, the United States is seeking to solidify its place by redefining outer space norms. In this pursuit, the Artemis Accords have been its main instrument. According to the U.S. Department of State, which co-developed the Artemis Accords with NASA, the Accords "are grounded in the Outer Space Treaty of 1967" and are meant to "establish a common framework to guide responsible space exploration."<sup>71</sup> The Accords opened for signature in October 2020, and now possess 21 signatories.<sup>72</sup> Signing the Artemis Accords is a prerequisite for countries wishing to participate in NASA's Artemis program.<sup>73</sup> Contrary to the State Department and NASA's interpretation of the Artemis Accords, observers have criticized the Accords as undermining international law in order to preserve U.S. space dominance.<sup>74</sup> Critics argue that by centering U.S. guidelines and providing the framework for U.S. companies to begin the commercial exploitation of outer space,<sup>75</sup> the Accords threaten the principle of *res communis* that the OST rests upon—the idea that outer space is something to be shared by all nations, by all mankind.<sup>76</sup> The Accords followed the Commercial Space Launch Competitiveness Act of 2015 (authorizing mining and the extraction of resources in outer space)<sup>77</sup> and were followed by President Trump's 2020 Executive Order explicitly rejecting space as a "global

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<sup>71</sup> Ned Price, "First Meeting of Artemis Accords Signatories," *U.S. Department of State*, September 19, 2022, <https://www.state.gov/first-meeting-of-artemis-accords-signatories/>

<sup>72</sup> *Ibid.*

<sup>73</sup> Alexander Stirn, "Do NASA's Lunar Exploration Rules Violate Space Law?," *Scientific American*, November 12, 2020, <https://www.scientificamerican.com/article/do-nasas-lunar-exploration-rules-violate-space-law/>

<sup>74</sup> *Ibid.*

<sup>75</sup> Mallick and Rajagopalan 2019.

<sup>76</sup> *Ibid.*

<sup>77</sup> *Ibid.*

commons.”<sup>78</sup> President Trump’s policy pushed forth a vision of outer space that will be hard to erase from the global conscious—one in which resources will be exploited, claims will be laid, and property rights must be developed. Everyone now wants a piece of the pie. France, Israel, Japan, South Korea, and the United Kingdom all seek to play an active role in space,<sup>79</sup> and Luxembourg looks to become the “Silicon Valley of asteroid mining.”<sup>80</sup> Nevertheless, no framework exists to govern the commercial ambitions of nations, and perhaps even more importantly, the private entities behind them. Without regulation, it is clear how outer space will devolve into a tragedy of the commons—it is simply a race between countries (or companies, for that matter) to develop the technology necessary to profit the most from the commons.

### *Militarization*

Having documented the situation in outer space as it pertains to the current state of exploration and commercialization, I will turn my attention to the militarization of outer space, a close study of which ought to frighten any observer. In 2019, President Trump authorized the creation of the U.S. Space Force.<sup>81</sup> The establishment of the sixth branch of the military was coupled with President Trump’s public call for the United States to achieve dominance in a “war fighting domain.”<sup>82</sup> Critics argue that, in addition to antagonizing Russia and China, President Trump’s rhetoric and actions were antithetical to the OST’s peaceful conceptualization of outer space.<sup>83</sup> Skeptics of the longevity and efficacy of the OST argued that if technology had allowed

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<sup>78</sup> Aaron Boley and Michael Byers, “U.S. policy puts the safe development of space at risk,” *Science* 370, no. 6513 (2020): 174-175.

<sup>79</sup> Christopher Mulder and Mir Sadat, “Russia’s pulling the plug on space cooperation. Should the world be worried?” *Atlantic Council*, July 27, 2022, <https://www.atlanticcouncil.org/blogs/new-atlanticist/russias-pulling-the-plug-on-space-cooperation-should-the-world-be-worried/>

<sup>80</sup> Mallick and Rajagopalan 2019.

<sup>81</sup> Buono 2020.

<sup>82</sup> Ibid.

<sup>83</sup> Boley and Byers 2020.

the great powers to militarize the final frontier in the 1960s, the OST would have never come to fruition.<sup>84</sup> With that technology now available, observers fear that those skeptics will be proven right. Already, the United States, Russia, China, and India have developed and tested ASAT weaponry.<sup>85</sup> Thus, multiple actors—all with starkly different ambitions, visions, and goals—possess the potential to destroy or disable the satellites that are crucial to nations’ militaries and economies (all without firing a single shot or crossing a single border).<sup>86</sup> The development of militaristic capabilities in outer space adds another weapon to the arsenal of aggressive actors, emboldening them and raising the likelihood of miscalculation when they test or threaten the use of their newfound capabilities.

Moreover, testing kinetic ASAT weapons creates dangerous space debris.<sup>87</sup> For example, Russia’s November 2021 test—in which the nation destroyed a defunct Soviet-era satellite by striking it with a PL19 Nudol interceptor missile—created over 1,500 pieces of debris in LEO.<sup>88</sup> India’s recent and unexpected test of a kinetic-kill ASAT weapon in August 2022 illuminates another concern: advancing ASAT technology is often developed under the guise of missile-defense systems.<sup>89</sup> This development contributes to the ambiguity of weapons systems—worsening the security dilemma identified by many of the authors summarized in the literature review. The particular tragedy of the commons of outer space is that not only does a lack of regulation enable commercial entities to theoretically exploit space resources without regard to

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<sup>84</sup> Ibid.

<sup>85</sup> Ankit Panda, “The Dangerous Fallout of Russia’s Anti-Satellite Missile Test,” *Carnegie Endowment for International Peace*, November 17, 2021, <https://carnegieendowment.org/2021/11/17/dangerous-fallout-of-russia-s-anti-satellite-missile-test-pub-85804>

<sup>86</sup> Ibid.

<sup>87</sup> Ibid.

<sup>88</sup> Ibid.

<sup>89</sup> Doris Elin Urrutia, “India’s Anti-Satellite Missile Test Is a Big Deal. Here’s Why.” *Space.com*, August 10, 2022, <https://www.space.com/india-anti-satellite-test-significance.html>

sustainability, but it allows states to weaponize space to their advantage. In this way, the competition over dominion of outer space is creating negative impacts on international security.

In terms of counterspace capabilities, Russia poses a salient threat to U.S. space assets. The country engaged in multiple tests of direct-ascent kinetic ASAT weapons in 2020, and is refining its missile defense technology so it may be repurposed as counterspace weapons.<sup>90</sup> According to the 2021 Space Threat Assessment published by the Center for Strategic and International Studies, the S-500 missile system, a replacement to the already effective S-400 system, “is capable of destroying hypersonic weapons and satellites in near space.”<sup>91</sup> Russia has continued to develop non-kinetic physical ASAT weapons such as advanced laser technology and electronic weapons, including satellite jamming technology.<sup>92</sup> The United States is also concerned that Iran and North Korea might develop counterspace capabilities.<sup>93</sup> The former currently lacks the technology, and in the future will likely opt for cyberattacks instead, but security experts fear that they might acquire such technology from Russia or China.<sup>94</sup> North Korea appears the more salient threat, as they already possess electronic and cyber weapons capable of jamming, and perhaps destroying, satellites.<sup>95</sup> They are also heavily pursuing a kinetic ASAT weapon, and while no open-source intelligence has confirmed possession of non-kinetic weaponry, reports from multiple security thinktanks suggest that North Korea can create a devastating EMP effect by placing a nuclear weapon on a long-range missile.<sup>96</sup> It is not unimaginable that the next set of comprehensive negotiations over outer space will involve issues as it pertains to resources and arms alike. Hence, issue linkages will make it difficult to

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<sup>90</sup> Harrison 2021

<sup>91</sup> Ibid.

<sup>92</sup> Ibid.

<sup>93</sup> Ibid.

<sup>94</sup> Ibid.

<sup>95</sup> Ibid.

<sup>96</sup> Ibid.

separate the two topics. Without resolving the tragedy of the commons that currently plagues space, any international regulation of ASAT capabilities seems unlikely, and as such, the negative security impacts of the weaponization of space will continue.

What likely worries U.S. policymakers the most, however, is China's military ambitions in outer space. On November 29, 2022, the Pentagon published its annual report on "Military and Security Developments Involving the People's Republic of China."<sup>97</sup> The report found that China intends to achieve "space superiority."<sup>98</sup> The Chinese Communist Party views space superiority as intrinsically tied with maintaining domestic power since satellites can be used for intelligence gathering, surveillance, and controlling communications.<sup>99</sup> To this end, China is investing heavily in modern satellite constellations and space technology.<sup>100</sup>

According to the Department of Defense's report, in addition to satellite development, Beijing has continued to develop counterspace capabilities.<sup>101</sup> The People's Liberation Army (PLA)—the armed wing of the CCP—is acquiring or developing "kinetic-kill missiles, ground-based lasers, and orbiting space robots, as well as expanding space surveillance capabilities, which can monitor objects in space within their field of view and enable counterspace actions."<sup>102</sup> The CSIS 2021 Space Threat Assessment found that China possesses the capability to "threaten any U.S. satellite in LEO, and likely those in MEO [medium Earth orbit] and GEO."<sup>103</sup> This development is alarming given that less than a decade ago, China's ASAT

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<sup>97</sup> Department of Defense 2022.

<sup>98</sup> Ibid.

<sup>99</sup> Ibid.

<sup>100</sup> Ibid.

<sup>101</sup> Ibid.

<sup>102</sup> Ibid.

<sup>103</sup> Harrison 2021.

capabilities were considered too weak to strike military satellites that were safely nestled in deeper orbits.<sup>104</sup>

Finally, China is seeking to integrate its space and ground capabilities. The DOD report notes that “the PLA views space operations as a means to deter and counter third-party intervention during a regional military conflict.”<sup>105</sup> If Beijing should decide to pursue reunification with Taiwan by force, academics suggest that the PLA could use its counterspace capabilities to attack early warning systems, effectively blinding Taiwan and the United States.<sup>106</sup> China has been accused of integrating capabilities before, when multiple news outlets accused the country of deploying satellite jammers near the Line of Actual Control in Ladakh (where India and China dispute territorial claims) in order to mask PLA movements.<sup>107</sup> Overall, China’s technological developments are of grave concern to the United States—for the first time in history, China threatens to surpass the United States in terms of technology and capabilities.<sup>108</sup> In the tragedy of the commons of space, states will try to maximize their relative gains vis-à-vis other spacefaring nations. In the minds of policymakers, the security dilemma presented in space only ends when security is ensured—through the absolute supremacy of capability and impenetrable defense. Thus, so long as the tragedy of the commons remains a tragedy—in other words, without the regulation, iteration, and reciprocity needed to reassure actors—the United States and China both possess an incentive to continue matching each other’s capabilities, fueling a space arms race and negatively impacting security.

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<sup>104</sup> Jaganath Sankaran, “China’s Deceptively Weak Anti-Satellite Capabilities,” *Diplomat*, November 13, 2014, <https://thediplomat.com/2014/11/chinas-deceptively-weak-anti-satellite-capabilities/>

<sup>105</sup> U.S. Department of Defense 2022.

<sup>106</sup> *Ibid.*

<sup>107</sup> Harrison 2021.

<sup>108</sup> Bryan Bender, “‘We’re falling behind’: 2022 seen as a pivotal lap in the space race with China,” *Politico*, December 31, 2021, <https://www.politico.com/news/2021/12/31/2022-space-race-china-us-526271>

It is worth noting, however, that there exists potential (albeit limited) for arms control regulation. In 2002, Russia and China introduced a working paper in the United Nations aimed at “preventing the deployment of weapons in space.”<sup>109</sup> In 2008, building upon their working paper, Russia and China introduced a joint treaty called the “Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects” (PPWT).<sup>110</sup> The PPWT would ban the deployment of weapons in space but would allow for ground-based weapons that can target satellites.<sup>111</sup> The United States, however, doubted how enforcement would work given the ambiguity of space weapons. Thus, due to the lack of enforcement mechanisms for preventing potential weapons from being deployed in space and the failure to ban kinetic ASAT weapons, the U.S. has opposed the PPWT.<sup>112</sup> The U.S. stands in the minority on this issue, however. In 2014, 125 countries voted for the treaty, whereas only four countries voted against it (the United States being one of them).<sup>113</sup> To its credit, the United States announced in 2020 a moratorium on direct-ascent kinetic ASAT weapons.<sup>114</sup> While certainly a sign of progress, much has changed since the 2020 announcement. Russia’s invasion of Ukraine has jeopardized any future arms control agreements—observers are more focused on preventing a nuclear war on Earth than limiting the potential future deployment of space weapons or the usage of counterspace weapons.

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<sup>109</sup> Max Bergmann and Andrew Lohsen, “Understanding the Broader Transatlantic Security Implications of Greater Sino-Russian Military Alignment,” *Center for Strategic and International Studies*, December 2022.

<sup>110</sup> *Ibid.*

<sup>111</sup> *Ibid.*

<sup>112</sup> *Ibid.*

<sup>113</sup> *Ibid.*

<sup>114</sup> Ankit Panda and Benjamin Silverstein, “The U.S. Moratorium on Anti-Satellite Missile Tests Is a Welcome Shift in Space Policy,” *Carnegie Endowment for International Peace*, April 20, 2020, <https://carnegieendowment.org/2022/04/20/u.s.-moratorium-on-anti-satellite-missile-tests-is-welcome-shift-in-space-policy-pub-86943>



The presence of non-state actors in space further complicates the tragedy of the commons—although commercial entities pursue space technology for the profit it can provide, they too can have impacts on global security. Even the regulation of arms in space, if possible, would not reduce the ability of these commercial actors to profoundly shape geopolitical dynamics from outer space. Their impact on security can then create the pretexts for further conflict. For example, SpaceX’s Starlink satellites have provided internet access to Ukraine following the Russian invasion of the country earlier this year.<sup>115</sup> In addition to keeping civilians online, Starlink has played a crucial role in guiding Ukrainian drone strikes targeting Russian tanks,<sup>116</sup> tracking Russian military movements, collecting evidence of war crimes, and identifying humanitarian corridors.<sup>117</sup> In response to SpaceX’s actions, a senior Russian defense official threatened that dual-use civilian satellites may become legitimate military targets.<sup>118</sup>

A kinetic attack on those satellites, while yet to occur, would add to with Russia’s history of targeting civilian space assets. In November 2021, Russia was suspected of jamming satellites that documented its troop buildup on the Ukrainian border.<sup>119</sup> Moreover, before it launched its invasion in February of 2022, Russia launched one of the largest cyberattacks ever against Viasat—a U.S. satellite comms provider—to disrupt the Ukrainian military’s communications.<sup>120</sup> Russia has even attempted to hack and jam SpaceX’s satellites, and recent military leaks suggest that they are currently attempting to develop more effective means of disabling some of

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<sup>115</sup> Fred Schwaller, “Starlink is crucial to Ukraine — here's why,” *Deutsche Welle*, October 14, 2022, <https://www.dw.com/en/starlink-is-crucial-to-ukrainian-defense-heres-how-it-works/a-63443808>

<sup>116</sup> *Ibid.*

<sup>117</sup> Kari A. Bingen, et al., “Russia threatens to target commercial satellites,” *Center for Strategic and International Studies*, November 10, 2022, <https://www.csis.org/analysis/russia-threatens-target-commercial-satellites>

<sup>118</sup> *Ibid.*

<sup>119</sup> *Ibid.*

<sup>120</sup> *Ibid.*

SpaceX's capabilities.<sup>121</sup> What is not clear, however, is whether the United States would treat a more damaging Russian attack against SpaceX's satellites as merely in line with previous actions, or as constituting a step-change escalation that mandates a response. The ambiguity is far more dangerous than it is tactical and marks a defining feature of a militarized tragedy of the commons—perpetual uncertainty that invites catastrophe. The possibility that conflicts over resources and assets in outer space could become the pretext for escalation on Earth is not only sobering, but it also represents a clear negative impact of the tragedy of the commons on global security.

An analysis of the security situation in outer space—coupled with the failure of states to agree on any sort of space arms control—seems to confirm the view of the current state of outer space as a tragedy of the commons and the hypothesis that such a situation is bound to have a negative impact on global and extraterrestrial security. From a scholarly perspective, the principal challenge that decision-makers face is clear. From the corridors of the White House and Zhongnanhai to the boardrooms of SpaceX and its competitors, relevant actors must balance their individual interest with mankind's interest in the preservation of outer space for scientific and regulated commercial purposes. With perhaps the sole exception of the OST and the related conventions, the latter interest has been severely overlooked since outer space first became a domain of competition. The commons have been neglected—Hardin's prophecy predicts that it is only a matter of time before they are effectively exhausted (if, for example, debris interference drastically raises the cost space operations) or, more likely, conflict breaks out over them. Skillful diplomatic maneuvering can likely guide mankind through turmoil such that the worst of the doomsday predictions do not materialize, but the optimization of space will remain elusive

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<sup>121</sup> Alex Horton, "Russia tests secretive weapon to target SpaceX's Starlink in Ukraine," *Washington Post*, April 18, 2023, <https://www.washingtonpost.com/national-security/2023/04/18/discord-leaks-starlink-ukraine/>

and the risk of conflict will remain ever-present until pursuit of interest is balanced against preservation of the commons.

The apparent tension between these two objectives is illustrated by the Artemis Accords—which requires that nations who wish to participate in NASA’s Artemis Program sign on. The Accords represent a refusal of the United States to cede the initiative to Russia and China, and an endorsement of the commercial exploitation of outer space by U.S. companies. Nevertheless, the Accords alienated other spacefaring actors that view them as a guise to assert U.S. hegemony over the outer space domain. The Accords thus limited the ability of the United States to engage in cooperation and jeopardized much of the moral legitimacy the U.S. previously could claim to lead international efforts aimed at new regulation.

The wisdom and work of Ostrom demonstrates, however, that national interest and the preservation of the commons need not be at odds. The tragedy of the commons stems from the situation in which an individual’s marginal benefit of increasing presence in the commons is not outweighed by the fraction of the collective cost borne by the individual—a situation that can be eliminated through regulation and iteration. Moreover, there are actually powerful economic incentives toward developing regulatory frameworks such as an internationally agreed upon scheme of property rights in outer space. For example—in the status quo—without an international legal framework governing resource extraction in space, companies are hesitant to invest the sufficient funds for high risk-high reward endeavors like mining.<sup>122</sup> It is all too easy for policymakers to pursue a narrow-minded view of immediate national interest—one that can be satiated by simply pursuing demonstrable dominance in outer space. What this strategy

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<sup>122</sup> Coffey 2009.

achieves in simplicity, however, it lacks in pragmatism and long-term effectiveness. A viable strategy, as is outlined in the next section, must combine security and statecraft.

## V. Policy Recommendations

The United States—as the historical leader in space capabilities and arguably possessing the most developed scientific, commercial, and militaristic space programs—is in a unique position to impact global discourse and policy vis-à-vis outer space. The Artemis Program and Accords represent a strong commitment on behalf of the United States to align itself once more toward the stars. With their significant stake in the preservation of the outer space commons, the United States would also serve as the perfect test case for a balancing strategy that considers both national interest and the commons. Moreover, I am admittedly more acquainted with its policymaking process than that of any other state. As such, the following recommendations will be limited to U.S. policy.

1. **The United States should pursue a binding international ban on direct-ascent kinetic ASAT weapons, negotiated through the United Nations.** The United Nations General Assembly recently passed such a ban with over 155 countries in favor and only nine against.<sup>123</sup> However, Russia and China were part of the nine, and since any binding version of the resolution would have to go through the Security Council, the ban is effectively toothless.<sup>124</sup> The United States should call the bluff of Russia and China as it pertains to the PPWT and concede to not placing weapons in outer space in order to force concessions on direct-ascent ASAT weapons tests. This effort should be led by the U.S. Ambassador to the

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<sup>123</sup> Jeff Foust, “United Nations General Assembly approves ASAT test ban resolution,” *Space News*, December 13, 2022, <https://spacenews.com/united-nations-general-assembly-approves-asat-test-ban-resolution/>

<sup>124</sup> *Ibid.*

United Nations and assisted by the State Department. The Ambassador should leverage the recent General Assembly vote to put pressure on Russia and China to reach a compromise.

**2. The United States should strengthen its deterrence against counterspace attacks.**

Deterring attacks in space is far preferable to retaliating after attacks in space. Thus, U.S. deterrence must be strong, clear, and credible, yet it is currently inadequate in three ways. First, the United States does not possess sufficiently advanced attribution technology, necessary to being able to credibly promise retaliation following an attack. Second, if and how the United States will respond following an attack on U.S. space systems is unclear. In this case, ambiguity invites disaster. Because the deployment of tripwire forces in space is hard to imagine, the United States does not possess the adequate incentives to respond strongly to an attack on U.S. space systems, weakening deterrence. Third, even after NATO rewrote Article V to include space,<sup>125</sup> the extent of our general deterrence is unclear. For U.S. deterrence to be effective, it must be clear to the world who falls within our security umbrella as it pertains to space.

The U.S. Congress should debate and pass HR 3713, the Space Infrastructure Act, to authorize the Department of Homeland Security to designate all U.S. space systems as critical infrastructure. The Executive Branch should then follow-up by drawing a red line on the attack of any critical infrastructure. Furthermore, the U.S. Ambassador to NATO, working in conjunction with the State Department, should pursue a mutual defensive pact with allies for the protection of satellites through extended deterrence. The United States should also create the necessary legal framework to pursue public-private partnerships

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<sup>125</sup> Lorne Cook, "NATO says attack in space could trigger mutual defense clause," *Defense News*, July 14, 2021, <https://www.defensenews.com/smr/nato-priorities/2021/06/14/nato-says-attack-in-space-could-trigger-mutual-defense-clause/>

between leading cyber firms and government agencies, principally the Cybersecurity and Infrastructure Security Agency (CISA) and the Defense Threat Reduction Agency (DTRA), to enhance attribution technology for non-kinetic physical, cyber, and electronic ASAT attacks. Attribution and deterrence should be combined with an effort to work with commercial partners to pursue “tactically responsive space,” which allows for the rapid repair or replacement of damaged satellites following an attack.<sup>126</sup> It may be the case that the United States has developed more advanced attribution technology than is publicly known, but if that is the case, they must balance the necessary secrecy with broadcasting the necessary strength to shape adversary perceptions in favorable ways.

Finally, the United States can bolster its national security through space policy by investing more heavily in emerging space defense technologies. A 2021 Strategy Paper from the Scowcroft Center for Strategy and Security at the Atlantic Council notes that “both direct-ascent and co-orbital ASAT weapons rely on terminal guidance” that can be defended against by using advanced electromagnetic weapons.<sup>127</sup> The Pentagon should allocate more funds toward the development of defensive electromagnetic weapons under the auspices of the Defense Advanced Research Projects Agency (DARPA) and the Defense Innovation Unit (DIU).

- 3. The United States should negotiate the international recognition of property rights in outer space.** The world is already moving in this direction after the Artemis Accords, and the now broadly accepted interpretation of the OST is that “nations, companies, and individuals may not own real estate on celestial bodies, but may have property rights to resources they

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<sup>126</sup> Sandra Erwin, “U.S. Space Command supports use of ‘responsive launch’ to deter China and Russia,” *Space News*, November 29, 2022, <https://spacenews.com/u-s-space-command-supports-use-of-responsive-launch-to-deter-china-and-russia/>

<sup>127</sup> Starling, et al., 2021.

derive from the moon or other celestial bodies.”<sup>128</sup> Solidifying this interpretation on a global stage will remove harmful ambiguity surrounding the OST and clearly delineate property rights so that commercial entities are willing to invest the necessary capital to begin the sustainable exploitation of outer space resources.<sup>129</sup> This effort should be conducted by the State Department and delegates to the United Nations, and negotiations should occur under the auspices of the UN Office for Outer Space Affairs.

**4. The United States Department of Education should explore potential partnerships with schools and universities around the country to promote STEM careers related to space.**

As Bruce Cahan of Stanford University and Mir Sadat note, “NASA’s Artemis program will require an additional 10,000 STEM graduates over the next five years for its civil space needs alone.”<sup>130</sup> China is outpacing the United States in STEM graduates and PHDs, and if the U.S. does not satisfy human capital needs, it will find itself struggling to stay innovative. The government agencies and entities that work on outer space affairs, such as Space Force and NASA, should work to develop new ways to identify and attract talent in the field as well as offer incentives that can compete with the private sector.

**5. The United States should finance and lead an international effort to revive and expand the Inter-Agency Space Debris Coordination Committee (IADC) to engender oversight over debris creation, debris cleanup, and facilitation of Rendezvous and Proximity Operations (RPOs).** The IADC should also work in conjunction with private companies to engage in technology sharing for debris cleanup. The IADC can serve as oversight while companies do the heavy lifting of debris cleanup. The IRS and the counterpart agencies in

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<sup>128</sup> Coffey 2009.

<sup>129</sup> Ibid.

<sup>130</sup> Bruce Cahan and Mir Sadat, “Space Policies for the New Space Age: Competing on the Final Economic Frontier,” *NewSpace*, January 6, 2021, <https://www.politico.com/f/?id=00000177-9349-d713-a777-d7cfce4b0000>

other countries can offer tax credits and incentives to companies who work with the IADC in order to incentive private sector buy-in.

These proposed recommendations represent a nuanced approach to security, superiority, and multilateralism. They defend U.S. national security while taking care not to excessively antagonize Russia and China. The proposed security measures mainly concern deterrence, weapon tests bans, and defensive measures, rather than any act that could directly threaten Russia or China. Furthermore, by engaging in multilateral diplomacy and bodies such as the IADC, which Russia and China are a part of, the United States shows that it is willing to include all nations in conversations about the sustainable use of outer space. The proposed strategy recognizes the importance of U.S. commercial interests, and the powerful role of economics in shaping geopolitics. It outlines multiple mechanisms by which U.S. companies can enter space in a secure environment and profit from the immense minerals and resources. Due to the multifaceted nature of the challenges that the United States now faces in regard to outer space, an effective foreign policy toward the final frontier must also be supported by U.S. allies, Congress, and the relevant commercial entities. Hence, an importance element of this strategy is its simultaneously bold yet politically moderate nature that can garner bipartisan domestic support in the United States as well as consensus among U.S. allies, who will be pleased with U.S. efforts to create extended deterrence.

## **VI. Concluding Thoughts**

Prior to the Iraq War, U.S. Air Force Major General Franklin J. Blaisdell, director of space operations and integration, stated, “We are so dominant in space that I pity a country that



would come up against us.”<sup>131</sup> Such days, however, are gone and unlikely to return soon. United States policy, and international law, need to update accordingly. Hence, policymakers and diplomats must adopt a mindset of adaptation. This paper intends to encourage that mindset by viewing outer space through the lens of a commons. This paper hopes to serve as reminder of the spirit and letter of the OST, which cements the use outer space as the “province of all mankind.” With the identification of outer space as a commons comes challenges, however. Currently, I argue that the increasingly commercialization and militarization of outer space constitutes a classic tragedy of the commons, in which the interests of states and commercial entities are trumping the interests of mankind. States and private entities are jockeying for the position to best exploit space resources, often with little to no consideration of the impacts on other actors. More concerning, the increasing development of counterspace capabilities and the linkages between space assets and terrestrial conflicts jeopardize an already-fragile security environment. The arms race that is breaking out among states—combined with the potential for space assets to be used as pretexts and the potential for weapons to start or escalate terrestrial conflicts—pose grave risks to international security. To navigate this challenging environment, actors must adopt a policymaking approach that balances national or commercial interest with the pursuit of sustainable common-pool resource management in outer space. Specifically, the United States should adopt the recommendations outlined in Section VI.

This paper does not, however, offer specific policy recommendations for other countries. It also suffers, in part, from limited information—much of the information surrounding the true capabilities of states and their outer space strategies is no doubt shrouded in secrecy. Outer space is also an incredibly complex topic area, and this paper was ambitious in the quantity of

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<sup>131</sup> Robert L. Paarlberg, “Knowledge as Power: Science, Military Dominance, and U.S. Security,” *International Security* 29, no. 1 (Summer, 2004): 122-151

subtopics it tried to touch on—any one of these subtopics could merit its own article or book, and thus further research and analysis should explore these subtopics more in-depth. Specifically, opportunities for global cooperation as it pertains to post-ISS scientific exploration and future arms control efforts should be explored in much more detail. If such opportunities are identified, framed properly to the right stakeholders, and then pursued, the tragedy of the commons might be averted.

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