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Space Mining

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SPACE MINING: RESTRICTED BY NON-APPROPRIATION; SET FREE BY PRINCIPLES OF PROPERTY

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ABSTRACT

The Outer Space Treaty, the leading source of law for activities in space, has laid out various limitations and regulations regarding actions in space and how space can be used. One of these limitations is commonly referred to as the "non-appropriation principle." The non-appropriation principle prohibits nations from making claims of sovereignty over celestial bodies in space. This presents a problem as the space industry continues to progress because it causes uncertainty regarding the meaning of appropriation, what is classified as a celestial body, what acts are allowed, and who specifically is prohibited from acting. This Comment identifies these problems and their potential solutions, specifically with the proposition of space mining in mind.

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I. INTRODUCTION

Space mining is more relevant now than ever before. The National Aeronautics and Space Administration (NASA) has been working steadily on the Artemis Project, which aims to have a long-term human presence on the Moon, to use as a jumping off point for getting to Mars.[1] NASA is currently in Phase D of Psyche, a mission to a metallic asteroid with the same name.[2] Psyche, the asteroid, is thought to be the remnants of a failed planet and scientists hope to learn more about the metals involved and the process of planet formation.[3] And last year, NASA contributed substantial funds to a program known as Project Olympus to develop technology to establish outposts on the Moon and Mars using lunar and Martian resources as building materials.[4] All projects present the need for space resources and the extraction thereof for sustainability and continued development.

In Episode 19 of the *Faster, Please!* podcast, host Jim Pethokoukis[5] talks to space resources expert Kevin Cannon about the economic and engineering challenges of mining the Moon, Mars, and asteroids across the solar system.[6] They discuss the future of civilization in space, an evolution of space exploration dependent

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1 *Artemis*, NASA, https://www.nasa.gov/specials/artemis/ [https://perma.cc/B9TR-MHLP].

2 *NASA's Psyche Mission Moves Forward, Passing Key Milestone*, NASA (Feb. 2, 2021), https://science.nasa.gov/mission/psyche/ [https://perma.cc/96TH-447N].

3 Psyche, NASA, https://www.nasa.gov/psyche [https://perma.cc/NET7-7QLD]; *see also Psyche Mission Timeline*, ARIZ. ST. U., https://psyche.asu.edu/ [https://perma.cc/K24V-VFDR]; *SwRI Scientists Use Webb, SOFIA Telescopes to Observe Metallic Asteroid*, SW. RSCH. INST. (Oct. 2, 2023), https://www.swri.org/press-release/swri-scientists-use-webb-sofia-telescopes-observe-metallic-asteroid [https://perma.cc/E9CG-DYY6].

4 *Project Olympus: Hello Moon*, ICON, https://www.iconbuild.com/off-world-construction [https://perma.cc/7H7E-X5EE].

5 James Pethokoukis is a fellow at the American Enterprise Institute and an official CNBC contributor. Kevin is a professor of space resources and geology and geological engineering at the Colorado School of Mines in Golden, Colorado. He is also the author of the *Planetary Intelligence* newsletter on *Substack*.

6 *Scholars: James Pethokoukis*, AEI https://www.aei.org/profile/james-pethokoukis/ [https://perma.cc/8BMC-5ZPT].

on raw materials, which is only economically feasible if we get the raw material from space itself.[7] An estimated $700 quintillion ($700,000,000,000 billion) worth of mineral wealth lies in the asteroid belt and is just waiting to be mined and put to use.[8] Resources like platinum, an increasingly rare metal on Earth, and water, which can be used as rocket fuel when separated into its elements (hydrogen and oxygen),[9] would be key to helping us go farther for cheaper.[10] Though Episode 19 of the podcast was published just earlier this year, the concept of space mining has been around for much longer, dating back to 1898 in science fiction[11] and to the 1970s, when NASA commissioned research on the idea of a space-based economy to supply the demand for a space civilization.[12]

Current ideas of space mining, as implied in the *Faster, Please!* podcast and mentioned in Weinzierl and Sarang's article, orbit around the idea of a space-to-space economy.[13] Being able to get resources from space while we are there is substantially more feasible economically than the alternative.[14] Propositions for the business of space mining emphasize its essential role in bringing

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7 James Pethokoukis, #19, *Faster, Please!*, SUBSTACK (Jan. 26, 2023), https://fasterplease.substack.com/p/faster-please-the-podcast-19 [https://perma.cc/65JV-9BTR].

8 Ezzy Pearson, *Space Mining: The New Goldrush*, BBC SCI. FOCUS MAG. (Dec. 11, 2018, 12:00 PM), https://www.sciencefocus.com/space/space-mining-the-new-goldrush/ [https://perma.cc/6XNP-N3SH].

9 *Id.* ("'[Y]ou can take the water molecule and split that into hydrogen and oxygen, which is rocket fuel,' says Chris Lewicki CEO of Planetary Resources."). The article also acknowledges the possibility of mining iron, nickel from near-Earth asteroids, every other metal we need for space from the asteroid belt, and even helium-3 from Jupiter for use in fusion technology.

10 *Id.*

11 Matt Novak, *Asteroid Mining's Peculiar Past*, BBC (Nov. 18, 2014, 3:12 PM), https://www.bbc.com/future/article/20130129-asteroid-minings-peculiar-past [https://perma.cc/7Z2D-4RYZ] (quoting Garret Serviss' 1898 story, *Edison's Conquest of Mars*, and listing it as the first-time space mining was mentioned in science fiction).

12 Matthew Weinzierl & Mehak Sarang, *The Commercial Space Age is Here*, HARV. BUS. REV., Feb. 12, 2021, https://hbr.org/2021/02/the-commercial-space-age-is-here [https://perma.cc/H2Y7-WR8K] (stating "As far back as the 1970s, research commissioned by NASA predicted the rise of a space-based economy that would supply the demands of hundreds, thousands, even millions of humans living in space, dwarfing the space-for-Earth economy (and, eventually, the entire terrestrial economy as well).") (citing a NASA Contractor Report from 1977 entitled *Long-Term Prospects for Developments in Space: A Scenario Approach*).

13 *Id.* ("[G]oods and services produced in space for use in space[.]"); James Pethokoukis, #19, *Faster, Please!*, SUBSTACK (Jan. 26, 2023), https://fasterplease.substack.com/p/faster-please-the-podcast-19 [https://perma.cc/65JV-9BTR].

14 James Pethokoukis, #19, *Faster, Please!*, SUBSTACK (Jan. 26, 2023), https://fasterplease.substack.com/p/faster-please-the-podcast-19 [https://perma.cc/65JV-9BTR].

the costs of space exploration down and thereby advancing the space industry, space economy, and future missions.[15] Though we have not met all our futuristic space goals, for instance, a Russian company intended to have an orbiting hotel by 2016,[16] we have made great strides and have continued to keep our eyes towards the stars.

In 2015, CNN Business posted an article describing the "gargantuan" task of traveling to Mars and explored the means of making it an easier feat.[17] "Six months each way" and "140 million miles" to cover would be extremely costly and require a monstrous payload if crews had to bring everything they would need with them.[18] To be more precise, "approximately 15,000 pounds (7 metric tons) of rocket fuel and 25,000 pounds (25 metric tons) of oxygen would be required to remove four astronauts from the Martian surface."[19] The Indian Mars Orbiter (the *Mangalyaan*) spacecraft weighs 3,000 pounds (a mass of 1,350 kg)[20] and is equipped with two tanks for a maximum capacity of carrying a little over 3,700 pounds of propellant.[21] One solution to replace costly logistics is asteroid mining. This idea is mentioned in a brief overview by CNN's Brandon Griggs.[22] Griggs's article points out the resources contained in the multitude of asteroids hurtling through space and their utility in creating fuel for rockets on the journey into deep space.[23] The article also touches on a

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15 George F. Sowers, *The Business Case for Lunar Ice Melting*, 9 NEW SPACE (ISSUE 2) 77, 79 (2021) ("If a viable business can be made to produce propellant from lunar ice, the availability of space-sourced propellant will dramatically lower the costs of all space activities beyond low Earth orbit (LEO). This will lower barriers of entry for every other potential space business, enabling the creation of a vibrant space economy.").

16 Andrew Tingkang, *These Aren't the Asteroids you are Looking for: Classifying Asteroids in Space as Chattels, Not Land*, 35 SEATTLE U. L. REV. 559, 572-73 (2012) ("A Russian company called Orbital Technologies recently stated that it intends to have an orbiting hotel in operation by 2016, racing to beat competitors to the punch.").

17 Brandon Griggs, *How Asteroids can Help us Reach Mars*, CNN BUS. (Oct. 19, 2015, 8:57 AM), https://www.cnn.com/2015/10/06/tech/asteroid-mining-nasa-mars-pioneers/index.html [https://perma.cc/RK89-UA6V].

18 *Id.*

19 Erickson, *How much Fuel does Nasa Need to Get to Mars?*, ECLIPSE AVIATION (Mar. 1, 2022), https://www.eclipseaviation.com/how-much-fuel-does-nasa-need-to-get-to-mars/ [https://perma.cc/Z2FA-TSQ9].

20 Venkatesan Prasad Sundararajan, Mangalyaan – Overview and Technical Architecture of India's First Interplanetary Mission to Mars (Sept. 10-12, 2013) (conference paper) (on file with the AIAA Space 2013 Conference and Exposition).

21 *Id. See also* Erickson, *supra* note 19, for a brief mention.

22 Griggs, *supra* note 17.

23 *Id.*

major area of uncertainty: the law.[24] As mentioned in the beginning of this article, there are various ongoing missions and projects that would rely heavily on being able to extract resources in space.[25] The legality of space mining is a question many experts have been asking since early propositions of mining in space, and now that extraction missions are just around the corner (in terms of the relative time it has taken the industry to get here) the legality of the ordeal is more important than ever.

In this Comment, I will outline the current legal framework and applicable documents, explain the nonissue of non-appropriation, and offer my thoughts on a path forward. Any plan for the development of, or attempt to begin, space mining missions will require strategic moves and deliberate planning in consideration of international obligations, domestic requirements, and the legal boundaries companies will have to work within. Part I introduces the subject matter and exhibits the novelty and application of the problems and solutions presented herein. Part II outlines the existing law in the area and notes the relevance and interconnectedness of each document while pointing out the questions that arise. Part III applies the leading law and presents possible solutions to central issues. Part IV answers questions raised throughout the Comment and Part V concludes with final remarks on next steps and moves for advancement.

II. THE LEGAL FRAMEWORK: INTERNATIONAL LAW AND DOMESTIC POLICY

The legal framework for space activities stems mostly from international law in the form of international treaties. These treaties are supported by executive orders and other legislation that clarify the intentions and domestic policy goals of the various spacefaring nations. Most important to our discussion are the Outer Space Treaty, The Moon Treaty, Executive Order 13914, and the SPACE Act.

A. The Outer Space Treaty

Most notably, in October of 1967, the United States and various other nations, including Great Britain and the Soviet Union, enacted the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon

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[24] *Id.*
[25] *Id.*

and Other Celestial Bodies (the "Outer Space Treaty").[26] The Outer Space Treaty is a multilateral international treaty written to establish common ground among nations engaging in space-related activities, to protect and delineate space as the "common interest of all mankind," and to promote the "use of outer space for peaceful purposes."[27] At its conception, eighty-five countries signed on, including the United States, in conjunction with both allies and adversaries.[28] At the time the Outer Space Treaty was written, it was focused on the prevention of weapons of mass destruction in space stemming from fears after the Cold War and the hostile climate of the Space Race between the United States and the Soviet Union.[29] Additionally, it is based *very loosely* on the 1959 Antarctic Treaty, which prohibits "any measures of a military nature."[30] The utilization of space resources was not considered feasible in the 1960s, so it is not mentioned.[31]

The Outer Space Treaty declares first and foremost that "[t]he exploration and use of outer space . . . shall be carried out for the benefit and in the interests of all countries . . . and shall be the province of all mankind."[32] This "province of all mankind" language is often interpreted under the same meaning as the "common heritage of mankind," though scholars will point out that they are distinct.[33] Regardless, both fall under the influence of

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[26] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[27] *Id.* at 206.

[28] *Id.* at 243-95. In addition to the U.S., allies like the United Kingdom, Mexico, Italy, Canada, Turkey, Israel, and France are State Party signatories. Additionally, adversaries, or countries we have had tense relationships with, like Russia, China, Afghanistan, Iraq, and Pakistan, are also State Parties to the Outer Space Treaty.

[29] Tingkang, *supra* note 16, at 570 ("The United States and the Soviet Union were particularly worried about the potential for weapons of mass destruction to be stationed in space or installed on celestial bodies. After each nation agreed on the scope of the potential treaty, and agreed to address the issue of nuclear weapons in outer space separately from other issues of disarmament, the General Assembly of the United Nations passed a unanimous resolution calling for a ban on the use of weapons of mass destruction in outer space. As a result, the United States and Soviet Union came to a satisfactory treaty by the end of 1966. The Outer Space Treaty, ratified and entered into force in 1967, remains the governing authority in outer space." (footnote omitted)).

[30] Antarctic Treaty art. 1, Dec. 1, 1959, 12 U.S.T. 794, 402 U.N.T.S 71 [hereinafter Antarctic Treaty].

[31] Martin Svec, *Outer Space, an Area Recognized as Res Communis Omnium: Limits of National Space Mining Law*, 60 SPACE POLICY at 1, 1.

[32] Outer Space Treaty, *supra* note 26, at 201-08.

[33] David Tan, *Towards a New Regime for the Protection of Outer Space as the Province of All Mankind*, 25 YALE J. INT'L L. 145, 162 (2000) (noting pointedly that "the

the doctrine of *res communis omnium* (discussed later). The Outer Space Treaty promotes free exploration without discrimination, free access to all celestial bodies, and international cooperation.[34]

One major pillar of legal discussion pertaining to space mining is the non-appropriation principle. Established in Article II of the Outer Space Treaty, the non-appropriation principle states in its entirety that "[o]uter space, including the [M]oon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[35] Not to worry, as this article will argue and as others have agreed: "[T]he exploitation of spatial resources is an inalienable sovereign right of every state not impaired by the non-appropriation principle."[36] In Article III, the signatory nations agree to "carry on activities in the exploration and use of outer space . . . in the interest of maintaining international peace and security and promoting international co-operation and understanding."[37] Signatories agree to refrain from establishing military bases, installations and fortifications, testing weapons, and conducting military maneuvers on celestial bodies,[38] to treat all astronauts as "envoys of mankind,"[39] and to assist, rescue, and return them to their states as necessary.[40] Parties bear responsibility for their own actions in space and retain jurisdiction over objects registered by the state and launched into space.[41] Additionally, any stations, installations, equipment, or vehicles on any celestial bodies shall be open to representatives of other state parties.[42] This is an interesting addition given the previously mentioned non-appropriation principle because, under traditional property law, you cannot establish anything in an area that is not yours. Thus, presumably, the Outer Space Treaty intended to allow structures to be built, equipment to be placed, and vehicles to roam on celestial bodies. What for? Perhaps for space resource extraction by private companies.

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concept of the 'province of all mankind' is not to be equated or confused with the notion of the 'common heritage of mankind.'").

34 Outer Space Treaty, *supra* note 26, at 207-08.

35 *Id.*

36 Zachos A. Paliouras, *The Non-Appropriation Principle: The Grundnorm of International Space Law*, 27 LEIDEN J. INT'L L. 37, 48 (2014).

37 Outer Space Treaty, *supra* note 26, at 208.

38 *Id.*

39 *Id.*

40 *Id.*

41 *Id.* at 209.

42 *Id.* at 211.

In Article VI, the Outer Space Treaty establishes that parties will "bear international responsibility for national activities in outer space" and that "activities of non-governmental entities in outer space, including the [M]oon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party."[43] Some argue that this section can serve as a "juridical link to bind non-state actors,"[44] but under a strict reading, and in short summation, the nation cannot claim sovereignty over or appropriate celestial bodies, and if a private company does so *and something goes wrong*, then the nation will be responsible. It does not directly impose the same prohibitions, and such prohibitions should not be read in. This concept of liability is addressed again in the Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention"),[45] enacted in 1973. The Liability Convention prescribes liability on the launching state for damage caused by its space object on the surface of the Earth onto aircraft in flight.[46] Damage caused elsewhere will only place liability upon the launching state if such damage is caused due to the fault of the state or a person for whom the state is responsible.[47] This is really only important to our conversation to the extent that when private companies are conducting space mining missions, the nation is on the hook for the actions and damages caused by the private company. Article VIII of the Outer Space Treaty states the following:

> Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return.[48]

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[43] Outer Space Treaty, *supra* note 26, at 209.

[44] Jonathan Sydney Koch, *Institutional Framework for the Province of all Mankind: Lessons from the International Seabed Authority for the Governance of Commercial Space Mining*, 16 ASTROPOLITICS INT'L J. SPACE AND POL., 1, 4 (2018).

[45] The Convention on International Liability for Damage Caused by Space Objects art. 2, Oct. 9, 1973, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

[46] *Id.* ("A launching state shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth or to aircraft in flight.").

[47] *Id.* at 190.

[48] Outer Space Treaty, *supra* note 26, at 209.

This is another area subsequently solidified by legislation. The Convention on Registration of Objects Launched into Outer Space (Registration Convention) was entered into force nine years after the Outer Space Treaty on September 15, 1976.[49] The Registration Convention is a multilateral agreement that seeks to make a provision for the national registration of objects launched into space. It requires the launching state to register space objects in the appropriate registry and permits the state to determine the contents required and the conditions under which the registry shall be maintained.[50] This prompts the question: If a spacecraft carrying resources mined from space crashes into another territory, does the mined material still belong to the nation that registered the spacecraft carrying the resource even though they have not registered the resources and cannot, under the Outer Space Treaty, lay a claim of sovereignty to outer space, including the Moon and other celestial bodies?

Article IX of the Outer Space Treaty requires all State Parties to conduct their activities "so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter."[51] Harmful contamination usually refers to biological contamination.[52] Thus, we would need to be cautious if the plan is to bring back anything biological in nature or any mined material that could affect biology on Earth. However, this is essentially a nonissue if we are mining space resources for use in space. Further, State Parties are prohibited from activities that could cause "potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space" and "shall undertake appropriate international consultations before proceeding with any such activity or experiment."[53] So, do we need international approval to conduct a space mining mission? What constitutes potential harmful contamination or interference? With regard to asteroid mining, what about the argument that

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[49] Convention on the Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

[50] *Id.*

[51] Outer Space Treaty, *supra* note 26, at 209-10.

[52] Glenn Harlan Reynolds & Juliet Leigh Outten, *Pulsed Nuclear Space Propulsion and International Law: Some Preliminary Observations*, 87 J. AIR L. & COM. 445, 472 (2022) (referencing Louis de Gouyon Matignon, *Harmful Contamination, Harmful Interference, and Space Debris*, SPACE LEGAL ISSUES (Oct. 7, 2019), https://www.spacelegalissues.com/harmfulcontamination-harmful-interference-and-space-debris/).

[53] Outer Space Treaty, *supra* note 26, at 209-10.

there are plenty of asteroids to go around and that taking one is not an interference?

If we were to establish a space mining mission, the duty to inform from Article XI[54] and the obligation to allow inspection under Article XII[55] would be problematic from a national security standpoint and an economic protection standpoint because it would empower adversaries to gain insight into any and all operations and equipment. Any camp we set up and the equipment we use would be open to other State Parties. Of course, this is dependent on the classification of asteroids as "celestial bodies," a determination that would also bring Article I into the forefront due to its provision declaring free access to all celestial bodies.[56]

B. The Moon Treaty and Executive Order 13914

In 1979, a number of nations began to sign the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the Moon Treaty).[57] In 1984, it entered into force.[58] The Moon Treaty reaffirms the Outer Space Treaty and goes a step further in ensuring peaceful uses of outer space, making emphatic use of phrases such as "on the basis of equality," "common heritage of mankind," and "for the province of all mankind."[59] Notably, though the terms seem interchangeable, the latter, "common heritage of mankind," carried deeper meaning as it implied a duty to share profits in the Law of the Sea.[60] Because of its detailed descriptions of what is, and more manifestly, what

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54 *Id.* at 210 ("State Parties . . . agree to inform the Secretary General . . . as well as the public and the international scientific community . . . of the nature, conduct, locations, and results of activities in outer space.").

55 *Id.* at 211 ("All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other State Parties to the treaty on the basis of reciprocity.").

56 *Id.* at 207 ("Outer Space, including the Moon and other celestial bodies, shall be free for exploration *and use* by all States. . . and there shall be free access to all areas of celestial bodies.") (emphasis added).

57 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Treaty].

58 *Id.*

59 *Id.* at 22-25 (first stating the parties to the Agreement are "determined to promote on the basis of equality the further development of co-operation among States"; then stating "exploration and use of the [M]oon shall be the province of all mankind"; then stating "there shall be freedom of scientific investigation . . . on the basis of equality"; then stating "the [M]oon and its natural resources are the common heritage of mankind"; and then stating "Parties have the right to exploration and use . . . on the basis of equality[.]").

60 Robert A. Fabian, *Space Economic Development in the Province of all Mankind: If no one goes, We all Lose*, 1 Astropolitics, 89, 91 (2003).

is not allowed, the Moon Treaty "sheds a light on what the Outer Space Treaty did not do—prohibit private ownership."[61] Article 2 sets the tone of cooperation and mutuality, and then Article 3 begins to get into specifically prohibited actions.[62] In relevant part, the Moon Treaty acknowledges the taking of samples in Article 6 and the non-appropriation principle in Article 11.[63] Article 6 allows States Parties the right to collect and remove samples from the Moon, and though the samples "remain at the disposal of those States Parties which caused them to be collected," the Moon Treaty encourages that at least a portion of the samples be made available to the other States Parties.[64] Article 11 Section 1 states that the "[M]oon and its natural resources are the common heritage of mankind."[65] Section 2 explicitly states that "the [M]oon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means."[66] Section 3 leaves no doubt when stating that "[n]either the surface or the subsurface of the [M]oon . . . shall become property of any State, international intergovernmental or nongovernmental organization, national organization, or nongovernmental entity, or any natural person."[67] Additionally, Sections 4 and 5 only provide

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61 Tingkang, *supra* note 16, at 572-73; *see also Reopening the American Frontier: Exploring How the Outer Space Treaty will Impact American Commerce and Settlement in Space*: Hearing Before the Subcomm. on Space, Sci., and Competitiveness, 115 Cong. 1 (2017) (statement of Laura Montgomery, Attorney and Proprietor, Ground Based Space Matters, LLC).

62 Moon Treaty, *supra* note 57, at 22-23 ("All activities . . . shall be carried out . . . in the interest of maintaining international peace and security and promoting international co-operation and mutual understanding, and with due regard to the corresponding interests of other States Parties." Art. 3 "1. The [M]oon shall be used by all States Parties *exclusively* for peaceful purposes. 2. Any threat or use of force or any other hostile act or threat of hostile act on the [M]oon is prohibited. States Parties shall not place in orbit . . . objects carrying nuclear weapons or any other kinds of weapons of mass destruction or use such weapons in or on the Moon. The establishment of *military* bases, installations, and fortifications, the testing of any type of weapons and the conduct of military maneuvers on the [M]oon shall be prohibited.") (emphasis added).

63 *Id.* at 23-25.

64 *Id.* at 24. ("States Parties shall have the right to collect on and remove from the Moon samples of its mineral and other substances. Such samples shall remain at the disposal of those States Parties that caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation.").

65 *Id.* at 25.

66 *Id.*

67 *Id.* ("The placement of personnel, space vehicles, equipment, facilities, stations, and installation on or below the surface of the [M]oon, including structures

for the right to exploration and use of the Moon, subject to the creation of an international regime to govern the exploitation of natural resources.[68] As one author summarized, the Moon Treaty appoints a UN-controlled international organization to determine what resources to pursue and how to distribute them, taking into account the needs of the developing world.[69]

Overall, the Moon Treaty imposes more restrictions on the freedoms of nations to conduct themselves in space and severely stifles efforts of commercial exploitation[70] of resources, which is a major obstacle for future plans of space mining and civilization. However, no space-faring nation[71] has signed on, and some nations are even withdrawing their signatures. Most recently, Saudi Arabia gave their notice of withdrawal on January 5, 2023.[72] Moreover, the United States expressly rejected the Moon Treaty at various Committee on the Peaceful Uses of Outer Space (COPUOS) conventions and continuously reaffirmed the position of the United States as not supporting the Moon Treaty and having no interest in signing it.[73] In line with decades of similar and consistent presidential policy actions, the Trump Administration issued Executive Order 13914 titled "Encouraging International Support for the Recovery and Use of Space Resources"[74] on April 6, 2020. This executive order outlines the intent of the United States to work with international partners to ensure commercial exploration and that the use of space resources is consistent with applicable law.[75]

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connected with its surface or subsurface shall not create a right of ownership over the surface or subsurface of the [M]oon or any area thereof.").

68 *Id.*

69 Fabian, *supra* note 60, at 91.

70 The United States did not originally enter the Treaty because the essence of the Moon Treaty counteracted our domestic policy goals of commercial exploitation. *See* Tingkang, *supra* note 16, at 572.

71 Most importantly, the United States, Russia, and China are not, and have never been signatories. *See* Katharina Buchholz, *The Countries That Signed the Moon Treaty*, STATISTA (Aug. 23, 2023), https://www.statista.com/chart/18738/countries-that-are-signatories-or-parties-to-the-1979-moon treaty [https://perma.cc/DHZ7-J3YW].

72 U.N. Secretary General, Depository Notification dated Jan. 5, 2023, Statement Submitted by the Secretary General, C.N.4.2023.TREATIES-XXIV.2 (Jan. 5, 2023); *see also Saudi Arabia's Moon Ambitions*, SUBSTACK: MIDDLE EAST SPACE MONITOR (Jan. 11, 2023), https://mideastspace.substack.com/p/saudi-arabias-moon-ambitions [https://perma.cc/R2LT-ZDKT].

73 Telephone Interview with Deborah Plunkett, General Counsel, Dep't of Defense (May 4, 2023).

74 Exec. Order No. 13,914, 85 Fed. Reg. 20381 (Apr. 10, 2020).

75 *Id.*

Executive Order 13914 acknowledges the "[u]ncertainty regarding the right to recover and use space resources" and the deterrent effect such uncertainty has had on the commercial industry.[76] It then recognizes the considerations of the Moon Treaty, the lack of the U.S. signature, and attempts to dispel all doubt by stating that "Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with applicable law" and "the United States does not view [outer space] as a global commons."[77] This mention of applicable law likely refers mostly to the Outer Space Treaty because Section 2 of the Executive Order reiterates that the United States is not a party to the Moon Treaty (though the Executive Order refers to it as the Moon Agreement), that the United States does not consider it effective or necessary to guide nations, and also disqualifies the Moon Treaty as an expression of "customary international law."[78] The Executive Order goes on to encourage garnering international support for public and private recovery of resources, provides for general reporting of space activities, and submits to applicable limitations.[79]

C. THE SPACE ACT

Underlying Executive Order 13914 is the U.S. Commercial Space Launch Competitiveness Act[80] (Competitive Space Launch Act) which was enacted five years prior. The Competitive Space Launch Act provides a statutory framework for the government to permit domestic private entities to extract and use resources

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[76] *Id.* ("Uncertainty regarding the right to recover and use space resources, including the extension of the right to commercial recovery and use of lunar resources, however, has discouraged some commercial entities from participating in this enterprise.").

[77] *Id.* ("Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with applicable law. Outer space is a legally and physically unique domain of human activity, and the United States does not view it as a global commons. Accordingly, it shall be the policy of the United States to encourage international support for the public and private recovery and use of resources in outer space consistent with applicable law.").

[78] *Id.* ("The United States is not a party to the Moon Agreement. Further, the United States does not consider the Moon Agreement to be an effective or necessary instrument to guide nation states regarding the promotion of commercial participation in the long-term exploration, scientific discovery, and use of the Moon, Mars, or other celestial bodies. Accordingly, the Secretary of State shall object to any attempt by any other state or international organization to treat the Moon Agreement as reflecting or otherwise expressing customary international law.")

[79] *Id.*

[80] U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, 129 Stat. 704 [hereinafter Competitive Space Launch Act].

in space, and it designates how the U.S. licenses and approves utilization of space resources in line with the Outer Space Treaty.[81] Title 1, entitled "Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015" (SPACE Act), provides indemnification for space flight participants,[82] flexibility in obtaining launch licenses,[83] and recommends "an authorization and supervision approach that would . . . promote the U.S. commercial space sector."[84] Additionally, Congress makes its intent very clear under Section 113 "STREAMLINE COMMERCIAL SPACE LAUNCH ACTIVITIES," stating that it is the "sense of Congress that elimination of duplicative requirements and approvals for commercial launch and reentry options will promote and encourage the development of the commercial space sector."[85] Here, the SPACE Act also affirms the policy to promote commercial space launches and reentries by the private sector, facilitates involvement in enhancing launch sites, and provides consistent application of licensing requirements.[86] Furthering the point of deregulation for the advancement of the space industry, Title III (as relating to the Office of Space Commerce)[87] functions to foster growth and advancement, coordinate policy issues, promote the advancement of geospatial technologies related to space commerce, and provide support to Federal Government Organizations.[88]

Most relevant to our discussion is the Title 51 Amendment entitled "Space Resource Commercial Exploration and Utilization

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81 *Id.*

82 *Id.* at §§ 101-11.

83 *Id.*

84 *Id.* at § 108(a)(3) ("Not later than 120 days after the date of enactment of this Act, the Director of the Office of Science and Technology Policy [shall] recommend an authorization and supervision approach that would prioritize safety, utilize existing authorities, minimize burdens to the industry, promote the U.S. commercial space sector, and meet the United States obligations under international treaties[.]").

85 *Id.* at § 113(a).

86 *Id.* at § 113(b).

87 *Id.* at § 301. (renaming the Office of Space Commercialization).

88 *Id.* at § 302. (providing that the functions of the Office of Space Commerce are: "(1) to foster the conditions for the economic growth and technological advancement of the United States space commerce industry; (2) to coordinate space commerce policy issues and actions with the Department of Commerce; (3) to represent the Department of Commerce in the development of the United States policies and in negotiations with foreign countries to promote United States space commerce; (4) to promote the advancement of United States geospatial technologies related to space commerce, in cooperation with relevant interagency working groups; and (5) to provide support to Federal Government organizations working on Space-Based Positioning Navigation, and Timing Policy").

Act of 2015."[89] Here, the SPACE Act explicitly defines "asteroid resource" as "a space resource found on or within a single asteroid."[90] "Space resource" is defined to mean "an abiotic[91] resource in situ[92] in outer space," including water and minerals.[93] The nature of space resources as abiotic should remove any "contamination" issues since such resources do not present biological threats. The next section goes on to assign duties to the President to:

> (1) facilitate commercial exploration for and commercial recovery of space resources by United States citizens; (2) discourage government barriers to the development in the United States of economically viable safe, and sustainable industries for commercial exploration for and commercial recovery of space resources in manners consistent with the international obligations of the United States; and (3) *promote the right of United States citizens to engage in commercial exploration for and commercial recovery of space resources free from harmful interference, in accordance with the international obligations of the United States and subject to authorization and continuing supervision by the Federal Government.*[94]

This section is instrumental in giving the private sector the green light to go ahead with space exploration and resource extraction missions, as well as acknowledging the commitment in place from the Outer Space Treaty. Section 51303 further solidifies the authorization of space mining by declaring rights to resources.[95] It declares that a U.S. citizen "shall be entitled to any asteroid or space resource obtained, including to possess, own, transport, use, and sell" such resource subject to applicable law and international obligations.[96] The SPACE Act goes so far as to even say that "asteroid resources obtained in outer space are property of the entity that obtained them," and that such entity "shall be entitled to all property rights" to the resources.[97] Though this section could be problematic as contrary to the Outer Space

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89 *Id.* at § 402(a).

90 *Id.* at § 51301(1).

91 *Abiotic*, BLACK'S LAW DICTIONARY (2d Ed. 1910) (defining "abiotic" as: "a non-biological element that has an effect on the ecosystem. The opposite of a naturally occurring environmental element.").

92 *In situ*, MERRIAM-WEBSTER.COM, https://www.merriam-webster.com/dictionary/in%20situ [https://perma.cc/JPQ9-JNHN] (defining "in situ" as: "In the natural or original position or place.").

93 Competitive Space Launch Act, *supra* note 80, at § 51301(2)(A-B).

94 *Id.* at § 51302(a)(1-3) (emphasis added).

95 *Id.* at § 51303.

96 *Id.*

97 Koch, *supra* note 44, at 4 (quoting Competitive Space Launch Act, *supra* note 80, at § 51303(a)).

Treaty's prohibition of claims of sovereignty in space, it is not because the SPACE Act specifically disclaims possession of space resources as a claim of extraterritorial sovereignty and denies exclusive rights or jurisdiction over any celestial body.[98]

The SPACE Act is incredibly important, not only as the enabling statute for the executive order, but more importantly as the enabling statute for regulations. Though executive orders and encouraging legislation are certainly beneficial, the most valuable pushes come in the form of regulatory relief: regulations that prove helpful to the expansion of our footprint in space and support and acknowledge the rights of private companies.[99] Regulations are the government's main controlling instrument, and the Commercial Space Launch Act of 1984 puts the Federal Aviation Administration (FAA) and the Department of Transportation (DOT) on duty to oversee, authorize, and regulate space activities in accordance with public, national, and foreign policy considerations and to do so in a way that encourages commercial space activity.[100] Additionally, the Commercial Space Transportation Regulations[101] set forth, among other items, various guidelines for launch licenses, payload inspections, and safety measures. Such guidelines give organizations assurance in moving forward and provide them with a plan to follow, which helps to promote progress in this area.

III. APPLICATION AND ANALYSIS: DEFINITIONS AND PROPERTY RIGHTS

Within the current legal framework, outer space and space resources are sometimes referred to under the principle of *res communis omnium*, a Latin word from Roman law meaning belonging to everyone.[102] The concept proposes that certain common areas, usually of limited spatial coverage, and their resources are "open

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[98] Competitive Space Launch Act, *supra* note 80, at § 403 ("It is the sense of Congress that by the enactment of this Act, the United States does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of any celestial body.").

[99] Telephone Interview with Deborah Plunkett, General Counsel, Dep't of Defense (May 4, 2023); *see generally* Commercial Space Launch Act of 1984, 51 U.S.C. § 509 [hereinafter Commercial Space Launch Act].

[100] *About the Office of Commercial Space Transportation*, U.S. DEPT. TRANSPORTATION: FAA, https://www.faa.gov/about/office_org/headquarters_offices/ast [https://perma.cc/2U4G-F6JM].

[101] Commercial Space Launch Act, *supra* note 99, at §§ 509905-907.

[102] *Wrapping Our Legal Minds Around the Global Commons: Res Nullius, Res Communis, and Res Divini Juris*, ON THE COMMONS (Feb. 16, 2007),

to inclusive use," that there may be no exclusive uses, and that the values and benefits must be shared.[103] Originally, *res communis* was used to refer to the light and air.[104] It was then interpreted by Western states in conjunction with the "common heritage of mankind" as meaning the "common property of mankind," thus disallowing space mining as it is inconsistent with a "commonness of ownership and benefit."[105] This note on interpretations was addressed in a comment on the Deep Seabed Hard Mineral Resources Act of 1980,[106] which uses similar language ("the common interest of mankind"). In application, the Moon Treaty defines the Moon and its natural resources as the "common heritage of mankind"[107] and thus, due to the generally accepted limited spatial range, only the Moon, its orbits and trajectories—but not the outer space environment generally—would be included.[108] Importantly, the Outer Space Treaty does not use this language, and the Moon Treaty is not ratified by spacefaring nations.[109] But, even if it did, such language would not preclude resource extraction; in fact, various nations have received approval for deep seabed mining.[110] Additionally, both the SPACE Act and the Deep Seabed Hard Mineral Resources Act of 1980 include disclaimers of extraterritorial sovereignty, emphasizing the point that the United States has, for years, viewed a relevant distinction between claims of sovereignty and the use of resources.[111] More congruent

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https://www.onthecommons.org/wrapping-our-legal-minds-around-global-commons-res-nullius-res-communis-and-res-divini-juris [https://perma.cc/7V98-4J8C].

[103] Tan, *supra* note 33, at 162.

[104] ON THE COMMONS, *supra* note 102.

[105] L. F. E. Goldie, *Title and Use (and Usufruct) - An Ancient Distinction Too Oft Forgot*, 79 AM. J. INT'L L. 689, 697-98 (1985) (quoting Pinto, *Statement*, in ALTERNATIVES IN DEEPSEA MINING 13 (S. Allen & J. Craven eds. 1979) ("This [i.e., the common heritage of mankind] means that those minerals cannot be freely mined. They are not there, so to speak, for the taking. The common heritage of mankind is the common property of mankind. The commonness of the 'common heritage' is a commonness of ownership and benefit. The minerals are owned in common by your country and mine, and by all the rest as well. In their original location these resources belong in undivided and divisible share, to your country and to mine, and to all the rest to all mankind, in fact, whether organized as States or not. If you touch the nodules at the bottom of the sea, you touch my property. If you take them away, you take away my property.").

[106] *Id.* at 689.

[107] Moon Treaty, *supra* note 57, at 25.

[108] Tan, *supra* note 33, at 162.

[109] Outer Space Treaty, *supra* note 26, at 13; Moon Treaty, *supra* note 57, at 51-85.

[110] *Exploration Contracts*, INT'L SEABED AUTH., https://www.isa.org.jm/exploration-contracts/ [https://perma.cc/C24X-NRNL].

[111] Simplified, the fact that both documents include disclaimers of claims of sovereignty yet encourage the use of the minerals and resources found within the

with national policies is the interpretation that a "common heritage of mankind" merely indicates a commonness of access.[112] This includes no right of title or ownership but allows one to enjoy and use the area and its resources.[113]

The Outer Space Treaty instead uses the language of the "province of all mankind" in Article I.[114] This could be a positive difference that would allow for easier commercial treatment of space and space resource, but that is up to interpretation because the Outer Space Treaty did not define the phrase.[115] In its parts, "mankind" refers to a collective body[116] and the meaning of province is up to interpretation. Arguments that it means the same as the common heritage language are countered by the fact that the spacefaring countries did not ratify the Moon Treaty.[117] If "province" has the meaning of being a duty or function[118] then the language is broad. This means that although there is an argument that the Outer Space Treaty blocks appropriation of celestial bodies by any means,[119] it is not the result merely of the "province of all mankind" language. Alternatively, space as the province of all mankind could mean that space shall be the duty or function of mankind. Space can be malleable to fit mankind's

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lands in question is prima facie evidence of the recognized distinction between claims of sovereignty and use of resources. Competitive Space Launch Act, *supra* note 80, at § 403; Deep Seabed Hard Mineral Resources Act, Pub. L. No. 96–283, § 1402, 94 Stat. 553, 555-56.

112 Goldie, *supra* note 105, at 698.

113 *Id.*

114 Outer Space Treaty, *supra* note 26, at 13-14.

115 *Id.*

116 Tan, *supra* note 33, at 163 ("[M]ankind as a concept should be distinguished from that of man in general. The former refers to a collective body of people, whereas the latter stands for individuals making up that body. Therefore, the rights of mankind should be distinguished, for instance, from the so-called human rights. Human rights are rights to which individuals are entitled on the basis of their belonging to the human race, whereas the rights of mankind relate to the rights of the collective entity and would not be analogous with the rights of the individuals making up that entity.") (citation omitted).

117 *Id.*

118 *Province*, BALLENTINE'S L. DICTIONARY, (3d ed. 1969).

119 Tingkang, *supra* note 16, at 571 ("The most important provision of the Outer Space Treaty in regards to ownership and property in outer space is the first paragraph of Article I, which states that 'exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries . . . and shall be the province of all mankind.' This is reinforced by language from Article II, which states that '[o]uter space . . . is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.' This language is meant to enforce a peaceful vision for outer space. A more controversial, though plausible, interpretation is that this language blocks appropriation of any celestial bodies for any means.").

needs. Consider: if space can be commercialized so as to increase global wealth, would the acquisition of such wealth be a function of mankind? As one author noted, bringing in new wealth and materials increases the overall global wealth, which increases the amount available for economic development: "[t]he rising tide of space wealth would float all boats, not just those of the spacefaring states."[120]

A. Definitions and Nonissues

Although the Outer Space Treaty prohibits claims of sovereignty by use or occupation, it allows the "exploration and use" of outer space.[121] This creates a need for separating claims of sovereignty, as have already been disclaimed with regard to space mining,[122] from use and distinguishing between use and appropriation.[123] First, some foundational definitions may be helpful to undermine arguments that the current legal framework is unsupportive of resource exploitation. "Appropriation" is defined as "the exercise of control over property, esp[ecially] without permission."[124] On a national scale, this refers to countries designating exclusive land for their own specific uses. "Sovereignty" refers to a state's right to exercise powers within the boundaries of its territory and its "supreme dominion, authority, or rule."[125]

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120 Fabian, *supra* note 60, at 97.

121 Outer Space Treaty, *supra* note 26, at 13-14.

122 Exec. Order No. 13,914, 85 Fed. Reg. 20381, 20382 (Apr. 10, 2020).

123 *Id.*

124 *Appropriation*, Black's Law Dictionary (11th Ed. 2019); *see also Appropriation*, Black's Law Dictionary (2d Ed. 1910) ("The act of appropriating or setting apart; prescribing the destination of a thing; [or] designating the use or application of a fund."); *Appropriation of Land*, Black's Law Dictionary (2d Ed. 1910) ("The act of selecting, devoting, or setting apart land for a particular use or purpose, as where land is appropriated for public buildings, military reservations, or other public uses.) (citations omitted).

125 *Sovereignty*, Black's Law Dictionary (11th Ed. 2019) ("The principle of legal sovereignty is an abstraction from a number of relevant rules: (1) Without its consent, a subject of international law is bound by applicable rules of . . . customary laws and general principles of law recognized by civilized nations. (2) Additional international obligations may be imposed on any subject of international law only with its consent. (3) Unless the territorial jurisdiction of a State is excluded or limited by rules of international law, its exercise is exclusively the concern of the State in question. (4) Subjects of international law may *claim* potential jurisdiction over persons or things outside the territorial jurisdiction. In the absence of permissive rules to the contrary, however, they may actually exercise such jurisdiction in concrete instances only within their territories. (5) Unless authorized by permissive rules to the contrary, intervention by subjects of international law in one another's sphere of exclusive domestic jurisdiction constitutes a breach of international law.") (citation omitted).

Thus, the prohibition of appropriation through claims of sovereignty in the Outer Space Treaty only precludes a *nation* from claiming *control* over land by claiming supreme dominion over it. (Land is presumed because "celestial bodies" is not defined, but we know that at the time of drafting the main concern was preventing the Soviet Union (or the U.S.) from taking the Moon for itself.) Though this may sound narrow at first glance, it is hard to use any land without owning it, especially as a nation, and this caused a great amount of hesitancy among private companies thinking about conducting space missions. Notably, this prohibition does not expressly include private ownership or the use of the land and its resources.[126] This gap in the prohibition is highlighted (1) by the express language in the Moon Treaty trying to add on to the Outer Space Treaty, (2) by Executive Order 13914, which encouraged resources extraction (something it surely would not do if resource extraction were prohibited), and (3) by the International Institute of Space Law stating that in "the absence of a clear prohibition . . . one can conclude that the use of space resources is permitted."[127] Importantly, scholars have noted in this arena that the "international community has never questioned whether scientific samples harvested from celestial bodies belong to the extracting nation."[128] There are even contracts in place supporting such endeavors. The company iSpace launched a lander to attempt a commercial landing on the Moon to scoop up some of the regolith[129] and sell it to NASA (the first-ever sale of a space resource) to "set a precedent that if you go out and mine material in space, then it is yours to then sell to someone else."[130] However, as discussed later, the U.S. has been resistant to recognizing individual claims of property rights and there are questions that arise given that the Registration and Liability Conventions place the liability of entity action on the responsible nation.[131] Thus, in the application of space mining and the

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[126] Stephen Gorove, *Interpreting Article II of the Outer Space Treaty*, 37 FORDHAM L. REV. 349, 351 (1969) (Noting that there appears to be no prohibition in the Outer Space Treaty of individual appropriation or acquisition by a private association or an international organization); *see also* Montgomery, *supra* note 61, at 2.

[127] Koch, *supra* note 44, at 5.

[128] John G. Wrench, *Non-Appropriation, No Problem: The Outer Space Treaty Is Ready for Asteroid Mining*, 51 CASE W. RES. J. INT'L L. 437, 447 (2019).

[129] *Regolith*, MERRIAM-WEBSTER.COM, https://www.merriam-webster.com/dictionary/regolith [https://perma.cc/J8JL-2DBN] (defining "regolith" as: "unconsolidated residual or transported material that overlies the solid rock on the Earth, Moon, or a planet").

[130] Pethokoukis, *supra* note 5.

[131] Liability Convention, *supra* note 45, at 25.

utilization of space resources, the non-appropriation principle is not as much of a barrier as it initially seems.[132] Further, though this Comment makes great effort to avoid the potential non-appropriation problem, such efforts are merely supplemental to the more decisive matter: that the non-appropriation principle does not even apply.[133]

B. Property Rights

The inapplicability of the non-appropriation principal hinges on property rights. Many scholars differentiate between ownership (or title) and use[134] to make room for the exploitation of resources in space despite the clear ban on sovereign claims of land.[135] For purposes of this Comment, "title," as defined by Black's Law Dictionary, is the "means whereby the owner of lands has the just possession of his property."[136] "Use" here means the right to "enjoy your property" or "to make use of something."[137] "Usufruct," from the Roman "*usufructus*," meaning "the right to enjoy the property of another and to take the fruits, but not to destroy it, or fundamentally alter its character,"[138] is another property right that has made its way into the discussion of space resources. Another commentator described *usufruct* as "lasting only

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[132] Montgomery, *supra* note 61, at 7 (arguing that Article VI does not forbid private operators from operating in outer space; does not say that either activity must be authorized, and, finally, is not, under U.S. law, self-executing, meaning that it does not create an obligation or a prohibition on the private sector unless Congress says it does).

[133] *Id.* at 12 (stating that "the Outer Space Treaty left the determinations of what requires authorization and continuing supervision to each signatory nation . . . The treaty does not say which activities must be regulated, and in the United States that determination lies with Congress.").

[134] *See, e.g.*, Goldie, *supra* note 105, at 691; Wrench, *supra* note 128, at 447; Tingkang, *supra* note 16, at 580 (discussing the differences between ownership rights of chattels versus real property).

[135] Outer Space Treaty, *supra* note 26, at 13.

[136] *Title*, Black's Law Dictionary (2d Ed. 1910) ("In real property law. Title is the means whereby the owner of lands has the just possession of his property. Title is the means whereby a person's right to property is established.") (citations omitted); *see also Title Legal*, Black's Law Dictionary (2d Ed. 1910) ("This relates to ownership of property that is seen as sufficient under the law that is different from title recognized under equity rules."); *Legal Title*, Black's Law Dictionary (2d Ed. 1910) ("legal ownership of an asset or property specified as a clear and enforceable title").

[137] *Use*, Black's Law Dictionary (2d Ed. 1910) (meaning "1. The right you have to enjoy your property. 2. To make use of or to employ something.").

[138] Goldie, *supra* note 105, at 691-92 (quoting William W. Buckland, A Text-Book of Roman Law From Augustus to Justinian 269-70 (3d ed. rev. Peter Stein 1963)).

as long as the character remains unchanged."[139] Some describe the right, essentially, only as a right of use and not entitling ownership or possession.[140] Thus, "distinct and disparate privileges and rights [may exist] in the same object without extinguishing" each other.[141] This is significant because although the existing legal framework would suggest that no nation may claim ownership of celestial bodies it does not prohibit lesser property rights from being established, and this encourages private companies in the U.S. to move forward with resource mining expeditions.[142]

Another property right regime enabling a workaround of the non-appropriation of space resources is to reframe the subject of the appropriation by removing asteroids from the protected class of "celestial bodies" and conceptualizing asteroids as chattels, as discussed at length by Andrew Tingkang from Seattle University School of Law.[143] Tingkang identifies regimes based on real property that could be utilized in the exploitation of space resources and apply just as well to chattels including proposals based on doctrines of discovery and conquest,[144] a land claim system of first possession,[145] the creation of "Exclusive Economic Zones,"[146] an

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[139] *Id.* (quoting H. F. JOLOWICZ, HISTORICAL INTRODUCTION TO THE STUDY OF ROMAN LAW 282 (2d ed. 1967) (citations omitted)).

[140] Koch, *supra* note 44, at 12.

[141] Goldie, *supra* note 105, at 693.

[142] *See* Carol R. Buxton, *Property in Outer Space: The Common Heritage of Mankind Principle vs. the First in Time, First in Right, Rule of Property*, 69 J. AIR L. & COM. 689, 702-03 (2004).

[143] Tingkang, *supra* note 16, at 575 ("Generally, the unique features of asteroids go unnoticed as they are lumped in with other celestial bodies, a problem that can be corrected by conceptualizing asteroids as chattels.").

[144] *Id.* (referencing systems "in which interested parties would find a sponsor state to grant them a charter, which they would then use to discover, claim, and possess a piece of property in outer space thereby granting property rights in outer space.").

[145] *Id.* at 576 (noting that any claims would be limited to areas put to productive use).

[146] *Id.* at 576-77 (Exclusive Economic Zones (EEZs) are the concept of Rosanna Sattler mimicking the design of the United Nations Convention on the Law of the Sea where the UN grants a country exclusive rights to the natural resources in its EEZ of a predetermined size. This scheme does not afford land ownership rights, so the categorization of asteroids as chattels would not have as meaningful of an impact in this regime. But, Tingkang argues, "[o]uter space is simply too vast to be regulated by EEZs forever; when humanity agrees on a system of property to govern outer space, the designation of asteroids will be relevant."); *see also* Rosanna Sattler, *Transporting a Legal System for Property Rights: From the Earth to the Stars*, 6 CHI. J. INT'L L. 23, 41-44 (2005).

auction scheme,[147] or limited leasehold rights.[148] The most narrow proposal specifically focuses on asteroids and builds off of current enterprise rights schemes, which would theoretically allow a company to lease out mining rights without actually owning the asteroid.[149] Tingkang's main thrust here is that none of these proposals present a problem as long as the system is treating asteroids as chattels, whereas treating them as real property could pose different issues with historical and contract law restrictions.[150] Essentially, classifying asteroids as chattels would be the path of least resistance. Tingkang's argument centers around the facts that chattels are moveable and real property is not,[151]

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147 *Id.* at 577-78 (The first auction proposal is one in which "initial investors who arrive at a celestial body would have access to a free market auction of property rights once they have established possession, made improvements to the area, and begun sharing the benefits of the area to satisfy the common heritage language of the Outer Space Treaty." Another, more commercial-encouraging auction system would allow investors to request public auction of a particular cite and then submit a development plan to an international registry agency for approval); *see also* Scott J. Shackelford, *The Tragedy of the Common Heritage of Mankind*, 28 STAN. ENVTL. L.J. 109, 164 (2009).

148 Tingkang, *supra* note 16, at 577-78 ("Limited leasehold rights would give investors exclusive tradable rights to an area for a set period of time." Tingkang notes that this regime is not as economically beneficial as some of the other proposals but would help protect the commons.).

149 *Id.* at 578 ("Leslie Tennen's proposal to create enterprise rights for NEOs is perhaps the most pertinent to this Comment's discussion because her system is specifically designed with asteroids in mind. Her system builds off of currently established enterprise rights schemes, such as those for grazing livestock, harvesting timber, and leasing offshore oil platforms. Tennen argues that a company would need to own an asteroid only if it planned to profit from the fact of ownership and the rights this would entail. With enterprise rights to an asteroid, a company could theoretically lease the mining rights to the asteroid for a period of time without actually owning the asteroid."); *see also* Ezra J. Reinstein, *Owning Outer Space*, 20 NW. J. INT'L L. & BUS. 59, 96 (1999).

150 Tingkang, *supra* note 16, at 580 ("[P]roperty rights in outer space will need to be unique and not 'burdened by historical restrictions and semantic dilemmas.' This does not mean, however, that traditional forms of property cannot substantially inform property rights in outer space. Treating asteroids as chattels recognizes their differences from real property on Earth while using traditional notions to inform their status. The chattel designation would allow freer use of contract law, promote efficiency, provide flexibility, and prevent idiosyncratic issues of property law from arising, such as the extent of subsurface and air rights.").

151 *Id.* ("Scientists have made proposals for how to move dangerous asteroids out of collision courses with the Earth to protect humanity from the perils of a meteorite impact. These large asteroids pose a significant threat to the Earth but would be harmless if their orbits were shifted a few kilometers one way or the other. More pertinently, with enough money and will, it is currently possible to move a smaller asteroid into orbit around the Earth, especially to one of the LaGrange points."); *see also Chattel*, BLACK'S LAW DICTIONARY (11th Ed. 2019) (defining "chattel" as "moveable or transferable property; personal property"). It further defines

chattel classification places the burden of control (for processes like tracking and registration) on the private entity,[152] and chattel classification relies on contract law to determine apportionment versus battling with historical approaches to subsurface and air rights connected to real property and the mathematical challenge of applying such to misshapen and asymmetrical asteroids.[153] Under this hypothetical scheme, the line of demarcation between asteroids and celestial bodies could be hydrostatic equilibrium,[154] which would also aid the international community in the process

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"personal property" as "any movable or intangible thing that is subject to ownership and is not classified as real property," while defining "real property" as "land and anything growing on, attached to, or erected on it, excluding anything that may be severed without injury to the land" and "land" as "an immovable and indestructible three-dimensional area consisting of a portion of the Earth's surface, the space above and below the surface, and everything growing on or permanently affixed to it." *Property*, BLACK'S LAW DICTIONARY (11th Ed. 2019); *Land*, BLACK'S LAW DICTIONARY (11th Ed. 2019).

[152] Tingkang, *supra* note 16, at 581-82 ("Tracking asteroids is already a tricky business; many times an asteroid is identified multiple times and given different designations, only to be later discovered as the same asteroid. Systems of real property need centralized tracking to function; official deeds must be recorded or an owner risks losing title to the land. Chattels are free from this centralization. For chattels, possession creates a presumption of ownership that must be rebutted by the other party. Treating asteroids as chattel puts the onus on their owners to make sure they know where their particular asteroid is and where it is going. The asteroid becomes an object owned and controlled by the company or individual, rather than land that is owned by the company or individual."). Note, however, that there would still need to be supervision and recognition from the nation.

[153] *Id.* at 583 ("The unique shapes of asteroids will likely cause problems for traditional approaches to subsurface and airspace rights to asteroids that contract law would help solve. Many minable asteroids are spheroids, but many are also irregularly shaped. Asteroids may be oblong, wedge[-]shaped, or two masses seemingly stuck together. It would certainly be possible to fairly apportion real property rights under a 'center of the rock' scheme, but the transactional costs would likely be high in the many cases where the rights would need to be adjusted to a particular asteroid. . . . The chattel approach would allow companies to rely on the business-friendly confines of contract law to determine how a given asteroid would be sliced, rather than the often-archaic realm of real property. . . . Under modern law, property owners are given airspace rights to the extent they can use them with normal usage of the land. It is unclear just how far from the asteroid these rights would extend. It is also unclear whether or not a competing corporation would be allowed to station a satellite over a rival's operation to gain data without the rival corporation's approval or knowledge. This might be considered airspace, or it could be an orbital slot. It is also difficult to seriously call it 'airspace' when asteroids are not large enough to have an atmosphere capable of supporting air.").

[154] *Id.* at 586 ("The hydrostatic equilibrium is the point at which a celestial body's mass is so great that its gravitational forces compress the object into a spheroid shape.").

of defining "celestial bodies" more concisely. As one esteemed writer on the subject noted: "It's not real estate; it's just a rock."[155]

One commonality among all proposed schemes is national recognition of property rights.[156] A glaring example of the importance of national recognition is in the case of *Nemitz v. United States*.[157] There, a U.S. citizen claimed to have acquired property rights on an asteroid when he registered the asteroid with the Archimedes Institute and attempted to charge NASA parking and storage fees of 20 cents per year for landing on "his" asteroid.[158] His argument that landing and failing to pay fees constituted a taking failed at the District Court due to a lack of a constitutionally protected property interest.[159] The Court of Appeals affirmed the holding against claims of violation of Public Law 85–568 § 102(c) and § 102(d)(9)[160] stating that the Archimedes Institute disclaims any authority to confer title or rights to its registrants and there is no legal basis that such registry creates a property interest in an asteroid.[161] Further, the opinion states that neither the ratification of the Outer Space Treaty nor the failure of the U.S. to ratify the Moon Treaty creates any rights to appropriate private property on asteroids.[162] The point of this case is to demonstrate the importance of national recognition and acknowledge the limits to private rights. As discussed, the appropriation of private property is different from use and from varying lesser property rights. Notably, the United States has had a policy of encouraging commercial space activity for over forty years and has tasked the Department of Commerce with supporting such endeavors.[163]

Consequently, there is room for space mining in the existing legal framework. It was not the intent of the Outer Space Treaty

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155 Glenn Harlan Reynolds, *Who has the Right to Mine an Asteroid?*, POPULAR MECHANICS (Mar. 26, 2013), https://www.popularmechanics.com/space/a12434/who-has-the-right-to-mine-an-asteroid-15265082/ [https://perma.cc/9ZDU-ABL9].

156 Wrench, *supra* note 128, at 446-47 ("At the very least the United States rejects the idea that its own citizens may enforce ownership of bodies in outer space without national recognition of those rights.").

157 Nemitz v. United States, No. CV-N030599-HDM (RAM), 2004 WL 3167042, at *1 (D. Nev. 2004), *aff'd sub nom*; Nemitz v. N.A.S.A., 126 Fed. Appx. 343, 343 (9th Cir. 2005).

158 Wrench, *supra* note 128, at 446.

159 *Nemitz*, 2004 WL 3167042 at *1.

160 *Id.* (referencing 51 U.S.C.A. § 20102(c) (2012), commonly known as the Act that established NASA).

161 *Id.* at *1.

162 *Id.* at *1-2.

163 Telephone Interview with Deborah Plunkett, Associate General Counsel, Department of Defense (May 4, 2023).

to limit commercial industries. Mining is distinct from ownership and claims of sovereignty. And, at least as far as the U.S. is concerned, governments have already approved of missions for resource exploitation and enacted encouraging legislation and regulations like the SPACE Act and the Commercial Space Transportation Regulations to support and encourage such missions.

IV. ANSWERS

1. *If a spacecraft carrying resources mined from space crashes into another territory, does the mined material still belong to the nation that registered the spacecraft carrying the resource even though they have not registered the resources and cannot, under the Outer Space Treaty, lay a claim of sovereignty to "outer space, including the Moon and other celestial bodies?"*[164]

   Yes. Although countries may not lay claims of sovereignty to land, this Comment has established the distinction between land rights of ownership and land rights of use and offered various property regimes to support space mining endeavors including categorizing land as chattels to avoid the problem of laying a claim to land and separating land rights from use rights. Furthermore, it should remain noted that the Outer Space Treaty does not expressly prohibit private ownership.[165]

2. *Do we need international approval for conducting a space mining mission?*

   It is not likely that we need international approval for a space mining mission, outside of maybe a consultation if serious questions of harmful interference arise (as discussed below). However, we would likely need national approval. Due to the burden the government carries in terms of liability for all objects launched by entities within the State, it is only natural that the government will maintain a continuing need to approve of missions and have knowledge of payloads, goals, and processes of ongoing missions. Additionally, the government is required to maintain involvement under the Outer Space Treaty's imposition of the duty of continued supervision.[166] Thus, the government would likely require companies to have their

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[164] Outer Space Treaty, *supra* note 26, at 13.
[165] *Id.* at 14.
[166] *Id.*

approval as long as they are the ones on the hook and have a continuing duty.

3. *What constitutes potential harmful contamination or harmful interference?*

   In relation to this Comment, this question essentially asks if the harmful contamination or the harmful interference clause could be used as an argument against space mining. Space mining is likely not harmful contamination because it, as plans currently stand, does not involve any biological contaminants, and elements extracted and brought back to Earth will not be harmful. This statement is made based on the recognition of the facts that countries have plans for and are attempting to conduct space mining missions and the international community has not pushed back on these grounds. Harmful interference is a different matter that would depend on the actions of other countries and of our mining interferes with their use of space. Additionally, as with non-appropriation, it is not evident that this clause applies to private actors.[167] The answer to this question would also potentially hinge on the definition of celestial bodies—does it include asteroids or just planets?

4. *With regard to asteroid mining, what about the argument that there are plenty of asteroids to go around and taking one is not an interference?*

5. This is another question that would be affected by the definition of celestial bodies. If the chattel theory is adopted, this has a higher chance of being persuasive because there would effectively be no "harmful interference with the activities of other States Parties in the peaceful exploration and use of outer space" as precluded by the Outer Space Treaty.[168]

Both answers to Question Three and Question Four should also note that even if there is a harmful interference question, the Outer Space Treaty provides that the party shall undertake international consultations.[169] It does not necessarily establish that countries need to come to an agreement.

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[167] Montgomery, *supra* note 61, at 2 ("This provision does not, on its face, apply to private actors. It is thus not an obligation on the United States to impose this requirement on the private sector.").

[168] Outer Space Treaty, *supra* note 26, at 16.

[169] *Id.* (providing that State Parties "shall undertake appropriate international consultations before proceeding with any such activity or experiment").

V. ADVANCING FORWARD

To begin with my simplest thought, I think the industry should move forward as it is. The United States should continue to pursue space resource exploration and extraction missions because the non-appropriation principle does not prevent such endeavors, and the government can continue to support the industry while the law develops. As the law develops, it will likely do so in a way favorable to how the industry has progressed and thus, it will likely be beneficial to lead the way. Take care and do your due diligence; act in good faith and act reasonably; and do what you want within the provided parameters. Especially because the United States government has already shared its intention to allow mining missions and it is going to be in favor of actions that bolster our domestic economy and our international standing. The fact of the matter is that when technology and innovation develop quickly, the law has to play catch up and work from what has already been done. This is a benefit for the industry because it allows wiggle room in processes and regulations. Although a lot of the mission has already been regulated, there is still a lot that is up in the air and I believe the most economic and efficient way forward is to get the mined material and handle it as you want and see what, if any, ramifications occur. When it comes time to justify actions, the space sector may look to any of the property regimes outlined above and choose the best fit.

For the government's part, it should continue to support the private sector and prioritize the space economy, especially as our adversaries reach for the same heights. Continuing the deregulation of the space industry will make private companies more willing to try missions that will create more competition and accelerate the learning curve. Specific statutes declaring asteroids as separate from celestial bodies and distinguishing them from application to traditional property land rights would be helpful in guarding against anticipated pushback. It also comes down to this: the international community has always been hard to regulate. Yes, you can sign treaties and say you are going to act in accordance with your word, but there is only so much other countries can do to hold you to it and there are only so many ways countries can punish each other. Additionally, the countries that do have the power to cause disruption are likely engaging in similar activity. Outside of potential repercussions from other countries, the only other real threat is to the reputation of the country, which is what bears the real weight of the actions taken.

Further, the international community should solidify definitions used throughout the Outer Space Treaty, whether this comes through usage in statements and consistent references or from specific legislation, it would greatly benefit the industry. Having clearer definitions provides for a surer understanding of the guidelines that would likely promote more activity from private enterprises, which is good for the economy and therefore good for the nation. For example, celestial bodies should be defined, especially as this definition has effects on various other aspects of space including the placement of researchers and facilities, military personnel and equipment, and, as obvious to this Comment, mining sites or other private ventures. For the benefit of the U.S. goals the narrowest definition would likely be the best fit because then only a small portion of the bodies in space would fall under stricter regulation. An example would be defining "celestial bodies" as relating to planets—maybe even planets currently recognized in our solar system. Additionally, the term space objects should be clarified—does this only refer to artificial objects in space? Does size or purpose matter? Is the International Space Station a space object? Being able to answer questions like these would give the space exploration industry a stronger foothold to continue progressing forward. "Harmful interference" would also be a helpful definition to have to be able to figure out what explorative activities may be problematic.

However, this is a bit of a double-edged sword because as long as the terms are undefined, there is room for argument, and with defined terms comes a clearer line which may end up cutting off the opportunity for specific endeavors. Additionally, as narrow definitions would open up more activities for the United States, it would do the same for the other countries relying on the Outer Space Treaty. The United States needs to make sure it's ready to take advantage.