

# Space Rocks: A Proposal to Govern the Development of Outer Space and Its Resources

THOMAS R. IRWIN\*

## TABLE OF CONTENTS

I. INTRODUCTION .....	217
II. THE CURRENT LEGAL LANDSCAPE: THE OUTER SPACE	
TREATY AND THE MOON AGREEMENT .....	221
A. <i>The Outer Space Treaty</i> .....	222
B. <i>The Moon Agreement</i> .....	225
III. OBSTACLES TO PRIVATE DEVELOPMENT UNDER THE OUTER	
SPACE TREATY AND THE MOON AGREEMENT .....	228
A. <i>Uncertainty</i> .....	229
B. <i>Incentive Problems</i> .....	231
C. <i>A Path Forward</i> .....	233
IV. ALLOCATION AND ENFORCEMENT OF PROPERTY AND USAGE	
RIGHTS: PARALLELS IN INTERNATIONAL AND NATIONAL LAW .....	233
A. <i>The ITU and Geostationary Orbit Slots</i> .....	234
B. <i>The Convention on the Law of the Sea</i> .....	236
C. <i>The Homestead Acts</i> .....	238
D. <i>Observations for a Future Regime</i> .....	239
V. A PROPOSAL FOR A NEW REGIME .....	240
A. <i>The Desirability Principle</i> .....	240
B. <i>Consistency with the Outer Space Treaty</i> .....	241
C. <i>Implementation of the Homestead Concept</i> .....	242
D. <i>Balancing Competing Interests</i> .....	244
VI. CONCLUSION .....	245

## I. INTRODUCTION

In 1996, the Ansari X Prize was announced to the world: the first team to launch a privately funded and developed manned spacecraft to 100 kilometers above the surface of the earth twice within two weeks would win the prize of

---

\* J.D. Candidate, May 2015, The Ohio State University Moritz College of Law; B.S., B.A., Ohio University. I would like to thank my father Dennis Irwin, Moss Professor and Dean of the Russ College of Engineering and Technology at Ohio University, for his helpful comments and suggestions on drafts of this Note, and for sparking my lifelong interest in manned spaceflight. I would also like to thank my good friend Taylor Byrd, whose thoughtful insight, sharp wit, and careful criticism consistently challenge me to think more carefully and more deeply.

\$10 million.<sup>1</sup> Eight years later, the prize was awarded to Mojave Aerospace Ventures for its craft SpaceShipOne built by Scaled Composites, an American aerospace engineering and design firm founded by famed engineer Burt Rutan.<sup>2</sup> In 2006, NASA began investing in private space ventures to develop commercial space transportation services capable of flying missions to resupply the International Space Station (ISS) after the retirement of the Space Shuttle.<sup>3</sup> Six years later, in May 2012, the first successful demonstration mission was flown by SpaceX, the commercial space launch company founded by e-commerce entrepreneur Elon Musk.<sup>4</sup> There is no indication that these companies plan to stop there; SpaceX unabashedly proclaims that it has “the ultimate goal of enabling human life on Mars.”<sup>5</sup>

These milestones signal the emergence of a new paradigm in spaceflight. No longer is spaceflight the sole province of government space agencies.<sup>6</sup> Increasingly, private actors are becoming involved with every aspect of activity in space. No longer can the major articles of space law, which speak almost exclusively about states and state actors, neglect the behavior of private

---

<sup>1</sup> *Ansari XPRIZE*, XPRIZE FOUND., <http://space.xprize.org/ansari-x-prize> (last visited Feb. 25, 2015), *archived at* <http://perma.cc/QB9B-VXVC>.

<sup>2</sup> Andrew Torgan, *Making History with SpaceShipOne*, XPRIZE FOUND., <http://ansari.xprize.org/news/making-history-spaceshipone> (last visited Feb. 25, 2015), *archived at* <http://perma.cc/KY8U-7EGU>; *About Us*, SCALED COMPOSITES, <http://www.scaled.com/about> (last visited Feb. 25, 2015), *archived at* <http://perma.cc/6XA2-XFX7>. SpaceShipOne was the precursor to SpaceShipTwo, a craft currently under development for Virgin Galactic at The Spaceship Company that, in cooperation with Scaled Composites, will make orbital flights with paying passengers aboard. *See Our Vehicles*, VIRGIN GALACTIC, <http://www.virgingalactic.com/human-spaceflight/our-vehicles/> (last visited Feb. 8, 2015), *archived at* <http://perma.cc/JPV3-CXPB>. Virgin Galactic and SpaceShipTwo made headlines recently as the result of a testflight crash in which one crew member was killed and another seriously injured. *E.g.*, Alan Boyle, *Virgin Galactic's SpaceShipTwo Crashes: 1 Dead, 1 Injured*, NBC NEWS, <http://www.nbcnews.com/storyline/virgin-voyage/virgin-galactics-spaceshiptwo-crashes-1-dead-1-injured-n238376> (last visited Feb. 28, 2015), *archived at* <http://perma.cc/3G4C-QZPU>.

<sup>3</sup> *Commercial Crew & Cargo*, NASA, <http://www.nasa.gov/offices/c3po/about/c3po.html> (last visited Feb. 28, 2015), *archived at* <http://perma.cc/C52V-X8AR>.

<sup>4</sup> Jane Wells, *Elon Musk on Why SpaceX Has the Right Stuff to Win the Space Race*, CNBC (Apr. 27, 2012, 2:23 PM), <http://www.cnn.com/id/47207833>, *archived at* <http://perma.cc/K59E-VNJ7>; Henry Fountain, *Its First Mission Done, SpaceX Looks to More Private Flights*, N.Y. TIMES (May 31, 2012), [http://www.nytimes.com/2012/06/01/science/space/first-spacex-dragon-cargo-flight-ends-with-a-splash.html?\\_r=0](http://www.nytimes.com/2012/06/01/science/space/first-spacex-dragon-cargo-flight-ends-with-a-splash.html?_r=0), *archived at* <http://perma.cc/8EHF-L9AE>.

<sup>5</sup> *Careers*, SPACEX, <http://www.spacex.com/careers> (last visited Feb. 28, 2015), *archived at* <http://perma.cc/V7E3-6V5J?type=live>.

<sup>6</sup> To be sure, the major national space agencies still dominate the field, and play an active role in private space flight ventures. Public funding from NASA has been of critical importance in making possible the development of private commercial space launch capability. *See, e.g.*, Wells, *supra* note 4.

companies and individuals in space.<sup>7</sup> Not only is the reality of who is acting in space poised to change dramatically in the decades to come, but also the focus on state actors actually impedes the ability of the law to adapt to emerging circumstances. As privately owned and operated firms seek to exploit the resources of other celestial bodies, including the Moon, the uncertain legal status of private activity on those bodies becomes problematic. Framing the legal structures around the behaviors of governments and their space agencies obscures the reality that private actors are beginning to take on a more important role in providing spaceflight capabilities. Until that reality is reflected in international law governing human activity in space, the legal uncertainty of private spaceflight may hobble further innovation.

The need for change is in part simply a result of time. The major treaties that still provide the framework for outer space law were drafted at a time when most computers were too large to fit on desktops and the dream of landing on the Moon was only just becoming a reality.<sup>8</sup> The world today is a dramatically different place than the world that existed at the drafting of the Outer Space Treaty and its entrance into force in 1967.<sup>9</sup> Even since the Moon Agreement was adopted in 1979 the world has seen remarkable changes in technology and international relations.<sup>10</sup> The Cold War has ended, the United States and China have normalized relations, China has grown to be the world's second largest economy,<sup>11</sup> and the global economy has generally become much more interdependent.<sup>12</sup> The world is no longer divided along the lines of

---

<sup>7</sup> See 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 Outer Space Treaty]; see also Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].

<sup>8</sup> Apollo 8, the first manned spacecraft to orbit the Moon, was launched on December 21, 1968, more than two years after the Outer Space Treaty was adopted by the United Nations General Assembly. See *Apollo 8*, NASA (July 8, 2009) [http://www.nasa.gov/mission\\_pages/apollo/missions/apollo8.html](http://www.nasa.gov/mission_pages/apollo/missions/apollo8.html), archived at <http://perma.cc/RN2B-TE43>.

<sup>9</sup> The Outer Space Treaty was adopted by the United Nations General Assembly on December 19, 1966, opened for signature on January 27, 1967, and entered into force on October 10th of that year. See U.N. OFFICE FOR OUTER SPACE AFFAIRS, UNITED NATIONS TREATIES AND PRINCIPLES ON OUTER SPACE, at v, U.N. Doc. ST/SPACE/11/Rev.2, U.N. Sales No. E.08.I.10 (2008) [hereinafter UNOOSA]. The first landing on the Moon would not take place for almost two more years. See *July 20, 1969: One Giant Leap for Mankind*, NASA (July 14, 2014), [http://www.nasa.gov/mission\\_pages/apollo/apollo11\\_40th.html](http://www.nasa.gov/mission_pages/apollo/apollo11_40th.html), archived at <http://perma.cc/Z8YD-FMHF>.

<sup>10</sup> The Moon Agreement was adopted on December 5, 1979 and entered into force on July 11, 1984. UNOOSA, *supra* note 9, at vi.

<sup>11</sup> See *GDP (Current US\$)*, WORLD BANK, <http://data.worldbank.org/indicator/NY.GDP.MKTP.CD> (last visited Mar. 29, 2015), archived at <http://perma.cc/8XEX-6VHV>.

<sup>12</sup> This can be demonstrated by examining trade flows and other economic data. Total world trade exports increased more than nine-fold in the last three decades, from approximately \$2.4 trillion in 1980 to more than \$22.6 trillion in 2012. *Exports and*

capitalist and communist, and as countries like China, India, and Brazil continue to experience economic growth and industrial development, the line between industrialized and developing nations grows blurry.<sup>13</sup> The motivations for reaching, exploring, and exploiting outer space have changed as well. National prestige is no longer the prime mover of human activity in space, especially as private companies take on a greater role.<sup>14</sup> Increasingly, scientific exploration and economic opportunity drive missions to space.<sup>15</sup>

This Note suggests the formation of a new international treaty designed from the outset to authorize and regulate private, non-governmental exploitation of space resources, guided by the principle that this exploitation is desirable and beneficial to mankind generally. This treaty must provide for a system of allocating some form of property rights, be they traditional or some form of particularized usage rights, under the authority of an independent body with international jurisdiction. This body must also have the power to resolve disputes over those rights. Part II describes the current state of international space law, specifically the Outer Space Treaty, the Moon Agreement, and their respective interpretations by scholars and governments. Part III analyzes this status quo, examining the legal uncertainties and economic problems that these treaties and their interpretations pose for private exploitation of extraterrestrial resources. Part IV discusses parallels to other systems of allocating and

---

*Imports of Goods and Services*, U.N. CONF. ON TRADE & DEV., <http://unctadstat.unctad.org/TableViewer/tableView.aspx?ReportId=25116> (last visited Mar. 23, 2014), *archived at* <http://perma.cc/8XEX-6VHV>. During the same period, total world gross domestic product (GDP) increased from \$22.4 trillion to \$54.8 trillion (constant 2005 dollars). *Nominal and Real GDP*, U.N. CONF. ON TRADE & DEV., <http://unctadstat.unctad.org/TableViewer/tableView.aspx?ReportId=96> (last visited Mar. 23, 2014), *archived at* <http://perma.cc/NZ9W-E8EL>. As a share of total output, therefore, international trade grew from approximately 16.6% to more than 25%.

<sup>13</sup> See *Globalization, Sustainable Development and Social Impact in World Rankings, Countries and Cities*, GLOBAL SHERPA, <http://www.globalsherpa.org/bric-countries-brics> (last visited Mar. 24, 2015), *archived at* <http://perma.cc/WP2K-KGCY>; see also Jayati Ghosh, *The Global Economic Chessboard and the Role of the BRICS: Brazil, Russia, India, China, South Africa*, GLOBAL RESEARCH (Nov. 10, 2013), <http://www.globalresearch.ca/the-global-economic-chessboard-and-the-role-of-the-brics-brazil-russia-india-china-south-africa/5357502>, *archived at* <http://perma.cc/6RFB-C3N2>.

<sup>14</sup> This is, of course, not to say that national prestige is irrelevant. Particularly for emerging global powers like China, national prestige might be a large part of the motivation for funding missions to space. China's first manned mission to space in 2003, Shenzhou V, may be understood in part as a statement of that country's economic and technological prowess. See *Making History: China's First Human Spaceflight*, SPACE.COM (Sept. 28, 2005, 4:21 PM), <http://www.space.com/1616-making-history-china-human-spaceflight.html>, *archived at* <http://perma.cc/C97E-A272>.

<sup>15</sup> For example, according to the Satellite Industry Association, global satellite industry revenues were nearly \$190 billion in 2012. SATELLITE INDUS. ASS'N, STATE OF THE SATELLITE INDUSTRY REPORT 5 (June 2013), [http://www.sia.org/wp-content/uploads/2013/06/2013\\_SSIR\\_Final.pdf](http://www.sia.org/wp-content/uploads/2013/06/2013_SSIR_Final.pdf), *archived at* <http://perma.cc/7SGN-9X64>. Clearly the use of outer space can be very lucrative.

regulating property and usage rights, including the International Telecommunication Union's allocation of geostationary orbit slots, the United Nations Law of the Sea Convention,<sup>16</sup> and the Homestead Act of 1862.<sup>17</sup> Finally, Part V outlines the basic structure of the proposed international system, discussing which ideas from other systems may be useful and which should be discarded.

## II. THE CURRENT LEGAL LANDSCAPE: THE OUTER SPACE TREATY AND THE MOON AGREEMENT

International space law is primarily governed today by five multilateral treaties: the Outer Space Treaty,<sup>18</sup> the Rescue Agreement,<sup>19</sup> the Liability Convention,<sup>20</sup> the Registration Convention,<sup>21</sup> and the Moon Agreement.<sup>22</sup> Of these, the first four have been signed and ratified by all of the major space powers, including the United States, Russia, France, and the United Kingdom, and each has been ratified by at least sixty different nations.<sup>23</sup> The last of these treaties, the Moon Agreement, has by contrast been ratified by only fifteen countries and has been signed only by a single major space power, France.<sup>24</sup>

The Outer Space Treaty and the Moon Agreement are the most important of these treaties to the discussion of exploitation of resources and opportunities on extraterrestrial bodies. These treaties establish the core principles that govern (or purport to govern) the activity of both nations and private actors on celestial bodies.<sup>25</sup> Their interpretation has been a matter of some debate, however, particularly in regard to how the exploitation of extraterrestrial territory and resources may be carried out. These interpretations will be examined in some detail to demonstrate the unpredictability of the current law and highlight the need for greater clarity.

---

<sup>16</sup> U.N. Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397, available at [http://www.un.org/depts/los/convention\\_agreements/convention\\_overview\\_convention.htm](http://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm), archived at <http://perma.cc/E5LN-3KTF> [hereinafter UNCLOS].

<sup>17</sup> Homestead Act of 1862, ch. 75, 12 Stat. 392.

<sup>18</sup> Outer Space Treaty, *supra* note 7.

<sup>19</sup> Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter Rescue Agreement].

<sup>20</sup> Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

<sup>21</sup> 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 Registration Convention].

<sup>22</sup> Moon Agreement, *supra* note 7.

<sup>23</sup> Comm. on the Peaceful Uses of Outer Space, Legal Subcomm., Status of International Agreements Relating to Activities in Outer Space as at 1 January 2013, 52d Sess., April 8–9, 2013, U.N. Doc. A/AC.105/C.2/2013/CRP.5, at 6–11 (Mar. 28, 2013).

<sup>24</sup> *Id.*

<sup>25</sup> See UNOOSA, *supra* note 9, at vi.

### A. *The Outer Space Treaty*

The Outer Space Treaty has been described as “the Magna Carta of Space,” a foundational document on which much of the rest of space law has been built.<sup>26</sup> The treaty itself was the product of negotiation and agreement among the members of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS),<sup>27</sup> a key United Nations forum for the creation of space law.<sup>28</sup> The treaty was largely one of principles rather than specifics and was designed to codify, in advance of what seemed to be imminent Moon landings by the United States and the Soviet Union, as many of the key points of agreement about what the legal framework in outer space should look like as possible.<sup>29</sup>

Three fundamental principles emerged from the Outer Space Treaty: (1) that international law applies in outer space; (2) that space is free and open to exploration by all nations and that its exploration is to benefit all countries; and (3) that nations may not claim sovereignty over space or celestial bodies.<sup>30</sup> Together, these principles establish a norm and expectation of cooperation among nations in the use of outer space.

The first principle is embodied in Article III of the treaty, which states that parties to the treaty “shall carry on activities in . . . outer space, including the moon and other celestial bodies, in accordance with international law . . . .”<sup>31</sup> Arguably this provision was redundant, because in the absence of any other rules it would seem that international law would necessarily be applicable to space.<sup>32</sup> Nevertheless, it makes clear that this law applies by agreement and that the purpose of Article III is to promote cooperation among nations.<sup>33</sup>

The second principle, that space is open to exploration by all nations and should be carried out for the benefit of all countries, is outlined in Article I.<sup>34</sup> It provides that the exploration and use of space “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

---

<sup>26</sup> FRANCIS LYALL & PAUL B. LARSEN, *SPACE LAW: A TREATISE* 53–54 (2009); *see also* FABIO TRONCHETTI, *THE EXPLOITATION OF NATURAL RESOURCES OF THE MOON AND OTHER CELESTIAL BODIES: A PROPOSAL FOR A LEGAL REGIME* 18–19 (2009).

<sup>27</sup> *See* Paul G. Dembling & Daniel M. Arons, *The Evolution of the Outer Space Treaty*, 33 J. AIR L. & COM. 419, 420 (1967).

<sup>28</sup> LYALL & LARSEN, *supra* note 26, at 18. Lyall and Larsen note also the importance of the U.N. Office for Outer Space Affairs (OOSA), which they describe as “now the main node for space affairs within the UN.” *Id.* at 17.

<sup>29</sup> *See* Dembling & Arons, *supra* note 27, at 427–28.

<sup>30</sup> LYALL & LARSEN, *supra* note 26, at 59–60.

<sup>31</sup> Outer Space Treaty, *supra* note 7, art. III.

<sup>32</sup> *See* Dembling & Arons, *supra* note 27, at 432.

<sup>33</sup> *See* Outer Space Treaty, *supra* note 7, at art. III (“[I]n the interest of maintaining international peace and security and promoting international co-operation and understanding.”).

<sup>34</sup> *Id.* art. I.

mankind.”<sup>35</sup> Further, it states that “there shall be free access to all areas of celestial bodies” for the purpose of exploration “without discrimination of any kind, on a basis of equality . . . .”<sup>36</sup>

Precisely what these provisions require is not clear from the language of the treaty itself. The requirement of free access on its face would seem at least to mean that no state could be arbitrarily restricted from exploring a location on the Moon or other celestial body. This view is supported by statements made in the Legal Subcommittee during negotiation of the treaty, suggesting that “the main consideration was not *de facto* equality . . . but rather the absence of discrimination between States.”<sup>37</sup>

Paragraph 1 of Article I, requiring that exploration and use of outer space and celestial bodies be carried out “for the benefit and in the interests of all countries” is even more ambiguous. Again, some basic prohibitions can be inferred from this language. For example, a nation could not, consistent with that language, purposefully spoil or degrade the environment of a celestial body for the sole purpose of excluding other nations from it or preventing them from exploiting its benefits. Beyond this extreme case, however, it is less clear what the operative effect of Paragraph 1 should be. What would be required, for example, if a nation or its citizens sought simply to mine and capture resources from the Moon and bring them back to Earth for use in various industries? Different interpretations of Article I, Paragraph 1 suggest different results.

One view is that these Article I provisions created an affirmative obligation on all signatories to engage in activities on a cooperative, international basis in space and share the benefits thereof.<sup>38</sup> In answering the question posed, those who take this view might suggest that a nation or other entity conducting such exploitive activities is obligated to share technical knowledge gained from the enterprise or even give up a share of the resources themselves.<sup>39</sup>

---

<sup>35</sup> *Id.* art. I, para. 1.

<sup>36</sup> *Id.* art. I, para. 2.

<sup>37</sup> Comm. on the Peaceful Uses of Outer Space, Legal Subcomm., 5th Sess. 63d mtg., July 20, 1966, U.N. Doc. A/AC.105/C.2/SR.63 (Oct. 20, 1966). Note, however, that the representative of Romania who made the statement also apparently thought that “without discrimination of any kind” and “on a basis of equality” were not entirely co-extensive. *See id.*

<sup>38</sup> *See* LYALL & LARSEN, *supra* note 26, at 62–65 (discussing several resolutions and declarations by the U.N. General Assembly and UNCOPUOS passed since the Outer Space Treaty was signed that seem to explicitly push for affirmative benefit sharing by spacefaring nations with developing countries); *see also* TRONCHETTI, *supra* note 26, at 64 (claiming that the interpretation of developing countries was that Paragraph 1 of Article I required states actually engaging in space exploration to take measures to ensure that developing countries would benefit from their activity).

<sup>39</sup> LYALL & LARSEN, *supra* note 26, at 63; *see also* N. Jasentuliyana, *Article I of the Outer Space Treaty Revisited*, 17 J. SPACE L. 129, 140–44 (1989) (describing how

The opposing view, largely adopted by the developed countries and the major spacefaring nations like the United States and Russia, is that Paragraph I is simply a “statement of general goals” and that it remains the right of each country to decide whether or how to share benefits and results of particular space endeavors.<sup>40</sup> Under this interpretation, a nation might be required to avoid conflict with other nations in exploiting lunar resources, but the sharing of technology and the resources themselves would be a matter of that nation’s own choosing. As several scholars have noted, consensus about these views has yet to be fully reached, and debate about the proper interpretation and application of these principles is ongoing.<sup>41</sup> This debate is even more hotly contested in the context of the Moon Agreement.<sup>42</sup>

The third and final key principle of the Outer Space Treaty that bears on the exploitation of extraterrestrial resources is the non-appropriation principle embodied in Article II. The treaty provides that “[o]uter 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.”<sup>43</sup> This is a clear prohibition on claims by nations to territory on extraterrestrial bodies. While some have argued that national appropriation and claims of sovereignty should be allowed on celestial bodies, those arguments have generally called for a modification of Article II in another multilateral agreement.<sup>44</sup>

The seeming clarity of Article II is deceiving, however, because the treaty does not expressly rule out the possibility that private actors like companies or even individuals might claim some sort of private property right. Some see the silence of the treaty on this point as opening the door to private claims of ownership on the Moon and other bodies.<sup>45</sup> Some organizations have gone so

---

developing countries have pushed to make the benefit-sharing principles of Outer Space Treaty Article I more concrete).

<sup>40</sup> See Jasentuliyana, *supra* note 39, at 139–40; *see also Treaty on Outer Space: Hearings Before the S. Comm. on Foreign Relations*, 90th Cong. 74 (1967) (“[I]t is the understanding of the Committee on Foreign Relations that nothing in Article I, paragraph 1, diminishes or alters the right of the United States to determine how and to the extent it shares the benefits and use of its outer space activities.”)

<sup>41</sup> See LYALL & LARSEN, *supra* note 26, at 63–65 (discussing continued U.N. activity in elaborating benefit-sharing principles); *see also* Jasentuliyana, *supra* note 39, at 140–44.

<sup>42</sup> *See infra* Part II.B.

<sup>43</sup> Outer Space Treaty, *supra* note 7, art. II.

<sup>44</sup> *See, e.g.,* Kurt Anderson Baca, *Property Rights in Outer Space*, 58 J. AIR L. & COM. 1041, 1084–85 (1993).

<sup>45</sup> *See, e.g.,* Stephen Gorove, *Interpreting Article II of the Outer Space Treaty*, 37 *FORDHAM L. REV.* 349, 351 (1969); Wayne N. White, Jr., *Real Property Rights in Outer Space*, AM. INST. AERONAUTICS & ASTRONAUTICS (1998), available at [http://www.spacefuture.com/archive/real\\_property\\_rights\\_in\\_outer\\_space.shtml](http://www.spacefuture.com/archive/real_property_rights_in_outer_space.shtml), archived at <http://perma.cc/N68K-VY7D>.



far as to claim that they offer lunar territory for sale.<sup>46</sup> The apparent majority position, on the other hand, is that Article II precludes private claims to ownership as well as sovereignty claims.<sup>47</sup>

### B. *The Moon Agreement*

The Moon Agreement has been much more controversial than the Outer Space Treaty. As mentioned above, it has been signed by a mere fraction of the countries that signed the Outer Space Treaty.<sup>48</sup> One scholar described the status of the Moon Agreement by saying that it “is, and will remain, of no relevance to the States non-Parties to the Agreement.”<sup>49</sup> This may slightly overstate the situation. Even if no other nations choose to be bound by the Moon Agreement, any attempt to add to or reform the main body of space law must come to terms with its provisions and what made the treaty fail in the first place. Thus, any attempt at a solution must first address what role the Moon Agreement currently plays and why it failed as an instrument of international space law.

Examining the provisions of the agreement and its departures from the basic framework of the Outer Space Treaty will help provide answers to these questions. The Moon Agreement was written in the shadow of the historic Apollo landings, which ran from the first successful landing by Apollo 11 in July 1969,<sup>50</sup> to the last manned mission to set foot on the Moon in December

---

<sup>46</sup> *E.g.*, LUNAR REGISTRY, <http://www.lunarregistry.com> (last visited Feb. 28, 2015), archived at <http://perma.cc/2NSX-PH3U>. The Lunar Registry proudly proclaims that it is “Earth’s Leading Lunar Real Estate Agency” and claims to sell lunar acreage in fee simple absolute, including mineral rights “to a plumb depth of five kilometers” in “compliance with the statutes of the Lunar Settlement Initiative.” *Frequently Asked Questions*, LUNAR REGISTRY, <http://www.lunarregistry.com/info/faq.shtml> (last visited Feb. 28, 2015), archived at <http://perma.cc/323T-HW8W>.

<sup>47</sup> See TRONCHETTI, *supra* note 26, at 29. For an explanation advocating this view see THOMAS GANGALE, *THE DEVELOPMENT OF OUTER SPACE: SOVEREIGNTY AND PROPERTY RIGHTS IN INTERNATIONAL SPACE LAW* 33–53 (2009); see also P.M. Sterns & L.I. Tennen, *Privateering and Profiteering on the Moon and Other Celestial Bodies: Debunking the Myth of Property Rights in Space*, 31 *ADVANCES SPACE RES.* 2433 (2003). These writers argue, in part, that to permit private citizens to make claims of ownership in the absence of some sort of international recognition or licensure would allow nations to circumvent their treaty obligations by acting through private entities as intermediaries, effectively eliminating any meaningful prohibition established by Article II. *Id.* at 2436.

<sup>48</sup> There are 128 countries that are either parties or signatories to the Outer Space Treaty, while only nineteen countries have signed the Moon Agreement. See Comm. on the Peaceful Uses of Outer Space, *supra* note 37, at 6–11. None of the major space powers are bound by its provisions. See *id.*

<sup>49</sup> Stephen E. Doyle, *Using Extraterrestrial Resources Under the Moon Agreement of 1979*, 26 *J. SPACE L.* 111, 127 (1998).

<sup>50</sup> *Apollo 11*, NASA (July 8, 2009), [http://www.nasa.gov/mission\\_pages/apollo/missions/apollo11.html](http://www.nasa.gov/mission_pages/apollo/missions/apollo11.html), archived at <http://perma.cc/8P8N-L4FJ>.

1972.<sup>51</sup> The preamble to the agreement begins by “[n]oting the achievements of States in the exploration and use of the Moon and other celestial bodies.”<sup>52</sup> Articles 1–6 borrow much of the language of the Outer Space Treaty: Article 2 specifies that activities on the Moon are subject to international law;<sup>53</sup> Article 3 prohibits military installations or hostile acts on the Moon;<sup>54</sup> Article 4 states in part that “[t]he exploration and use of the Moon shall be the province of all mankind;”<sup>55</sup> and Article 6 provides that “[t]here shall be freedom of scientific investigation on the Moon . . . without discrimination of any kind, on the basis of equality . . . .”<sup>56</sup>

Article 7 adds to the principles of the Outer Space Treaty that parties should take steps to prevent environmental degradation on the Moon and other celestial bodies.<sup>57</sup> Articles 8 and 9 clarify that certain activities like landing on the Moon and establishing stations and installations on or below the surface are permitted to states’ parties.<sup>58</sup> These principles, for the most part, merely recognized what was already happening on the Moon and the planets.<sup>59</sup>

The expanded non-appropriation principle and the common heritage of mankind concept in Article 11 of the Moon Agreement were the most controversial in the negotiations leading to the agreement.<sup>60</sup> They have also been the subject of much scholarly discussion,<sup>61</sup> and are of the most interest to

---

<sup>51</sup> *Apollo 17*, NASA (Apr. 7, 2011), [http://www.nasa.gov/mission\\_pages/apollo/missions/apollo17.html](http://www.nasa.gov/mission_pages/apollo/missions/apollo17.html), archived at <http://perma.cc/J98J-93BD>. No manned landing has occurred in the more than four decades since the Apollo 17 mission. See *id.*

<sup>52</sup> Moon Agreement, *supra* note 7, at pmbl. (emphasis added).

<sup>53</sup> *Id.* art. 2

<sup>54</sup> *Id.* art. 3

<sup>55</sup> *Id.* art. 4, para. 1.

<sup>56</sup> *Id.* art. 6, para. 1.

<sup>57</sup> *Id.* art. 7.

<sup>58</sup> Moon Agreement, *supra* note 7, at art. 8, paras. 1 & 2; *id.* art. 9.

<sup>59</sup> The manned Apollo landings had already occurred by the time the treaty was negotiated and promulgated. See *supra* notes 50–51 and accompanying text. Other landings had also taken place including the Soviet Union’s 1970 mission to Venus, Venera 7, which was the first to transmit a signal that was successfully received from another planet. See *Solar System Exploration: Venera 7*, NASA, [http://solarsystem.nasa.gov/missions/profile.cfm?Sort=Nation&Nation=USSR&MCode=Venera\\_07](http://solarsystem.nasa.gov/missions/profile.cfm?Sort=Nation&Nation=USSR&MCode=Venera_07) (last updated Jan. 24, 2011), archived at <http://perma.cc/JF9G-CUNA>. Further landings continued to take place during the negotiations, including the American Viking missions in 1975. See *Viking 1–2*, NASA, <http://science.nasa.gov/missions/viking> (last updated Sept. 24, 2014), archived at <http://perma.cc/SV7X-QWGR>.

<sup>60</sup> See Fabio Tronchetti, *The Moon Agreement in the 21st Century: Addressing its Potential Role in the Era of Commercial Exploitation of the Natural Resources of the Moon and Other Celestial Bodies*, 36 J. SPACE L. 489, 506 (2010).

<sup>61</sup> See, e.g., Martin Menter, *Commercial Space Activities Under the Moon Treaty*, 7 SYRACUSE J. INT’L L. & COM. 213, 217–24 (1979–80); Carl Q. Christol, *The 1979 Moon Agreement: Where is it Today?*, 27 J. SPACE L. 1, 10–26 (1999); Timothy G. Nelson, *The Moon Agreement and Private Enterprise: Lessons from Investment Law*, 17 ILSA J. INT’L & COMP. L. 393, 394–403 (2011).

the present analysis of private exploitation of space resources. The common heritage of mankind principle is stated simply, if unhelpfully, in Paragraph 1 of Article 11: “The Moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 of this article.”<sup>62</sup> The agreement reaffirms the Outer Space Treaty’s statement of the non-appropriation principle in Paragraph 2 of Article 11: “The Moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means.”<sup>63</sup> The agreement clarifies that principle (or extends it, depending on how the Outer Space Treaty is interpreted) in Paragraph 3, providing that no part of the Moon or its natural resources “shall become property of any State, . . . national organization or non-governmental entity or of any natural person,” with the qualification that “[t]he foregoing provisions are without prejudice to the international régime referred to in paragraph 5 of this article.”<sup>64</sup> The Moon Agreement therefore makes clear what the Outer Space Treaty did not: there may be no property claims by private entities on the Moon or other celestial bodies.

Paragraph 5, mentioned in Paragraphs 1 and 3, requires parties to the agreement to establish “an international régime . . . to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible.”<sup>65</sup> Thus, the Moon Agreement by its own terms contemplates and calls for an international regime to govern the exploitation of lunar resources. Paragraph 7 identifies four main purposes of this international regime: “(a) The orderly and safe development of the natural resources of the Moon; (b) The rational management of those resources; (c) The expansion of opportunities in the use of those resources; and (d) An equitable sharing by all States [p]arties in the benefits derived from those resources,” giving special consideration to the interests of developing countries and the efforts of countries contributing to the exploration of the Moon.<sup>66</sup>

There remains substantial ambiguity about the precise meaning of these provisions. Aside from requiring the establishment of an international regime to govern the exploitation of lunar resources, it is unclear what the “common heritage of mankind” might encompass. The position of the United States during the negotiation of the treaty and beyond was that the common heritage of mankind concept, although appearing in other treaties,<sup>67</sup> was to be interpreted only in light of the express provisions of the Moon Agreement

---

<sup>62</sup> Moon Agreement, *supra* note 7 art. 11, para. 1.

<sup>63</sup> *Id.* art. 11, para. 2.

<sup>64</sup> *Id.* art. 11, para. 3.

<sup>65</sup> *Id.* art. 11, para. 5.

<sup>66</sup> *Id.* art. 11, para. 7.

<sup>67</sup> *E.g.*, UNCLOS, *supra* note 16, at pt. XI, §2, art. 136.

itself<sup>68</sup> and would not require a moratorium on resource exploitation or other commercial activity.<sup>69</sup>

Even if one accepts this position, the provisions of Paragraph 7, which are connected to and guide the interpretation of Paragraph 5 and the common heritage of mankind, are subject to debate. It is unclear, for example, what “equitable sharing” of the benefits derived from exploitation of extraterrestrial resources actually entails. The United States’ position, similar to its position regarding benefit-sharing provisions in Article I of the Outer Space Treaty, was that the equitable sharing provision did not “in any way diminish[] the exclusive right of the United States to determine how it shares the benefits derived from exploitation by it or its nationals.”<sup>70</sup> Another perspective, shared by some developing nations, was that equitable sharing did in fact require some sort of mandatory benefit sharing, whether in the form of technology transfer or division of resources.<sup>71</sup>

While the “equitable sharing” provision does pose some ambiguity, the more plausible interpretation of the Moon Agreement in light of its own provisions is that it is simply a principle of construction for the international regime referred to in Paragraph 5 of Article 11. Until the negotiation of that international regime occurs, the best interpretation is that Paragraph 7’s provisions are legally inoperable and do not impose affirmative obligations on parties to the agreement. The Moon Agreement thus continues to stand as a call to action to all nations to engage in negotiations and establish an international regime to govern the exploitation of extraterrestrial resources.

### III. OBSTACLES TO PRIVATE DEVELOPMENT UNDER THE OUTER SPACE TREATY AND THE MOON AGREEMENT

The current state of international law governing private development under the Outer Space Treaty and the Moon Agreement is unsatisfactory and does not provide a stable and hospitable legal environment for large-scale use of celestial bodies and their resources. The treaties have two major shortcomings with respect to encouraging the private development of the Moon and its resources. First, there is substantial legal uncertainty about the proper interpretation of key provisions of these treaties and the correct application of those provisions given that most states—and all of the major

---

<sup>68</sup> See *The Moon Treaty: Hearings Before the Subcomm. on Science, Technology, and Space of the S. Comm. on Commerce, Science and Transportation*, 96th Cong. 12 (1980) [hereinafter *Moon Treaty Hearings*] (statement of Roberts B. Owen, Legal Adviser, U.S. Department of State).

<sup>69</sup> *Id.* at 22.

<sup>70</sup> *Id.* at 18; see Ram Jakhu, *Twenty Years of the Moon Agreement: Space Law Challenges for Returning to the Moon*, 54 ZEITSCHRIFT FÜR LUFT UND WELTRAUMRECHT 243, 253–54 (2005) (Ger.) (rejecting the interpretation that “equitable sharing” includes mandatory benefit sharing as “wrong and misleading”).

<sup>71</sup> See Christol, *supra* note 61, at 10–26.

space powers—have ratified the Outer Space Treaty but not the Moon Agreement.<sup>72</sup> Second, certain interpretations of the Moon Agreement, in particular those requiring mandatory sharing of benefits derived from exploitive activities, create strong disincentives to investment in extraterrestrial development by private entities.<sup>73</sup> Where costs are high, as has historically been true of major undertakings in space,<sup>74</sup> high payoffs and reasonably certain expectations of returns are necessary to make development worthwhile. Those seeking to extract, or otherwise make use of extraterrestrial resources, are much less likely to undertake expensive space launch endeavors if they are either unsure of their ability to reap the benefits of their investments, or are certain that those benefits will be redistributed to benefit third parties. These shortcomings of the existing treaties are explored in turn.

### A. Uncertainty

An initial point of uncertainty arises as a result of the uneven ratification of the various treaties forming the foundation of international space law. As discussed above, a substantial majority of states, including every major space power, have ratified the Outer Space Treaty, while an overwhelming majority of them have *not* ratified the Moon Agreement.<sup>75</sup> The Outer Space Treaty, having entered into force nearly fifty years ago and binding all major space powers,<sup>76</sup> will undoubtedly continue to act as the foundation of international space law. Indeed, some have argued that its key provisions have attained the status of customary international law and are thus binding on all states.<sup>77</sup> The

---

<sup>72</sup> See Comm. on the Peaceful Uses of Outer Space, *supra* note 37, at 11.

<sup>73</sup> See *infra* Part III.B.

<sup>74</sup> See DEBORAH D. STINE, CONG. RESEARCH SERV., RL34645, THE MANHATTAN PROJECT, THE APOLLO PROGRAM, AND FEDERAL ENERGY TECHNOLOGY R&D PROGRAMS: A COMPARATIVE ANALYSIS 2–3 (2009), available at <http://www.fas.org/sgp/crs/misc/RL34645.pdf>, archived at [perma.cc/S4M6-7JZP](http://perma.cc/S4M6-7JZP). Stine cites the total cost of the Apollo program as \$97.9 billion in 2008 dollars. *Id.* While it may be tempting to conclude from this undeniably massive sum that exploitation of extraterrestrial resources is *prohibitively* expensive, it should be remembered that the Apollo program was the first of its kind and was undertaken at a time when it was unclear whether the proposed methods to send a human being to the Moon and back again would actually work in practice. With more than four decades of technological advances in computing, navigation, control systems, and other fields—and the certainty that the task is in fact possible—it seems reasonable to expect that the cost of a return trip would be significantly lower.

<sup>75</sup> See Comm. on the Peaceful Uses of Outer Space, *supra* note 37, at 11.

<sup>76</sup> *Id.*

<sup>77</sup> See LYALL & LARSEN, *supra* note 26, at 70–80. Lyall and Larsen argue that at a minimum these provisions include: (1) the applicability of international law in outer space, (2) that outer space, the Moon, and other celestial bodies are not subject to national appropriation, (3) outer space is free for exploration and use by all, (4) exploration and use of outer space is to be for the benefit of all, (5) that states are responsible for the activities of their nationals in outer space, (6) that states have a continuing duty to authorize and supervise such actions by their nationals, and (7) that states are liable for any damages

relevance of the Moon Agreement is less clear. The Agreement entered into force in 1984<sup>78</sup> and more than thirty years later binds only fifteen countries.<sup>79</sup>

Because the Moon Agreement builds directly on the foundation of principles laid by the Outer Space Treaty and borrows much of that treaty's language,<sup>80</sup> it is less likely that directly conflicting obligations will arise under each treaty than that it will be unclear which rules to apply to which entities. For example, what law would govern the extraterrestrial activities of citizens of the United States, an Outer Space Treaty party, working for a corporation organized in Austria, which is a Moon Agreement party? This question is important to ensure that private actors comply with the appropriate law, but a non-uniform regime governing outer space law may also have a substantial effect on the competitive environment of extraterrestrial resource exploitation. In particular, if the Moon Agreement is interpreted to require mandatory benefit or technology sharing, nations and private entities subject to its provisions may be at a substantial disadvantage compared to those governed only by the Outer Space Treaty, which has generally been interpreted by the spacefaring powers not to require these measures.<sup>81</sup> It is undesirable that certain nations be given an artificial advantage over others in the use of

---

caused by these activities. *Id.* at 71. They also suggest that there is “considerable strength in the argument . . . that the fundamental principles of the OST now come into the category of *ius cogens*, principles of law that cannot be receded from, any attempt to legislate to the contrary being void.” *Id.* at 80 (citing Carl Q. Christol, *Judge Manfred Lachs and the Principle of Jus Cogens*, 22 J. SPACE L. 33, 33–45 (1994)).

<sup>78</sup> *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, U.N. OFF. FOR OUTER SPACE AFF., <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/moon.html> (last visited Mar. 7, 2015), *archived at* <http://perma.cc/WQF5-3U3R>.

<sup>79</sup> *See* Comm. on the Peaceful Uses of Outer Space, *supra* note 37, at 11. These countries, as of January 1, 2013, were Australia, Austria, Belgium, Chile, Kazakhstan, Lebanon, Mexico, Morocco, the Netherlands, Pakistan, Peru, the Philippines, Saudi Arabia, Turkey, and Uruguay, all of which have ratified the agreement. *Id.* at 6–10. Note that none of these states carries on substantial independent space activity, although Austria and the Netherlands are both members of the European Space Agency (ESA). *See New Member States*, EUR. SPACE AGENCY, [http://www.esa.int/About\\_Us/Welcome\\_to\\_ESA/New\\_Member\\_States](http://www.esa.int/About_Us/Welcome_to_ESA/New_Member_States) (last visited Mar. 7, 2015), *archived at* <http://perma.cc/429L-R27D>. The ESA's purpose is “to provide for, and to promote . . . cooperation among European States in space research and technology and their space applications . . . by coordinating the European space programme and national programmes, and by integrating the latter . . . as completely as possible into the European space programme . . .” *ESA's Purpose*, EUR. SPACE AGENCY, [http://www.esa.int/About\\_Us/Welcome\\_to\\_ESA/ESA\\_s\\_Purpose](http://www.esa.int/About_Us/Welcome_to_ESA/ESA_s_Purpose) (last visited Feb. 3, 2015), *archived at* <http://perma.cc/429L-R27D>. The Agency has recently attracted attention and fame for its Rosetta mission, the first to land a probe and collect data from the surface of a comet. *Touchdown! Rosetta's Philae Probe Lands on Comet*, EUR. SPACE AGENCY (Nov. 12, 2014), [http://www.esa.int/Our\\_Activities/Space\\_Science/Rosetta/Touchdown!\\_Rosetta\\_s\\_Philae\\_probe\\_lands\\_on\\_comet](http://www.esa.int/Our_Activities/Space_Science/Rosetta/Touchdown!_Rosetta_s_Philae_probe_lands_on_comet), *archived at* <http://perma.cc/8Q9V-XDMB>.

<sup>80</sup> *See infra* note 79.

<sup>81</sup> *See* Jasentuliyana, *supra* note 39, at 139–40.

extraterrestrial resources by virtue of differing legal obligations that are the result of uneven ratification of the major treaties of international space law.

The meaning of certain provisions of the Outer Space Treaty and Moon Agreement themselves is even less certain than determining which treaty should govern in a given circumstance. As examined above, there is not a settled interpretation of these treaties that establishes what the obligations of spacefaring nations are with respect to ensuring that their activities benefit all mankind.<sup>82</sup> The “common heritage of mankind” principle of the Moon Agreement is especially fraught with confusion, not only because the language itself is ambiguous but also because its interpretation in the Moon Agreement is colored by the use of the same language in the United Nations Law of the Sea Convention (UNCLOS).<sup>83</sup> As the legal adviser to the Department of State at the time noted in hearings before a Senate subcommittee in 1980, negotiations of the two treaties “were somewhat parallel in time, and the two negotiating texts contain some common phraseology.”<sup>84</sup> The legal adviser ultimately concluded that the view of the United States “was and is that the . . . meaning of the Moon Treaty should be determined independently of other international instruments and negotiations,”<sup>85</sup> but no fewer than five of twenty questions posed to the adviser by the subcommittee were directed toward the common heritage principle.<sup>86</sup>

### B. *Incentive Problems*

This uncertainty, coupled with the possibility of certain unfavorable substantive interpretations of the treaties, generates disincentives for private entities to invest in extraterrestrial development. Launching objects into space is exorbitantly expensive. NASA estimates suggest that the cost of launching a

---

<sup>82</sup> See *supra* notes 38–42, 72–73 and accompanying text.

<sup>83</sup> See Moon Agreement, *supra* note 7, art. 11, para. 1; see also UNCLOS, *supra* note 16, pt. XI, § 2, art. 136. The interpretation of this provision is discussed *infra* at Part IV.B.

<sup>84</sup> Moon Treaty Hearings, *supra* note 68, at 12.

<sup>85</sup> *Id.* It has been noted by some writers as a point of irony that the common heritage principle was ultimately found unpalatable to U.S. politicians since the language was supported by the Nixon administration over the opposition of the Soviet Union. See Nelson, *supra* note 61, at 396.

<sup>86</sup> See Moon Treaty Hearings, *supra* note 68, at 19–27. Another question inquired directly about the effect of the Agreement on commercial uses of space, asking if its ratification would “give other nations any control over the timing and direction of U.S. private sector engaging in and expanding the commercial uses of outer space[.]” *Id.* at 22. The Adviser opined that the Agreement would not establish a legal moratorium on “resource exploitation or other commercial uses of outer space” and that the United States “would not be obligated to adhere to a future international regime for resource exploitation.” *Id.*

single pound of cargo into Earth's orbit is about \$10,000.<sup>87</sup> While this cost is expected to decrease in the future as space launch technology continues to improve, it seems certain that for the foreseeable future space-based enterprise will continue to be a high-cost venture.<sup>88</sup> It seems unlikely that profit-driven companies will make such substantial investments unless they can be assured of the gains. The existing legal uncertainty is a significant obstacle to private development, given the already-substantial technological and economic risk that accompanies activity in space.

For the same reason, mandatory benefit and technology sharing provisions are substantial burdens on private space development, especially in its early stages. Research and development costs early in the lifecycle of a project are inevitable in high technology fields where several stops and starts are to be expected before a technologically feasible solution is found. Perhaps the single most important reason that private commercial exploitation of extraterrestrial resources has not already occurred is that it is simply not yet profitable to do so.<sup>89</sup> Requirements that profits or other benefits be shared with others regardless of their level of involvement in the endeavor only continues to delay the potential profitability of extraterrestrial enterprise. Considerations of

---

<sup>87</sup> *Advanced Space Transportation Program: Paving the Highway to Space*, NASA, [http://www.nasa.gov/centers/marshall/news/background/facts/astp.html\\_prt.htm](http://www.nasa.gov/centers/marshall/news/background/facts/astp.html_prt.htm) (last visited Mar. 7, 2015), archived at <http://perma.cc/VVF7-6HKR>.

<sup>88</sup> A description of NASA's Advanced Space Transportation Program suggested a target of \$100 per pound by 2025. *Id.* While a laudable goal, it seems unlikely that it will be met within that time frame. SpaceX, one of the most ambitious and successful companies driving the commercial space launch market today, has estimated that its Falcon Heavy rocket that is currently in development will be able to reach only the \$1,000 per pound mark. See David Kestenbaum, *Spaceflight Is Getting Cheaper. But It's Still Not Cheap Enough*, NPR (July 21, 2011, 12:01 AM), <http://www.npr.org/blogs/money/2011/07/21/138166072/spaceflight-is-getting-cheaper-but-its-still-not-cheap-enough>, archived at <http://perma.cc/8H6M-4X8V>.

<sup>89</sup> See B. KENT JOOSTEN & LISA A. GUERRA, AM. INST. AERONAUTICS & ASTRONAUTICS, *EARLY LUNAR RESOURCE UTILIZATION: A KEY TO HUMAN EXPLORATION I* (1993) ("The primary obstacle to renewed human exploration of the moon is the high design, development, test and evaluation... and production costs of the required transportation systems."). As a further illustration of this fact, which may be difficult to prove without more detailed analysis, consider the SpaceX Dragon capsule that will resupply the International Space Station. The capsule has a payload of approximately 1,000 pounds and will resupply the ISS over twelve flights at a contract price of \$1.6 billion. See Dan Turner, *In a New Space Race, the Dragon, and Musk, Have Landed*, L.A. TIMES (May 31, 2012), <http://articles.latimes.com/2012/may/31/news/la-ol-musk-spacex-20120531>, archived at <http://perma.cc/DLV2-WMC3>. Assuming, purely for the sake of simplicity, that SpaceX is breaking even on the transaction, i.e., that the total cost of the twelve launches is also \$1.6 billion, and that the cost of going to the Moon and retrieving resources is the same as reaching the ISS, Dragon would need to be able to return with a cargo worth over \$133,000 per pound in order to be profitable. While this is only the roughest of "back of the napkin" calculations, it is clear that in the early stages of extraterrestrial development companies and other private entities will need very strong economic incentives to consider taking on such expensive projects.



equity in the allocation of previously unclaimed resources are key in the development of an international regime, but ultimately these considerations are moot if the exploitation of resources never makes the jump from hypothetical to reality.

### *C. A Path Forward*

In light of these observations, some initial conclusions may be drawn about the best path to encouraging commercial development of extraterrestrial resources. First, the Outer Space Treaty and the Moon Agreement cannot sufficiently address the problem on their own. These treaties are either too ambiguous or too contentious to form a predictable basis for private commercial exploitation of resources. Second, mandatory benefit sharing provisions are likely to be non-starters in a regime governing commercial exploitation of extraterrestrial resources because they exert a strong disincentive to invest in risky space-based ventures. This is most certainly not to say that the interests of developed spacefaring nations are the only ones to be considered. Clearly this, too, is a non-starter for what is supposed to be an international regime. Nevertheless, special consideration must be given to the practical economic and technological reality that developed nations are, for the foreseeable future, the only ones likely to be able to undertake private commercial space ventures.<sup>90</sup> Thus, while developing nations should play a significant role in the process of creating a new regime, the first goal of the new system must be the encouragement of exploitive activity rather than putting the brakes on that activity until a perfectly equitable situation may be realized.

These general principles are only a start to a proposal. To develop a meaningful path to certainty that will also encourage investment and innovation in space exploration, more specific conclusions about the content of a new treaty must be drawn. These are best found by examining parallels with other national and international legal regimes governing the use of common resources.

## IV. ALLOCATION AND ENFORCEMENT OF PROPERTY AND USAGE RIGHTS: PARALLELS IN INTERNATIONAL AND NATIONAL LAW

To understand what features a new regime must have, it is helpful to examine historical examples in which unclaimed or public resources have been allocated to private use, and to try to determine which elements of these systems were successful and which were not. Three such examples are especially relevant to the question of allocation of extraterrestrial development

---

<sup>90</sup> This conclusion is compelled by the magnitude of the cost of space activity, discussed *supra* notes 87–89.

rights to private parties: (1) the International Telecommunications Union's<sup>91</sup> (ITU) regime governing the allocation of geostationary orbit (GSO) slots; (2) the United Nations Convention on the Law of the Sea (UNCLOS) governing the allocation of deep seabed mineral resources;<sup>92</sup> and (3) the Homestead Act governing the allocation of public federal land in the American West to farmers in the nineteenth century.<sup>93</sup>

### A. *The ITU and Geostationary Orbit Slots*

Geosynchronous orbit refers to the orbit at which an object has the same orbital period as the period of rotation of the Earth.<sup>94</sup> Geostationary orbits (GSO) are a subset of geosynchronous orbits where the orbiting object revolves around the Earth in the same plane as the equator.<sup>95</sup> In practice, this means that an object in a GSO would appear to remain fixed in the sky above a particular point on the Earth, because the object would be traveling around the Earth in the same time it took the Earth to rotate.<sup>96</sup> As a result, this is a highly sought-after orbital position for telecommunications satellites because they are able to remain stationary over a specific position on Earth to continuously serve that region's communications and remote sensing needs.<sup>97</sup> The allocation of these orbits is regulated by the International Telecommunication Union (ITU).<sup>98</sup>

It may sound odd that the allocation of slots in geosynchronous orbit would be such an important task. Space is quite large, after all, and even a large communications satellite is unlikely to occupy much of the physical space at such a distant orbit.<sup>99</sup> The answer to this puzzle is that physical

---

<sup>91</sup> *Overview of ITU's History (5)*, ITU, [http://www.itu.int/en/history/Pages/ITUs\\_History-page-5.aspx](http://www.itu.int/en/history/Pages/ITUs_History-page-5.aspx) (last visited Mar. 7, 2015), *archived at* <http://perma.cc/WPF3-PC3S>.

<sup>92</sup> *See generally* UNCLOS, *supra* note 16.

<sup>93</sup> Homestead Act of 1862, ch. 75, 12 Stat. 392.

<sup>94</sup> *See* Lawrence D. Roberts, *A Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union*, 15 BERKELEY TECH. L.J. 1095, 1098–1100 (2000). The orbital period of an object depends on its orbital radius, thus the geosynchronous orbit refers to that orbit in which objects are approximately 22,300 miles above the surface of the Earth. *Id.* at 1099.

<sup>95</sup> *Id.*

<sup>96</sup> Jonathan Keohane & Gail Rohrbach, *Geostationary Orbit Altitude*, NASA, [http://teacherlink.ed.usu.edu/tlnasa/reference/imaginedvd/Files/Imagine/docs/ask\\_astro/answers/970408d.html](http://teacherlink.ed.usu.edu/tlnasa/reference/imaginedvd/Files/Imagine/docs/ask_astro/answers/970408d.html) (last updated Apr. 13, 2011, 3:32 PM), *archived at* <https://perma.cc/L98C-9RZ6>.

<sup>97</sup> Roberts, *supra* note 94, at 1098–1100. As Roberts notes, a geostationary satellite has a view of as much as forty percent of the Earth's surface at any given time. *Id.* at 1100 n.24 (citing Martin A. Rothblatt, *Satellite Communications and Spectrum Allocations*, 76 AM. J. INT'L L. 56 (1982)). Hundreds of satellites take advantage of this orbit for communications and other purposes. *Id.* at 1100.

<sup>98</sup> *Id.* at 1105.

<sup>99</sup> An FCC guide to satellites for schoolchildren suggests that “modern communications satellites can weigh up to six tons and be the size of a small school bus.”

proximity of satellites is not the primary limiting factor on the availability of GSO slots.<sup>100</sup> Instead, the problem of radio interference, where one signal interferes with another at the same frequency, is the most important limitation on the number of communications satellites that may be operated in GSO—if communications satellites using the same frequencies are too close together, their signals will interfere with one another and they will be effectively useless.<sup>101</sup>

The ITU's approach to assigning this limited number of slots has evolved over time. The initial method was a sort of first-come, first-served approach, where the first to apply for a slot was the first to be allowed to use it and could exclude others from interfering with that use so long as use was continuous.<sup>102</sup> This system generally benefited developed countries and spacefaring states, which had the resources to make use of GSO far in advance of the developing countries.<sup>103</sup>

Some of these developing nations responded with the 1976 Bogota Declaration, in which they claimed that the GSO slots were not properly part of outer space as described by the Outer Space Treaty, but rather part of the natural resources of the territory over which the slots lay.<sup>104</sup> The Declaration was ultimately unsuccessful, in large part because none of these nations had independent space-launch capability allowing them to force the issue and actually take advantage of their legal claim.<sup>105</sup> Since then, however, the ITU has begun to make accommodations for the interests of developing states. The organization now employs a “hybrid system” in which first-come, first-served is supplemented by a nominal allocation of an orbital slot to each ITU

---

*FCC Satellite Learning Center: What Is a Satellite?*, FED. COMM. COMMISSION, [http://transition.fcc.gov/cgb/kidszone/satellite/kidz/how\\_big\\_are\\_sats.html](http://transition.fcc.gov/cgb/kidszone/satellite/kidz/how_big_are_sats.html) (last visited Mar. 7, 2015), archived at <http://perma.cc/8V73-RDEB>. Compared to the size of geosynchronous orbit this is very small. If the orbit is circular it will have a circumference of  $2 \times \pi \times 26,200 \text{ miles} \approx 165,000 \text{ miles}$  and the arc length of a single degree along this orbit will be several hundred miles.

<sup>100</sup> See Roberts, *supra* note 94, at 1102.

<sup>101</sup> See *id.* at 1102–04. Because the availability of GSO slots is primarily a function of the potential for radio interference between satellites, the number of slots available for allocation is dependent on the capabilities of radio communications technology and is not necessarily fixed. *Id.* at 1101. The upper limit on the number of satellites that may be placed in GSO is about 1800 based on navigational hazards associated with physical proximity. *Id.* The number of available orbital slots for communications satellites as dictated by radio interference limitations is substantially less than that. *Id.* at 1104. As communications technology progresses, problems of interference may be mitigated and the number of available orbital slots might increase.

<sup>102</sup> See TRONCHETTI, *supra* note 26, at 170–72.

<sup>103</sup> *Id.*

<sup>104</sup> See Roberts, *supra* note 94, at 1126. The eight countries joining the Bogota Declaration were constrained to make this argument since the Outer Space Treaty expressly prohibits claims of national appropriation over any part of outer space. *Id.*; Outer Space Treaty, *supra* note 7, art. II.

<sup>105</sup> See Roberts, *supra* note 94, at 1127.

member.<sup>106</sup> Under this system, members are given priority for this existing slot in the application process.<sup>107</sup>

Several significant observations can be drawn from the ITU's system that are applicable to a system of allocating extraterrestrial resource rights. First, freeze-out problems are a significant concern that should be addressed if a system is to be both fair and palatable to developing nations that do not currently have the capacity to exploit extraterrestrial resources. A first-come, first-served system may be unable to adequately address these concerns.<sup>108</sup> On the other hand, a system reserving a certain number of sites or amount of resources to developing states ahead of time is likely to be inefficient because it allocates resources to countries potentially far in advance of their being able to exploit them.<sup>109</sup>

### B. *The Convention on the Law of the Sea*

The United Nations Convention on the Law of the Sea (UNCLOS) is a natural point of comparison to a regime for allocating extraterrestrial resource rights. Quite apart from commonly drawn analogies between spacefaring and seafaring, a comparison to UNCLOS is apt because the treaty was intended to regulate the exploitation of resources on the deep seabeds, an area regarded as not subject to claims of national appropriation.<sup>110</sup> Furthermore, the treaty

---

<sup>106</sup> *Id.* at 1128.

<sup>107</sup> *Id.*

<sup>108</sup> Tronchetti says categorically that such a system “would deny [developing states] any possibility to access lunar and other celestial bodies [sic] resources.” TRONCHETTI, *supra* note 26, at 189. Tronchetti's argument is well-taken, but his conclusion is perhaps too strong in the context of extraterrestrial resources. A salient feature of the ITU and GSO slots is that there are so few slots to go around and so much demand for them. By contrast, it is not clear what the full extent of lunar mineral resources is, although there are indications that there may be substantial concentrations of both titanium, *see Moon Packed with Precious Titanium, NASA Probe Finds*, SPACE.COM (Oct. 11, 2011, 7:00 AM), <http://www.space.com/13247-moon-map-lunar-titanium.html>, *archived at* <https://perma.cc/42MJ-S2AC>, and rare earth elements, *see* Brian Palmer, *Moon Draws Growing Interest as a Potential Source of Rare Minerals*, WASH. POST (Feb. 6, 2012), [http://www.washingtonpost.com/national/health-science/moon-draws-growing-interest-as-a-potential-source-of-rare-minerals/2012/01/30/gIQAqHvUuQ\\_story.html](http://www.washingtonpost.com/national/health-science/moon-draws-growing-interest-as-a-potential-source-of-rare-minerals/2012/01/30/gIQAqHvUuQ_story.html), *archived at* <https://perma.cc/8MK4-4KXU>. Tronchetti rightly points out that GSO slots are non-exhaustible resources while lunar minerals may not be mined again once collected, but his conclusion that these resources “would be soon exhausted,” *see* TRONCHETTI, *supra* note 26, at 189, is far from certain. A variety of factors, including the cost of exploitation and the amount of available mineral reserves, will have a substantial impact on the results of such a system in practice.

<sup>109</sup> *See* TRONCHETTI, *supra* note 26, at 189–91.

<sup>110</sup> UNCLOS, *supra* note 16, pt. XI, § 2, art. 137.

shares the controversial “common heritage of mankind” language that is found in the Moon Agreement’s Article 11.<sup>111</sup>

UNCLOS set up a relatively complicated regime for governing the exploitation of deep seabed mineral resources. This regime included provisions governing the sharing of technology<sup>112</sup> and specific provisions specifying precisely how certain resources were to be developed.<sup>113</sup> These development procedures included a “parallel system” in which the International Seabed Authority would hold some mining sites in reserve to be exploited either by the Authority itself or in partnership with developing nations.<sup>114</sup> Like the Moon Agreement, UNCLOS made clear that the seabed and ocean floor beyond established limits of national jurisdiction were not subject to appropriation by either nations or their citizens.<sup>115</sup>

Developed nations, most notably the United States, were not satisfied with this regime, thinking that it placed too many restrictions on their ability to freely exploit deep seabed mineral resources.<sup>116</sup> President Reagan, in his announcement that the United States would not sign the Convention, specifically cited mandatory technology transfer and economic disincentives to development of resources as key problems with the Convention as written.<sup>117</sup>

The UNCLOS demonstrates some of the problems with mandatory benefit sharing provisions. Like exploitation of extraterrestrial resources, the exploitation of deep seabed mineral resources could not be accomplished without the participation of the developed nations because they were the only states with the technological capacity to do it.<sup>118</sup> Mandatory benefit sharing provisions have proven to be unappealing to developed nations, especially the United States, which is arguably the most important of the spacefaring powers. Absent strong countervailing consensus, American opposition to a new legal regime to govern the exploitation of extraterrestrial resources may make that

---

<sup>111</sup> See Moon Agreement, *supra* note 7, art. 11, para. 1; see also UNCLOS, *supra* note 16, pt. XI, § 2, art. 136.

<sup>112</sup> UNCLOS, *supra* note 16, pt. XI, § 2, art. 144.

<sup>113</sup> *Id.* pt. XI, § 3, art. 150.

<sup>114</sup> See TRONCHETTI, *supra* note 26, at 106.

<sup>115</sup> UNCLOS, *supra* note 16, pt. XI, § 2, art. 137. Unlike the Moon Agreement, UNCLOS went on specifically to say that rights to resources were “vested in mankind as a whole, on whose behalf the [International Seabed] Authority shall act.” *Id.*

<sup>116</sup> See TRONCHETTI, *supra* note 26, at 106–09.

<sup>117</sup> Statement on United States Actions Concerning the Conference on the Law of the Sea, 2 PUB. PAPERS 911–12 (July 9, 1982). Other problems noted in the statement related to the decisionmaking process, in which it was felt the United States was not given a strong enough role to sufficiently protect its interests, and provisions of the Convention that allowed amendments to bind the United States without its own approval. *Id.*

<sup>118</sup> See *Seafloor Mining*, WOODS HOLE OCEANOGRAPHIC INST., <https://www.whoi.edu/main/topic/seafloor-mining> (last visited Mar. 7, 2015), archived at <http://perma.cc/DG3Q-H2LY> (noting the development of “specialized dredgers, pumps, crawlers, drills, platforms, cutters and corers, many of them robotic and all designed to work in the harsh conditions of the deep ocean”).

regime practically meaningless. Mandatory benefit sharing should be avoided, therefore, if the necessary buy-in of developed nations is to be achieved.

### C. *The Homestead Acts*

The Homestead Acts are seemingly the most remote of the parallels discussed herein, but they also offer some of the most useful features to apply to a new system to govern the exploitation of extraterrestrial resources. Most significantly, they demonstrate the success of a use-based system of allocation that ultimately resulted in the grant of full private property rights rather than mere license to exploit. The grant of such a right gives several significant benefits to development, including ease of transferability, security of investment in improvements, and adaptability to changing economic circumstances.

The Homestead Act of 1862 provided for the allocation of public lands to private individuals on the satisfaction of certain conditions.<sup>119</sup> The Act entitled citizens of the United States to enter into unappropriated public lands and claim no more than 160 acres in the aggregate for use as a homestead or for cultivation and farming.<sup>120</sup> It required entrants to use the land for a continuous period of five years of “actual settlement and cultivation, and not either directly or indirectly for the . . . benefit of any other person,” after which they would be given title to the land.<sup>121</sup> While not free from the problem of fraudulent claims,<sup>122</sup> the Homestead Act was responsible for the distribution of 270 million acres of land to settlers in the American West.<sup>123</sup>

The Homestead Act is of course not a perfect comparison to the case of exploitation of lunar resources under an international regime. For one, the U.S. federal government had clear authority over the lands it was distributing to settlers, whereas no comparable body exists having certain authority over the Moon and other celestial bodies. Another point of departure is that the Homestead Act was by and large an act to benefit small-scale, independent farmers,<sup>124</sup> whereas those who will ultimately exploit extraterrestrial resources will, by necessity, be well-funded companies or governments with the deep pockets necessary to fund space-based enterprise. However, this does not

---

<sup>119</sup> Homestead Act of 1862, ch. 75, 12 Stat. 392.

<sup>120</sup> *Id.*

<sup>121</sup> *Id.*

<sup>122</sup> See Roger D. Billings, *The Homestead Act, Pacific Railroad Act and Morrill Act*, 39 N. KY. L. REV. 699, 720 (2012).

<sup>123</sup> *Id.* at 722.

<sup>124</sup> Desmond A. Jolly, *Small Farms Re-emerge in National Agenda*, 53 CAL. AGRIC., Nov.–Dec. 1999, at 2, 2, available at <http://ucanr.edu/repositoryfiles/ca5306p2-67421.pdf>, archived at <http://perma.cc/S3BR-6SGL>. Indeed, this boon for small-scale farmers was one of the principle objections to the Act prior to the Civil War since slave owners operating plantations in the South believed the independent homesteaders would be hostile to slavery. See Billings, *supra* note 122, at 713.

affect the usefulness of the Homestead Act as a model for the allocation of other resources and territory, provided that the goal is made clear from the outset. While making it easier for a large, well-financed corporation to achieve its aims is less politically exciting than making land freely available to the rugged individualist farmer, it may nevertheless be used as a means to achieve the ultimate goal of encouraging the development of extraterrestrial resources.

There are several key advantages of the homestead concept as applied to the development of extraterrestrial resources. First, the homestead concept carries with it the obligation of use. The prospective homesteader cannot get title to the land or resource in question unless he uses it continuously for the defined period, and perhaps for a specified purpose. This helps alleviate the freeze-out problems discussed above in connection with the first-come, first-served filing system used by the ITU.<sup>125</sup> Second, a cap is placed on how much territory or resources the homesteader may gain title to. This further alleviates freezeout of developing countries by ensuring that the citizens and companies of developed countries may only get certain defined parcels. It also has the salutary effect of encouraging competition and participation in commercial space activity by a large number of private entities, which is likely to be beneficial for innovation and driving down costs. Third, and perhaps most importantly, at the end of the homestead period, title is granted free and clear to the homesteader provided he has satisfied the applicable requirements. This is the most difficult aspect to reconcile with the non-appropriation principles of the Outer Space Treaty and the Moon Agreement, but is also vitally important to encouraging economic development.

#### *D. Observations for a Future Regime*

These parallels point to certain foundational principles that must be part of any new international regime to govern the allocation of rights to extraterrestrial resources or territory. As a starting point, the ultimate and most important goal of a new treaty should be to encourage the exploration and development of extraterrestrial resources. The legitimate interests of both developing and developed nations must also be considered. These interests are reconcilable and their accommodation is not mutually exclusive; however, it requires careful balancing to ensure that developed nations are given the ability to conduct resource-extractive activities as they see fit while also protecting the interests of developing nations in future access. A new treaty must also address certain political realities, namely that mandatory technology or benefit sharing provisions are not likely to be acceptable to developed countries, while unfettered, unregulated use and appropriation is not acceptable to developing nations. With these principles in mind, a new international regime can be elaborated to govern the allocation of private usage and ownership rights to extraterrestrial resources.

---

<sup>125</sup> See *supra* Part IV.A.

## V. A PROPOSAL FOR A NEW REGIME

Four features should be present in a new legal regime to govern the use of extraterrestrial resources and territory. First, and most important, the new regime must accept that the use of these resources for scientific and productive purposes is desirable, and its central goal must be to encourage this use. This principle would animate the others, and should serve as a guide to the implementation of the regime's other requirements. Second, the regime should be constructed and interpreted so as to be consistent with the provisions of the Outer Space Treaty that have arguably become customary international law.<sup>126</sup> This would provide continuity and consistency in international space law, avoiding potential problems of uneven application. Third, the homestead concept should be incorporated in a form that allows for the recognition of private property rights under the authority of an independent international body after a defined term of use. This would allow for both certainty and adaptability for private entities seeking to make investments in extraterrestrial territory and resources. Fourth, and finally, the international regime should take care to balance the interests of technologically advanced space-capable nations against the interests of developing countries that do not yet have the technological capability to reach and use extraterrestrial resources. The regime should also balance the interests of private entities seeking to extract resources against the larger interests of humanity.

Together, these features describe a system that can solve legal uncertainties and economic incentive problems while simultaneously serving the peaceful and cooperative aims of existing international space law. The utility of these features, and their operation in practice, is examined below.

### A. *The Desirability Principle*

The core principle of a new regime to govern the use of extraterrestrial resources by private actors is first and foremost that the development of those resources for scientific and productive purposes is desirable, and the facilitation of that development is the most important purpose of the treaty. Because the issue of private use of outer space is fraught with controversy, it is important to be clear at the outset what this principle means and what it does not. To say that the exploitation of resources is desirable, and the most important goal, does not mean that any mode of exploitation is beneficial or that any intended use is to be tolerated. The use of the Moon as a base for military operations or the development of weapons, for example, is antithetical to the cooperative, peaceful use of space contemplated by the widely accepted Outer Space Treaty,<sup>127</sup> and is rightly rejected. Using the Moon as a toxic waste

---

<sup>126</sup> See LYALL & LARSEN, *supra* note 26, at 71.

<sup>127</sup> See Outer Space Treaty, *supra* note 7, art. IV (forbidding the establishment of military bases or the testing of weapons on celestial bodies).



dump might also be rejected, because such use has the potential to render the Moon's resources unsuitable for use in the future.<sup>128</sup>

The most important idea underlying the desirability principle as well as instructing the outcomes of the examples above, is that efficient, value-maximizing use of resources is inherently beneficial to mankind.<sup>129</sup> This is obscured by the Outer Space Treaty and the Moon Agreement because their focus is regulating state actors. This casts the discussion in competitive terms, as there is a tendency to imagine that what a Russian or a Chinese company receives, an American has had to forgo. While this state-oriented approach made sense when the current space law treaties were drafted—a time when government space agencies were the only ones capable of reaching other celestial bodies—this approach is no longer useful. In the context of private commercial actors, the focus on states encourages only narrow, mercantilist thinking. In an interconnected global economy, economic development is not a zero-sum game, and the use of resources by the citizens of one nation does not imply a harm, or even a lack of benefit, to the citizens of another.

### B. Consistency with the Outer Space Treaty

The new regime must also be consistent with the obligations of the Outer Space Treaty, in particular the non-appropriation principle and the prohibition against weapons of mass destruction in space.<sup>130</sup> These provisions serve a vital function in discouraging national competition that otherwise might lead to conflict. As such, it will be important that an international body be established to govern the allocation of rights to extraterrestrial resources and territory. Independent claims to national sovereignty must continue to be rejected by the international community so that peace and cooperation may prevail in space.

The establishment of a new international regime is not inconsistent with either the Outer Space Treaty or the Moon Agreement. Indeed, the Moon Agreement itself calls for the establishment of just such a scheme when the

---

<sup>128</sup> Such a use would bear further analysis before being rejected out of hand, however. Environmental regulation may be a necessary and desirable thing to impose on private actors in space. But if the Moon is found to be clearly more valuable to humanity as a waste dump than for any other reasonably foreseeable future purpose, it should not be rejected simply because it seems to run counter to the notion of space as an untouched, pristine frontier. Article 7 of the Moon Agreement contemplates some form of environmental regulation. *See* Moon Agreement, *supra* note 7, art. 7, para. 1. This concern for the protection of uniquely pristine environments untouched by human designs should be carried on into a new regime, to one degree or another.

<sup>129</sup> The phrase “efficient, value-maximizing” assumes, of course, a full accounting of the costs and benefits so that externalities are internalized as part of the cost of taking a particular action. For a classic discussion of externalities as they relate to the importance of and development of property rights, see generally Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347 (1967).

<sup>130</sup> Outer Space Treaty, *supra* note 7, art. IV.

exploitation of extraterrestrial resources “is about to become feasible.”<sup>131</sup> The “common heritage of mankind” language does nothing to change this, because Article 11.1, the only place where the phrase appears in the Agreement, provides that the phrase “finds its expression in the provisions of [the] Agreement and in particular in paragraph 5” where the international regime is discussed.<sup>132</sup>

In light of ongoing uncertainty and debate about the meaning of certain provisions of the existing treaties, the new legal regime must not be subjected to a rigid test of consistency with all parts of the Outer Space Treaty or the Moon Agreement. In particular, provisions of those treaties interpreted to require sharing of the benefits from the use of extraterrestrial resources<sup>133</sup> should not be used to prevent the adoption of a new treaty that does not have this feature. Benefit sharing has been shown to be unpalatable to the developed nations whose citizens and companies are most likely to be able to conduct extraterrestrial resource-extractive activity. It also frustrates the desirability principle by decreasing the profits of extraterrestrial ventures and thus decreasing the incentives for private entities to invest in developing extraterrestrial resources. The best interpretation of the existing treaty framework allows for the possibility of a new international regime that is structured to encourage private development while at the same time embracing the core principles of international cooperation that are the bedrocks of the Outer Space Treaty.

### *C. Implementation of the Homestead Concept*

The homestead concept is of vital importance to the success of the new regime. Several important purposes would be served by granting property rights to private entities after a period of use. First, the grant of property rights in extraterrestrial territory and resources would allow companies to flexibly adapt to changing economic circumstances through transfer and other disposition of property. Second, the requirement that certain use-based, pre-grant conditions be satisfied before property rights are created allows the regime to avoid land grabs and waste associated with other systems, like the allocation of GSO slots by the ITU.<sup>134</sup>

The grant of property rights provides flexibility and adaptability because it allows property holders to transfer their property to others. This allows property holders to recoup investments they have made in the territory or resources themselves by charging a higher price for the improved land. Furthermore, the ability to transfer property allows for spontaneous development that might not be predicted by an international governing

---

<sup>131</sup> Moon Agreement, *supra* note 7, art. 11, para. 5.

<sup>132</sup> *See id.* art. 11, para. 1.

<sup>133</sup> *See supra* Part II.A.

<sup>134</sup> *See supra* Part IV.A.

authority because transfer permits property holders to sell all or a portion of their possession to another user who might get more value from it.<sup>135</sup> By contrast, a regime requiring licensure to grant only usage rights to extraterrestrial resources is limited to allowing only those activities that the licensing body can predict and sees fit to authorize.<sup>136</sup>

The homestead concept also captures the benefits of a system granting only usage rights by premising the grant of the right on the satisfaction of certain use-based criteria for a defined period. This avoids a first-come, first-served land grab where claims are made for the sole purpose of being able to exclude latecomers (or charge them a holdup price) before the claimant is truly able to take advantage of the opportunity. This helps alleviate the concern that space-adept nations and their citizens will be able to freeze out latecomers in developing countries that do not yet have the technology or resources to conduct space-based activities. The homestead concept also accounts for the interests of the space-adept nations, because it makes using the resources the

---

<sup>135</sup> A simple hypothetical helps explain how this might work in practice. Suppose that the international governing authority was in the habit of making use-based grants to lunar mining companies. Operating under the homestead principle, a mining company who had taken title of the lunar land it used could sell a portion of its land to another company to provide various support services for the mining operation, perhaps including food, breathable oxygen, and housing for the miners. A mining company, after all, may wish to specialize in mining itself, rather than having to also maintain these additional facilities to sustain the operation. Under some other licensure scheme not allowing for property rights and transfer, the mining company may be limited to providing these support services itself. Alternatively, a support company will need to independently engage in a process of licensure through the international authority simply to provide support services that must necessarily exist if the original mining operation is to begin in the first place. Property rights and transferability mitigate these problems by allowing private entities to interact, transfer the necessary property rights, and realize gains from trade in specialization.

<sup>136</sup> Fabio Tronchetti outlines in detail an international regime of this kind to allow resource exploitation by private actors under the legal authority of the United Nations. *See* TRONCHETTI, *supra* note 26, at 249–63. This system is problematic, because it is premised on a lengthy licensure process during which the licensee is expected to provide detailed plans of whatever activity may be undertaken during the term of the license, and is expected to restrict its activities to what is outlined in those plans. *See id.* at 257–63. This does not allow private entities to take advantage of serendipitous opportunities for development that present themselves unless they are already within the scope of the existing license. Furthermore, Tronchetti's system must jump through hoops in order to allow private entities to recoup any investments they may have made in extraterrestrial land at the expiration of a license. *See id.* at 262 (suggesting the intervention of the international authority to determine the value of improvements to be sold to the next licensee). Tronchetti's system contemplates that all licensees would have a duty to remove any facilities or improvements from the lunar surface if they cannot be sold to a new licensee of the same plot. *Id.* Again, the homestead system, with its grant of full private property rights avoids all of these problems. In the event that an entity wishes to cease operations, it may simply do so with no further fanfare. It may also transfer the land, facilities and all, to a new entity at a mutually agreeable price without the need for intervention of a regulatory authority to estimate what value the parties might place on the improvements.

most important, and effectively the only substantial, condition on the grant of property rights. This avoids the problem of having vast resource deposits and tracts of land set aside and unusable simply to provide for the possibility that some nation, someday, might want to undertake space-based resource extraction.

#### D. *Balancing Competing Interests*

The last principle, but by no means the least important, is the balancing of interests between developed spacefaring countries and developing countries, and between private developers and humanity as a whole. To a certain extent, the balance of these interests is accomplished by the use of the homestead concept to allocate rights to extraterrestrial territory and resources. Special consideration should be given, however, to ensure that this allocation is encouraging the use and development of extraterrestrial resources in a responsible fashion that benefits mankind broadly.

It is readily apparent that other regulatory authority must necessarily be granted to the international body administering the new regime of private property to accomplish these purposes. There must of course be a binding mechanism for settling property and other disputes.<sup>137</sup> As mentioned previously, there should also be an international body given the authority to create and enforce appropriate environmental regulation to prevent the degradation of extraterrestrial environments. The unique nature of outer space and the celestial bodies should not be neglected. The “province of mankind”<sup>138</sup> and common heritage principles recognize more than just that outer space in some sense belongs to all of us; they point out the unique quality that it is, by and large, untouched by human activity. While this singular characteristic should not discourage us from seeking to explore and establish a presence elsewhere in the universe, neither should humanity neglect its responsibility to ensure that the knowledge and resources left undiscovered in the vastness of space are not inadvertently lost.

A final important principle should be kept in mind when drafting and implementing the new regime. As Gennady Danilenko, a Soviet legal expert, once noted, “[i]nternational space law is traditionally based on anticipatory regulation producing rules governing topics that might arise only in the future.”<sup>139</sup> But while this sort of regulation “may be useful for the establishment of a broad legal framework . . . it is dangerous to rely on it too heavily . . . where detailed regulation of complex technical or economic issues

---

<sup>137</sup> For more on disputes in space law, see generally GÉRARDINE MEISHAN GOH, *DISPUTE SETTLEMENT IN INTERNATIONAL SPACE LAW: A MULTI-DOOR COURTHOUSE FOR OUTER SPACE* (2007).

<sup>138</sup> Moon Agreement, *supra* note 7, art. 4, para. 1.

<sup>139</sup> Gennady M. Danilenko, *International Law-Making for Outer Space*, *SPACE POL’Y*, Nov. 1989, at 321, 325.

is required.”<sup>140</sup> This Note intends to make an approach to a “broad legal framework” rather than attempt to express detailed regulation. What is proposed here then is a refreshed starting point of principles, to restart negotiation and deliberation that has been stalled for nearly thirty-five years, while recognizing that the principles that are established today will likely guide and control how humanity is able to expand to the stars for decades to come.

## VI. CONCLUSION

The day is fast approaching when private expeditions to the Moon and other celestial bodies will be possible, perhaps even routine. It will not be long after these expeditions begin that profit from them is sought. Currently, however, the legal landscape that might govern such profit-seeking ventures is uncertain and potentially hostile. The Outer Space Treaty and the Moon Agreement leave open substantial questions about what activity is permitted and whether private parties might have affirmative obligations to share the benefits of their activities in space. So long as these questions are not resolved by a new treaty, the uncertainty they cause and the costly outcomes they might permit create substantial disincentives to private investment in the development and use of extraterrestrial resources.

Several historical approaches to similar problems have helped illustrate how these problems might be avoided in space. The experience of allocating GSO slots suggests that first-come, first-served systems not premised on actual use insufficiently protect the interests of developing states.<sup>141</sup> On the other hand, a system that sets aside certain resources as reserved for developing states inefficiently eliminates opportunities for development to protect interests that may never be exploited. The failure of UNCLOS indicates that benefit-sharing provisions are virtually non-starters for developed nations that are key players in spaceflight.<sup>142</sup> The Homestead Acts suggest a model for the grant of property rights based on use that has the potential to solve conflicts between developing and developed states in the development of property in outer space.<sup>143</sup>

It is nearly certain that the process of exploring and exploiting outer space in the future will defy our best predictions. As such, the new international regime must be flexible enough to respond to changing circumstances. Its provisions should be based on the principles described above. Human use of extraterrestrial resources is a desirable goal to be achieved. Outer space should not be subject to national military or territorial competition. Property rights should be granted based on the use of resources and territory. The interests of

---

<sup>140</sup> *Id.*

<sup>141</sup> *See supra* Part IV.A.

<sup>142</sup> *See supra* Part IV.B.

<sup>143</sup> *See supra* Part IV.C.

all mankind should be considered in regulating the development of space. These principles can serve as a foundation that will support not only foreseeable private expeditions in the near future, but also unforeseen and unimaginable efforts by humans to expand into outer space and make it their own.