FROM INTERSTATE TO INTERSTELLAR COMMERCE: INCORPORATING THE PRIVATE SECTOR INTO INTERNATIONAL AEROSPACE LAW*

I. INTRODUCTION

"If the era of commercial spaceflight has a birthday, it's April 28, 2001."[1] It was on that date, forty years after Yuri Gagarin of the Soviet Union became the first human to enter Earth's orbit, that Dennis Tito, a wealthy American businessman, paid his way into space as the world's first "space tourist."[2] He reportedly brokered a deal with Russia's space program, estimated at $20 million, to accompany one of its shuttles to the International Space Station.[3] Tito's flight signaled to the world that there was private money to be made beyond Earth's atmosphere.

One of the major players in the emerging space tourism market is Virgin Galactic.[4] Richard Branson, the billionaire founder of Virgin Group, officially created Virgin Galactic in 1999.[5] The company cosponsored SpaceShipOne's award-winning Ansari X Prize flight, which conducted its first two missions in 2004.[6] Virgin Galactic boasts that it will be the world's first commercial space line and plans to begin commercial flights for paying customers as early as 2015.[7] Virgin Galactic joins a

---

* Kyle A. Jacobsen, J.D. Candidate, Temple University Beasley School of Law, 2015. I would like to thank the editorial board and staff of the *Temple Law Review* for their hard work in preparing this Comment for publication. Special thanks to Jordan Ellis, Eleanor Bradley, and Professor Duncan Hollis for their valuable feedback and encouragement. Finally, I would like to thank my lovely wife Ashley for her ongoing love and support.

1. Mike Wall, *First Space Tourist: How a U.S. Millionaire Bought a Ticket to Orbit*, SPACE.COM (Apr. 27, 2011, 6:00 AM), http://www.space.com/11492-space-tourism-pioneer-dennis-tito.html.

2. *Id.* "Space tourism" may be defined as "any commercial activity offering customers direct or indirect experience with space travel." Frans G. von der Dunk, *Passing the Buck to Rogers: International Liability Issues in Private Spaceflight*, 86 NEB. L. REV. 400, 402 (2007) (internal quotation marks omitted).

3. Wall, *supra* note 1.

4. *See Human Spaceflight,* VIRGIN GALACTIC, http://www.virgingalactic.com/human-spaceflight/ (last visited Dec. 12, 2014) (discussing the company's origins and entry into the space tourism industry).

5. Elizabeth Howell, *Virgin Galactic: Richard Branson's Space Tourism Company*, SPACE.COM, (Dec. 20, 2012, 12:13PM), http://www.space.com/18993-virgin-galactic.html.

6. *Id.* On October 4, 2004, the X Prize Foundation awarded $10 million (referred to as the Ansari X Prize) to a team of pilots who became the first private citizens to successfully launch a commercial spacecraft sixty-two miles above Earth's surface twice within two weeks. *Ansari X PRIZE*, X PRIZE FOUNDATION, http://space.xprize.org/ansari-x-prize (last visited Dec. 12, 2014). The foundation credits itself with the launching of a new industry—the private space industry. *Id.*

7. David Gilbert, *Virgin Galactic Passengers Just Miss Going into Space*, INT'L BUS. TIMES (May 12, 2014, 4:50 PM), http://www.ibtimes.co.uk/virgin-galactic-may-not-bring-passengers-into-space-1448266. Virgin Galactic continues to receive deposits from wealthy individuals interested in becoming some of the world's first space tourists. Mike Wall, *Trip to Space with Leonardo DiCaprio Sells for $1 Million*, SPACE.COM (May 23, 2014, 2:34 PM), http://www.space.com/25996-leonardo-dicaprio-spaceshiptwo-spaceflight-auction.html. Celebrities such as Leonardo DiCaprio and Justin Bieber have reportedly paid deposits to be one of the first seven hundred customers aboard Virgin Galactic's commercial shuttles. *Id.* Passengers will fly up to fifty thousand feet in Virgin Galactic's commercial spacecraft, which will provide an

small, specialized group of companies[8] that have begun to position themselves as pioneers in the emerging space tourism industry.[9]

The international laws governing the exploration of outer space were first drafted by the United Nations Committee on the Peaceful Uses of Outer Space during the Cold War's Space Race.[10] A series of international treaties were enacted that set forth regulations to govern all nations party to the treaties.[11] Of paramount concern to the international community was the notion that space exploration benefit *all* mankind and

---

environment of weightlessness and views of Earth once only seen by NASA's astronauts. *Id.*

8. Denise Chow, *Future of Space Tourism: Who's Offering What*, SPACE.COM, (Apr. 25, 2011, 11:59 AM), http://www.space.com/11477-space-tourism-options-private-spaceships.html (describing the major players in the space tourism industry and what they have to offer space tourists). SpaceX is another company contributing to the commercial space race. "SpaceX designs, manufactures and launches advanced rockets and spacecraft. The company was founded in 2002 to revolutionize space technology, with the ultimate goal of enabling people to live on other planets." *About SpaceX,* SPACEX, http://www.spacex.com/about (last visited Dec. 12, 2014).

9. Looking beyond space tourism, Branson has also invested in another company, Planetary Resources. *Team Overview*, PLANETARY RESOURCES, http://www.planetaryresources.com/team/ (last visited Dec. 12, 2014).

> Planetary Resources' mission is clear: apply commercial, innovative techniques to explore space. We will develop low-cost robotic spacecraft to explore the thousands of resource-rich asteroids within our reach. We will learn everything we can about them, then develop the most efficient capabilities to deliver these resources directly to both space-based and terrestrial customers.

Evan Schneider, *Powerhouse of Talent Inaugurates Planetary Resources*, AMATEUR ASTRONOMERS ASS'N OF NEW YORK, http://www.aaa.org/node/978 (last visited Dec. 12, 2014). Its core group of investors and advisers reveals much about the potential for this technology. Peter H. Diamandis, Planetary Resources' cofounder and cochairman, is also the CEO of the X Prize Foundation—the organization that awarded ten million dollars for the first commercial space flight. *Team Overview,* PLANETARY RESOURCES, *supra*. Eric E. Schmidt, the Executive Chairman of Google, is also a primary investor. *Id.* Charles Simonyi, the chief architect for Microsoft behind such programs as Microsoft Word, Excel, and others, has also joined the ranks as one of Planetary Resources' notable investors. *Id.* The common thread that these investors share is that they all introduced new technologies that the world had never seen before.

10. *See* Daniel A. Porras, Comment, *The "Common Heritage" of Outer Space: Equal Benefits for Most of Mankind*, 37 CAL. W. INT'L L.J. 143, 147–48 (2006) (noting that the Soviet Union's launch of the first artificial satellite (Sputnik 1) in 1957 prompted the United States to view its capacity to travel in space not so much as a scientific or technological feat, but rather one of military capabilities); *see also* Lawrence L. Risley, *An Examination of the Need to Amend Space Law to Protect the Private Explorer in Outer Space*, 26 W. ST. U. L. REV. 47, 52 (1999) (describing the Space Race as "a superpower struggle for strategic [military] advantage and national prestige").

11. *See* Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, *opened for signature* Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter the Moon Agreement] (stating all explorations of the moon must be in accordance with international law and must be peaceful); Convention on Registration of Objects Launched into Outer Space, *opened for signature* Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter the Registration Convention] (stating that all objects launched into space must be registered); Convention on International Liability for Damage Caused by Space Objects, *opened for signature* March 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter the Space Liability Convention] (stating that damages caused by space objects must be paid for by states and international intergovernmental organizations that launched the object(s)); Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* April 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter the Rescue Agreement] (stating the intention to promote international cooperation in the use and exploration of outer space); Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter the Outer Space Treaty] (stating that the use and exploration of outer space will be used for the benefit and interests of all countries).

be used strictly for peaceful purposes.[12] The treaties signaled to the world's superpowers that they were not to transport political and military disputes into Earth's orbit.[13] As a result of this history, provisions within the Outer Space Treaty expressly forbid assertions of sovereign domain over celestial bodies and severely limit the rights of private actors to commercially exploit extraterrestrial resources.[14]

Until recently, governments only needed to legislate with respect to government-sponsored space programs.[15] Governments—often in cooperation with one another—were the only entities capable of space travel.[16] However, the last two decades have witnessed a departure from this model. Private entities and individuals have begun efforts to explore outer space for economic gain.[17] Space tourism is poised to become a viable industry in the coming decade, and the extraction of natural resources from extraplanetary bodies may not be far behind.[18] The current international legal framework, however, is inadequate to effectively regulate the *private* use and exploitation of outer space. It will stifle and disincentivize efforts of the private sector and private investors to fund new ventures that will allow Earth's population to take advantage of extraterrestrial resources.[19]

This Comment explores the underlying tension between the *res communis* principle,[20] with its goal of communal access, and private actors' interest in exploiting

---

12. *See* Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2413, 610 U.N.T.S. at 208 ("States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.").

13. Joanne Irene Gabrynowicz, *Space Law: Its Cold War Origins and Challenges in the Era of Globalization*, 37 SUFFOLK U. L. REV. 1041, 1043 (2004) (stating that the treaties were signed to avoid parties extending disputes into outer space).

14. Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2413, 610 U.N.T.S. at 208 ("Outer space, including the moon 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.").

15. *See* Bonnie E. Fought, *Legal Aspects of the Commercialization of Space Transportation Systems*, 3 HIGH TECH. L.J. 99, 99–100 (1988) (discussing the growing privatization of space travel).

16. *Id. See also How Much Does It Cost?*, EUR. SPACE AGENCY, http://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/How_much_does_it_cost (last updated May 14, 2013) (noting that the International Space Station—an ongoing joint venture pursued by the United States, Russia, Japan, Canada, and ten members of the European Space Agency—is the "greatest international cooperative project ever undertaken" at a price exceeding $125 billion).

17. See *supra* notes 1–9 and accompanying text for a discussion of private space tourism endeavors.

18. *See* Andy Pasztor & Rory Jones, *How U.K. Plans to Take Tourists Into Space by End of Decade*, WALL ST. J. (July 17, 2014, 5:06 AM), http://online.wsj.com/articles/u-k-space-program-seeks-change-with-zero-gravity-tourism-push-1405535070 (discussing how the British government, in conjunction with aerospace industry officials, has unveiled plans for a commercial spaceport due for completion in 2018 that will allow private entities to pursue space tourism ventures that are "shielded from the bickering and budget uncertainties [ruining] government-run space programs").

19. See *infra* Part III.A for a discussion of how outer space is currently experiencing a "tragedy of the anticommons."

20. Generally speaking, the *res communis* principle declares that certain territories or resources are collectively owned by the international community and thus are not subject to appropriation by a single nation or private entity. OXFORD REFERENCE, http://www.oxfordreference.com/view/10.1093/acref/9780195369380.001.0001/acref-9780195369380-e-1816 (last visited Dec. 12, 2014).

extraterrestrial resources.[21] Commercial exploitation of such resources has the potential to create significant positive externalities[22] that could improve the standard of living for *all* of mankind.[23] Therefore, this Comment argues that the interests of private actors should be incorporated into an amended body of international aerospace law, one that encourages capable entities—whether public *or* private—to engage in spacefaring missions for economic gain.

Section II examines the current international treaties that regulate space travel, with a particular focus on the Outer Space Treaty, the seminal codification of space law. Section III explores the opposite side of the well-known property theory, the "tragedy of the commons," and how it relates to the current laws governing space exploration. Section IV discusses the benefits that extraterrestrial resources hold for mankind, and why the international community should encourage private entities to engage in commercial space travel. Finally, Section V discusses *why* and *how* the current body of international aerospace law should be amended. Ultimately, the goal of this Comment is to outline how amending the current body of international space law will produce both immediate and secondary benefits for private actors and the developing world.

II. INTERNATIONAL LAW GOVERNING SPACE TRAVEL, EXPLORATION, AND EXPLOITATION

A. The Outer Space Treaty

In the wake of World War II, the United States and Soviet Union each allocated substantial resources toward the development of their respective nuclear arms programs. The Space Race between the world's two superpowers attracted international attention and came to symbolize each country's military capabilities.[24] With mounting global pressure, the United Nations responded to the international community's concerns of nuclear war by enacting the Outer Space Treaty in 1967.[25] It is regarded as the basic international framework for the laws that govern the use, exploration, and exploitation of outer space.[26] Currently, 103 countries—including the United States and

21. See *infra* notes 56–59 and accompanying text for commentary on the tension between the *res communis* principle and the desire of private entities to mine extraterrestrial resources.

22. A "positive externality" for the purposes of this Comment may be defined as an unforeseen or unintended benefit conferred upon a third party from a transaction in which the third party was not involved. Daniel B. Kelly, *Strategic Spillovers*, 111 COLUM. L. REV. 1641, 1649–50 (2011).

23. *See infra* Part IV.A for a discussion of the positive externalities of space exploration as demonstrated through NASA spinoff technologies.

24. *See* Daniel A. Porras, *supra* note 10, at 147–48 ("In 1957, the [Soviet Union] launched the first satellite . . . into outer space as the first step in the Space Race. . . . The United States believed it needed to gain the position as the leader in space or risk losing the Cold War. This created a direct connection between outer space exploration and military superiority.") (footnotes omitted); *see also* Benjamin David Landry, *A Tragedy of the Anticommons: The Economic Inefficiencies of Space Law*, 38 BROOK. J. INT'L L. 523, 528–29 (2013) (noting that the impetus for the Space Race was the rivalry of the Cold War, and that the Soviet Union's ability to operate in space was problematic for the United States as it could have led to a substantial competitive advantage in international politics).

25. Glenn Harlan Reynolds, *Space Law in the 21st Century: Some Thoughts in Response to the Bush Administration's Space Initiative*, 69 J. AIR L. & COM. 413, 414 (2004).

26. *See* Bryon C. Brittingham, *Does the World Really Need New Space Law?*, 12 OR. REV. INT'L L. 31,

Russia—have ratified the treaty.[27]

Of paramount concern to the United Nations delegates was the idea that national governments, particularly the world's superpowers, would explore and use outer space purely as an arena for military operations.[28] This trepidation is reflected throughout the text of the Outer Space Treaty, which declares in Article III that states party to the treaty "shall carry on activities in the exploration and use of outer space . . . in the interest of maintaining international peace and security and promoting international cooperation and understanding."[29] The spirit of the Outer Space Treaty is best captured in Article I, which proclaims 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, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."[30] The treaty further stipulates in Article II that neither the moon nor any other celestial body shall become the sovereign domain of any one nation.[31]

Legal scholars and commentators have acknowledged that the current framework of the "province of all mankind" concept presents legal challenges for private entities attempting to exploit extraterrestrial resources for commercial gain.[32] Professor Joanne

---

34 (2010) (acknowledging that the Outer Space Treaty is "widely accepted as the international law governing outer space activities"); Edwin W. Paxson III, Note, *Sharing the Benefits of Outer Space Exploration: Space Law and Economic Development*, 14 MICH. J. INT'L L. 487, 489 (1993) (noting that the Outer Space Treaty is considered the "Magna Carta" of international space law, and establishes "general principles for the use and exploration of outer space") (internal quotation marks omitted).

27. Comm. on the Peaceful Uses of Outer Space, Legal Subcomm., *Status and Application of the Five United Nations Treaties on Outer Space*, U.N. Doc. A/AC.105/C.2/2014/CRP.7 (Mar. 20, 2014).

28. *See* Porras, *supra* note 10, at 147–48 (noting that the Space Race was carried out as much for military purposes as it was for scientific research).

29. Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2413, 610 U.N.T.S. at 208.

30. *Id.* at 2412, 207. This provision has been the subject of a significant amount of legal scholarship with respect to its exact meaning and role within international law. *See, e.g.*, Scott J. Shackelford, Comment, *The Tragedy of the Common Heritage of Mankind*, 28 STAN. ENVTL. L.J. 109, 156–57 (2009) (acknowledging the lack of a precise definition for "the province of all mankind" in Article I of the Outer Space Treaty); *see also* 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, 147 (2000).

31. Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2413, 610 U.N.T.S. at 208 ("Outer space, including the moon 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.").

32. *See, e.g.*, Gabrynowicz, *supra* note 13, at 1053 (discussing the challenges of international space law in the context of globalization and competing visions among countries on how the law should develop); Landry, *supra* note 24, at 525 (stating that current international space law does not offer a clear framework for the commercial use of resources in space); Ezra J. Reinstein, *Owning Outer Space*, 20 NW. J. INT'L L. & BUS. 59, 65–68 (1999) (same); Risley, *supra* note 10, at 49 (stating that the Outer Space Treaty removes incentives to explore commercial ventures in space); Sarah Coffey, Note, *Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space*, 41 CASE W. RES. J. INT'L L. 119, 125–26 (2009) (stating that because the Outer Space Treaty was meant to be broad, it does not resolve many specific issues in space law today, such as proprietary rights in terms of what nations extract from space); Fred Kosmo, Note, *The Commercialization of Space: A Regulatory Scheme that Promotes Commercial Ventures and International Responsibility*, 61 S. CAL. L. REV. 1055, 1066–68 (1988) (discussing the interpretative issues of the phrase "shall be the province of all mankind" and its effect on commercial exploitation of space resources); Zach Meyer, Comment, *Private Commercialization of Space in an International Regime: A Proposal for a Space District*, 30 NW. J. INT'L L. & BUS. 241, 252 (2010) (positing several different interpretations of the kind of access to extraterrestrial resources that the Outer Space Treaty allows); Jeremy L. Zell, Comment, *Putting a*

Gabrynowicz has examined the Outer Space Treaty's Cold War origins and the current challenges posed by an era of increasing globalization.[33] She notes that space law is a "complex mixture of international and domestic laws," with the Outer Space Treaty at the apex of the hierarchy.[34] The treaty may therefore be categorized as "quasi-constitutional" because it articulates a set of fundamental principles that transcend all other aspects of space law.[35] Hence, if the international community were to incorporate any property or commercial rights into space law, the Outer Space Treaty would be the appropriate starting point.[36] Gabrynowicz also emphasizes the collective fear of the international community during the Cold War, and how it is reflected throughout the treaty's text.[37] She is not alone. Other commentators have also recognized how the tumultuous geopolitical climate of the 1960s *continues* to influence international law and policy through adherence to the Outer Space Treaty.[38]

Gabrynowicz's examination of the treaty's role in modern-day space law is useful in that it raises several important questions with respect to the future of space law and how the international community must address the commercial exploitation of extraterrestrial resources:

> [I]nternational space law has completed its first phase. . . . The next generation of space law involves agreeing on specific norms. Is sovereignty necessary to establish property rights? Are space resources, as well as space itself, the province of all humankind? If so, how are they to be allocated? If not, why? How can non-spacefaring nations be assured use of outer space? How will the investments of spacefaring nations be honored? What is the appropriate relationship between the public and private sectors in space? How will private space activities be regulated? These questions, and more, are yet to be answered.[39]

Several commentators have answered these questions by arguing that the Outer Space Treaty should be abolished or amended in favor of a more permissive set of guidelines that reflect the current geopolitical landscape.[40] Lawrence Risley posits that

---

Mine on the Moon: Creating an International Authority to Regulate Mining Rights in Outer Space, 15 MINN. J. INT'L L. 489, 490–91 (2006) (arguing that the ambiguity of the common heritage of mankind language in the Outer Space Treaty decreases the likelihood that the private sector will explore commercial ventures in space).

33. Gabrynowicz, *supra* note 13, at 1043, 1048. Professor Gabrynowicz is the Editor-in-Chief of the Journal of Space Law, Professor of Space Law and Remote Sensing Law, and Director of the National Remote Sensing, Air, and Space Law Center, University of Mississippi School of Law. *Id.* at 1041, n. †.

34. *Id.* at 1041–42.

35. *Id.* at 1042 ("President Lyndon Johnson believed that the Outer Space Treaty was important enough to the United States' national interests to ask then Supreme Court Justice Arthur Goldberg to step down from the Supreme Court in order to negotiate it for the United States.").

36. Risley, *supra* note 10, at 66–68 (arguing that a competent international authority must amend the Outer Space Treaty to encourage and promote private exploration of outer space).

37. Gabrynowicz, *supra* note 13, at 1043.

38. *See, e.g.*, Ty S. Twibell, *Circumnavigating International Space Law*, 4 ILSA J. INT'L & COMP. L. 259, 276 (1997) (noting that the "no-sovereignty provision [Article II of the Outer Space Treaty] was viewed as the means of preventing the spread of the Cold War into space"). Twibell further notes, "Certainly times have changed. The Union of Soviet Socialist Republics no longer exists. The Cold War is gone and has been for some time. There could not be a clearer demarcation of a change in the political arena." *Id.*

39. Gabrynowicz, *supra* note 13, at 1047.

40. *See, e.g.*, Ty S. Twibell, Note, *Space Law: Legal Restraints on Commercialization and Development of Outer Space*, 65 UMKC L. REV. 589, 638 (1997) ("Amendment of the 1967 Space Treaty is a

the Outer Space Treaty "discourages development of space by removing the economic incentive that is essential to any exploration and development project."[41] He thus adopts the position that a "legitimate body governing activities in outer space must change space law to encourage free enterprise in space by allowing explorers and developers of outer space to realize the financial rewards from what they discover."[42] He provides the following reasons for amending the treaty:

> [T]he concerns of the people of the world have changed since the end of the Cold War. . . . [I]nterests in space have changed and the law should change with those interests to encourage both scientific inquiry and private exploration thereby improving life on Earth and in space. . . . The Outer Space Treaty attempts to remove national conflicts from scientific inquiry. Yet, the United Nations has failed to recognize the need for explorers to realize rewards for their efforts.[43]

Risley ultimately concludes that the treaty should be amended to reflect his proposal that "outer space should be a free enterprise zone, allowing those who claim property to own and develop it."[44] This position represents one of the outermost calls for reform in that it focuses almost exclusively on economic efficiency, with little contemplation of equitable access for those governments or private entities incapable of pursuing space travel. This proposal appears to advocate for the traditional "first in time, first in right" concept of property law.[45]

Other commentators have echoed similar sentiments in terms of the need to reform space law, but differ as to exactly how the law needs to change. These commentators assert that the Outer Space Treaty is in need of "substantial revision and amendment" in order to accommodate the interests of those seeking to exploit extraterrestrial resources for economic gain.[46] This camp argues essentially that the Outer Space Treaty has fulfilled its duty of promoting peace, which comports with Professor Gabrynowicz's "first phase" idea.[47] However, they argue that the treaty is an

---

very attractive method for promoting space commercialization for three reasons. First, and most obvious, it is the most efficient means because it removes the very clause causing the main legal restraints on space commercialization [referring to the nonappropriation provision within Article II]. Second, investors would have control, protection, and certainty over their investments in space. Third, the treaty can be amended in such a fashion that nations' rights and access to space are protected.").

41. Risley, *supra* note 10, at 48.

42. *Id.*

43. *Id.* at 52.

44. *Id.* at 68.

45. *Id.* 68–69. *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 Law*, 69 J. AIR L. & COM. 689 (2004) (exploring the tension between the traditional "first in time, first in right" property rule and the common heritage of mankind principle expressed in the Outer Space Treaty); *see also* Lori Magee Laird, *Space Resuscitation: Capitalism to the Rescue? When International Cooperation Becomes International Complication*, 12 CURRENTS: INT'L TRADE L.J. 87, 94 (2003) (arguing that "the time has come to take . . . a free market approach to space exploration"). Laird does, however, envision the need for an international regulatory agency to oversee and monitor such a system in order to "prevent inconsistent results that may lead to international conflicts." *Id.*

46. Reinstein, *supra* note 32, at 94.

47. *See, e.g.*, Twibell, *supra* note 40, at 595 (noting that the Outer Space Treaty has achieved the goal of avoiding national rivalries in the field of space law); *see also* Gabrynowicz, *supra* note 13, at 1047 (explaining that the "first phase" of international space law has been completed through the creation of

ineffective instrument for modern regulation of space tourism ventures, the establishment of property rights, and environmental concerns pertaining to Earth's orbit.[48] Ty S. Twibell argues:

> Amendment to the treaty is simple. Article II, the no-sovereignty provision, can be removed and replaced with a clause articulating a reference to a method or legal regime for appropriating celestial bodies to various entities. The remaining principles would not contradict the creation of property rights in the use or disposal of celestial property.[49]

In comparing an amendment to the Outer Space Treaty to other approaches, such as abrogation or the enactment of an entirely new treaty, Twibell argues that while an amendment may take more time up front to negotiate, it will save time and energy in the long run.[50] It would directly address the inadequacies of the current system and provide legal certainty to the international community.[51] "If such great effort is taken to reinterpret, withdraw, repudiate, or create an entirely new treaty, that effort needs to be directed at all the needed changes."[52]

At the other end of the spectrum of reformers, opposite a purely free market approach focused on economic efficiency, are commentators who feel the current framework of the Outer Space Treaty and accompanying agreements is adequately suited to govern modern-day commercial ventures.[53] Their interpretations of Articles I and II of the Outer Space Treaty appear at odds with many scholars and commentators who have examined those same provisions.[54]

---

important historic principles regarding peaceful exploration of space).

48. Reinstein, *supra* note 32, at 65, 98.

49. Twibell, *supra* note 40, at 638. Twibell goes on to say that "[t]here is some concern that some nations' access to space could be stifled by other nations acquiring preeminence in celestial property acquisition." *Id.* He notes that "[s]ome argue, therefore, that the treaty's principles promoting the concept of access to space by all nations would contradict property rights in space." *Id.* However, he rejects that argument as "an overbroad interpretation" of the Outer Space Treaty. *Id.* Instead, he argues that "[a]mendment to the treaty would not allow an entity to suddenly claim half of the Moon." *Id.* at 639. Accordingly, Twibell advocates for a "legal regime . . . that could oversee and regulate celestial property distribution and inherent rights to claim property." *Id.* He suggests that the proposed regime "would take into account the use of various portions of space and of the rights of the owners allowing them to be certain that use of the property will be free from harmful interference." *Id.* Twibell reasons that "[p]roductive use of the celestial property would be one way of insuring access and promoting investment." *Id.*

50. Twibell, *supra* note 38, at 293–94.

51. *Id.* at 294.

52. *Id.* "Amending the 1967 Space Treaty by removing the no-sovereignty clause . . . solves many problems in implementing desired changes in space law. These qualities make it the best [option] available." *Id.*

53. *See* Meyer, *supra* note 32, at 258–59 ("Rather than settling for drafting another principled document, the international community could establish a more concrete, material regime in the form of a physical space district.").

54. *Compare* Twibell, *supra* note 40, at 638 (arguing that "[a]mendment of the [Outer] Space Treaty is a very attractive method for promoting space commercialization"), *and* Zell, *supra* note 32, at 508 ("Traditionally the Common Heritage Concept has been understood to prohibit appropriation in outer space. The Outer Space Treaty and Moon Agreement are explicit in this prohibition."), *and* Risley, *supra* note 10, at 48 (suggesting that "the Outer Space Treaty could be amended . . . . [and discussing the need to] change space law to encourage free enterprise in space."), *with* Kelly M. Zullo, Note, *The Need to Clarify the Status of Property Rights in International Space Law*, 90 GEO. L.J. 2413, 2420 n.43 (2002) (acknowledging the idea that "Article II should be interpreted 'narrowly to prohibit only national appropriation'" (citing Wayne N. White,

Different interpretations of Article I have led commentators to reach conflicting conclusions as to the extent to which nations, let alone private entities, may engage in exploitation and control of extraplanetary resources.[55] While the Outer Space Treaty makes clear that space must be used for peaceful purposes, there is debate as to the treaty's stance on the need to share benefits within the scope of the *res communis* principle.[56] There is also disagreement with respect to whether private entities may appropriate celestial resources for economic gain.[57] Many commentators share the view, however, that commercial exploitation by private entities is prohibited under Article II of the Outer Space Treaty.[58] These private actors would operate as representatives of their respective countries, all of which are forbidden from asserting a claim to real property or natural resources in outer space.[59]

One commentator, Zach Meyer, argues that the Outer Space Treaty does *not* require reform, and has called for the creation of a "space district" to govern the allocation of extraterrestrial resources and "encourage private commercial space enterprises to exploit outer space."[60] Meyer sees this sort of regime as a way to resolve conflicts between spacefaring countries and the developing world—a tension recognized by the Outer Space Treaty—without amending the treaty itself.[61] Such a regime would be designed to supplement the Outer Space Treaty, not replace it. Meyer's vision essentially calls for a regulatory agency to be established, one that

---

Jr., *Real Property Rights in Outer Space*, SPACE FUTURE, http://www.spacefuture.com/archive/real_property_rights_in_outer_space.shtml (1998) (internal quotation marks omitted))).

55. *See, e.g.*, Brandon C. Gruner, Comment, *A New Hope for International Space Law: Incorporating Nineteenth Century First Principles into the 1967 Space Treaty for the Colonization of Outer Space in the Twenty-First Century*, 35 SETON HALL L. REV. 299, 332–33 (2004) (noting that an inherent problem with international treaties is that they often suffer from ambiguities due to their translation into several languages, and, in the case of the Outer Space Treaty, whether the nonappropriation principle is absolute or flexible); *see also* David Johnson, Comment, *Limits on the Giant Leap for Mankind: Legal Ambiguities of Extraterrestrial Resource Extraction*, 26 AM. U. INT'L L. REV. 1477, 1500 (2011) (arguing that the Outer Space Treaty's "expressed object and purpose to establish a general set of peaceful principles, rather than a detailed property rights system, color the analysis of its operative provisions").

56. *Compare* Meyer, *supra* note 32, at 250 (contending that the Outer Space Treaty does not prohibit private commercialization of space "outright," as long as "international interests are given their due consideration"), *with* Twibell, *supra* note 40, at 619 (arguing that the *res communis* principle "prevents man from receiving space's incomparable rewards").

57. Gruner, *supra* note 55, at 332. *But see* Heidi Keefe, *Making the Final Frontier Feasible: A Critical Look at the Current Body of Outer Space Law*, 11 SANTA CLARA COMPUTER & HIGH TECH. L.J. 345, 359 (1995) (examining the negotiating history of the Outer Space Treaty and noting that it is "the words 'by any other means' at the end of Article 2 which extend the limitations imposed by the Article to individuals as well as international or intergovernmental organizations. The first, and perhaps most persuasive argument is that all persons of the earth, whether juridical (corporations, organizations) or natural, are subject to some national jurisdiction and control. Consequently, they are extensions of the States Parties to the treaty, and can not accomplish independently that which the States are prevented from doing.") (citation omitted).

58. Zell, *supra* note 32, at 508. *See* Gruner, *supra* note 55, at 333 (outlining the competing views as to whether the Outer Space Treaty prohibits all property rights in outer space).

59. Gruner, *supra* note 55, at 333; Keefe, *supra* note 57, at 359.

60. Meyer, *supra* note 32, at 258–61.

61. *Id.* at 259 ("[A]n independent, international space district could potentially resolve the conflicts between developed space-faring States and undeveloped Earth-bound States and between public sovereigns and private enterprise.").

would facilitate and coordinate the exploitation of resources located beyond Earth's atmosphere.[62] His proposal is interesting in that it suggests that this type of space district would not necessarily be an international organization, "but instead a new national entity created by the international community."[63] Thus, it would be a "supra-national" organization whose citizenship and allegiance would be entirely new—citizenship belonging to Earth alone.[64] Meyer thus rejects the notion that the Outer Space Treaty prohibits private property rights and exploitation of natural resources because a supranational entity would not fall under the umbrella of the Outer Space Treaty.[65]

Perhaps not surprisingly, spacefaring countries, such as the United States, have begun to recognize the value that outer space holds, and are in favor of establishing its use for commercial purposes.[66] The developing world, however, objects to this view, arguing that commercial development would not benefit all mankind.[67] Its constituent nations tend to adhere to the principles originally set forth in the Outer Space Treaty; namely, that space exploration should be a communal pursuit with shared benefits.[68] This tension—that is, balancing economic efficiency with equitable access—will be discussed throughout the remainder of this Comment.

B. The Moon Agreement & Bogota Declaration

The Moon Agreement, opened for signature on December 18, 1979, received far less acceptance by the international community than the Outer Space Treaty, particularly among industrialized nations.[69] As of January 1, 2014, only fifteen countries are party to the Moon Agreement, none of which are spacefaring.[70] The Moon Agreement represents one of the best examples of the divide between spacefaring nations and the developing world. While the text of the agreement itself does little more than expand upon and clarify earlier text from the Outer Space Treaty, it was widely rejected and is considered the least successful of the five major space

62. *Id.* at 259–60.

63. *Id.* at 259.

64. *Id.* at 259–60.

65. *Id.* at 252.

66. *See, e.g.*, 51 U.S.C. § 50111(a) (2010) ("Congress declares that a priority goal . . . is the economic development of Earth orbital space. Congress further declares that free and competitive markets create the most efficient conditions for promoting economic development, and should therefore govern the economic development of Earth orbital space.").

67. Paxson, *supra* note 26, at 487–88.

68. *See id.* at 487 (noting that "developing countries favor a broad obligation to share the tangible benefits derived from space exploration as a means of promoting economic development").

69. Moon Agreement, *supra* note 11, 1363 U.N.T.S. at 3; *see also* Landry, *supra* note 24, at 534 (noting that the Moon Agreement's failure is due in large part to the fact that no major spacefaring countries have ratified it).

70. *See* United Nations Office for Outer Space Affairs, Status of International Agreements Relating to Activities in Outer Space (last visited Dec. 12, 2014), http://www.oosa.unvienna.org/pdf/limited/c2/AC105_C2_2014_CRP07E.pdf (providing a numerical breakdown of the number of countries party to each of the five international outer space treaties). This is a difference of eighty-eight countries when compared to the Outer Space Treaty. Those countries that have ratified the agreement include: Australia, Austria, Belgium, Chile, Kazakhstan, Lebanon, Mexico, Morocco, the Netherlands, Pakistan, Peru, Philippines, Saudi Arabia, Turkey, and Uruguay. *Id.*

treaties.[71]

Article 11 of the Moon Agreement states that "[t]he moon and its natural resources are the common heritage of mankind . . . . Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity . . . ."[72] The Moon Agreement therefore expressly forbids private ownership of resources extracted from or mined on the moon. Thus, there would be little economic incentive for spacefaring countries to carry out such recovery missions to exploit these extraterrestrial resources for commercial gain. While spacefaring countries are not bound by the Moon Agreement's terms, most *are* bound by the Outer Space Treaty, which contains similar language within its provisions.[73]

A second example of the divide between spacefaring nations and the developing world was seen in the Bogota Declaration.[74] In 1976, "eight equatorial nations asserted sovereignty over portions of the geostationary orbit directly over their respective territories."[75] These nations argued essentially that the geostationary orbit was not an extraterrestrial resource, but rather a terrestrial one because its existence was directly linked to and conditioned upon Earth's gravitational pull.[76] Their claims were in response to the growing number of telecommunication satellites being placed above their territories, which were launched by industrialized nations and private companies.[77] The Bogota Declaration was largely unsuccessful. Developed nations rejected the notion that developing states could assert ownership over segments of Earth's orbit; this would be a direct violation of the Outer Space Treaty's nonappropriation provision, Article II.[78]

Notwithstanding the Bogota Declaration's failure to secure certain property rights for its signatories, it sent a clear message to the industrialized world. Developing nations were not going to sit idly by while Earth's orbit came under the exclusive

---

71. *See* Blake Gilson, Note, *Defending Your Client's Property Rights in Space: A Practical Guide for the Lunar Litigator*, 80 FORDHAM L. REV. 1367, 1377 (2011) (noting that of the five major international treaties governing space travel, four were widely accepted by spacefaring nations; the Moon Agreement, however, is "widely viewed as a failure"). It is possible that the Moon Agreement was an attempt to clarify and resolve different interpretations of the Outer Space Treaty that are discussed in Part II.A.

72. Moon Agreement, *supra* note 11, 1363 U.N.T.S. at 26–27.

73. *See* Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2412, 610 U.N.T.S. at 207 ("[E]xploration 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, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."); *see also* Zell, *supra* note 32, at 491 (noting that the Moon Agreement acted to expound on the basic ideas and principles of the Outer Space Treaty).

74. *The Bogota Declaration*, 6 J. SPACE L. 193, 193-196 (1978) [hereinafter "Bogota Declaration"].

75. Jannat C. Thompson, *Space for Rent: The International Telecommunications Union, Space Law, and Orbit/Spectrum Leasing*, 62 J. AIR L. & COM. 279, 306 (1996).

76. Bogota Declaration, *supra* note 74, at 193 ("The equatorial countries declare that the synchronous geostationary orbit is a physical fact arising from the nature of our planet, because its existence depends exclusively on its relation to gravitational phenomena caused by the Earth, and for that reason it must not be considered part of the outer space. Therefore, the segments of synchronous geostationary orbit are an integral part of the territory over which equatorial States exercise their national sovereignty.").

77. Thompson, *supra* note 75, at 284–85, 306–07.

78. *Id.* at 307–08.

control of a small handful of industrialized nations and global companies.[79] Non-spacefaring nations essentially used the Bogota Declaration as a formal opportunity to object to the way that spacefaring nations exploited extraterrestrial resources. More specifically, it charged that spacefaring nations and private entities were in effect exploiting the geostationary orbit on a "first-come, first-served" basis—a concept inconsistent with the goal of equitable access underlying international aerospace law.[80]

Ironically, rejection of the Bogota Declaration reinforced the international community's adherence to the Outer Space Treaty's nonappropriation principle found in Article II.[81] In other words, the same spacefaring nations that claimed certain rights of exclusivity and access to the geostationary orbit were at the same time dismissing claims of ownership by non-spacefaring nations.

III. REGULATING TERRESTRIAL AND EXTRATERRESTRIAL COMMONS

A. Tragedy of the Anticommons

Because of the Outer Space Treaty's nonappropriation provision,[82] outer space may appropriately be categorized as a "commons."[83] Some scholars have posited that exploitation of resources beyond Earth's atmosphere is currently experiencing a "tragedy of the anticommons" type of situation.[84] Just as the traditional "tragedy of the commons" occurs where a shared resource is overexploited by individuals who consume it without internalizing the broader social costs,[85] the opposite may also be true. Where a resource is available to a group, but any benefit accrued must be shared equally with the entire group, the resource will be underexploited if the cost of resource

79. *Id.* at 308.

80. *Id.* at 290–93.

81. *See* Zullo, *supra* note 54, at 2421 (noting that when industrialized nations dismissed the Bogota Declaration's claims, it was evidence of "strong support for the [Outer Space] treaty's principle that limited outer space resources may not be appropriated").

82. *See* Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2413, 610 U.N.T.S. at 208 ("Outer space, including the moon 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.").

83. A "commons" may be thought of as a territory not subject to national control, but rather belonging collectively to the international community. *See* Lawrence D. Roberts, *A Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union*, 15 BERKELEY TECH. L.J. 1095, 1124 (2000) ("The fundamental instrument guiding space activity is the Outer Space Treaty. Because it was drafted at a time when space activity meant rare and expensive government forays . . . . the treaty focused on ensuring freedom of access and forestalling the exercise of national control . . . . As a consequence, outer space itself was [and still is] treated as a commons.") (citations omitted).

84. *See* Landry, *supra* note 24, at 528 (explaining that in light of the current legal framework governing space law, states have not been willing to expend financial resources to exploit the vast economic potential of space); *see also* Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 622 (1998) (noting that "[w]hen too many owners hold such rights of exclusion, the resource is prone to underuse—a tragedy of the anticommons").

85. *See* Heller, *supra* note 84, at 677 ("A *tragedy of the commons* can occur when too many individuals have privileges of use in a scarce resource. The tragedy is that rational individuals, acting separately, may collectively overconsume scarce resources. Each individual finds that she benefits by consumption, even though she imposes larger costs on the community.") These harmful social costs are commonly referred to as "negative externalities." *Id.* at 675.

recovery is borne solely by the individual.[86] As applied to the current body of international space law, proponents of this theory argue that

> [b]ecause each state has an equal right to the "benefits" derived from outer space, and because national sovereignty is prohibited, no state has been willing to bear the enormous cost of exploitation. This is made worse because the benefits of the use of outer space will be difficult to quantify until commercialization begins.[87]

In essence, the "tragedy of the anticommons" theory suggests that from an economic and commercial perspective, outer space is being underutilized. Until private actors are afforded a legal regime that guarantees a recognized right to recoup their investments—and, more importantly, an opportunity for a return on those investments—the market will remain at a standstill.

Like outer space, there are international commons located on Earth. Two of the most cited examples are the high seas and Antarctica.[88] These remote areas, though still terrestrial, are similar to extraplanetary bodies in terms of commercialization—that is, they have harsh environments and are difficult to access for the purpose of extracting minerals.[89] They also represent some of the only territory on Earth designated international areas, where no single state has a sovereign claim.[90] A closer examination of these two commons may shed light on the need for, and perhaps also the difficulty of, formulating an appropriate regime to regulate the use and commercial exploitation of extraterrestrial resources.[91]

"The branch of international law with the longest, most well-developed history is the law of the sea."[92] Like outer space, the high seas are governed by a series of international treaties enacted by the United Nations. Three of the most pertinent are the 1958 Geneva Convention on the High Seas,[93] the Convention on Fishing and Conservation of Living Resources of the High Seas,[94] and the United Nations

---

86. Landry, *supra* note 24, at 527–28.

87. *Id.* at 528.

88. *See* Shackelford, *supra* note 30, at 121 ("Outer space, the deep seabed, the Arctic, and Antarctica are similar in that they are in remote and relatively unexplored areas. Resources have only recently been identified and are regarded as common property under the common heritage or property of mankind. Recent developments in these branches of international law also show similarities. . . . In all of these regimes, capital-exporting nations are increasingly seeking license for greater private economic activity.") (internal citations omitted); *see also* Risley, *supra* note 10, at 57 (noting that space may be analogized to the high seas and Antarctica because all three possess resources that could benefit all nations).

89. Coffey, *supra* note 32, at 129.

90. *Id.*

91. *See* Barbara Ellen Heim, Note, *Exploring the Last Frontiers for Mineral Resources: A Comparison of International Law Regarding the Deep Seabed, Outer Space, and Antarctica*, 23 VAND. J. TRANSNAT'L L. 819, 845 (1990) ("The basic similarities between the areas are threefold: the minerals lie outside any nation's territory; important technological difficulties require substantial expenditures for mineral exploration now and in the future; and environmental concerns are a high priority. All three areas also face the problems of resolving the debate over the common heritage principle and establishing an international management regime that emphasizes environmental protection.").

92. Shackelford, *supra* note 30, at 122.

93. The Convention on the High Seas, *opened for signature* Apr. 29, 1958, 13 U.S.T. 2312, 450 U.N.T.S. 82.

94. The Convention on Fishing and Conservation of Living Resources of the High Seas, *opened for signature* Apr. 29, 1958, 17 U.S.T. 138, 559 U.N.T.S. 285.

Convention on the Law of the Sea.[95] Collectively, these treaties sought to establish a legal framework to declare what would and would not be tolerated with respect to economic activities and assertions of national sovereignty over the high seas.[96] In fact, the Law of the Sea is cited as one of the origins of the "province of all mankind" and "common heritage" principles, later included in the Outer Space Treaty and Moon Agreement, respectively.[97] There was once a divide among nations seeking to exploit the oceans that closely resembles the one seen today regarding rights in extraterrestrial resources:

> Technologically advanced, sea-faring nations felt that the [oceanic] resources should become the property of the nation that extracted them. Smaller nations without the capabilities or funds to launch expeditions felt that the profits and benefits of the resources should be shared among all nations, since the high seas are international territory belonging equally to all nations.[98]

The sea treaties also attempted to establish ground rules to promote the conservation of oceanic resources through sustainable commercial practices. Today, the general effect of these treaties ensures that a nation or private entity may consume resources from the oceans so long as it does not prevent another nation from doing so.[99] Environmental concerns and prevention of overfishing are subsumed within this principle.[100]

Antarctica provides another useful comparison to outer space, not just because of its status as a commons, but also because of its history under international law. "The Antarctic Treaty,[101] the first and core treaty of the [Antarctic Treaty System], was born out of Cold War hostilities and tensions among the competing claimant countries."[102] Seven countries had staked claim to vast portions of the continent.[103]

> The Antarctica Treaty established three main goals: (1) provide that the continent is used solely for peaceful purposes; (2) ensure the prohibition of military activities; and (3) support freedom of scientific research. While the treaty did not solve disputed sovereignty issues, the treaty did freeze all claims on the continent and prohibited the assertion of new claims or the enlargement of existing claims.[104]

In 1998, a comprehensive environmental agreement was passed that placed a

---

95. The United Nations Convention on the Law of the Sea, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397; *see also* Johnson, *supra* note 55, at 1488–92 (discussing the intricacies of the laws that govern the high seas); Shackelford, *supra* note 30, at 120–30 (same).

96. Johnson, *supra* note 55, at 1490–92; Shackelford, *supra* note 30, at 124.

97. *See* Henry R. Hertzfeld & Frans G. von der Dunk, *Bringing Space Law into the Commercial World: Property Rights Without Sovereignty*, 6 CHI. J. INT'L L. 81, 96 (2005) (noting that the common heritage concept is found in the Law of the Seas Treaty).

98. Coffey, *supra* note 32, at 129 (internal citation omitted).

99. Johnson, *supra* note 55, at 1490–91.

100. *Id.*

101. The Antarctic Treaty, Dec. 1, 1959, 12 U.S.T. 794, 402 U.N.T.S. 71.

102. Christopher C. Miller, Note, *To the Moon and Beyond: The United States and the Future of International Space Law*, 35 SUFFOLK TRANSNAT'L L. REV. 121, 135 (2012).

103. *Id.* at 134. France, Argentina, Norway, Great Britain, Chile, Australia, and New Zealand all asserted competing claims. *Id.*

104. *Id.* at 135 (internal citations omitted).

fifty-year moratorium on mining in Antarctica.[105] This approach was adopted as an alternative to a permanent ban.[106] While the treaty does not expressly include the "common heritage of mankind" language, it effectuates the concept nonetheless.[107] Antarctica's legal history and harsh environment make it a good source of comparison to the laws governing extraterrestrial commons. Both treaty systems were created during the 1960s and placed great emphasis on peaceful scientific development. One of the primary differences, however, is that mining in Antarctica appears to be feasible in the future.[108] The current laws governing outer space, on the other hand, impose significant economic barriers on mining in outer space.

In addition to the high seas and Antarctica, there are other examples—although not as familiar—that prove illustrative of alternative potential solutions to establishing commercial rights in outer space. The Guano Islands Act of 1856[109] was enacted by Congress to meet the growing demand of American farmers seeking to use guano as fertilizer.[110] The Act gave the discoverer of guano deposits on uninhabited islands a protected right to profit from the deposits without vesting the discoverer with absolute property rights over the island itself.[111] In essence, the United States issued licenses to private citizens engaging in resource recovery activities on foreign lands.[112] This model—that is, private citizens being granted limited property rights by the U.S. government to resources not located on American soil—has been proposed by one commentator as a means of effectively regulating the next generation of spacefaring activities.[113]

B. The International Telecommunication Union

Notwithstanding the current legal hurdles and ambiguities facing the private sector, there is one segment of the global economy within which private entities have been able to leverage outer space for significant economic gain: telecommunications. The International Telecommunication Union (ITU) is "the United Nations specialized agency for information and communication technologies—ICTs."[114] The ITU allocates global radio spectrum and orbital satellite slots for both states *and* private

105. *Id.* at 136–37.

106. *Id.* at 137.

107. *See* Buxton, *supra* note 45, at 696 ("The Antarctic Treaty came into force in the early 1960s, when the international community strived to establish that some areas simply belong to all inhabitants of the earth. . . . The Antarctic Treaty does not expressly include common heritage language, but application of the principle to Antarctica appears widely accepted.").

108. Miller, *supra* note 102, at 137.

109. 48 U.S.C. §§ 1411–19 (2014).

110. Matthew Johnshoy, Comment, *The Final Frontier and a Guano Islands Act for the Twenty-First Century: Reaching for the Stars Without Reaching for the Stars*, 37 J. CORP. L. 717, 720–21 (2012) Guano consists of bat feces and urine. Christina Burnett, *The Edges of Empire and the Limits of Sovereignty: American Guano Islands*, 57 AM. Q. 779, 779 (2005).

111. Johnshoy, *supra* note 110, at 721.

112. *Id.*

113. *Id.* at 736.

114. *About ITU*, INT'L TELECOMM. UNION, http://www.itu.int/en/about/Pages/default.aspx (last visited Dec. 12, 2014).

organizations.[115] It also establishes standards to ensure the coordination of interconnected networks and works to improve the developing world's access to ICTs.[116] In short, the ITU designates where each satellite shall be placed in outer space and determines the radio frequencies on which it will operate.[117]

The ITU is unique in that it has been "[a]n organization based on public-private partnership since its inception."[118] One hundred ninety-three countries and approximately seven hundred private entities and academic institutions comprise its membership base.[119] When a government or private company wishes to launch a telecommunications satellite into space, it is likely to be placed at an elevation of 22,300 miles above Earth's equator.[120] At precisely this latitude and altitude, objects orbit Earth exactly once in a twenty-four-hour period.[121] From Earth, these objects appear to be stationary since their orbits are synchronized with Earth's rotation. This positioning allows satellites to constantly transmit their signals to approximately forty percent of Earth's surface.[122] This also allows for seamless coordination of signal and frequency transmission between destinations on Earth.[123] Placement of geostationary satellites above Earth's equator may be considered the impetus for the Bogota Declaration; developing nations recognized that the space above their countries was a valuable and limited resource.[124]

Because this satellite band is comprised of a finite number of "slots," countries and companies alike must apply to the ITU and outline their desired use for each slot before actually launching a satellite into orbit.[125] This has in essence created a merit-based system,[126] whereby any organization—irrespective of its status as a public or

---

115. *Id.*

116. *Id.*

117. *Id.* It is worth noting that the ITU allocates geostationary positions and radio frequencies *after* they have been approved by an applicant's respective sovereign state. The ITU may be thought of as

> an efficiency-enhancing resource through which sovereign states . . . avoid potential usage conflicts and as a convenient forum for resolving disputes that arise. Nevertheless, the economic incentives perpetuated by the process as well as the legal preferences accorded to successful applicants have a significant impact on the development and operation of geostationary systems.

Roberts, *supra* note 83, at 1111.

118. *About* ITU, *supra* note 114.

119. *Id.*

120. *See* Roberts, *supra* note 83, at 1099–1100 (discussing the optimal conditions in outer space for the placement of communication satellites).

121. *Id.* at 1099.

122. *Id.* at 1100.

123. *Id.*

124. *Id.* at 1125–26. See *infra* notes 74–81 and accompanying text for a discussion of the Bogota Declaration.

125. Roberts, *supra* note 83, at 1101–02, 1112. Lawrence D. Roberts notes that while there are technically 1,800 available slots, a far fewer number are actually suitable for communication satellites as many slots are located over oceans where signals are not as strong compared to those placed above North America or Europe. *Id.*

126. *See* Brittingham, *supra* note 26, at 46 (noting that "[t]he ITU temporarily grants the owners of these satellites specific GEO positions on a first-come, first-served basis so that no spaces remain reserved and therefore unused") (footnote omitted).

private entity—may occupy designated areas of space for a defined period of time.[127] However, the ITU has also stated that a country's status as a developing nation may be considered when reviewing applications.[128] The ITU employs a two-tiered allocation system. First, it uses a "first-come, first-served" basis, which developed, spacefaring nations tend to prefer.[129] Secondly, it relies on an *a priori* system that grants each nation a designated frequency and future use of an orbital slot, regardless of technological capacity.[130] Naturally, developing nations tend to favor this approach.[131]

C. Proposed Solutions for Regulation of Extraterrestrial Commons

Those scholars who argue that the Outer Space Treaty must be amended offer solutions of their own, each at a different point along the spectrum between equitable access and economic efficiency. One of the most common calls for reform involves the establishment of some type of international authority to adequately monitor and regulate the next generation of spacefaring activities.[132] While the United Nations provides a global stage for international debate and humanitarian issues, it lacks the ability to foster a concerted effort toward establishing a viable space industry—one comprised of both public *and* private entities.[133] One commentator notes that the first step toward a successful legal regime is the creation of an international management framework.[134] "Chaos would result if substantial development of [extraplanetary] minerals . . . began without a management system already in place."[135]

Barbara Ellen Heim suggests that one way to equitably distribute rights among developing and developed nations would be to divide extraplanetary bodies "into

---

127. Part of the ITU application process requires applicants to specify how long they intend to use the orbital slot by estimating the life expectancy of their satellite. From a legal standpoint, it appears that these slots resemble quasi licenses as opposed to leases or real property. *See* Hertzfeld & von der Dunk, *supra* note 97, at 83 (positing that although the "right to use the [orbital] spectrum is not exactly a traditional property right, it does grant use of a limited resource in space for business purposes for the lifetime of the particular satellite proposed to be used").

128. *See* Susan Cahill, *Give Me My Space: Implications for Permitting National Appropriation of the Geostationary Orbit*, 19 WIS. INT'L L.J. 231, 240 (2001) (discussing a 1982 amendment to the ITU radio regulations, which requires the ITU to take into account "the special needs of developing countries") (internal quotation marks omitted).

129. *See id.* at 238 (stating that this is an *a posteriori* method of assignment, which protects satellites already in orbit).

130. *Id.* at 238–39.

131. *Id.* at 239.

132. *See, e.g.*, Laird, *supra* note 45, at 94 ("A free-market approach . . . that provides defined property rights . . . . should be developed via an international regulatory regime to prevent inconsistent results that may lead to international conflicts.") (footnote omitted).

133. *See* Robert C. Bird, *Procedural Challenges to Environmental Regulation of Space Debris*, 40 AM. BUS. L.J. 635, 645–649 (2003) (noting that informal professional contacts within the scientific community would be a more effective tool for changing international standards surrounding space debris, despite the ability of the United Nations to impose military and economic sanctions).

134. Heim, *supra* note 91, at 845.

135. *Id.* at 845; *see also* Twibell, *supra* note 40, at 639 ("A legal regime would have to be put into place that could oversee and regulate celestial property distribution and inherent rights to claim property. Such a regime would take into account the use of various portions of space and of the rights of the owners allowing them to be certain that use of the property will be free from harmful interference. Productive use of the celestial property would be one way of insuring access and promoting investment.") (footnotes omitted).

distinct geographic portions, with each nation getting a share."[136] Under this proposal, "nations possessing the technology could exploit their portions today; developing nations would reserve their region for future development."[137]

Other scholars and commentators focus less on equitable access and more on economic efficiency principles.[138] Some suggest that an auction-system model would allow resources to flow to those companies or nations that value them most.[139] Proponents of this theory acknowledge, however, that the primary beneficiaries of this model will be corporations and developed nations, not developing countries.[140] This approach closely resembles proposals to subject the final frontier to a level of free market capitalism reminiscent of the United States in the early twentieth century.

Other scholars have suggested that an international organization be established, one whose role would be more akin to a deed registry.[141] This proposal advocates for the acquisition of private property rights and envisions the role of the international authority to be only "semi-centralized."[142] It would simply apply an agreed-upon rule for resource allocation.[143] Moreover, this argument posits that one way to bridge the gap between spacefaring nations and the developing world would be to set aside "development preserves."[144] In essence, it would require technologically capable entities to set aside roughly ten percent of a given resource on an extraplanetary body in order to ensure developing nations have future access.[145] The proponents argue that this approach "makes good political sense since it will give developing countries a greater stake in peaceful space development, and perhaps even bring them more readily into an international regime to recognize property rights in the first place, rather than encouraging them to adopt the role of spoilers."[146]

Additionally, the authors propose that environmental research and conservation preserves ought to be incorporated into any system of property allocation, the reason being:

> If preserves are built into the development scheme from the beginning, many of the problems of terrestrial environmental preservation can be avoided. If it

136. Heim, *supra* note 91, at 846.

137. *Id.* (footnote omitted). Heim further states that "[a]nother possibility is to allow those nations possessing the necessary technology to exploit any region they choose on the condition that they place a percentage of their profits into a fund that would be available in the future to countries in earlier technological stages." *Id.*

138. *See, e.g.*, Charity Trelease Ryabinkin, Note, *Let There be Flight: It's Time to Reform the Regulation of Commercial Space Travel*, 69 J. AIR L. & COM. 101, 134 (2004) (arguing that "[b]y facilitating competition among private companies, deregulation would reduce costs to society to the extent that it renders government-funded space expenditure[s] unnecessary") (footnote omitted).

139. *See* Leslie I. Tennen, *Towards a New Regime for Exploitation of Outer Space Mineral Resources*, 88 NEB. L. REV. 794, 825–30 (2010) (examining a variety of proposals for the regulation of extraterrestrial resources).

140. *Id.* at 828.

141. Robert P. Merges & Glenn H. Reynolds, *Space Resources, Common Property, and the Collective Action Problem*, 6 N.Y.U. ENVTL. L.J. 107, 119 (1997).

142. *Id.*

143. *Id.*

144. *Id.* at 123.

145. *Id.* at 123–24.

146. *Id.* at 124.

> turns out over some suitably long period of time that little interest is expressed in the preserved areas, then they can be auctioned off or given to developing countries.[147]

In sum, under this proposal roughly two-thirds of a given resource may be exploited under a free market system, with one-third being preserved for developing nations, environmental research, and scientific study. Of the various solutions discussed, this one comes closest to striking a balance between economic efficiency and equitable access.

IV. BENEFITS OF SPACE EXPLORATION

Before addressing *how* the law needs to change, it is important to first understand *why* it needs to change. In other words, why should the private sector care about exploiting outer space for economic gain in the first place? This Section briefly discusses the primary and secondary benefits that may be captured from the extraction of extraterrestrial resources.

A. Primary Benefits of Space Exploration

Maximizing our use of extraterrestrial resources could fundamentally change the way humans experience life on Earth. The U.S. Energy Information Administration, a subsidiary of the U.S. Department of Energy, projects that "world energy consumption will grow by 56 percent between 2010 and 2040."[148] Setting aside the debate over climate change, it is clear that many of Earth's natural resources are finite.[149] The rate at which humans consume natural resources is unsustainable,[150] and a growing body of evidence suggests that we are causing irreparable harm to some of Earth's most fragile ecosystems.[151] Outer space, however, as far as we can tell, is limitless.[152]

While the thought of a permanent human presence in outer space may seem likely only in the distant future, significant strides have already been taken toward achieving that goal. The International Space Station, a joint venture pursued by the United States, Russia, the European Space Agency, Japan, and Canada, has had at least one person

147. *Id.*

148. U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, INT'L ENERGY OUTLOOK 2013 DOE/EIA 0484 1 (2013), *available at* http://www.eia.gov/forecasts/ieo/pdf/0484(2013).pdf. It further predicts that worldwide energy-related carbon dioxide emissions will experience a forty-six percent increase during the same time period. *Id.*

149. WWF, LIVING PLANET REPORT 2012: BIODIVERSITY, BIOCAPACITY AND BETTER CHOICES 136 (2013), *available at* http://assets.worldwildlife.org/publications/333/files/original/Living_Planet_Report_2012_Biodiversity__biocapacity_and_better_choices.pdf?1345733116.

150. *Id.* at 40 (explaining that since the 1970s humans have increasingly consumed more resources annually than the planet can renew in a year).

151. *Id.* at 10 (noting that "continued increases in greenhouse gas emissions will irreversibly commit the world to a global average temperature rise . . . which will severely disrupt the functioning of almost all global ecosystems and dramatically affect human development and well-being").

152. *How Big is Our Universe?*, NAT'L AERONAUTICS & SPACE ADMIN., http://www.nasa.gov/audience/foreducators/5-8/features/F_How_Big_is_Our_Universe.html (July 15, 2014) (discussing how we are unable to determine the size of the universe because light from its more distant parts has not yet reached us).

physically manning the controls in space for over a decade.[153] Since its launch on November 20, 1998, the International Space Station has contributed a wealth of scientific knowledge to our understanding of both Earth and the cosmos.[154] It has also allowed scientists to study outer space's environment and its long-term impact on the human body.[155] With the explosive rate of global population growth over the past few decades, the number of humans living on Earth is expected to reach 10.9 billion by the year 2100.[156] Exploring the idea of life-supporting civilizations in outer space could present a viable solution to this rapid growth. Some private entities have confronted this dilemma.

Mars One is a nonprofit foundation whose mission is to establish a permanent human presence on Mars by 2025 using existing technologies.[157] The project, funded through private investment and crowdfunding, has planned several unmanned preparatory missions, beginning in 2018, to ensure that adequate supplies and resources are waiting for the astronauts upon their arrival.[158] Mars One announced that it finalized contracts with Lockheed Martin and other satellite companies to develop concept models for a robotic lander and a communications satellite that will orbit Mars.[159] Mars One's goal is to send four astronauts to Mars every two years at a cost of $6 billion per mission.[160] Noteworthy about the cost per mission is that NASA once estimated it would require roughly $100 billion of government funding to successfully bring humans to Mars and safely bring them back to Earth.[161]

Of the more than two hundred thousand applicants from across the globe to apply, Heidi Beemer, a twenty-five-year-old first lieutenant with the United States Army, was selected as one of the 1,058 candidates who will be interviewed and medically screened by Mars One to gauge mental and physical stamina for the seven-month journey to Mars.[162] Should she be selected as one of Mars One's astronauts, she will begin a nine-year training regimen to prepare her for life on Mars.[163] There is one major caveat to being selected as a Mars One astronaut—the missions are *not* designed to bring people

153. *International Space Station: Facts and Figures*, NAT'L AERONAUTICS & SPACE ADMIN., http://www.nasa.gov/mission_pages/station/main/onthestation/facts_and_figures.html#.VFLGjEsQ7wI (noting that the "International Space Station marked its 10th anniversary of continuous human occupation on Nov. 2, 2010") (last updated Nov. 3, 2014).

154. *Id.*

155. *See, e.g.*, *Student Features: My How You've Grown!*, NAT'L AERONAUTICS & SPACE ADMIN., http://www.nasa.gov/audience/forstudents/5-8/features/F_How_Youve_Grown_5-8.html (Feb. 26, 2004) (explaining that an astronaut's height may increase by up to two inches while in orbit due to a lower gravitational pull on the body's spine).

156. Floyd Norris, *Population Growth Forecast From the U.N. May Be Too High*, N.Y. TIMES, Sept. 20, 2013, at B3.

157. Philip Grey, *2 Tenn. Soldiers Make First Cut for Mars Mission*, USA TODAY (Jan. 3, 2014, 6:59 AM), http://www.usatoday.com/story/news/nation/2014/01/03/fort-campbell-soldiers-mars-mission/4301759/.

158. *Id.*

159. *Id.*

160. *Id.*

161. *Id.*

162. *Id.*

163. *See Roadmap*, MARS ONE, http://www.mars-one.com/mission/roadmap (last visited Dec. 12, 2014) (indicating that applicants will start training in 2015, which will continue until the launch in 2024).

back to Earth.[164] That's correct, these are one-way tickets to the Red Planet. No other organization appears more focused on establishing a permanent human presence in outer space.

In addition to pure human intrigue, depletion of Earth's natural resources will also likely be a primary catalyst that causes further exploration of extraterrestrial resources. Scientists estimate that the moon and certain other celestial bodies possess enormous quantities of useful minerals and precious metals that could power Earth for centuries.[165] The estimated quantities are so great that as technology develops and becomes cheaper and more scalable, there will eventually be a positive cost-benefit incentive to pursue mining efforts on extraplanetary bodies.[166]

The moon, Mars, and near-Earth asteroids (NEAs) present the most feasible sites for mining operations.[167] It is estimated that the moon possesses enough Helium-3 to power Earth for generations.[168] Scientists predict that a mere two cargo loads (roughly forty tons) of this compound has the capacity to power the whole United States—which consumes roughly one-quarter of the world's energy supply—for an entire year.[169] To put that number in perspective, U.S. coal consumption totaled 889.2 million tons in 2012.[170]

In addition to the moon's Helium-3 deposits, several NEAs are believed to possess concentrated quantities of precious metals such as iron, nickel, gold, platinum, and cobalt.[171] For example, the asteroid 3554 Amun is approximately two kilometers long and contains an estimated $8 trillion worth of nickel and iron, another $6 trillion worth of cobalt, and $6 trillion of other precious metals.[172] Because it possesses a weak

---

164. *Is This Ethical?*, MARS ONE, http://www.mars-one.com/faq/health-and-ethics/is-this-ethical (last visited Dec. 12, 2014).

165. *See* Richard B. Bilder, *A Legal Regime for the Mining of Helium-3 on the Moon: U.S. Policy Options*, 33 FORDHAM INT'L L.J. 243, 243–46 (2010) (discussing the compound Helium-3 as a potential clean alternative fuel source for Earth's energy needs).

166. *See id.* at 246–47 (noting that while the harvesting of Helium-3 on the moon is "at best decades away, the implications of such a development could be far-reaching and profound") (footnote omitted).

167. NEAs are defined as those asteroids with orbits within 0.3 Astronomical Units of Earth's orbit. One Astronomical Unit represents the distance between the Sun and Earth. Hence, these are some of the closest objects to planet Earth, and may even be potentially hazardous because their orbits could eventually intersect with Earth's. *Near Earth Asteroids (NEAs): A Chronology of Milestones*, INT'L ASTRONOMICAL UNION (Oct. 7, 2013), http://www.iau.org/public/themes/neo/nea.

168. Bilder, *supra* note 165, at 243–47 (discussing the potential use of Helium-3 mined from the moon as a sustainable alternative to the world's current dependence on fossil fuels). There are scarce amounts of Helium-3 on Earth, but there are believed to be substantial quantities located on the moon and other celestial bodies. *Id.* at 243. Helium-3 is important for mining efforts in outer space because it is believed to be a form of clean nuclear energy. *Id.* at 243, 246. In other words, Helium-3 may represent an abundant, nonpolluting source of energy capable of powering Earth for generations to come. *Id.* at 247.

169. *Id*. at 246. Cargo load in this context refers to the cargo capacity of one U.S. space shuttle. *Id.*

170. U.S. ENERGY INFO. ADMIN., ANNUAL COAL REPORT 2012 vii (2013), *available at* http://www.eia.gov/coal/annual/pdf/acr.pdf.

171. *See* Reinstein, *supra* note 32, at 60 (discussing the quantities of precious metals and raw materials contained within NEAs that could ultimately incentivize extraterrestrial mining efforts); *see also* Zell, *supra* note 32, at 490–91 (noting that although celestial bodies contain vast quantities of these precious metals, legal uncertainties concerning property rights could limit mining efforts); Landry, *supra* note 24, at 525 (noting that Mars is thought to possess significant quantities of silicon).

172. John Adolph, *The Recent Boom in Private Space Development and the Necessity of an*

gravitational field, 3554 Amun presents ideal conditions for extraterrestrial mining.[173] As of 2012, scientists have discovered nine thousand NEAs, many of which are located not much farther from Earth than our moon.[174] And it is estimated that this number could represent as little as one percent of the total number of NEAs that we can reach *already* given our current technological capabilities.[175]

The company that demonstrates an ability to recover resources from NEAs could very well be on its way to becoming the richest company in the world. A useful example is provided by 3554 Amun, which contains an estimated $20 trillion of precious metals.[176] To put that number in context, the company that is able to harvest and recover all of 3554 Amun's mineral deposits would be valued at forty times greater than Apple, Inc.—currently the world's most valuable corporation with a market capitalization of more than $500 billion.[177] Thus, the economic incentives to pursue commercial space efforts are readily apparent.

The technology that will physically bring humans and machinery to these asteroids and extract minerals on a systematic and continuous basis is still in its infancy.[178] However, necessity tends to breed innovation. Earth's increasing reliance on fossil fuels, coupled with rapid population growth, could soon force governments and companies alike to look to the sky for answers. As technology continues to reveal more efficient and effective ways to harvest these valuable resources from extraplanetary objects, the private sector will become increasingly involved with such recovery efforts. However, investors will only become more involved if they are assured that their efforts will be rewarded and legally recognized by the international community.[179] Hence, private entities need a stable and predictable legal landscape to ensure that not only will they have the ability to recover these resources, but a legally recognized right to do so.[180] Current international laws do not provide the private sector with this peace

---

International Framework Embracing Private Property Rights to Encourage Investment, 40 INT'L LAW 961, 976 (2006).

173. *Asteroids*, NAT'L SPACE SOCIETY, http://www.nss.org/settlement/asteroids (last updated Apr. 26, 2012).

174. Chris Taylor, *This $20 Trillion Rock Could Turn a Startup Into Earth's Richest Company*, MASHABLE (Apr. 26, 2012), http://mashable.com/2012/04/26/planetary-resources-asteroid-mining-trillions/; *see also* William J. Broad, *Vindication for Entrepreneurs Watching Sky: Yes, It Can Fall*, N.Y. TIMES, Feb. 17, 2013, at A1 (discussing NASA's estimate of twenty thousand asteroids and comets whose orbits are close enough to Earth for a potential collision).

175. *See* Taylor, *supra* note 174 (estimating that the number of NEAs discovered so far represents only one percent of the total that is out there).

176. *Id.*

177. *Id.*

178. Companies like Virgin Galactic have yet to operate their commercial space tourism ventures on a regular basis. *See* Matt Novak, *15 Years of Virgin Galactic's Failed Space Age Promises*, GIZMODO AUSTRALIA (May 15, 2014 12:00 AM), http://www.gizmodo.com.au/2014/05/15-years-of-virgin-galactics-failed-space-age-promises/ (indicating that Virgin Galactic has yet to operate its commercial space tourism ventures); Kenneth Chang, *Privately Financed Spaceship Roars Closer to Space*, N.Y. TIMES, Apr. 29, 2013, http://www.nytimes.com/2013/04/30/science/space/virgin-galactics-spaceshiptwo-inches-closer-to-space.html (discussing delays to Virgin Galactic's original plan to begin commercial flights in 2007 due to technological challenges).

179. See *supra* Part III.A for a discussion of the tragedy of the anticommons theory and how it explains the underutilization of extraterrestrial resources.

180. See *supra* Part III.C for an overview of various proposals to create a regulatory regime that

of mind.[181]

B. Secondary Benefits of Space Exploration: Positive Externalities

Because outer space presents an environment unlike any on Earth, new technologies are constantly required to further explore its conditions. Over time, these new technologies find uses in other sectors of the economy. In 1962, as a result of a congressional mandate issued through the Space Act of 1958,[182] NASA created its Technology Utilization Program.[183] The goal of the program was to actively facilitate the transfer of technology developed by NASA to the private sphere.[184] Products put to new uses in other areas of the economy would later be called "spinoff technologies."[185] As of 2012, there are approximately 1,800 documented NASA spinoff technologies used across a variety of industries.[186] The program attracted so much attention that, since 1974, NASA has published annual reports detailing its new spinoff technologies.[187]

For example, main engine fuel pumps originally designed for NASA's rockets were later used to create artificial heart pumps.[188] Heat-resistant material formulated for the high temperatures experienced during reentry has been incorporated into the uniforms of firefighters.[189] NASA once used memory foam to improve crash protection measures for its pilots.[190] Today, that same material is commonly used in consumer mattresses and pillows.[191] Ultrasonic detectors, originally used to identify hydrogen leaks in space shuttle fuel systems, are now used in factories and industrial plants across America to identify gas leaks.[192] These detectors not only make factories safer

---

recognizes property rights in outer space.

181. See *supra* Part II.A for a discussion of the current debate over the meaning of the Outer Space Treaty and its impact on ownership of extraterrestrial resources.

182. National Aeronautics and Space Act of 1958, Pub. L. No. 85-568, 72 Stat. 426) (codified as amended in scattered sections of 5, 10, 18, 42, and 50 U.S.C.).

183. *About Spinoff*, NASA SPINOFF: OFFICE OF THE CHIEF TECHNOLOGIST, http://spinoff.nasa.gov/spinhist.html (last visited Dec. 12, 2014); *see also* 51 U.S.C. § 50116(a) (2014) ("The Administrator shall execute a commercial technology transfer program with the goal of facilitating the exchange of services, products, and intellectual property between the Administration and the private sector. This program shall place at least as much emphasis on encouraging the transfer of Administration technology to the private sector ('spinning out') as on encouraging use of private sector technology by the Administration.").

184. *About Spinoff*, *supra* note 183.

185. *Spinoff Frequently Asked Questions*, NASA SPINOFF: OFFICE OF THE CHIEF TECHNOLOGIST, http://spinoff.nasa.gov/spinfaq.htm#spinfaq (last visited Dec. 12, 2014).

186. *Id.*

187. *About Spinoff*, *supra* note 183 (stating that the Spinoff magazine is distributed to politicians, academics, CEOs, the news media, and the general public).

188. J.R. Wilson, *Space Program Benefits: NASA's Positive Impact on Society*, NAT'L AERONAUTICS & SPACE ADMIN., http://www.nasa.gov/50th/50th_magazine/benefits.html (last updated Aug. 27, 2008).

189. *NASA Technologies Benefit Our Lives*, NAT'L AERONAUTICS & SPACE ADMIN., http://spinoff.nasa.gov/Spinoff2008/tech_benefits.html (last visited Dec. 12, 2014).

190. *Spinoff Frequently Asked Questions*, NASA SPINOFF: OFFICE OF THE CHIEF TECHNOLOGIST, *supra* note 185.

191. *Id.*

192. OFFICE OF THE CHIEF TECHNOLOGIST, NASA, SPINOFF 64 (2012), *available at* http://spinoff.nasa.gov/Spinoff2012/pdf/Spinoff2012.pdf.

places to work, but also save companies money.[193] Some civilian aircrafts now use voice-recognition software to change flight plans midflight. This software makes plotting a new course safer as the pilot remains in control at all times, and also saves fuel because a new plan can be entered in roughly ten percent of the time.[194]

The list goes on. Medicine, energy, national defense, consumer goods, telecommunications, and information technology—all of these industries have benefited immensely from research and development efforts originally pursued by NASA.[195] The Technology Utilization Program may be one of the best examples in American history of a government entity providing a return on the taxpayers' investment. These technologies have found uses in other markets and have created jobs, cut costs, improved safety, and generally benefited the private sector. It suffices to say that NASA's efforts have created positive externalities for the global economy, which have led to secondary benefits for all mankind.

V. AMENDING INTERNATIONAL AEROSPACE LAW

A. Why Amend?

The time has come for the international community to shift its focus. The lens through which we view outer space should not be one of fear, but rather one of fortune. The technical and monetary barriers to space travel are large enough;[196] added legal hurdles will benefit no one. Times have changed; the law has not.

The common heritage of mankind concept is not inherently flawed. It represented the best solution at a time when the world was on the brink of a nuclear war, where the actions of two nations had the potential to irreparably damage the entire planet.[197] Hence, mandating that space be used strictly for peaceful purposes and with due regard for all other states was an admirable and noble goal that drew support from over one hundred countries, both spacefaring and non-spacefaring.[198] The simple fact, however, is that the geopolitical landscape has changed since the Cold War.[199] Political relations between the United States and Russia, while they may never be perfect, do not remotely resemble what they once were.[200]

The Outer Space Treaty was written at a time when Earth's orbit was perceived as

193. *Id.*

194. *Id.*

195. *Spinoff Frequently Asked Questions*, *supra* note 185.

196. *See* Keefe, *supra* note 57, at 347 (asserting that "the technical problems, while difficult to solve, are not as drastic or injurious to the progress of space exploration and exploitation as the problems which exist behind the space treaties").

197. *See* Gabrynowicz, *supra* note 13, at 1043 (discussing how the impetus for the Space Race was the potential of a nuclear war between the United States and Soviet Union).

198. *See* UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, *supra* note 70 (providing a numerical breakdown of the number of countries party to each of the five international outer space treaties).

199. *See* Risley, *supra* note 10, at 57 (noting that "[t]he Cold War concern was that if the United States and Soviet Union were to dominate space, and there were a confrontation between them, global disaster could result").

200. *See* Twibell, *supra* note 38, at 276 (recognizing that "times have changed. The Union of Soviet Socialist Republics no longer exists. The Cold War is gone and has been for some time. There could not be a clearer demarcation of a change in the political arena.").

little more than a battlefield, rather than an untapped market.[201] Hence, the first step toward establishing a legal regime capable of supporting and regulating exploitation of celestial resources is to amend the Outer Space Treaty.[202] Through their work on the International Space Station, the United States and Russia have indeed dominated space. However, this cooperative is regarded as one of the best examples of international collaboration in mankind's history, and has afforded *all* nations access to unprecedented scientific research and knowledge.

The Outer Space Treaty must be amended, and not abrogated altogether, for several reasons. First, abrogating the treaty and attempting to enact an entirely new one could lead to similar disputes and ambiguities that are posed by the current version.[203] In other words, energy should be expended to ensure that the Outer Space Treaty is adequately adjusted to reflect the current state of geopolitical conditions, our recent discovery of the wealth that lies beyond Earth's atmosphere, and current technological capabilities. By rewording the no-sovereignty provision (Article II) to expressly state that extraterrestrial resources may be acquired and legally recognized under certain conditions, the Outer Space Treaty would provide a predictable legal landscape within which private entities could operate.[204]

The second, and perhaps more important justification for amendment, is that the Outer Space Treaty still has a role in international law. The notion that outer space should be used for peaceful purposes should remain intact within an amended treaty.[205] Amending the treaty would also provide developing nations with an opportunity to offer suggestions as to how exactly the treaty should be amended to preserve and promote their interests. Abrogation of the treaty might cause spacefaring nations to simply create bilateral agreements with each other, which could cause the development of commercial rights to be fragmented and divided. Such agreements could thus threaten international consensus and cause the international community to take steps backward.

B. Proposed Amendments to International Space Law

The notion that the Outer Space Treaty has completed its "first phase" is a cogent observation.[206] We must now look to the next fifty years and ask how we plan to solve

---

201. *See* Risley, *supra* note 10, at 49 (noting that instead of encouraging space exploration, the United Nations adopted the Outer Space Treaty in an effort to prevent national rivalries from extending into space); Porras, *supra* note 10, at 147 (emphasizing that while there have been efforts to create a cooperative community in space, space law has been deeply influenced by the Cold War era in which it was written).

202. See *supra* notes 40–52 for a discussion of legal scholarship in support of amending the Outer Space Treaty.

203. *See* Twibell, *supra* note 38, at 267–70 (noting that the no-sovereignty provision in Article II of the Space Treaty, which discourages space enterprise, has become customary international law and is thus included in any subsequent international or domestic agreements).

204. See *supra* notes 230–31 and accompanying text for a proposed amendment to Article II of the Outer Space Treaty.

205. Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2413, 610 U.N.T.S. at 208 ("States Parties to the Treaty shall carry on activities in the exploration and use of outer space . . . in the interest of maintaining international peace and security.").

206. Gabrynowicz, *supra* note 13, at 1047 (arguing that "international space law has completed its first phase" through the creation of important, generally agreed upon principles to govern outer space).

Earth's energy needs in a sustainable way while simultaneously improving the standard of living for all of mankind. Incentivizing the private sector to exploit celestial resources appears to be an attractive option to meet these two goals, but it will require an amendment to the Outer Space Treaty—the "constitution" of space law—as well as willingness to compromise. As Barbara Heim notes:

> [D]eveloping countries must recognize that allowing some structured development is preferable to uncontrolled mining by industrialized countries. Industrialized countries, for their part, must recognize that they can obtain more benefits within an [amended] international system than from exploitation in the absence of such a system. If an agreement is not reached, no group will be satisfied because all . . . will suffer from erratic development, which eventually will destroy both the environment and the opportunities for peaceful, profitable development.[207]

Environmental regulations ought to be included in an amended Outer Space Treaty as well. We do not want to start off on the wrong foot, so to speak, as we have with our oceans and ozone.[208] It is estimated that over twenty-one thousand pieces of space debris longer than four inches in diameter are currently circling the planet.[209] Another half-million pieces smaller than four inches are orbiting Earth as well.[210] Shards of metal left over from the separation of shuttles from rockets, inactive satellites, and even tiny flecks of paint comprise much of this body of debris.[211]

Fifty years of space shuttle and satellite launches with little regard for Earth's orbital environment have led to the current volume. When one considers that these objects travel at high speeds, a collision with a manned shuttle or artificial satellite by even the smallest piece of debris could threaten an entire mission.[212] Without putting the proper measures and safeguards into place *now*, unleashing an entire industry of private shuttles could exacerbate this problem to the point where space travel generally would be threatened. Therefore, any provision added to the Outer Space Treaty should include the need for *sustainable* commercial space travel, one that allows shuttles and satellites to pass freely through Earth's lower orbit without substantial risk of harmful collision.

A second aspect of environmental concern should also be incorporated into an amended treaty. As some scholars advocate, "environmental research and conservation preserves" should be set aside on extraplanetary objects.[213] This will again ensure that

---

207. Heim, *supra* note 91, at 847.

208. *See, e.g.*, Chao-chan Cheng, *A Comparative Study of the Formation and Development of Air & Water Pollution Control Laws in Taiwan and Japan*, 3 PAC. RIM L. & POL'Y J. S-43 (1993) (highlighting how Taiwan and Japan's focus on economic development, rather than environmental law, has resulted in environmental pollution, specifically in oceans).

209. Nola Taylor Redd, *Space Junk: Tracking and Removing Orbital Debris*, SPACE.COM (Mar. 8, 2013, 5:00 PM), http://www.space.com/16518-space-junk.html; *see also* Tan, *supra* note 30, at 151 (discussing the mounting concern by scientists and policymakers of the international community that space debris could threaten future spacefaring activities).

210. Redd, *supra* note 209.

211. *Id.*

212. *See* Tan, *supra* note 30, at 151–52 (discussing the threat posed by space debris).

213. Merges & Reynolds, *supra* note 141, at 123–24 (suggesting that "[i]f preserves are built into the development scheme from the beginning, many of the problems of terrestrial environmental preservation can be avoided").

we start off such an industry on the right foot. If, one hundred years from now, we come to realize that these designated zones yield little scientific value, they may be exploited or perhaps awarded to a developing nation for future development.[214]

The idea of preserves could actually be taken one step further.[215] A likely scenario might be that certain extraplanetary bodies possess resources of extreme scientific value. These bodies might include planets of similar composition to Earth that contain water and exhibit moderate temperatures.[216] Other bodies, such as asteroids, may tell us very little about our solar system, but may possess vast amounts of valuable minerals.[217] The Outer Space Treaty could thus be amended in such a way that profits must bow to scientific progress. In other words, if NASA uncovers a scientific breakthrough on Mars that could add substantially to our understanding of the universe's inner workings, such a venture must be recognized by the international community and private sector alike as worthy of protection. In this example, a competent international authority would reserve the right to exclude any private entity from exploiting resources found on Mars until the research project reached completion.

To ensure the recognition and protection of extraterrestrial rights, an independent international agency that works in conjunction with the United Nations should be established. With the help of an amended Outer Space Treaty, this international authority would facilitate access for private companies and national governments seeking to exploit extraterrestrial resources. While this Comment is not the first to suggest that an international authority should be established to regulate the commercial development of a viable space industry,[218] it is unique in ascertaining an appropriate role and scope of authority for such an agency.

An international authority focused on allocation of rights to extraterrestrial resources—much like to how ITU has facilitated coexistence and coordination of telecommunications technologies among governments and corporations—would maximize the economic efficiency of celestial resources. Previous proposals have ranged from a laissez-faire approach where such an agency would act as more of a hands-off deed registry[219] or auction system,[220] to supranational entities designed to enhance global cooperation in coordinating the consumption of extraterrestrial

214. *Id.*

215. See *supra* notes 141–47 and accompanying text for a discussion of the proposal to set aside preserved areas in outer space.

216. Earth is located in the sun's habitable zone. This zone is thought to possess the optimal conditions for the flourishing of life. Specifically, water exists in liquid form and temperatures are moderate, which is not the case on Earth's neighboring planets such as Mercury or Venus. *See* Dennis Overbye, *Two Promising Places to Live, 1,200 Light-Years from Earth*, N.Y. TIMES, Apr. 19, 2013, at A1 (explaining that only Earth and Mars are within the solar system's habitable zone); *NASA's Kepler Discovers First Earth-Size Planet in the "Habitable Zone" of Another Star*, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (Apr. 17, 2014), http://www.nasa.gov/ames/kepler/nasas-kepler-discovers-first-earth-size-planet-in-the-habitable-zone-of-another-star (discussing what is required for a planet to be in a star's "habitable zone").

217. See *supra* notes 165–181 and accompanying text for a discussion of the potential mineral wealth on various celestial bodies.

218. *E.g.*, Meyer, *supra* note 32, 259–60 (proposing for the international community to create a supranational entity that would oversee commercialization in space on behalf of Earth's entire population).

219. Merges & Reynolds, *supra* note 141, at 117–19.

220. Tennen, *supra* note 139, at 827–28.

resources.[221] Scholars have also debated whether absolute property rights are required to effectively regulate space, or whether the right to use and exclude will suffice.[222] Absolute rights are *not* necessary; quasi-property rights will suffice for the next phase of spacefaring activities. The high seas and the Guano Islands Act illustrate that it is possible to grant private entities certain commercial rights to exploit natural resources within international commons.[223] In both cases private actors require only access—not absolute property rights—to conduct resource recovery activities. "Corporations exist to make profits, and property rights only matter to the extent that they are necessary to fulfill the objective of maximizing profit."[224]

Presuming orbital environmental compliance with an amended Outer Space Treaty, any *capable* entity should be allowed to pursue commercial missions. As seen with the ITU, once a company or country submits an application for its intended use of an orbital slot, that application is evaluated on the merits of the entity's intentions.[225] Once approved, the entity may pursue its use and occupation of the slot. An international regime regulating extraterrestrial resources could operate in a similar fashion. In much the same way that Verizon does not "own" any of the orbital slots harboring its communication satellites, a mining company need not own the asteroid 3554 Amun to reap its benefits. To use the familiar "bundle of sticks" property analogy, access rights, the right to use, and the right to exclude will suffice for the foreseeable future. The right to sell or destroy, however, would not be included with any grant of access. Furthermore, the right to use, harvest, or exploit would only last for as long as the entity was reasonably capable of continuing proper use, as outlined in its application, or until the targeted resource was exhausted. This type of resource allocation will promote efficiency and will result in a merit-based system of allocating rights.

As discussed earlier, economic efficiency is only one side of the coin; equitable access is an equally relevant component to the creation of an international authority charged with overseeing the next generation of spacefaring activities.[226] As seen in Part III, the ITU takes into consideration the needs of the developing world when evaluating applications.[227] While it primarily operates on a "first-come, first-served" basis, it

221. *See* Meyer, *supra* note 32, at 259–60 (suggesting various way the proposed supranational "space district" could maintain its independence from influence of international community).

222. *See, e.g.*, Kevin V. Cook, *The Discovery of Lunar Water: An Opportunity to Develop A Workable Moon Treaty*, 11 GEO. INT'L ENVTL. L. REV. 647, 694 (1999) (asserting that property rights need not be unlimited, but sufficient in "scope, duration, and legal enforceability" so as to afford protection to commercial ventures); Jonathan Thomas, *Privatization of Space Ventures: Proposing A Proven Regulatory Theory for Future Extraterrestrial Appropriation*, 1 INT'L L. & MGMT. REV. 191, 218–19 (2005) (advocating for departure from the *res communis* principles that currently govern outer space in favor of a traditional property regime—one that allows for discovery, claim, and possession).

223. See *supra* notes 88–113 for a discussion of the treaties governing the high seas and the Guano Islands Act.

224. Hertzfeld & von der Dunk, *supra* note 97, at 91.

225. See *supra* Part III.B for an overview of the ITU and its process of allocating orbital satellite slots to states and private organizations.

226. See *supra* Part III.C for a discussion of proposals that highlight the tension between the need to balance economic efficiency and equitable access when regulating extraterrestrial commons.

227. See *supra* notes 126–31 for a discussion of ITU's current approach to allocating satellite and frequency slots.

reserves certain frequencies and slots for developing nations.[228] The needs of the developing world should not be abandoned in the pursuit of commercializing outer space. If a developing nation submits an application to the international agency, its status as a developing nation may be taken into consideration when awarding licenses for a given resource.

Ensuring that the developing world benefits from advances in the exploitation of extraterrestrial resources will maintain a sense of equitable access that international space law has endeavored to achieve over the past several decades. One of the most effective ways to achieve equilibrium between economic efficiency and equitable access is through spinoff technologies. Spinoff technologies are, proportionally, one of the most equitable and efficient ways to ensure that private actors are rewarded for their risks and successes achieved in outer space, while at the same time ensuring that the developing world captures secondary benefits.[229] A revolutionary technology that enhances our understanding and use of outer space should be profitable for its creators; however, the worry of the developing world that commercialization of extraterrestrial resources will widen the already sizeable global wealth gap is a legitimate concern. It is a worry that is deserving of inclusion in the discussion and debate on the future of international aerospace law.

Keeping these considerations in mind—that is, the need for commercial rights, equitable access for the developing world, an international authority, and environmental regulation—the following two amendments should replace Article II[230] of the Outer Space Treaty:

> **Article II § 1:** States party to the Treaty, recognizing the scarcity of Earth's natural resources, agree that commercial exploitation of celestial resources shall be permitted, subject to oversight and regulation by an international authority, in the interest of preserving and improving the quality of life for all mankind.
>
> **Article II § 2:** States shall pay due regard to the environment of outer space, and use all reasonably available efforts and technology to ensure sustainable development of Earth's orbit. The parties agree that space debris shall be viewed as detrimental to the continued use and exploration of outer space, and diminishing to the quality of life for all mankind. States further agree to designate one quarter of any celestial body or object as a preserve, which shall be the sole province of the scientific community for the purpose of improving our understanding of our solar system, galaxy, and universe.

The final step needed to ensure countries—both developed and developing—and companies alike benefit from a new regime governing space exploitation is a charter for the international agency that oversees the allocation of extraterrestrial resources. It must incorporate the *active transfer* of new technologies to the developing world. As

---

228. *See* Cahill, *supra* note 128, at 238–40 (explaining that under an *a priori* system where each developing nation is guaranteed at least one predetermined frequency and orbital position, "considerations of economic efficiency often conflict with those concerning equity").

229. See *supra* Part IV.B for a discussion of NASA spinoff technologies.

230. Outer Space Treaty, *supra* note 11, 18 U.S.T. at 2413, 610 U.N.T.S. at 208 ("Outer space, including the moon 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.").

seen in section 102 of the National Aeronautics and Space Act of 1958,[231] the transfer of new technologies should be a priority for the international community.[232] By emphasizing transfer, developing nations will have the "blueprints" for space travel, even if the means are not available. They can then conduct a cost-benefit analysis to decide if pursuing development of a specific technology or mission is economically feasible, either by its own national government, a government contractor, or a private entity. The agency's charter should include the following in its preamble:

> *Recognizing the pivotal role of emerging technologies in space exploration, and the ability of those technologies to improve the quality of life for all mankind, applications submitted for review must certify that the applicant, whether private entity, nonprofit organization, national government, or any combination thereof, will make reasonable accommodations and a good faith effort to transfer successful new technologies to the international community after a period of time not to exceed five years.*

As previously discussed, developing nations may very well find new, immediate uses for newly created technologies—likely in different areas of their economies not considered by the technologies' creators. In this sense, developing nations will essentially be creating something of their own—a new use for an existing technology. Hence, they will be given the opportunity to reap the benefits of the technology, even if they do not use it for spacefaring missions. This balance, as stated above, provides sufficient economic incentive for the commercialization of outer space while ensuring that the developing world is not left behind. They too will have the opportunity to capture the secondary benefits of space travel.

VI. CONCLUSION

The United States must begin a dialogue within the international community to reform the Outer Space Treaty and establish an international authority capable of overseeing the private exploitation of celestial resources. This discussion should attempt to strike a balance between economic efficiency and equitable access. Allowing private actors to engage in commercial missions while at the same time actively transferring technology to the developing world will strike such a balance. This approach will ensure that both public and private entities are rewarded for their efforts, while those without the means to exploit extraterrestrial resources are able to capture the secondary benefits of space travel through spinoff technologies.

The current state of the law does little but hinder future progress. The amendments proposed in this Comment would not only permit progress to take place, but would encourage it. Unleashing the private sector could reignite a global interest in space travel, and would most certainly lead to the creation of entirely new industries, thus spurring economic growth. Enhancing our ability to further explore and exploit outer space could also instill a sense of solidarity at the international level. The Space Race began as a way for the world's superpowers to gain military leverage over one another. It resulted in a joint venture—the International Space Station—whose construction is heralded as one of the greatest scientific achievements in the history of

231. National Aeronautics and Space Act of 1958, 3 Pub. L. No. 85-568, § 102, 72 Stat. 426 (1958) (codified as amended at 51 U.S.C. § 20102 (West 2014)).

232. See *supra* Part IV.B for a discussion of NASA's spinoff program.

mankind. Adjusting the lens through which we view space exploration could very well lead to a series of scientific milestones of similar magnitudes—achievements that will undoubtedly improve the quality of life for all mankind.

"*Asteroid mining may sound like fiction, but it's just science*."[233]

233. *Schneider*, *supra* note 9.