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A Tragedy of the Anticommons: The Economic Inefficiencies of Space Law

Benjamin David Landry

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A TRAGEDY OF THE ANTICOMMONS: THE ECONOMIC INEFFICIENCIES OF SPACE LAW

*Benjamin David Landry**

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INTRODUCTION

The commercialization of outer space has been stunted by inefficiencies in the international laws regulating its use. International law classifies outer space as the common heritage of mankind.¹ Under this regime, (1) neither outer space nor any celestial body is subject to national (and, under some interpre-

* J.D., The University of Chicago Law School; B.A., Albion College. I would like to thank Professor Tom Ginsburg at The University of Chicago Law School, Isaac Gruber at Simpson Thacher & Bartlett LLP, and the staff of the *Brooklyn Journal of International Law*. All remaining errors are, of course, my own.

1. *E.g.*, Agreement Governing the Activities of States on the Moon and Other Celestial Bodies art. 11, *opened for signature* Dec. 18, 1979, 1363 U.N.T.S. 21 [hereinafter Moon Treaty] (entered into force July 11, 1984); Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. I, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 207-08 [hereinafter Outer Space Treaty] ("The exploration and use of outer space . . . shall be the province of all mankind.").

tations, private) appropriation,² and (2) any use of outer space must be carried out for the benefit of all states “*irrespective of their degree of economic or scientific development.*”³ The particular quantity and type of “benefits” which must be shared are unclear. No state or private entity has been willing to bear the enormous cost of commercialization in part because international law prohibits national and, potentially, private appropriation, and even if the laws are interpreted to allow private appropriation, they require private entities to share some unclear quantity of returns (“benefits”) with every state on Earth. Indeed, the diversity of interpretation itself creates an uncertainty that is prohibitive of meaningful investment. The tragedy, of course, is that we possess the technical capability to commercialize outer space.

While the precise profitability of the commercial use of outer space is unknown, space-faring states possess the capacity to develop commercial uses. They have abstained from doing so, at least in part, because international law has not provided them with the assurance that they will reap the full benefit of their efforts.⁴ For example, some potential commercial uses of outer space include mining, manufacturing, and energy generation. There is silicon on Mars and platinum on Near Earth Asteroids (“NEAs”) and the Moon.⁵ A rare isotope of Helium, Helium-3, exists in abundance on Mars and the Moon.⁶ This isotope can be used in proposed fusion reactors, which, using the Helium-3 on the Moon alone, could power the Earth for 500

2. Outer Space Treaty, *supra* note 1, art. II.

3. *Id.* art. I (emphasis added).

4. See David Collins, *Efficient Allocation of Real Property Rights on the Planet Mars*, 14 B.U. J. SCI. & TECH. L. 201, 208 (2008) (“No country is likely to undertake the enormous risks, economic and otherwise, associated with Mars colonization without the legal certainty that their rewards will not be distributed to others.”).

5. Jeremy L. Zell, Note, *Putting a Mine on the Moon: Creating an International Authority to Regulate Mining Rights in Outer Space*, 15 MINN. J. INT’L L. 489, 490 (2006).

6. See Collins, *supra* note 4, at 203 (“It is already known that Mars possesses vast resources of frozen carbon dioxide from which the important fuels of oxygen, deuterium and helium-3 can be derived.”); Zell, *supra* note 5, at 505 (“Helium-3 is a helium isotope that is rare on Earth but is believed to be abundant on the Moon.”).

years.⁷ Separately, technology is being developed to harness solar energy from the Sun's rays in outer space and then transmit it to Earth.⁸ Outer space also presents the opportunity for zero gravity manufacturing, which would allow companies to manufacture "products in increased quantities and at greater levels of quality, all at a lower price than could be achieved on Earth."⁹

Additionally, there are contingent benefits to the commercialization of outer space. Heart monitoring technologies were developed initially to monitor astronauts' hearts during the Apollo missions, and the need for more powerful and efficient computer technologies initiated major developments at technology companies like IBM.¹⁰ These "positive externalities" are contingent upon demand from programs like Apollo. While these uses only scratch the surface of those proposed, they illustrate the great potential that lies just out of reach, arguably obstructed by the collective inaction problem created by our international space laws.

This Article will proceed in three Parts. Part I will discuss the anticommons problem: the development of space law, the current law, and other regimes that employ the common heritage of mankind principle. Part II will survey and analyze nine proposed property regimes for outer space that claim to resolve

7. See Yukihiro Tomita et al., *Use of Polarized Helium-3 for the Energy Production*, NUCLEAR INSTRUMENTS & METHODS PHYSICS RES. 421, 424 (1998) ("The minable helium-3 on the lunar surface is estimated as about 10⁶ tons, which corresponds to the amount of the energy demand in all of the world at the middle of the next century during 500 yr.").

8. See generally George I. Seffers, *Space-Based Solar Power Comes Closer to Reality*, SIGNAL MAG. (Dec. 2010), <http://www.afcea.org/content/?q=node/2461>.

9. James J. Trimble, *The International Law of Outer Space and its Effect on Commercial Space Activity*, 11 PEPP. L. REV. 521, 524 (1983–1984). See also Leslie I. Tennen, *Outer Space: A Preserve for All Humankind*, 2 HOUS. J. INT'L L. 145, 147 (1979–1980); Martin Menter, *The Impact of Treaties on Commercial Space Operations*, 1 HASTINGS INT'L & COMP. L. REV. 389, 390 (1977–1978). See generally *Manufacturing*, SPACE ISLAND GROUP, <http://www.spaceislandgroup.com/manufacturing.html> (last visited Jan. 2, 2013) (describing the benefits of producing products such as electronics and pharmaceuticals in zero gravity).

10. See CHRIS KRAFT, *FLIGHT: MY LIFE IN MISSION CONTROL* 192–93, 353–54 (2001) (describing the domestic and international economic benefits of the Apollo space program).

this problem. Finally, Part III will propose a two-tier regime of first possession property rights wherein entities could, first, commercialize space, keep their returns, and be regulated to protect against inefficiencies, and, second, upon the satisfaction of certain requirements, obtain territorial sovereignty.

I. A TRAGEDY OF THE ANTICOMMONS

A. Economic Inefficiencies Arising from the Regulation of Shared Resources

A tragedy of the commons occurs when a shared resource is overexploited by the individuals who share it.¹¹ This occurs because the cost of increasing individual activity is borne by the group as a whole, but the benefit of increased activity inures to the individual alone—so each individual will increase her activity knowing that she will only bear a fraction of the cost, resulting in overexploitation. The cost of each individual's increased exploitation is an "externality": "a cost (or benefit) of any given action that is not taken into consideration by the actor in determining the level of that activity that is optimal from the actor's point of view."¹²

The classic example of a tragedy of the commons is a plot of land on which multiple farmers graze cattle. Each farmer will, rationally, seek to maximize her gain. If one farmer chooses to introduce one extra animal to the plot, the benefit inures to her alone, but the cost in terms of space, waste, and consumption are borne by all of the farmers equally. Introducing one extra animal is an economically rational decision for the farmer to make because the personal benefit will outweigh the cost, so she will add the animal. Because each farmer seeks to maximize her own personal gain, each will make this individually rational economic decision and the plot will soon be overexploited.¹³ As Garrett Hardin put it, "[t]herein is the tragedy."¹⁴

The opposite, however, is also true. If a shared resource is accessible to a group, but any benefit taken by an individual must

11. See generally Garrett Hardin, *The Tragedy of the Commons*, 162 *SCI.* 1243, 1243–48 (1968).

12. JAMES E. KRIER, *PROPERTY* 364 (17th ed. 2006).

13. See Hardin, *supra* note 11, at 1244.

14. *Id.*

be shared equally among the group, the resource will be underexploited. For example, suppose that the plot of land from the previous example is owned by a group of individuals, and that under the land is a well of oil. If the land is regulated such that any oil taken must be shared equally among all owners, no individual is incentivized to drill—if an individual does, she alone will bear the cost while the group will share equally in the benefit. In this hypothetical, the resource will be underexploited. Michael Heller has termed this situation a “tragedy of the anti-commons.”¹⁵

There are two exceptions, or solutions, to the anticommons problem. First, if the benefit is large enough (such that it outweighs the cost by a large margin), an individual might rationally choose to drill, knowing that even her equal share will outweigh the cost. However, resources of uncertain value are particularly susceptible to anti-commons problem, like, for instance, the resources in outer space. The second solution is collective action. Each of the owners could work together, bearing the cost equally. However, this solution gives rise to transaction costs (negotiation and decision-making, for example) and these costs rise with the number of members in the group. The transaction costs between, for example, all of the states on Earth would be, well, astronomical.

This is the problem facing the international community today. Because each state has an equal right to the “benefits” derived from outer space, and because national sovereignty is prohibited, no state has been willing to bear the enormous cost of exploitation. This is made worse because the benefits of the use of outer space will be difficult to quantify until commercialization begins.

B. A Brief History of Space Law

The impetus for the original space race was the international rivalry of the Cold War,¹⁶ specifically the Soviet Union’s launch

15. See Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 624 (1998).

16. See John Hickman & Everett Dolman, *Resurrecting the Space Age: A State-Centered Commentary on the Outer Space Regime*, 21 COMP. STRATEGY 1, 2 (2002).

of the Sputnik satellite in 1957.¹⁷ The Soviet Union's ability to operate in space was problematic for the United States because if any one state obtained control of, or militarized, outer space it would gain a tremendous competitive advantage in international politics.¹⁸ The United States and Soviet Union immediately began to negotiate the proper uses of outer space.¹⁹ Throughout late 1957 and early 1958, they exchanged "mutually unacceptable proposals" intended solely to "portray [each state] as [a] peacemaker," which resulted in no settlement.²⁰

On March 15, 1958, the United States requested that the U.N. General Assembly establish an Ad Hoc Committee on the Peaceful Uses of Outer Space ("ADCOPUOS").²¹ ADCOPUOS was formed in 1958 and became a permanent body of the U.N. the next year.²² Today, the group is known as "COPUOS". COPUOS "is the primary international forum for the development of laws and principles governing outer space,"²³ and is "charged with investigating the legal and political problems posed by the use of outer space and determining what role the United Nations should play in solving those problems."²⁴ Ini-

17. *Sputnik and the Dawn of the Space Age*, NASA, <http://www.hq.nasa.gov/office/pao/History/sputnik> (last visited Dec. 24, 2012).

18. See Hickman & Dolman, *supra* note 16, at 3.

19. See *id.* at 4–5.

20. *Id.* at 5. For example, one proposal, clearly intended to be unacceptable, came from the United States on January 12, 1958, which proposed that Intercontinental Ballistic Missiles ("ICBMs") be prohibited in space. *Id.* ICBMs are long-range missiles that necessarily pass through outer space en route to their destination. *Id.* At this time, the United States had numerous foreign bases from which they could strike deep into Soviet territory, while the Soviets had none—ICBMs were one of the Soviets' only equalizing forces. *Id.* This type of ill-willed proposal was representative of the climate of these negotiations.

21. See Brandon C. Gruner, Comment, *A New Hope for International Space Law: Incorporating Nineteenth Century First Possession Principles into the 1967 Space Treaty for the Colonization of Outer Space in the Twenty-First Century*, 35 SETON HALL L. REV. 299, 321 (2011).

22. See Question of the Peaceful Use of Outer Space, G.A. Res. 1348 (XIII), ¶ 1, U.N. Doc. A/RES/1348(XIII) (Dec. 13, 1958); International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 1472 (XIV), ¶ 1, U.N. Doc. A/RES/1472(XIV) (Dec. 12, 1959).

23. *International Space Law*, U.N. OFF. FOR OUTER SPACE AFF., <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/index.html> (last visited Dec. 24, 2012).

24. Trimble, *supra* note 9, at 526.

tially, COPUOS was a failure, having not even formally met during its first two years of existence.²⁵ Then, in 1961, President John F. Kennedy addressed the U.N. General Assembly, proposing that the U.N. Charter, the governing document of the United Nations, be extended beyond Earth to outer space.²⁶ In response, COPUOS convened for the first time and agreed on a proposal to extend the U.N. Charter to the entire universe.²⁷ This resolution, Resolution 1721, was passed by the UN General Assembly unanimously.²⁸

To clarify, under Resolution 1721, "the UN claimed legal authority and collective ownership of every natural body, and any artificial structure, found anywhere in the universe."²⁹ Ignoring, for the moment, the legal and rational absurdity of this claim (which will be addressed in Part III), Resolution 1721 was the basic framework from which space law was born. From 1967 to 1979, COPUOS enacted five major treaties that form our space law: (1) the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (the "Outer Space Treaty") in 1967,³⁰ (2) the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space in 1968,³¹ (3) the Convention on International Liability for Damage Caused by Space Objects in 1972,³² (4) the Convention on the Registration of Objects

25. See Hickman & Dolman, *supra* note 16, at 6.

26. *Id.*

27. See International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 1721 (XVI), ¶ 1, U.N. Doc. A/RES/1721(XVI) (Dec. 20, 1961) [hereinafter G.A. Res. 1721]; Hickman & Dolman, *supra* note 16, at 6.

28. Hickman & Dolman, *supra* note 16, at 6.

29. *Id.* at 18 n.25.

30. Outer Space Treaty, *supra* note 1 (entered into force with respect to the United States on Oct. 10, 1967).

31. 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 (entered into force with respect to the United States Dec. 3, 1968).

32. Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389 (entered into force with respect to the United States Oct. 9, 1973).

Launched into Outer Space in 1975,³³ and (5) the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the “Moon Treaty”) in 1979.³⁴

The two treaties governing property rights of celestial bodies are the Outer Space Treaty and the Moon Treaty. These two treaties establish outer space as *res communis*—in Latin, a “thing” (*res*) “for everyone” (*communis*)—or, using the treaty language, the “common heritage [or, ‘province’] of mankind.”³⁵ The *res communis* approach prohibits national appropriation of property in outer space. It was chosen by the United States and Soviet Union to “ensur[e] that no state could achieve an unanticipated advantage in space—for if any one state could dominate space, the face of international politics might be changed forever.”³⁶ In sum, the common heritage of mankind principle was created during the Cold War for geopolitical stability, if not out of fear. Non-space-faring states also supported this concept because it allowed all states to collectively “own” outer space regardless of their economic development or contribution.³⁷

The Outer Space Treaty now has over 100 parties—some have argued that it represents customary international law.³⁸ The Outer Space Treaty is the seminal treaty on space law, and the other four treaties, including the Moon Treaty, “are to a great extent simply amplifications and clarifications of the principles set forth in the Outer Space Treaty.”³⁹ The Moon

33. Convention on the Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695 (entered into force with respect to the United States Sept. 15, 1976).

34. Moon Treaty, *supra* note 1. The United States is not a party.

35. Outer Space Treaty, *supra* note 1, art. I (using “province of all mankind”); Moon Treaty, *supra* note 1, arts. 4, 11 (using both “province” and “common heritage” of mankind).

36. Hickman & Dolman, *supra* note 16, at 3.

37. *See id.* at 7–8; Outer Space Treaty, *supra* note 1, pmbl. (“Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development.”).

38. *See* ANTHONY AUST, HANDBOOK OF INTERNATIONAL LAW 339 (2d ed. 2010) (“The [Outer Space] Treaty’s basic principles . . . can now be regarded as representing customary international law.”).

39. Trimble, *supra* note 9, at 528 (quoting C. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 20 (1982) for the proposition that the

Treaty has only thirteen signatories and none of them are space-faring, which means the Moon Treaty has little relevance to the practical discourse on space law.⁴⁰

C. *The Outer Space Treaty*

The Outer Space Treaty was signed in 1967 and entered into force with respect to the United States that same year.⁴¹ The operative language comes from Article I and II of the treaty. In its first sentence, Article I states: “[t]he exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.”⁴² “The word ‘use’ has been interpreted to mean ‘exploitation’ on a non-exclusive basis.”⁴³ However, there has been some debate over the effect of this clause. In 1967, when the U.S. Congress ratified the Outer Space Treaty, the U.S. Senate Committee on Foreign Relations stated that “nothing in Article I, paragraph 1, diminishes or alters the right of the United States to determine how . . . it shares the benefits and use of its outer space activities.”⁴⁴ Indeed, some have asserted that “a state or private entity would not be required to relinquish its . . . profits from space ventures.”⁴⁵ James Trimble writes:

[T]he benefits derived from space must be shared with all humankind. Sharing expected benefits does not necessarily mean sharing profits, but rather is intended more as a philosophical guideline. The manner in which a benefit will be shared depends upon the nature of the benefit and the activity which generates the benefit.⁴⁶

Outer Space Treaty is the “main base for the legal order of the space environment”).

40. See AUST, *supra* note 38, at 340–41. (“When [space] exploitation does become feasible, one can expect the major space players to promote another treaty better suited to the needs of the time.”).

41. See Outer Space Treaty, *supra* note 1.

42. *Id.* art. I.

43. Trimble, *supra* note 9, at 530.

44. *Treaty on Outer Space: Hearings before the S. Comm. on Foreign Relations*, 90th Cong. 74 (1967) [hereinafter *Outer Space Treaty Hearings*].

45. Trimble, *supra* note 9, at 530.

46. *Id.* at 560 (citations omitted) (internal quotation marks omitted).

This uncertainty over the type and quantity of benefits to be shared is at the root of the anticommons problem. The same author concludes, “[c]orporations may undertake space ventures with an expectation of retaining some of the profits to reward their efforts, but a portion of the proceeds and benefits must be made available to the world community.”⁴⁷

Article II of the Outer Space Treaty states, in its entirety: “Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”⁴⁸ There has been debate over whether this anti-appropriation language applies to public *and* private entities, with scholars coming to conflicting conclusions.⁴⁹ So even if private entities are able to retain most of their profits through interpretation of Article I, it is uncertain whether they can take property without staking a sovereign claim to it.⁵⁰

The Outer Space Treaty regime made sense during the Cold War—both the United States and the Soviet Union sought to ensure that neither gained a competitive advantage. And they succeeded. But this regime has had a stifling effect on the post-Cold War international space-economy.

47. *Id.* at 567.

48. Outer Space Treaty, *supra* note 1, art. II.

49. See generally Rosanna Sattler, *Transporting a Legal System for Property Rights: From the Earth to the Stars*, 6 CHI. J. INT’L L. 23, 28–29 (2005). Compare Wayne N. White, Jr., *Real Property Rights in Outer Space*, in PROCEEDINGS OF THE FORTIETH COLLOQUIUM ON THE LAW OF OUTER SPACE 370 (1998), available at http://spacefuture.com/pr/archive/real_property_rights_in_outer_space.shtml (“When Article II is compared to similar provisions in other documents, however, it becomes clear that the narrow interpretation[, which only applies the anti-appropriation mandate to public entities,] is correct.”), with Jonathan Thomas, Note, *Privatization of Space Ventures: Proposing a Proven Regulatory Theory for Future Extraterrestrial Appropriation*, 1 INT’L L. & MGMT. REV. 191, 200 (2005) (“The majority of scholars agree that the Outer Space Treaty and the anti-appropriation clause apply to both public and private entities.”).

50. “[How could] a private entity remove resources or a celestial body from space as personal property without making a claim of ownership over the land or area itself[?]” John Adolph, Note, *The Recent Boom in Private Space Development and the Necessity of an International Framework Embracing Private Property Rights To Encourage Investment*, 40 INT’L LAW. 961, 964 (2006).

To recap, the Outer Space Treaty is problematic for two reasons. First, it prohibits states, and potentially private entities, from exercising sovereignty (e.g., appropriating, using, or exploiting) over outer space. Second, it requires a vague amount of the benefits to be shared between all states.⁵¹ And, even if a party interprets the Outer Space Treaty favorably—to allow the private appropriation of property and to allow private entities to retain all of their profits—the sheer legal uncertainty of this interpretation will preclude meaningful investment.⁵² The combination of these problems has created an environment where a potential space venture bears all of the cost, and stands to lose a significant portion of the return.

D. The Moon Treaty

The Moon Treaty was signed in 1979.⁵³ It has only thirteen signatories, none of whom are space-faring.⁵⁴ As such, the relevance of the Moon Treaty is questionable. Nevertheless, a brief overview will highlight the concerns of space-faring states and explain why the Moon Treaty has not been ratified by any such state.

The Moon Treaty classifies outer space as the common heritage of mankind, contains a more inclusive non-appropriation clause, and contains a more direct requirement that benefits be shared equally among all states. Article 11, paragraph 3 states:

51. See, e.g., White, *supra* note 49 (“Existing international law provides limited legal protection and little incentive for investment in outer space.”); Trimble, *supra* note 9, at 565 (“The greatest negative effect of international space law is the uncertainty of the principles contained in the space treaties. A determinative factor in a corporate decision to undertake a commercial space venture will be [among other things] to what extent the corporation believes international space law provides freedom from . . . deprivation relating to its right to conduct business, its equipment, its employees, its technology, and its profits.”) (citations omitted) (internal quotations omitted).

52. See *id.*; see also Evan Sankey, *Coase, Incentives, and the Final Frontier*, 1 *ECONPRESS* 67, 70 (2010) (“Even if some narrow conception of property rights can be teased out of the language of [the Outer Space Treaty], the wide range of interpretations seems to defeat the purpose of property law. . . . I cannot imagine a wealthy person who would provide the venture capital for, say, a lunar mining company without being absolutely sure that said company could procure widely recognized rights to property on the Moon.”).

53. Moon Treaty, *supra* note 1.

54. See AUST, *supra* note 38, at 340.

“Neither the surface nor the subsurface of the moon [or any celestial body] . . . shall become property of any state, international, inter-governmental or non-governmental organization, national organization or non-governmental entity or of any natural person.”⁵⁵ Therefore, under the Moon Treaty, not even private entities can appropriate property in outer space. Article 11 continues: “State Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible.” The appropriation of property is therefore outlawed, pending the establishment of an international organization to facilitate it.

Space-faring states make two major arguments against the Moon Treaty. First, these states claim that the language places “a moratorium on the commercial exploitation of resources until the international regime is established”⁵⁶—no regime has yet been established. Second, space-faring states allege that, once the regime is established, it will be “unsympathetic to free enterprise”⁵⁷ because the benefits will have to be divided equally among all states, regardless of their economic contribution.⁵⁸ In these ways, the Moon Treaty goes a step further than the Outer Space Treaty, but because it has failed to gain the support of any space-faring state, it has little relevance to enforceable space law.

55. White, *supra* note 49 (“[R]eferences to ‘the moon’ in the Moon Treaty refer to all celestial bodies and areas of outer space other than Earth and Earth orbits.”).

56. Trimble, *supra* note 9, at 549.

57. *Id.* at 550. See also White, *supra* note 49 (“As a result, the Moon Treaty has encountered resistance from countries with free market economies.”).

58. See Gruner, *supra* note 21, at 328–29 (“The United States’ primary concern was that the incorporation of Common Heritage principles . . . would discourage development by United States government agencies or private companies, since developers of resources would lose control over those resources to an international regime after that developer spent money harvesting the resources.”).

E. Other Applications of the Res Communis Principle

The *res communis* principle has been applied to two other international territories, Antarctica and the deep sea, and has resulted in a similar collective inaction problem.

1. Antarctica

Antarctica is governed by a series of treaties: the Antarctic Treaty of 1959,⁵⁹ the Environmental Protocol of 1991,⁶⁰ the Convention on the Conservation of Antarctic Marine Living Resources of 1980,⁶¹ the Convention on the Conservation of Antarctic Seals of 1972,⁶² and the various measures adopted under each (collectively, the "ATS").⁶³ The ATS is unique because it suspends, but does not renounce, the numerous state claims of sovereignty over various parts of Antarctica.⁶⁴ Indeed, numerous states had and still hold claims to parts of Antarctica, but each recognized that, as the preamble to the Antarctic Treaty states, "it is in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord."⁶⁵ Importantly, the ATS adopts a *res communis* approach and restricts the use of Antarctica to scientific exploration.⁶⁶

The Antarctic Treaty divides its members into two categories: consultative parties and non-consultative parties.⁶⁷ The consultative parties have demonstrated an "interest in Antarctica by

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

60. Protocol on Environmental Protection to the Antarctic Treaty, *opened for signature* Oct. 4, 1991, 30 I.L.M. 1460 [hereinafter Environmental Protocol].

61. Convention on the Conservation of Antarctic Marine Living Resources, May 20, 1980, 1329 U.N.T.S. 47.

62. Convention on the Conservation of Antarctic Seals, June 1, 1972, 29 U.S.T. 441, 1080 U.N.T.S. 175.

63. See AUST, *supra* note 38, at 328.

64. See The Antarctic Treaty, *supra* note 59, art. XI.

65. *Id.* at pmbl.

66. See *id.* arts. II, IV, VII.

67. See Andrew H. Pontious, Note, *A Proposed Regime and Its Ramifications on the Commercialization of Outer Space*, 7 SANTA CLARA COMPUTER & HIGH TECH. L.J. 157, 164 (1991).

conducting substantial scientific research activity there.”⁶⁸ Under the ATS, the consultative parties are also the ones who make binding decisions concerning the uses of Antarctica.⁶⁹ “The non-consultative parties are those states which have acceded to the treaty but have not yet complied with the ‘demonstrated interest’ test.”⁷⁰ The non-consultative parties cannot vote, but may observe the decision-making meetings.⁷¹ This system keeps control of Antarctica in the hands of those states with true, vested interests.

In the 1970s, mining companies attempted to adopt a convention to regulate mining and the development of resources in Antarctica.⁷² Environmental groups, however, strongly opposed the initiative, and it was not adopted. As a result, the Environmental Protocol of 1991 governs, which strictly prohibits all non-scientific mining in Antarctica.⁷³ The ATS’ use of the *res communis* principle has been prohibitive of commercialization (beyond tourism) and environmental groups have refused to allow it.

2. The Deep Sea

The deep sea is governed by the U.N. Convention on the Law of the Sea of 1982 (“UNCLOS”).⁷⁴ Like the Moon Treaty, and similar to the Outer Space Treaty, UNCLOS uses the term “common heritage of mankind.” Under UNCLOS, the deep sea and ocean floor, which do not come under the purview of any state’s territorial sovereignty, are classified as the common her-

68. The Antarctic Treaty, *supra* note 59, art. IX (providing “the establishment of a scientific station or the despatch [sic] of a scientific expedition” as examples of substantial Antarctic research activity).

69. See Pontious, *supra* note 67, at 165.

70. *Id.*

71. See *id.*

72. The Convention on the Regulation of Antarctic Mineral Resource Activities “sought to regulate minerals prospecting, exploration and development activities, although mining would only be permitted if all Parties agreed that there was no risk to the environment.” *Mining in Antarctica*, BRIT. ANTARCTIC SURV., http://www.antarctica.ac.uk/about_antarctica/geopolitical/environmental_issu es/mining.php (last visited Jan. 2, 2013).

73. See Environmental Protocol, *supra* note 60, art. 7.

74. United Nations Convention on the Law of the Sea, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397 [hereinafter UNCLOS].

itage of mankind.⁷⁵ These areas are rich in mineral deposits.⁷⁶ So, naturally, many states and private entities wish to mine these deposits. When UNCLOS was being negotiated—at the same time, incidentally, as the Moon Treaty—the developed states were wary of adopting a *res communis* regime (for the same reasons discussed above with the Moon Treaty) and the developing states sought to adopt a *res communis* regime so that they would not be disadvantaged by their inability to participate.⁷⁷ In contrast with the ATS, “membership in UNCLOS is not limited to those involved in active exploration, and each member may cast one vote.”⁷⁸ Which, given the larger number of developing states, resulted in the adoption of the *res communis* principle.⁷⁹ However, similar to the Moon Treaty, UNCLOS called for the establishment of an independent body to regulate exploitation, and in 1994, the International Seabed Authority (“ISA”) was established to regulate mining operations.⁸⁰

The ISA governs deep sea exploitation by requiring miners to pay fees amounting to \$500,000, part of which is given to non-mining states. The ISA operates under three phases: (1) prospecting, or the non-exclusive search for minerals, which can be done for free; (2) exploration, in which a state or private entity can explore mineral deposits with exclusivity for \$250,000; and (3) exploitation, which is the actual commercial recovery of minerals for a fee of \$250,000.⁸¹ Applicants are also required to set aside a minable area of equal size to be reserved for mining by the ISA’s intergovernmental mining body, whose purpose is

75. See Sattler, *supra* note 49, at 34.

76. See AUST, *supra* note 38, at 290 (“[The area] is important because parts of it (mostly in the Pacific and Indian Oceans) are rich in mineral nodules (lumps), manganese in particular.”).

77. See Sattler, *supra* note 49, at 34–35.

78. *Id.* at 34.

79. See *id.*

80. See UNCLOS, *supra* note 74, art. 156.

81. See International Seabed Authority, Decision of the Assembly Relating to the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area, 6th Sess., 76th mtg., § 1 ¶ 3(a)–(c), § 3 ¶ 1–3, U.N. Doc ISBA/6/A/18, at 2, 12–13 (July 13, 2000); Zell, *supra* note 5, at 502–03.

to “compete with the private entities granted licenses by the ISA.”⁸²

To this day, mining has failed to develop, likely due to the effects of this common heritage of mankind regime and the huge costs (\$500,000 in fees plus the mandatory reserves) associated with development.⁸³ Indeed, the United States and other industrialized states are not a party to UNCLOS.⁸⁴ In sum:

[B]ecause UNCLOS required mandatory transfers of technology, employed an economic model that preempted free-market enterprise, failed to assure access to future deep seabed resources, and included a voting structure that gave all nations equal control regardless of their technological capabilities or contributions to undersea exploration, the United States and other industrialized nations refused to ratify the 1982 agreement.⁸⁵

II. SEARCHING FOR THE OPTIMAL REGIME

A number of scholars have offered solutions to the anticommons problem in space. These proposals range from mirroring the regime used in Antarctica to auctioning off planets. This Part will analyze nine of the leading theories in a search for the optimal regime. Many of the proposals assume the legitimacy of the common heritage of mankind principle, while others reject it. Several attempt to interpret the relevant language of the Outer Space Treaty to allow for private property rights, and thus claim to operate within its bounds.

Ultimately, in Part III, this Article concludes that the common heritage of mankind principle should be rejected and offers a solution accordingly. Each section below will clarify

82. Sattler, *supra* note 49, at 34. *See also* UNCLOS, *supra* note 74, at annex III, art. 8.

83. *See also* Sattler, *supra* note 49, at 44.

84. *See* AUST, *supra* note 38, at 279; Sattler, *supra* note 49, at 35.

85. Sattler, *supra* note 49, at 34–35. In the mid-90s the U.N. renegotiated several aspects of UNCLOS including guaranteeing the United States a seat on the decision-making body and removing the requirement of transfers of technology. *See id.* at 35. Although the United States was involved in the negotiations, and the United States signed the amended UNCLOS in 1994, the Senate has still not ratified it—which indicates that, even in its amended form, a common heritage of mankind regime is unsupported by free-enterprise nations. *See id.*

whether the author of the proposal under review assumes or rejects the legitimacy of the common heritage of mankind principle.

A. Proposals Mirroring Existing Regimes

The first three proposals mirror regimes in use today. They will be covered initially because they are the least likely to yield different results—each incorporates the *res communis* principle, which has resulted in a tragedy of the anticommons.

1. Mirror UNCLOS

Jeremy Zell suggests mirroring UNCLOS' ISA structure with the establishment of a Space Resource Authority ("SRA").⁸⁶ This proposal assumes that the common heritage of mankind regime is legitimate, and that all states are deserving of at least some of the benefits of outer space. As discussed previously, the ISA requires that miners: (1) pay fees to obtain proprietary rights over discovered resources (\$500,000), which are allocated to non-mining states; and (2) set aside a mining area of equal size to be mined sometime in the future by the ISA itself (known as "reserves"). The SRA would mirror this structure with slight modifications.

Similar to the ISA, prospecting under the SRA regime would be free and subsequently obtaining proprietary rights would require fees. Once mining begins, the entity would be required to pay royalties to the SRA. The entity would also be required to set aside reserves; however, the reserves would not be set aside for the SRA, itself, to mine, but instead would be sold to other states.⁸⁷ The proceeds would then be equally distributed to non-space-faring states.⁸⁸ While the proceeds from reserve sales would go directly to non-space-faring states, the fees and royalties from activity would not.⁸⁹ The SRA would offer reductions of the royalties, fees, and reserve areas for entities that operate in non-space-faring states.⁹⁰ Zell's idea here is to en-

86. See generally Zell, *supra* note 5, at 492–93.

87. See *id.* at 510–11.

88. *Id.* at 511.

89. Zell does not say where the proceeds from fees and royalties would go; presumably the proceeds would fund the SRA.

90. See Zell, *supra* note 5, at 512–14.

courage the development of non-space-faring states by incentivizing the operation of Earth-based space functions in those states. Examples of potential space operations that could be conducted in non-space-faring states include mission control stations, equipment manufacturing, and launch sites. The anti-commons problem, however, remains.

Again, under the hypothetical SRA, all of the cost and only a portion of benefit go to the space-faring entities. This system is effectively the same as the current one. With respect to the reserves, the state to whom the reserve is ultimately sold or the method by which that state obtains it does not affect the original mining entity's incentives. Still, it must put up the initial investment and part with a substantial portion of the mining area without being adequately compensated—the original mining entity is not selling it, but giving it away to the SRA to sell. With respect to the potential reduction of fees, royalties, and reserves, even if they can be reduced or forgiven, there are hidden costs in obtaining such reductions that create a subtler, deeper problem.

The problem with the proposed reduction in fees, royalties, and reserves is that developing states do not have the technology, government, security, or infrastructure to support many of the necessary operations. The cost of developing and establishing those necessities in under-developed states will require an enormous investment. Space-faring entities are able to conduct activities in space because of the security and stability of their Earth-based operations. Developing states with, for instance, weak police enforcement, undeveloped laws, or unreliable energy sources could put space operations at a huge risk. One can imagine situations where a command center loses power during a space mission, or one in which corrupt officials are able to deny police protection to facilities without the payment of bribes. These are examples of necessities that we often take for granted but that are essential to the safe and efficient operation of space activity. The cost of developing these necessary elements in under-developed states will be borne by the space-faring states in order to obtain reductions. This investment is

effectively a fee.⁹¹ For this reason, Zell's solution is likely to result in the same inefficiencies that we face today.

2. Mirror the ATS

Andrew Pontious suggests adopting a regime similar to the ATS.⁹² Again, this proposal contemplates the continuation of the common heritage of mankind principle, and therefore operates under the assumption that all states are entitled to at least some portion of outer space and its resources. Pontious suggests a decision-making structure that will mirror the ATS' consultative/non-consultative structure, but instead uses states' levels of investment to determine voting status.⁹³ Only those states which meet a certain threshold level of investment will be allowed to vote (compared to the ATS threshold of "demonstrated interest").

In addition to the decision-making structure, Pontious provides three general principles that such a regime must include:

- 1) [A] call for regulation of activities only by those undertaking the activities (albeit with the input of non-participant members); and 2) it must not require the transfer of specific amounts of resources, benefits, or technology, to countries not undertaking the risks of development; and 3) must allow for some express distribution of benefits to all member countries.⁹⁴

It is not entirely clear, but it seems as if the distinction between the second principle and the third principle is that the third principle benefits are, in some form, distributed to all member countries that are undertaking the risks of development. How a country obtains the status of "undertaking the risks of development" is left unanswered—certainly not by non-consultative membership alone, as there must be some level of

91. The author seems to inadvertently make this point. *See id.* at 515 ("[I]t is possible for [a space-faring entity] to receive complete forgiveness of its fee and royalty obligations with a large enough investment in developing nations."). The problem, of course, is that we cannot ignore that "large enough investment."

92. *See* Pontious, *supra* note 67, at 184 ("[A] regime similar to but not identical to that of Antarctica should be adopted.").

93. *See id.*

94. *Id.* at 187.

contribution (monetary or otherwise). Assuming this is the case, this proposal is superior to a pure common heritage of mankind regime because states' contributions are taken into consideration when distributing benefits. Still, the problem remains that different entities putting up different investments will likely yield different returns. And requiring them to share all or "some express amount" of returns will incentivize entities to invest the lowest possible amount while still retaining their allocation of the returns—a type of moral hazard. This is the classic anticommons problem.

This is not to say that *any* form of return allocation will destroy market efficiencies. Royalties and fees, for instance, are used in several industries today.⁹⁵ But, these regimes are different from a regime mandating the "express distribution of benefits to all member[s]," particularly because the moral hazard problem is not present.

3. Mirror the International Space Station Intergovernmental Agreement

In a 2005 article, Rosanna Sattler proposes what she considers to be "the most workable model for a property rights regime in outer space" for the short term.⁹⁶ Her model is based on the International Space Station Intergovernmental Agreement ("IGA"). The IGA has a "hub and spoke structure" with NASA acting as the hub. NASA signs Memoranda of Understanding with other space agencies, which, together, govern the International Space Station ("ISS"), a research lab in low Earth orbit.⁹⁷ Under this regime,

The members of the IGA contribute funds and technology, and each owns some portion of the space station. The country with the ownership interest retains control of its particular physical module and its crew. The nation may contract with other countries that wish to use its portion for scientific research. The work that takes place on the module then re-

95. Indeed, while UNCLOS was being negotiated, the United States passed the Deep Seabed Hard Mineral Resources Act, which "requires that undersea mining companies apply for permits and licenses to mine the deep seabed." Sattler, *supra* note 49, at 36.

96. *Id.* at 37.

97. *See id.* at 37–38.

mains subject to the laws of that nation and is considered to be within its jurisdiction.⁹⁸

NASA then “serves as the coordinator,”⁹⁹ and disputes are settled by the International Court of Justice (“ICJ”) or World Trade Organization (“WTO”), depending on the nature of the dispute.¹⁰⁰

According to Sattler’s proposal, this IGA regime could be applied to the commercialization of space.¹⁰¹ NASA could continue to serve as the coordinator unless a non-governmental organization is agreed upon by the participating states. Other countries would contribute funds and place technology on the Moon through their space agencies. These space agencies would secure the technology and funding from private businesses which enter into contracts for such services with these agencies. In accordance with the terms of the IGA and the Outer Space Treaty, each individual country, or space agency, would retain jurisdiction over its crew, its spacecraft, and any structures or equipment.¹⁰² It is unclear how certain forms of commercialization, mining for instance, would mesh with Sattler’s intent to remain in “accordance with the terms of . . . the Outer Space Treaty.”¹⁰³

98. *Id.* at 38.

99. *Id.*

100. *See id.*

101. *See id.* at 39 (“The IGA could easily be applied to space tourism, settlement, development, and bases of operation on asteroids, the moon, and Mars.”).

102. *See id.*

103. Sattler’s earlier analysis of the Outer Space Treaty outlines the differing interpretations (that the Outer Space Treaty might only prohibit the national appropriation of land, and that “land” might not include the resources mined from the land) but ultimately Sattler remarks that “the appropriation provision of the treaty is . . . unworkable.” *Id.* at 28–29. In all likelihood, Sattler is interested only in according with the agreeable terms of the Outer Space Treaty, which would not include the prohibition on property appropriation. This is supported by the lack of benefit-sharing discussion in Sattler’s article. She does remark, in her conclusion, that “[t]here would be a need to accommodate the views of nations with space resources and those in process of development.” *Id.* at 44. This suggests that Sattler is assuming all states are due some portion of outer space, although this point is not clear. Still, Sattler’s proposal can be implemented in any number of property right distributions.

Sattler proposes adopting the concept of Exclusive Economic Zones (“EEZs”) to supplement the IGA regime. EEZs are areas up to 200 miles from a state’s coast which that state has the right to “declare” as an EEZ.¹⁰⁴ Once declared, that state has the “exclusive right to explore, exploit, conserve, and manage the natural resources” located in the EEZ, subject only to the right of other states to “navigate through the waters, fly over the area, and lay pipelines or other cables on the seafloor.”¹⁰⁵ Other states cannot conduct commercial activity in another state’s EEZ, but states are free to license or rent the area or resources.¹⁰⁶ Sattler proposes transferring this EEZ system to outer space. Sattler would “giv[e] each nation the option of building a structure on a celestial body or occupying an orbit with spacecraft, and then claiming up to a certain amount of area around their structure or craft for their use.”¹⁰⁷ Indeed the IGA already uses this approach with respect to ISS vessels.¹⁰⁸ Sattler’s thought is that “each nation would retain jurisdiction over its EEZ and could create its own regulations and permitting procedures.”¹⁰⁹

Sattler presents a very workable theory, particularly for practical purposes. However, Sattler provides no method of *allocating* property in the first place. Certainly, Sattler is not proposing that all a state or entity needs to do is drop a spacecraft down on a planet to obtain an EEZ over the surrounding area—this would incentivize the placement of numerous, likely meaningless, vessels all over the reachable property within our galaxy. Building on Sattler’s proposal, however, a regime for defining or distributing property rights over outer space could utilize the IGA/EEZ regime to govern the use of certain property and the interaction of states around it.¹¹⁰ Without a base property regime, Sattler’s proposal passes on the fundamental question of how to distribute property rights in outer space.

104. *See id.* at 42.

105. *Id.*

106. *See id.* This is a concept embodied in Part V of UNCLOS, and even the United States has declared an EEZ. *See id.* at 41–42.

107. *Id.* at 43.

108. *See id.*

109. *Id.*

110. This will be revisited in Part III.

B. State-Centered Property Rights

John Hickman and Everett Dolman offer a solution under which “a state would be permitted to claim sovereignty over territory on a large celestial body in proportion to its share of the Earth’s land surface.”¹¹¹ The particular piece of land a state claimed would be determined by “the priority of arrival by its human representatives.”¹¹² This theory is informed by the Coase Theorem, which suggests that if transaction costs are low or zero, any allocation of property rights is preferable to no allocation of property rights.¹¹³ This is because, regardless of how the property rights are allocated initially, the individuals who value it most will purchase it from the existing owner.¹¹⁴ The authors conclude that “if the policy goal is to encourage the development of outer space, then any assignment of sovereignty over territory on celestial bodies would be preferable to the existing structure of vesting collective rights in all states.”¹¹⁵

The State-Centered solution requires withdrawing from the Outer Space Treaty, but, importantly, it does not abandon the common heritage of mankind principle because it vests rights in all states by virtue of their territory (not their contribution or investment).¹¹⁶ This “proportional allocation upon arrival” solution was chosen over assigning territory pre-arrival because pre-arrival assignments would not have incentivized space-faring states to hasten their development of space technologies.¹¹⁷ Allocation upon arrival also avoids having to determine which bit of land to assign to each state, which would be unsolvable given the varying quality of celestial territory.

111. Hickman & Dolman, *supra* note 16, at 14. The authors also considered basing the proportional allocation off of GDP and population, but ultimately declined to do so because of the perverse population growth and GDP reporting incentives they could create. *Id.*

112. *Id.*

113. *See id.* at 12. *See generally* R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

114. *See generally id.*

115. Hickman & Dolman, *supra* note 16, at 12.

116. *See id.* at 13–14 (“The solution would continue to designate genuine common pool resources as *res communis* while permitting space faring states to claim sovereign ownership of territory on celestial bodies and other geo/astrographic positions.”).

117. *See id.* at 14.

The authors argue that this solution would garner at least *some* support from developing states:

Japan, Malaysia, and Thailand might assert sovereignty over adjacent territories on Mars by sending a joint team of human representatives together on a Japanese spacecraft. International inequality would be reduced because non-space faring states would be at liberty to lease or sell outright their sovereign territories on celestial bodies to other states.¹¹⁸

The primary problem with this solution is that it assumes the legitimacy of the common heritage of mankind principle. In this iteration, the entities or states that put up the cost retain all of their return on investment, but that return is limited to the land area of the state or the entity's state of origin. In order for an entity to obtain more property it would need to pay other, non-space-faring states, which allocates return to states that are not putting up the cost.

Another consequence of this solution is that states with small territories are massively disadvantaged. The absurdity of this result can be illustrated in a few examples.¹¹⁹ Consider Japan, which has a land area of 145,920 square miles. The total land area of Earth (excluding the oceans) is 57,510,000 square miles. This means Japan's proportional allocation of any celestial body is limited to, roughly, 0.25%. The actual amount of property this 0.25% represents depends upon the size of the celestial body. However, this small percentage would likely provide very little incentive for states like Japan, who have the technological capability of commercializing outer space but are only entitled to a small fraction of those resources by virtue of their small territory on Earth. This small fraction of territory might not yield enough gains to incentivize Japan to invest. So too could the cost of purchasing additional territory from non-space-faring states be prohibitive, particularly if those states demand high prices for their territorial rights.

118. *Id.*

119. All geographical information analyzed in the following examples is derived from CENTRAL INTELLIGENCE AGENCY (CIA), *THE WORLD FACTBOOK, COUNTRY COMPARISONS: AREA*, available at <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2147rank.html>.

Consider the other side of the spectrum. Sudan, for instance, is the tenth largest state by land area, at 967,500 square miles. This entitles it to roughly 1.7% of any celestial body. Sudan does not have a space program.¹²⁰ This State-Centered regime would give Sudan a huge benefit without requiring any investment in space commercialization. Smaller states, like Japan, will be forced to purchase property rights from larger developing states, simply by virtue of having a smaller territory on Earth. In fact, under this system, Russia would have a right to roughly 11.5% of every single celestial body in the universe—the next closest state is Canada with 6.7%—and the other states of Earth would certainly be wary of such a regime.¹²¹ Israel, for example, is space-faring, but is only entitled to 0.01%.

Further, the transaction costs of these bargains would be very high. In a market with perfect information there would be no transaction costs or holdouts. But transaction costs “are likely to be high, at least where rights holders are widely dispersed and the value of rights is subject to a great deal of imprecision,” as they would be in international bargaining over plots of celestial property.¹²²

A practical problem with this solution is that not all outer space resources can be divided by territorial surface distinctions. Consider the atmosphere of a celestial body—for instance, the nitrogen in the atmosphere of Mars, which could be used for rocket fuel.¹²³ Allocating different pieces of the Martian territory will not inform the portion of the atmosphere to which each state is entitled. Indeed, the same problem arises with underground reserves, for example, oil wells stretching across multiple plots of land.

120. See generally *Space Program of the Sudan*, SUDANESE SPACE AGENCY, <http://www.hudsonfla.com/asudan.htm> (last visited Dec. 24, 2012) (“[Sudan’s] space program is . . . nonexistent.”).

121. Russia is 6,601,100 square miles and Canada is 3,855,100 square miles.

122. Robert P. Merges & Glenn H. Reynolds, *Space Resources, Common Property, and the Collective Action Problem*, 6 N.Y.U. ENVTL. L.J. 107, 116 (1997). The high transaction costs involved with pre-arrival valuations of celestial resources are dealt with in more detail in Part II.D.

123. See *Rocket Fuel from Mars’ Atmosphere*, 22 MEMBRANE & SEPARATION TECH. NEWS, (Jan. 1, 2004), http://goliath.ecnext.com/coms2/gi_0199-653172/Rocket-Fuel-from-Mars-Atmosphere.html.

Hickman and Dolman might suggest the implementation of a number of property regulations, similar to those on Earth, to protect and control the harvesting of underground resources—like, for instance, the rule that so long as land owners drill straight down under the land, they may extract a resource even if it is drained from a part of the well located under neighboring land (the so-called “bottoming rule”)¹²⁴ or regulations on “the number of acres required for a well and requiring apportionment of the drilling profits among the surface owners within the acreage unit.”¹²⁵ Terrestrial property laws may mitigate the problem of controlling underground resources, but they cannot eliminate it.

Consider a different iteration of this problem: the “seed in the middle of the fruit” situation. Imagine that a valuable resource is located in the very center of an NEA. If we divide up the surface territory on the NEA between all states, or only those who reach it, we have a problem. If we assume that the NEA is a sphere, then the resource at the core is accessible from every spot on the NEA. How are we to divide this resource? Logically, if the resource is truly at the center of the NEA and accessible from all points on the surface, each state would be entitled to its proportional share. In this case, then, we have a space-faring entity with an entitlement to only a fraction of the resource *no matter when it reached the NEA or the cost it expended doing so*. This not only removes the incentive to reach outer space resources quickly, but may reduce the incentive to reach them at all, as the investing entity will have to share the resource with all states proportionally to its land area.

What is worse, resources at the core of NEAs and other celestial bodies may not be knowable until commercialization begins. Imagine the frustration of a space-faring state which puts up all the cost and successfully reaches an NEA, only to find that its percentage of the resource is miniscule—and, because not all states are space-faring, the space-faring state just has to leave the part of the resource to which it is not entitled untouched, which is a huge inefficiency. This risk is a powerful disincentive, and, practically, is very similar to the common heritage of mankind principle in the first place. The State-

124. See KRIER, *supra* note 12, at 7.

125. *Id.*

Centered solution is interesting, but limiting the gains of space-faring entities to a portion relative to their land area on Earth gives rise to problems that will likely result in similar, potentially prohibitive, disincentives.

C. Functional Property Rights

Wayne White proposes a regime of Functional Property Rights.¹²⁶ This solution would grant non-sovereign property rights to private entities (but not states) who control space objects by virtue of (a) that control and (b) personnel at the location.¹²⁷ White argues that a state's legislation would extend to the area of occupation through its citizens who occupy the area. Private entities would thereby have law under which to operate, but the territory would not be owned by that state.¹²⁸ The areas that an entity could occupy would be determined on a first-come, first-served basis.¹²⁹ White writes: "These rights would terminate if activity were halted, as for example, if a space object was abandoned or returned to Earth. [Additionally], rights would be limited to the area occupied by the space object, and to a reasonable safety area around the facility."¹³⁰ This regime would allow individual states to determine the conditions necessary for their citizens and corporations to establish and maintain private property rights and the terms of abandonment—the inactivity which would extinguish such rights.¹³¹ White argues that these rights, although non-sovereign, would be "almost identical to terrestrial property rights."¹³²

White argues that territorial sovereignty should be prohibited and therefore, under his regime, only private entities may appropriate extraterrestrial property.¹³³ He does this for two reasons. First, he believes that his proposal is permitted under the Outer Space Treaty. White subscribes to the interpretation of the Outer Space Treaty which holds that "Article II . . . pro-

126. See generally White, *supra* note 49.

127. See *id.*

128. See *id.*

129. See *id.*

130. *Id.* This is similar to Sattler's EEZ proposal.

131. See *id.*

132. *Id.*

133. See *id.*

hibits territorial sovereignty but does not prohibit private appropriation.”¹³⁴ As discussed above, this interpretation is highly contentious. Second, White argues that sovereign property rights “could potentially preclude free access to outer space.”¹³⁵ Why free access to all of outer space is necessary is not stated, although one can infer that White subscribes to the *res communis* principle.

Even ignoring his adherence to *res communis*, there is a more fundamental question. White states that “[t]hese rights would terminate if activity were halted, as for example, if a space object was abandoned *or returned to Earth*.”¹³⁶ This seems wholly incompatible with the practical advantages of private property rights. Does this mean that once a resource is returned to Earth for manufacture or sale the private entity loses all claim to ownership? Certainly this cannot be the case, because only celestial operations which do not require the transfer of resources back to Earth would be profitable. This would eliminate a large number of proposed uses—mining and energy production, for example. But, even if we assume that private entities can keep the resources they return to Earth, there are further problems.

If no one truly *owns* the territory, potentially harmful or inefficient uses will go unpunished because entities can simply use the land and then abandon it. Further, entities will have no incentive to use the land efficiently or to get the most out of resources—there are no long-term incentives. “The results are intuitive. Who takes better care of a house, an owner or a renter?”¹³⁷ Of course, regulations could be established by an inter-governmental body which could regulate the uses and practices on celestial bodies. This would add transaction costs. However, those costs might be naturally mitigated if states could, at some point, exercise some form of sovereignty over celestial

134. *Id.*

135. *Id.*

136. *Id.* (emphasis added).

137. Sam Dinkin, *Property Rights and Space Commercialization*, SPACE REV. (May 10, 2004), <http://thespacereview.com/article/141/1>.

territory.¹³⁸ This option will be explored in more detail later in this Article.¹³⁹

D. Unilateral Domestic Auctions (Pseudo Property Rights)

Economist Sam Dinkin has proposed an interesting property rights regime in which the United States would unilaterally grant what he calls "pseudo property rights" to its citizens through domestic auctions.¹⁴⁰ Pseudo property rights are necessary, Dinkin believes, because *true* property rights are unavailable, or at least questionable, under the Outer Space Treaty. Dinkin reasons that because the Outer Space Treaty prohibits states from making sovereign claims to outer space, the treaty "effectively limits the property rights that U.S. can grant to its citizens."¹⁴¹ However, Article VI of the Outer Space Treaty does say that "[t]he activities of non-governmental entities in outer space . . . shall require authorization and continuing supervision by the appropriate State Party to the Treaty." Under Dinkin's interpretation, this provision allows a state to regulate the activity of its citizens in outer space.¹⁴² Dinkin argues further that, because a property right is essentially "a right to exclude someone from doing something[,] [b]y excluding US citizens and corporations from doing certain things, the US can create pseudo property rights in outer space for other US citizens and corporations."¹⁴³ Dinkin likens these pseudo property

138. The idea being that, if nations were working towards establishing territorial sovereignty, they would take better, more efficient care of the property (having an eye towards long term return).

139. Specifically in Part III.

140. *See generally* Dinkin, *supra* note 137.

141. *See id.*

142. *See id.* Several scholars support this interpretation. *See, e.g.,* Trimble, *supra* note 9, at 563–64.

Space law has an additional effect on corporations' space activities through the grant of jurisdiction to the United States over space objects and their personnel. This jurisdiction provides the United States with broad powers to regulate corporate activities in space . . . This authority is necessary in order for the United States to comply with its obligation to authorize and supervise the activities of its citizens in space.

Id.

143. Dinkin, *supra* note 137.

rights to the U.S. patent system.¹⁴⁴ This regime could arguably hold water under the Outer Space Treaty's prohibition on territorial sovereignty because the United States would only be regulating the actions of its citizens, not the territory or property itself. Dinkin writes:

The US should begin to regulate these pseudo property rights. We should register them. We should hold hearings on them. We should auction them off in some cases where there is contention just like for spectrum licenses or government land. We should hold the money in trust until the international community decides who should get it. The President should establish a property rights regime by executive order that is later written into law by Congress.¹⁴⁵

Implicit in this quotation are several points worth discussing. First, this theory presents the same problem we had with White's proposal: what happens when resources are returned to Earth? In this case, the United States could no longer rely upon Article VI because the non-governmental entities are no longer in space, and any subsequent grant of private property rights in the celestial resources would violate Dinkin's interpretation that private property rights are prohibited under the Outer Space Treaty.

Additionally, Dinkin states that "[w]e should hold the money in trust until the international community decides who should get it."¹⁴⁶ Why Dinkin wants the international community to decide who gets the money is unclear. Perhaps he believes that this money will satisfy the Outer Space Treaty's province of mankind principle—that each state is due its share of outer space. Placing the funds in such a trust is unlikely to be workable for two reasons. First, the U.S. agency responsible for the hearings and auctions will likely need the money for funding, unless it tries to raise taxes or divert already stretched funds. Second, the United States has already stated that, under its interpretation of the Outer Space Treaty, "nothing in Article I, paragraph 1, diminishes or alters the right of the United States to determine how . . . it shares the benefits and use of its outer

144. *See id.*

145. *Id.*

146. *Id.*

space activities.”¹⁴⁷ Of course the United States could, of its own good will, provide these funds to other states, but it is unlikely to do so—particularly when it could use the money to fund the auctions. Dinkin does not clarify this problem.

There are several other problems that Dinkin does anticipate. “Having a piece of paper from the United States saying that no US entities may interfere with what you are doing does not necessarily give a US person or business the right to do something.”¹⁴⁸ There are two potential problems here which Dinkin anticipates: (1) prior claims to property and resources and (2) states which do not recognize the United States’ pseudo property rights regime.¹⁴⁹

Regarding the existence of prior claims, Dinkin argues that because “there is no proven enforcement mechanism for prior claims, they are unlikely to deter investment if a new strong property rights regime were established.”¹⁵⁰ Indeed there are a number of groups who have staked claims to property on the Moon and other planets, but Dinkin is right that there is not, at present, a mechanism to enforce, or even legitimize, such claims.¹⁵¹

147. *Outer Space Treaty Hearings*, *supra* note 44, at 74.

148. Dinkin, *supra* note 137.

149. *See id.*

150. *Id.*

151. “The Lunar Embassy Corporation” has claimed ownership of the Moon and several other planets. On their legal basis for doing so, their website states:

Well, in 1980, a very bright, young and handsome Mr. Dennis Hope, went to his local US Governmental Office for claim registries, the San Francisco County Seat, and made a claim for the entire lunar surface, as well as the surface of all the other eight planets of our solar system and their moons (except Earth and the sun). Obviously, he was at first taken for a crackpot, until, 3 supervisors, 2 Floors and 5 hours later, the main supervisor accepted, and registered his claim.

Now, even if you get the claim registered, you are definitely not out of the woods yet. You must inform others. For example, at the same time, the Lunar Embassy was obliged to inform the General Assembly of the United Nations, and the Russian Government in writing of the claim and the legal intent to sell extraterrestrial properties. Now we’re still not out of the woods. The US government has several years to contest such a claim. They never did. Neither did

The more onerous problem is non-recognition by other states, or worse, similar but unconnected foreign regimes. For example, one can imagine China developing a parallel regime but refusing to coordinate it with the United States', such that property rights to the same celestial property are granted to both a Chinese entity and a U.S. entity. In response, Dinkin makes a clever argument using the Outer Space Treaty.¹⁵² Article IX of the Outer Space Treaty states that:

the United Nations nor the Russian Government. This allowed Mr. Hope to take the next step and copyright his work with the US Copyright registry office. So, with his claim and Copyright Registration Certificate from the US Government in hand, Mr. Hope became what is probably the largest landowner on the planet today. This is the legal basis by which the Lunar Embassy is selling extraterrestrial properties.

The Frequently Asked Questions List, LUNAR EMBASSY, <http://lunarembassy.com> (select "World Headquarters U.S.A." under the "Please choose your country" dropdown next to "English;" then select "General FAQ" appearing under "News & FAQs") (last visited Dec. 24, 2012). For a full description of their legal basis, see Question #2 "What is the Lunar Embassy's legal basis for selling extraterrestrial properties?" on their FAQ page. But see *Who Really Owns The Moon?*, LUNAR REGISTRY, <http://www.lunarregistry.com/info/embassy.shtml> (last visited Dec. 24, 2012), for a competing view. This site states in relevant part:

These claims are, sadly, false. No single person owns the Moon, regardless of whether that person sent a letter to the President of the United States or the Secretary-General of the United Nations. And just because the U.S. or U.N. never responded to this person's letter, that does not mean that he automatically became the owner of the Moon and the other planets. Check with any attorney and they'll confirm for you that this isn't the way the law works in any country on Earth.

In fact, Dennis Hope of the Lunar Embassy has fabricated a fictional tale in which a vision came to him, and led him to register a claim to owning the Moon in 1980. He claims to have filed a document with "his local US Governmental Office for claim registries," an entity that simply does not exist. To this date, Hope has not been able to produce the original document that he purports to have registered; instead, he offers a poorly-worded page that he made up on his home computer several years after the fact.

Id. (emphasis omitted).

152. See Dinkin, *supra* note 137.

A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space . . . would cause potentially harmful interference with activities in the peaceful exploration and use of outer space . . . may request consultation concerning the activity or experiment.¹⁵³

Accordingly, whichever entity reached the property first could utilize Article IX. There are several problems, however, with Dinkin's reliance on this Article. A "consultation," and nothing more, will likely provide little protection. Dinkin agrees that the "consultation" process would not be as "ominous" as a WTO or North American Free Trade Agreement ("NAFTA") complaint, but concludes that "it is *something*."¹⁵⁴ Further, it is uncertain whether the commercial use of property under a pseudo property rights regime would constitute "activities in a peaceful exploration and use" under Article IX. "Use," as discussed previously, has been interpreted to mean non-exclusive exploitation, which by its very nature excludes private commercialization.¹⁵⁵ This problem would come down to interpretation, which is contentious. Dinkin's ultimate solution to this problem is to "hope that the US" works with other space-faring states to sign coordinated, bilateral agreements effectuating the pseudo property rights.¹⁵⁶

Another problem concerns the valuations of property in outer space. If a resource is discovered on Mars, for instance, and several U.S. entities possess the capacity to process the raw resource and turn a profit, the allocation of exclusive rights will be contentious. According to Dinkin's regime, a U.S. agency would hold hearings and eventually auction the property rights. But prior to arrival, which is when the auction would

153. Outer Space Treaty, *supra* note 1, art. IX.

154. Dinkin, *supra* note 137 (emphasis added).

155. Compare Trimble, *supra* note 9, at 530 ("The word 'use' has been interpreted to mean 'exploitation' on a non-exclusive basis."), with Sankey, *supra* note 52, at 69 ("[One scholar] has claimed that the right of 'use' referred to in [the Outer Space Treaty] implies a kind of narrow property right. Under this interpretation, for example, a private body would have a legal right to the land under a lunar base as long as the base is in use. . . . [I]t seems like there is sufficient scope of interpretation to mount an argument for at least narrow property rights in the context of the Outer Space Treaty.").

156. Dinkin, *supra* note 137.

occur given that an entity would not invest in unless it had exclusive rights, a multitude of variables exist. Consider such variables as quantity, quality (in terms of purity of minerals or liquids), and the cost of harvesting or mining the materials from the celestial body's surface. These variable costs will be difficult to predict until entities actually arrive on the celestial body and start harvesting or mining.¹⁵⁷ The large amount of variability would make the process similar to buying a lottery ticket—you can predict expected returns to a certain extent, but it is largely a gamble. This example embodies the general problem that “[t]ransaction costs are likely to be high, at least where rights holders are widely dispersed and the value of rights is subject to a great deal of imprecision.”¹⁵⁸

One final problem remains. When entities are forced to bid against one another, the costs will rise. It is questionable whether the market will function “perfectly” such that the winning entity can still make enough profit to incentivize actually competing.

[T]he winning bidder would be forced to expend vast resources in compensating the losers . . . [which is] clearly an inefficient cost from the perspective of space resource improvement . . . [because] valuable resources would still be wasted in the purchase of the land . . . that could have been channeled more efficiently into reaching or developing the planet.¹⁵⁹

A looming question for Dinkin is how his proposal and its purported legality under the Outer Space Treaty mesh with interpretations of the Outer Space Treaty that require benefit-sharing. Perhaps the auction price could be put towards the satisfaction of this requirement—although, given the discussion above, this is unlikely. The sharing of profits is equally unlikely given the requirement to pay an auction price upfront. If it is decided that profits must be shared, it will likely, as it

157. Consider an example: “If, for instance, space minerals are discovered that were not known at the time rights were initially allocated, it may be practically difficult for a company that is well-positioned to take advantage of the new mineral to locate and bargain with all rights holders whose permission must be obtained.” Merges & Reynolds, *supra* note 122, at 116.

158. *Id.*

159. Collins, *supra* note 4, at 213–14.

does now, continue to disincentivize commercialization. Even if the United States refuses to abide by this requirement—if it is so interpreted by an authoritative body, like the ICJ—doing so would constitute a breach, which would likely give rise to the United States' withdrawal. The same uncertainty that gives rise to the anticommons problem is ever present in Dinkin's proposal: even a unilateral decision by the United States to grant pseudo property rights would be susceptible to uncertainties in terms of legality and international comity under the Outer Space Treaty, keeping in mind that if the United States withdrew, it would not be able to avail itself of any of the Article IX anti-interference safeguards.

E. Multilateral International Auctions (True Property Rights)

Evan Sankey has proposed a similar regime to Dinkin's. Sankey proposes that we withdraw from the Outer Space Treaty (or amend it to allow property rights) and have an international body auction off real property rights.¹⁶⁰ Sankey argues that all extraterrestrial "property would first come under the jurisdiction of an international regime."¹⁶¹ Then, "[l]ike the [Federal Communications Commission], this international regime could then auction property rights . . . to the highest bidder."¹⁶² And under economic theory, the rights would end up in the hands of those entities who value them most. "This efficient allocation of clear and transferable property rights would . . . provide a much clearer incentive for companies which wish to develop and exploit resources on other celestial bodies to secure funding to do so."¹⁶³

An initial question is whether Sankey envisions the amendments to the Outer Space Treaty to remove all sentiments of the common heritage of mankind principle and the prohibition on territorial sovereignty. It seems implicit enough that to add

160. See Sankey, *supra* note 52, at 70 ("One option would be to amend the Outer Space Treaty to allow for the auction of extraterrestrial property rights.").

161. *Id.*

162. *Id.* at 71.

163. *Id.* Sankey also argues that this system would "eliminate problems of congestion in orbit by assigning a value to the scarce geosynchronous orbit space" which would eliminate the tragedy of the commons plaguing the reachable space resources (as discussed in Part I.A.). *Id.*

real property rights, the prohibition on national appropriation of property rights must be removed. But whether some portion of the benefit must be allocated to all states is unclear. Due to the lack of discussion, it might be safe to assume that Sankey envisions a complete overhaul of the Outer Space Treaty. If not, many of the same concerns addressed in the analysis of Dinkin's regime above will plague this proposal—although it seems likely that withdrawing from the Outer Space Treaty is not necessarily a bad thing for Sankey.¹⁶⁴

This proposal will face the same problems as Dinkin's. Entities must expend resources compensating the losers, and must attempt to value property with huge variable costs, which will give rise to high transaction costs. But there is a new twist to the transaction costs here. While the costs of unilateral domestic auctions would likely be high due to the problems associated with the valuation, *international* auctions on the scale envisioned by Sankey would give rise to increased and even new transaction costs that may be prohibitive of investment in the first place.¹⁶⁵

First, the multiplicity of participants on an international forum would dwarf those of a domestic auction. As stated above, “[t]he more parties involved, the higher the transaction costs.”¹⁶⁶ However, in an *auction*, the additional players in the market process add liquidity and improve the quality and accuracy of the prices. And the bidders do not typically interact with each other. These factors mitigate transaction costs in the traditional sense. But still, managing the enormous number of participants and facilitating the process will give rise to bureaucratic costs, which will need to be accounted for. As one author writes, “[the auction method] has been rejected as inefficient because of the immense bureaucracy that would be needed to conduct auctions.”¹⁶⁷

164. *See id.* (“[F]or ventures as large, expensive, and inherently uncertain as the first commercial forays to the Moon are likely to be, it is imperative that the legal environment be as accommodative as possible.”).

165. *See Collins, supra* note 4, at 213 (“[The auction method] has been rejected as inefficient because of the immense bureaucracy that would be needed to conduct auctions.”).

166. KRIER, *supra* note 12, at 365.

167. Collins, *supra* note 4, at 213.

Second, the introduction of governments will add an entirely new cost. "In short, politics will enter the picture. When this happens, the efficient auction mechanism could be transformed into a bureaucratic monster."¹⁶⁸ It is all but certain that states will be heavily involved in the bidding process, given the huge potential competitive advantage that accompanies ownership of terrestrial property. The addition of multiple international participants and their politically motivated governments make the transaction costs unique to the international auction proposal arguably less palatable than Dinkin's.¹⁶⁹ Indeed, the entities and states would not only have to pay off the losers of the auction, but spend money on the process, potentially prohibiting investment in the first place.

F. Non-sovereign First Possession (res nullius humanitatus)

The final two proposals grant property rights to entities based upon their time of possession, often called "first possession" regimes. Under a first possession regime, property rights are granted to entities by virtue of their rank-in-time of possession.¹⁷⁰ That is, whoever satisfies the requirements of "possession" (whatever they are determined to be) first is granted ownership.¹⁷¹ This rule is also called the "Rule of Capture" and it is "[t]he most fundamental rule for determining ownership" in American property law.¹⁷² This rule has been applied to wild animals, land, surface water, and oil and gas reserves underground.¹⁷³ The first proposal, in this section, argues for a modified version of the traditional first possession regime that could exist under the Outer Space Treaty regime. The second pro-

168. Merges & Reynolds, *supra* note 122, at 118 ("In the international arena where space issues arise, great potential exists for bureaucratic nightmares.").

169. Indeed several scholars support, as does this Article, a form of first possession property rights over international auctions, as will be discussed in more detail in Parts II.F, II.G, and III. *See id.* at 125 ("Properly crafted, property rights approaches are likely to be lower in cost, and better at protecting the environment, than are centralized bureaucratic regimes.").

170. *See, e.g.,* Dean Lueck, *The Rule of First Possession and the Design of the Law*, 38 J.L. & ECON. 393, 393-394 (1995).

171. *See id.* *See also* KRIER, *supra* note 12, at 2.

172. KRIER, *supra* note 12, at 2.

173. *See id.* at 2-13.

posal, discussed in the next section, advocates for a pure first possession regime in which the current treaty structure is abandoned.

The Non-sovereign First Possession proposal argues that celestial bodies should be classified as *res nullius humanitatus*.¹⁷⁴ *Res nullius* is the antithesis of *res communis*—meaning, in Latin, a “thing” (*res*) “for no one” (*nullius*). The addition of *humanitatus*, or “humanity,” would classify celestial territory as “a place where people can still have individual property rights and be rewarded for their labor based on first possession, but where settlers will act on behalf of the interests of humanity rather than a single terrestrial nation.”¹⁷⁵ The key is that, rather than claiming the property on behalf of a single state, it would be claimed “on behalf of all mankind.”¹⁷⁶ The author, Brandon Gruner, argues that “*res nullius humanitatus* would guarantee all humans *equal access* to the rewards offered by outer space, rather than a *de facto* equal share in the rewards reaped from such exploration and exploitation simply because they are human.”¹⁷⁷

The first question is whether equal access alone will satisfy the Outer Space Treaty’s requirement of benefit-sharing. Gruner’s proposal requires that settlers “act on behalf of the interests of humanity.”¹⁷⁸ Yet he claims that his system would “not reject the concept of individual property rights that rewards governments and persons for their efforts”¹⁷⁹ and that there would be no “*de facto* equal share in the rewards.”¹⁸⁰ It is clear that private entities (or privatized government entities) would be the sole beneficiaries of their immediate tangible gains of property ownership—that is, profits from resources or manufacturing. The “interests of humanity” that are being served by this regime, however, are not clear. “[E]qual access to the rewards offered by outer space” is the only thing which

174. See Gruner, *supra* note 21, at 354.

175. *Id.*

176. *Id.* at 353.

177. *Id.* at 354 (emphasis in original).

178. *Id.*

179. *Id.* at 355.

180. *Id.* at 354. As discussed above, the extent to which the common heritage of mankind principle requires *de facto* equal sharing in rewards is questionable.

Gruner cites that might benefit the international community. This equal access is clearly insufficient to satisfy non-space-faring states, as they have strongly opposed any regimes other than those employing the common heritage of mankind. Gruner's interpretation of the Outer Space Treaty—that states do not have to share the profits of outer space—is also extremely contentious as it is, and because we know that non-space-faring states will almost certainly reject the claim that “equal access to the rewards” satisfies the treaty's requirement, it is uncertain why Gruner is concerned with staying within the bounds of the treaty at all.

The second, and more practical, issue is who *actually owns* the property. Property rights are rights against others, and if individual states cannot obtain territorial sovereignty, they cannot grant these rights, save for a Dinkin-esque pseudo property regime. Gruner proposes the establishment of an international regime to create and enforce this non-sovereign first possession legal system.¹⁸¹ It is not entirely clear, however, how ownership would work. If ownership is governed by the regime itself, the laws and regulations would need to be extremely comprehensive if they are to be the exclusive and complete body of law on outer space.¹⁸² This would give rise to enormous transaction costs, and would arguably be impossible. Such a utopian regime would require the agreement of every state on Earth, or at the least the U.N., which we can assume would be extremely difficult. The question then becomes why Gruner bothers with the addition of “*humanitatus*” to “*res nullius*.” Claiming property on behalf of the “interests of humanity” without giving any tangible benefits to humanity—because individuals reap all the benefit of their property—will not only fail to satisfy non-space-faring states and the Outer Space Treaty, but will necessitate the creation of a new legal regime with enormous transaction costs.

181. *See id.*

182. If no nation has sovereignty, the rights of all individuals in outer space would be governed by the new regime, which includes all aspects of law, not just property.

G. Sovereign First Possession (pure res nullius)

A group of scholars propose a pure first possession regime for the allocation of property rights in outer space, which would require abandonment of the Outer Space Treaty. First, Jonathan Thomas argues for a free-market first possession regime.¹⁸³ The key to Thomas's regime is state sponsorship, or "chartering." Under this system, a space-faring entity would be granted a charter from a state that would "allow the grantee to claim land in the name of the grantor state and entitle the grantee to certain contractual benefits and obligations pursuant to the provisions of the charter."¹⁸⁴ The entity would, once granted a charter, act "on behalf of" the sovereign state to claim territory, which the entity would then own by virtue of rights granted from the charter state.

With charter in hand, each entity would be required to fulfill three steps: discovery, claim, and possession. Discovery would "require that the discoverer ambulate and physically stake a claim upon the extraterrestrial region because ambulation entails significant labor and peril."¹⁸⁵ The claim requirement is simple enough: "[t]he state should put the rest of the world on notice that the state believes it owns the property."¹⁸⁶ And the possession requirement would perfect title to the property.¹⁸⁷

Effective possession requires the sovereign to secure its position and continually perform symbolic acts to indicate its legitimate authority over the territory. . . . These acts could include enacting municipal laws, appointing administrators, levying taxes, providing civil dispute resolution, providing protection from hostile forces, excluding non-citizens, and other exercises of police, administrative, and judicial authority.¹⁸⁸

Soon after Thomas published his proposal, John Adolph responded with the addition of several elements.¹⁸⁹ Adolph supports the "discovery, claim, and possession" system, but would

183. *See generally* Thomas, *supra* note 49.

184. *Id.* at 220.

185. *Id.* at 229–30.

186. *Id.* at 231.

187. *See id.* at 232.

188. *Id.* at 233–34 (citations omitted) (internal quotation marks omitted).

189. *See generally* Adolph, *supra* note 50.

require the establishment of an international regulatory agency to monitor and regulate activities in outer space.¹⁹⁰ Adolph fears that the fate of outer space would mirror that of pre-twentieth century property rights concepts of *terra nullius* ("territory of no one," similar to *res nullius*¹⁹¹) which were plagued by "[a]rmed conflict, environmental devastation, and a lack of regard for the rights of other nations."¹⁹² Accordingly, Adolph would have the international agency perform three functions. First, it would allow for non-space-faring states to participate as observers or non-consultative parties, similar to the ATS structure, until they actively began to support space research.¹⁹³ Second, it would protect the space environment through regulations to "ensure that one [entity's] activities do not prevent others from enjoying the same benefits of space."¹⁹⁴ Third, it would manage conflict—particularly by establishing "explicit rules for how sovereignty" is established, presumably through Thomas' "discovery, claim, and possession system."¹⁹⁵

Along similar lines, Robert Merges and Glenn Reynolds have proposed a modified first possession and deed registry regime.¹⁹⁶ Merges and Reynolds argue that possession must be defined narrowly enough to prevent over claiming and must use technology to "coordinate with a 'deed registry' on Earth, so that the positions of boundaries could be confirmed remotely from the registry office."¹⁹⁷ They also suggest setting aside two types of preserved areas. The first, "development preserves," would be set aside for developing states to give them "a greater stake in peaceful space development."¹⁹⁸ The second would be for environmental research and conservation purposes.¹⁹⁹ Merges and Reynolds suggest that these areas constitute 10-15% of the area capable of commercial development.²⁰⁰

190. *Id.* at 983.

191. "*Terra nullius* is vacant land that belongs to no State. The clearest case is the unclaimed sector of Antarctica." AUST, *supra* note 38, at 37.

192. Adolph, *supra* note 50 at 985.

193. *See id.* at 983.

194. *Id.*

195. *Id.* at 984.

196. *See generally* Merges & Reynolds, *supra* note 122.

197. *Id.* at 121-23.

198. *Id.* at 123-24.

199. *See id.* at 124.

200. *See id.*

These proposals have merit. While each plan contemplates an abandonment of the common heritage of mankind principle, each anticipates providing a voice, and in Merges and Reynolds' case, actual preserves, to non-space-faring states. Setting aside area for environmental protection is also agreeable. Adolph's conflict concern is well taken, and indeed a system similar to the WTO or NAFTA structures—inter-organization arbitrations with the possibility of ICJ referrals—might be efficient.

First possession regimes do, however, suffer from a theoretical defect. The problem is that “the first nation to land on [a celestial body, and effectively obtain title,] is not necessarily the one that will use the [celestial body's] land in the most productive way.”²⁰¹ The result is too-rapid development in the technologies required to obtain title, which results in entities obtaining title without the necessary technology to efficiently commercialize the property.²⁰² From the analysis above, we know that the alternative—international auctions—would give rise to prohibitive transaction costs; so this requires the United States to make a choice between the lesser of two evils. The choice becomes clearer when we examine some of the positive externalities that accompany a first possession race to the property. As discussed above, an externality “is a cost (or benefit) of any given action that is not taken into consideration by the actor.”²⁰³ This gives rise to the classic tragedy of the commons problem. But here, with a race to the property induced by a first possession regime, there are positive externalities (benefits) that are non-existent in an international auction process.²⁰⁴

“[I]nefficient races to claim and develop space resources will come with a significant spillover benefit: the development of

201. Collins, *supra* note 4, at 212.

202. *See id.* at 213–14; Merges & Reynolds, *supra* note 122, at 119–20. Indeed, this occurred in the American West in the nineteenth century—people entered the land sooner than they would have under a competitive bidding process and were unable to efficiently develop it. *See id.* at 117.

203. KRIER, *supra* note 12, at 364.

204. This is not to say that there are no positive externalities existent at all in international auctions, but that they are distinct.

more rapid and more diverse space exploration vehicles.”²⁰⁵ Other innovations such as “food synthesis or alternative energy sources, could lead to the improvement of the standards of living for people on Earth.”²⁰⁶ “In much the same way that society encourages technical progress through what might be described as ‘racing for patents,’ on the belief that the spillovers to society exceed the costs of racing, it should consider encouraging a race ever deeper into space.”²⁰⁷ Indeed, the space race of the 1950s and 1960s did exactly this.²⁰⁸ Still, the problem of inefficient use could be mitigated further.

These authors have provided what I would call the second step of an ideal property rights regime for outer space. First possession rights would relieve the tragedy of the anticommons problem by allowing space-faring entities to retain the full return of their investments. But a practical problem is that, while enumerating specific elements necessary to “take possession” is reasonable—enacting municipal laws, levying taxes, policing inhabitants, providing civil dispute resolution—the satisfaction of those elements in the near-future is unlikely given the proposed uses of celestial property and our current technological capabilities. The initial uses of celestial property—mining and manufacturing, for example—can be done with few astronauts and mostly machines. These types of missions would be unable to satisfy the possession requirements as set forth in Thomas’s and Adolph’s proposals. However, it is also true that these mining missions should not convey title to the property for lack of establishing true possession.

A regime is needed in which entities can commercialize outer space at lower operating levels than would satisfy “possession,” with effective protection of their rights, and effective regulation of their activities, *and* a regime in which true territorial sovereignty is available upon the satisfaction of certain factors simi-

205. Merges & Reynolds, *supra* note 122 at 120–21 (describing how this is different than the American West, where exploration vehicles were already developed to the fullest extent possible).

206. Collins, *supra* note 4, at 213 (describing these innovations as an “explicit aim of the Moon Treaty”).

207. Merges & Reynolds, *supra* note 122, at 120.

208. See *supra* INTRODUCTION (citing positive externalities of the Apollo program such as heart-monitoring technologies and faster, more efficient computer systems).

lar to the possession requirements. In this way, we can incentivize investment (avoiding a tragedy of the anticommons), avoid overconsumption (avoiding a tragedy of the commons), regulate activities (avoiding inefficient use and environmental damage), and allow entities and states to do so without having to establish the onerous possession requirements in order to obtain *any* property rights. The first possession advocates provide the second step; what is needed is a first step. Such a two-tiered property rights regime, combining many of the positive aspects of the proposals studied in this Article, is proposed below.

III. THE PROPOSED TWO-TIER PROPERTY RIGHTS REGIME

A. Tier One: Non-Sovereign First Possession

The first tier is a system of non-sovereign first possession. Entities would be able to obtain property rights to areas of celestial bodies and the orbits upon which they operate, much like Dinkin's Pseudo Property Rights and White's Functional Property Rights. An International Regulatory Body ("IRB") would be established to serve two purposes: (1) to provide property rights to and between entities and (2) to regulate their activity. The IRB would be less comprehensive than other proposals' international regimes because the IRB would not establish a comprehensive new legal regime. The IRB regime would be much simpler. It would establish basic rights to property exercisable against other entities and regulate human activity in outer space. Importantly, entities would be governed by the laws of their states of origin and international law, but only to the extent that those laws are not preempted by IRB regulations—much like U.S. federal/state preemption. Because the IRB only regulates activity between humans (and their entities), it would only have jurisdiction over humans and their activity while in space. To be clear, the IRB would not claim ownership over the entire universe. All of outer space would be classified as *res nullius*.

This would be the first tier; the IRB would only preemptively regulate activity up to the point that the activity satisfies the criteria for territorial sovereignty, discussed in the next section, at which point the state (or the state of origin of the space-faring entity) would obtain sovereignty and fall out of the purview of the IRB.

The IRB could be run like an arm of the U.N. Its composition could be similar to the ATS or the U.N. Security Council. The IRB could be made up of permanent members who are space-faring and a smaller number of rotating members who are non-space-faring—collectively these members would make up an “IRB Council.”

For the IRB's first function, granting property rights, the IRB would use a pure first possession rule to allow entities entering space to operate on celestial bodies. These operations would not convey title. They would only allow the entity to exclusively operate (mine, drill, manufacture, etc.) and retain any returns (profits, resources, goods, etc.). True ownership rights would only be granted in the returns—that is, what an entity “captures” or creates is theirs. Disputes over who should get what part of a celestial body would be decided by first possession—the entity which gets there first and starts mining obtains exclusive rights against others to the area on which it operates—granted by the IRB. To be clear, an entity could have exclusive operating rights only over the area on which it is actually operating (with specific definitions to be determined by the IRB Council). This system would prohibit giant unsubstantiated claims to celestial bodies.

There are a number of problems that could arise under this system, which necessitates the IRB's second function.²⁰⁹ When entities do not *own* the property they are less likely to use it in its most efficient or sustainable way. Entities would be incentivized to use the property in whatever way would be the most profitable at that time—the “race to the property” problem described above. This use of property—maximizing short-term gains at the expense of sustainability—is problematic from both an efficiency and environmental standpoint. The IRB's second function, then, would be to serve as the custodian of outer space *res nullius* property.

The IRB Council would set regulations on the use of celestial property. Activities which would severely damage or pollute the

209. Certain finite resources, like Earth orbits, will require protection as well—as a race to the orbit might give rise to collisions, overcrowding, and overconsumption. To avoid a tragedy of the commons, as is the present problem with the geosynchronous orbit, the IRB would simply regulate that a finite number of satellites may be in orbit and that they will be provided on a first-come, first-served basis.

property would be prohibited. Inefficient uses would be regulated to incentivize efficient ones. The IRB could levy fines or fees for failures to meet these standards. Admittedly, not all inefficient or destructive uses would be predictable, but any protection is good protection.

The IRB could also play to the concerns of developing states and environmentalists. In line with the Adolph and Merges and Reynolds proposals, this regime could establish scientific reserves for exploration and study, as well as portions of usable land for developing states. These preserves could be established by the IRB from areas not in use by space-faring entities. Indeed, these reserves would diminish available resources, but would likely not be prohibitive if limited to an amount less than 10%, as compared, for instance, to the 50% requirements of UNCLOS. This is especially true where none of the returns are required to be distributed to other states.

In terms of procedure, an entity would need to apply for a use permit prior to launch. The IRB would approve the permit provided that it met all of the regulatory standards. The entity would then be entitled to operate as set forth in the permit. The entity's rights to specific resources and territory located in the permit area would be granted to the entity upon their successful arrival and operation thereupon. Using similar elements from proposals above, the operations facilities would be entitled to some EEZ to enable safe and efficient movement. When the operations ended or fell below a certain level, the entity will be said to have abandoned its temporary, non-sovereign claim to the area and it will lose its IRB-granted rights against other entities. Funding for the IRB could come from application fees or taxes paid by space-faring entities. These would only fund the IRB's operational costs. At this stage, disputes could be sent to the IRB Council or a dispute resolution body made up of IRB Council members. Interactions between entities would be governed as they are between entities in the High Seas or Antarctica.

To reiterate, this first tier would not require the IRB to establish a comprehensive legal regime, but simply to create a body of regulations on which to judge proposed permits, regulate use, and grant exclusive rights against others. This first tier is necessary because (1) non-sovereign first possession regimes can give rise to inefficient and damaging uses of property and (2) the initial uses of space are unlikely to satisfy the posses-

sion requirements for territorial sovereignty. However, at some point, the establishment of those possession requirements may become a possibility.

B. Tier Two: Sovereign Possession upon the Establishment of Modified Statehood Factors

The second tier is a system of sovereign possession in which territorial sovereignty (i.e., national appropriation) would be available upon the satisfaction of certain modified statehood factors. To obtain territorial sovereignty, an entity, operating as an extension of the state of its origin, would need to manifest its intent to own title of the land through acts similar to those proposed by Thomas and Adolph for possession. Once territorial sovereignty is obtained by an entity's state of origin, the entity would be free to operate in any way it liked subject only to the domestic laws of its state and international law. Prior to that point, entities could mine, harvest, drill, manufacture, and operate so long as they act in accordance with the regulations of IRB. While under IRB regulation, there would be one of two ending options: (a) the property is abandoned and the entity loses its IRB rights against others or (b) the property comes under the territorial sovereignty of a state. To reemphasize, the race to the property problem is mitigated first by the IRB regulations, and second, in the event that it comes under the ownership of a state, it would, by virtue of the factors, be used efficiently.

To determine the elements which a state must satisfy through its entity's activities, we can turn to existing international law. How we classify these extraterrestrial territories will inform the elements. The requirements needed for a territory to be recognized as a "state" with international personality are a good place to start.

On Earth, "[t]he generally accepted criteria for statehood is that the entity has to demonstrate that it has (a) a permanent population; (b) defined territory; (c) a government; and (d) capacity to enter into relations with other States."²¹⁰ The extent to which we should employ each of these traditional factors should be dependent upon the classification of outer space ter-

210. AUST, *supra* note 38, at 15 (citations omitted) (internal quotation marks omitted).

ritory—are these entities starting brand new states or colonies? Colonies, or “overseas territories,” are those territories which come “under the sovereignty of a State (‘parent State’), but which [are] not governed as part of its metropolitan territory.”²¹¹ The U.N. Charter describes overseas territories as non-self-governing.²¹² In colonies, the parent state decides the extent, if any, to which the colony has control over such things as internal affairs, defense, and foreign relations.²¹³ This “colony” or “overseas territory” classification fits our scenario more accurately than a classification as a brand new state. Using the colony classification, the traditional statehood requirements of “government” and “capacity to enter into relations with other states” will necessarily be satisfied, leaving “a permanent population”²¹⁴ and “defined territory.” Yet, because we are not dealing with the creation of a new state, but instead with the establishment of a colony on *res nullius*, we should also look to how international law handles states’ acquisition of *terra nullius*.

On Earth, “[*t*]erra nullius can be acquired by any State (but, unless acting on behalf of a State, not by a private person or company) which has the intention to claim sovereignty and occupies the territory by exercising effective and continued control.”²¹⁵ The operative elements are (1) intent and (2) effective and continued control. In the *Island of Palmas* arbitration, it was held that the continuous and peaceful display of territorial sovereignty, manifested in different ways depending on the time and place, was as good as title.²¹⁶ “The arbitrator stated the display of sovereignty should be open and public”²¹⁷ “Open” and “public” are vague terms and are subject to the aspects of each individual situation. If we were to implement

211. *Id.* at 29.

212. See U.N. Charter arts. 79, 81.

213. See AUST, *supra* note 38, at 30.

214. The establishment of a permanent population is, at present, practically impossible. However, the use of a permanent population (1) can be justified to a certain extent and (2) is accompanied by some powerful and critical incentives. The use of this factor is discussed below.

215. AUST, *supra* note 38, at 37–38.

216. See ELINA STEINERTE & REBECCA M. M. WALLACE, NUTCASES: INTERNATIONAL LAW 91–92 (2008).

217. *Id.* at 92.

solely the *terra nullius* acquisition requirements, entities operating under the first tier could be said to have obtained title to the property. This would allow for a state to claim territorial sovereignty without manifesting a true intent to establish a colony. The problem with this outcome is that it would allow states to bypass the IRB regulations. When states manifest a true intent to remain, that is, a true intent to take ownership of, sustain, and develop the property, they are less likely to allow it to be devastated by overconsumption and environmental damage or to use it inefficiently—the things that plague non-sovereign first possession.

If we combine the remaining elements of statehood with those required to acquire *terra nullius*, we have: (a) a permanent population, (b) defined territory, (c) intent to claim sovereignty, and (d) effective and continued control, with the caveat that such control be peaceful, open, and public.

Retaining the permanent population factor from the traditional statehood factors appears on its face to be problematic. Because, at present, establishing permanent populations on celestial bodies is practically impossible, this factor has the potential to hold states back more than any other. Making it all but impossible in the immediate future for states to establish territorial sovereignty could cause an anticommons problem in the first tier, as will be discussed Part III.C.3. However, a permanent population is a powerful measure of a state's vested interest in territory. A state is less likely to act in a way that is damaging or wasteful of territory when it has a permanent population there—this is the benefit of using it as a factor. Doing so, however, is a policy choice. Should states be allowed territorial sovereignty without establishing a permanent population? As discussed, a permanent population is not required to bring *terra nullius* under the territorial sovereignty of a state; but space is different. Human mobility to and from celestial territories is far more difficult and costly than mobility from state to state on Earth, and this investment of resources can serve as (1) a manifestation of a state's long-term, sovereign interest in the territory and (2) a powerful incentive to use the territory in way that is efficient and sustainable—more so than mere ambulation.

Certainly, a medium between Thomas's and Adolf's ambulation and the permanent population statehood factor might exist to bridge the gap—for example, sustained ambulation or the

establishment of permanent bases capable of long-term human habitation. And in terms of efficient and sustainable use, more strict and comprehensive international regulations on the uses of outer space could mitigate the problem. But whether we should enable states to obtain territorial sovereignty over celestial territory without first establishing a permanent population remains a policy question. Normatively, states will act most consistently with efficient use and conservation when they have vested interests in the territory for the long-term, which, arguably, is manifested most directly through the establishment of a permanent population.

With the permanent population factor, again, we have: (a) a permanent population, (b) defined territory, (c) intent to claim sovereignty, and (d) effective and continued control. These elements combine the requirements of the discovery, claim, and possession system proposed by Thomas and Adolph. The discovery element is satisfied through the more onerous requirement of (a) a permanent population, as opposed to ambulation alone. The claim element is satisfied through (c) intent to claim sovereignty. And possession is encompassed more broadly in (d) effective and continued control. Element (b) defined territory, as discussed above, is included both to encourage clear demarcation and to narrow the scope of territory claimed—in conjunction with (d)—in accordance with Merges and Reynolds's suggestion. Thomas's list of possession manifestations could be used as examples of ways to manifest a state's effective and continued control of a defined territory: "enacting municipal laws, appointing administrators, levying taxes, providing civil dispute resolution, providing protection from hostile forces, excluding non-citizens, and other exercises of police, administrative, and judicial authority."²¹⁸

The final arbiter of statehood (i.e., whether a state has satisfied the factors) should be left to an international body, like, for instance the ICJ or even the IRB Council.²¹⁹ Once title is obtained, the territory would be free of IRB regulation and would be subject only to the parent state's laws and international law. An entirely new international legal regime to govern the con-

218. Thomas, *supra* note 49, at 234.

219. Although it could be left up to recognition treaties with other states or the U.N.

duct of colonies is unnecessary—current international law can provide ample precedent.

Consider, for example, the *Trail Smelter* arbitration between the United States and Canada. In 1986, a smelter was started near Trail, British Columbia.²²⁰ The smelter produced, as a by-product, mass quantities of sulfur dioxide, which it released into the air. This sulfur dioxide caused damage in the state of Washington in the United States.²²¹ The arbitral tribunal held that “no state had the right to use or permit the use of its territory in such a manner so as to cause injury by fumes to the territory of another, or to the properties or to persons within that territory.”²²² Indeed, the ICJ or another system of international courts could be established to handle the disputes between colonies—which would likely arise early and involve property disputes of the *Trail Smelter* and *Island of Palmas* flavor—using existing international law. *Trail Smelter* is only one example of many that can provide ample precedent.²²³

The tragedy of the anticommons can be avoided by opening up outer space to commercialization. However, a pure first possession regime may have the alternative effect of a tragedy of the commons. A two-tiered system can achieve, arguably, a happy medium. Tier one will allow entities to commercialize outer space at low levels of operation. The IRB will grant entities property rights against others and enable them to retain their return on investment. The IRB will also serve as the custodian of the *res nullius* territory, regulating its use and setting aside preserves for study and use by developing states. If an entity's use, in conjunction with its parent state, satisfies the modified statehood factors—(a) a permanent population, (b) defined territory, (c) intent to claim sovereignty, and (d) effective and continued control—the parent state would be able to establish territorial sovereignty over the property. Upon acquisition of territorial sovereignty, the colony would leave the ju-

220. See STEINERTE & WALLACE, *supra* note 216, at 175.

221. *See id.*

222. *Id.* at 176.

223. *See, e.g.,* Lake Lanoux (Fr. v. Spain), 12 R.I.A.A. 281 (1957) (endorsing that a state has responsibility to protect other states from injurious acts perpetrated from within its territory); Gut Dam (U.S. v. Can.), 8 I.L.M. 118 (1969) (finding that a state is responsible for the injurious consequences of acts which have taken place within its territory).

risdiction of the IRB and be run solely by the parent state and relevant international law.

C. Drawbacks and Assumptions

Several problems which exist in other proposals exist here, but to mitigated extents. The race to the property problem is, as described above, mitigated by the positive externalities of the race and the regulations of the IRB. The transaction costs of the IRB still exist, but to a lesser extent than a new comprehensive legal regime or an international auction regime. But here there are some different assumptions and new potential problems.

1. Costs of the IRB

In this proposal, I have assumed that fees and taxes on space-faring entities would fund the IRB. This is a big assumption. In 2010, the ISA adopted a \$13 million budget for its 2011-2012 operations.²²⁴ These funds came from the U.N.'s regular budget, which, incidentally, is another potential avenue for funding. The ISA also requires dues from UNCLOS member states, which may be yet another option for financing. On the other end of the spectrum, the U.S. Patent and Trademark Office ("USPTO") 2011 budget was just over \$2 billion.²²⁵ The USPTO vets patents as they are requested, which is similar to the vetting the IRB would do to commercial proposals. The cost of the IRB would need to be explored in more detail.

2. The Creation of New States

One question left unanswered is whether private entities could establish entirely new states.²²⁶ As discussed, generally

224. See Press Release, International Seabed Authority, Seabed Assembly Adopts \$13,014,700 Budget for Authority's Operations in 2011-2012 Biennium (May 6, 2010), <http://www.isa.org.jm/files/documents/EN/Press/Press10/SB-16-17.pdf>.

225. See David Kappos, Dir. of the U.S. Patent and Trademark Office, *An Update on the USPTO's FY 2011 Budget*, DIRECTOR'S FORUM: DAVID KAPPOS' PUB. BLOG (Apr. 22, 2011, 9:08 AM), http://www.uspto.gov/blog/director/entry/an_update_on_the_uspto.

226. See, e.g., AUST, *supra* note 38, at 17–18, 26–27, for a discussion as to whether non-recognized states like Taiwan, Palestine, or the Vatican could start colonies.

terra nullius cannot be claimed by new states. But the traditional statehood factors are used to establish international recognition of new states.²²⁷ This proposal does not contemplate the creation of new states. Of course, it is possible, and even likely, in the long-term future. This proposal could be modified to allow for the creation of new states upon the establishment of all traditional statehood factors. The current international laws on statehood and recognition could be used in outer space as they are on Earth. This would likely occur through secession, given the ease of initially gaining territorial sovereignty as a colony.²²⁸

3. Uncertainty in the Second Tier

One potential problem is the uncertainty of the second tier. If the modified statehood factors are vague or uncertain, or if states fear that they are too onerous, the factors may induce an anticommons problem in the first tier. This problem can be avoided with realistic and clear requirements—like Thomas and Adolf's examples. The IRB Council would be responsible for enumerating the specifics. As technologies develop and uses become clearer, it would be important for the IRB Council to revisit the specific requirements of each modified statehood factor, or even the factors themselves, if, for instance, a permanent population is determined to be too onerous. One possibility is to allow entities to apply for milestone certificates from the IRB Council which would certify and legally acknowledge certain milestones met by the entity as it approached satisfaction of the statehood factors. These milestone certificates could be renewable and could serve as evidence supporting a determination of sovereign possession. In any case, the second tier must have sufficient regulatory certainty so as to avoid an anticommons problem in the first tier.

4. The Illegitimacy of the Common Heritage of Mankind

Finally, this theory assumes that the common heritage of mankind principle is illegitimate. This principle is the primary catalyst of the anticommons problem. Its premise, that all states are due an equal share of outer space, is largely unsub-

227. *See id.* at 15–17.

228. *See id.* at 37.

stantiated. *Perhaps*, by virtue of states' proximity, its use on Earth is justified for the purposes of ensuring our peaceful co-existence.²²⁹ But aside this practical point, the sheer absurdity of the U.N.'s claim to all of outer space exemplifies its illegitimacy.²³⁰ On what basis should humanity simply claim ownership of the entire universe? Imagine making contact with intelligent life and attempting to explain how humans own the entire universe, including the planet or system on which they live. In fact, this even goes against our traditional notions of property ownership. John Locke's theory of private property ownership was that, generally, property belongs to everyone—arguably all life in the universe—equally until one “admixed his labor to it,” at which point it becomes the private property of that individual.²³¹ Indeed, Locke's theory is vindicated through the first possession proposals. Common heritage regimes grant everyone equal rights regardless of their labor or input of value. There is simply a lack of support for granting every state a right to every part of outer space by virtue of its existence on Earth. Further, history and economic theory prove—by UNCLOS, the ATS, and the Outer Space Treaty—that such regimes are inefficient. For these reasons, this proposal rejects the legitimacy of the common heritage of mankind principle. Even still, this proposal supports the establishment of preserves for developing states and for study—not out of a belief that it is required, but for environmental protection, scientific research, and to encourage developing states to develop space-faring technologies.

CONCLUSION

The commercialization of outer space is suffering from a tragedy of the anticommons. No state or private entity has been willing to bear the cost of commercialization because international law prohibits national and, potentially, private appropriation; and even if the laws are interpreted to allow private appropriation, they require private entities to share some quantity of the returns with all states. Indeed, the diversity of

229. Similar to the ATS.

230. See G.A. Res. 1721, *supra* note 27, ¶ 1; Hickman & Dolman, *supra* note 16, at 6–7.

231. Hickman & Dolman, *supra* note 16, at 7 (citations omitted).

interpretation itself creates such an uncertainty that it is prohibitive of meaningful investment. As discussed, the prohibition on appropriation is a remnant of the Cold War era, and the benefit-sharing requirement is largely unsubstantiated.

This Article has analyzed nine of the leading proposals for property rights regimes aimed at avoiding the tragedy of the anticommons. Many of these proposals give rise to new, prohibitive inefficiencies and costs, while others result in arbitrary results, like Russia being entitled to over 10% of all celestial bodies and Israel only 0.01%. Drawing from each potential regime, this Article has proposed a two-tier system wherein entities could, first, commercialize space, keep their return on investment, and be regulated to protect against inefficiencies, and, second, upon the satisfaction of certain modified statehood factors, obtain territorial sovereignty.