IAC-10-B3.8-E7.7.9

COMMERCIALIZATION OF OUTER SPACE: MOVING TOWARDS LEGAL CERTAINTY

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ABSTRACT

Space offers the potential for practically limitless wealth - some already being exploited, some we may only harness in the distant future, and undoubtedly some we cannot begin to guess. Realizing the potential to *shape the course of human destiny*, it's pertinent to incentivise entrepreneurial investment in space, by creating significant monetary prizes for the accomplishment of space missions and/or technology developments and by *assuring property rights for those who seek to develop space resources and infrastructure*. The current legal regime restrains the commercialization and development of outer space, and subsequently, its infinite economic and humanitarian rewards. Uncertainty in the legal consequences of space ventures make the vast potential rewards somewhat unattainable. The Outer Space Treaty (OST) of 1967 and its progeny established a basis for the allocation of property rights in outer space, subsumed under the concept of the 'common heritage of mankind', which is antithetical to the economic development of space resources; and is in contradiction to Article I of OST. Critics argue that the 'non-appropriation' clause in Article II of OST is a result of the socialist ideals that were prevalent at the time but is outdated and at odds with today's free market economy. It's also debatable whether Article II of OST and Article 11(2) of the Moon Treaty (MT), does include 'individual non-appropriation'. A regulatory system must be enacted that provides private enterprise with long-term predictability and minimizes regulatory interference. The purpose of this paper is to address: what is necessary to create a stable, yet equitable, legal regime that would incentivise private investment in space. The challenge is to build a regime that encourages the beneficial aspects of property rights, while formulating rules that discourage conflict and predation. How about the efficacy of market instruments - such as licensing, and quotas? Accordingly, Part II provides a brief introduction to space resources and their emerging commercial relevance. Part III discusses the Outer Space Treaty, resolving if it espouses a system of property rights. This section concludes delving on the need for a law of property, which follows as a natural corollary. Finally, Part IV analyses ideas and and proposals for an international legal regime to govern the use of outer space resources, providing some suggested changes in international space law - such as providing for a centralized development authority, on lines of the United Nations or the World Trade Organization.

TEXT

I. INTRODUCTION

Mankind's journey into space, like every great voyage of discovery, will become part of our unending journey of liberation. In the limitless reaches of space, we will find liberation from tyranny, from scarcity, from ignorance and from war. We will find the means to protect this Earth and to nurture every human life, and to explore the universe. This is our mission. This is our destiny.[1]

- President Ronald Reagan

In January 2004, President George W. Bush commissioned 'President's Commission on Implementation of United States Space Exploration Policy,'[2] (hereinafter "the Commission"). Having held public hearings and testimonials from industry, education, media, & various other agencies and professional bodies - on way's to expand space exploration, discovery and commercialization by private entities; it recommended 'greater reliance on private industry in space operations, reducing

[1] Remarks to Employees of the National Aeronautics and Space Administration (NASA) at the Johnson Space Center in Houston, Texas, (Sept. 22, 1988).

[2] 'President's Commission on Implementation of United States Space Exploration Policy', A journey to Inspire, Innovate, and Discover (June 2004), available online at http://www.nasa.gov/pdf/60736main_M2M_report_small.pdf last accessed on 4 July 2010. (The President's vision is infused with "A Renewed Spirit of Discovery" aimed at exploring the Moon, Mars and beyond.)

NASA's involvement to *only those areas where there is irrefutable demonstration that only government can perform the proposed activity.*'[3]

Recommendation 5-2 states: Congress increase the potential for commercial opportunities related to the national space exploration vision by providing incentives for entrepreneurial investments in space, by creating significant monetary prizes for the accomplishment of space missions and/or technology developments and *by assuring property rights for those who seek to develop space resources and infrastructure.*

To spark 'entrepreneurial investment' in space technologies, the non-profit X-Prize Foundation awarded $10 million Ansari X-Prize to the spacecraft *SpaceShipOne,* for having achieved sub-orbital flight twice in a week.[4] Richard Branson, agreed to pay up-to $21 million over the next 15 years to provide spaceships and technology for his sub-orbital space airline - 'Virgin Galactic.'[5] The birth of this nascent commercial space tourism industry is supported by President Bush, who on 23 December 2004 signed into law H.R.5382: Commercial Space Launch Amendment Acts of 2004[6] intended to stimulate private investment in sub-orbital ventures, and to assist the flight of the American public into space.

The Commission also promotes the creation of tax incentives for private industry, such as making profits tax free until they equal five times the initial investment, or tying tax incentives to specific milestone achievements.[7] Also tied up with this notion is the need to secure and protect the property rights of private industry in space.

Espousing the need to 'think different' the report states: 'Because of this treaty regime, the legal status of a hypothetical private company engaged in making products from space resources is uncertain. Potentially, this uncertainty could strangle a nascent space-based industry in its cradle; no company will invest millions of dollars in developing a product to which their legal claim is uncertain. The issue of private property rights in space is a complex one involving national and international issues. However, it is imperative that these issues be recognized and addressed at an early stage in the implementation of the vision, *otherwise there will be little significant private sector activity associated with the development of space resources, one of our key goals.*'[8]

The current legal regime restrains the commercialization and development of outer space, and subsequently, its infinite economic and humanitarian rewards. Uncertainty in the legal consequences of space ventures make the vast potential rewards somewhat unattainable. A regulatory system must be enacted that provides private enterprise with long-term predictability and minimizes regulatory interference. The purpose of this paper is to address: what is necessary to create a stable, yet equitable, legal regime that would incentivise private investment in space. The challenge is to build a regime that encourages the beneficial aspects of property rights, while formulat

[3] Id. Recommendation 3-1

[4] Starship enterprise: the next generation, THE ECONOMIST (24 January 2008)

[5] Knight in shining armour, THE ECONOMIST (31 July 2008)

[6] 49 U.S.C. §§ 70101- 21 (2004)

[7] In 2003, the Invest in Space Now Act was introduced into the US House of Representatives. This Act recognizes the need for immediate development of the US commercial space transportation industry and proposes a tax credit to spur this development. Taxpayers who purchase stock in a US company whose primary mission is providing space transportation vehicles or components would receive a tax credit equal to a certain percentage of the price they paid for that stock during that year. In the first year after this Act is passed, taxpayers would receive a tax credit equal to 50% of the price they paid for the stock in that year. The percentage would remain at 50% for new stock purchased in the following two years and then decrease according to a pre-set timetable. See H.R. 2358, 108th Cong. (2003). Also, A Zero Gravity, Zero Tax Act has been introduced to the House and if passed would allow space-related income (income de-rived from the production of items in space or the provision of services in or from space) to be excluded from taxable gross income. Such income would be completely exempt until the year 2012 when it would begin to be slowly phased out based on the number of years an entity has taken advantage of the exclusion. The bill also includes a tax credit for stock in companies involved in space. See H.R. 914, 108th Cong. (2003). In 2003, the Spaceport Equality Act was presented to the House and if passed would allow tax-free bonds to be issued for the construction and renovation of space-port facilities. See H.R. 644, 108th Cong. (2003)

[8] "The Commission," supra 2 at 34.

-ing rules that discourage conflict and predation. Accordingly, Part II provides a brief account to space resources and their emerging commercial relevance. Part III discusses the OST, and concludes with the need for a property regime. Finally, Part IV analyses ideas and and proposals for an international legal regime to govern the use of outer space resources.

II. PROFITEERING FROM SPACE'S RESOURCE POTENTIAL

Space offers the potential for practically limitless wealth, some already being exploited, some we may only harness in the distant future and undoubtedly some we yet can't begin to guess. Telecommunications' and remote satellite observations are some of the benefits of space. Research in materials science has unearthed phenomena unique to the low end and 'no-gravity' environment of space and the space based processing of these alloys, composites, ceramics and polymers would soon become an important industry.[9] Pharmaceutical R&D debates the possibility of manufacturing protein crystals to manufacture drugs capable of 'turning off' a protein and thereby regulate metabolic process.[10] Of recent interest to the scientific community has been the detection of ice deposits in the lunar north pole, by scientists using the Mini-Sar instrument on board India's 'Chandrayan I'. This has helped espouse the notion that prolonged stay on the Moon may be now feasible, cheaper and more importantly space colonizations doesn't seem science-fiction any more. How about the feasibilities of laying out giant solar cells in space and on the moon and to capture solar energy in massive quantities? Sounds optimistic, I guess!

One of the most lucrative areas of development would be the mining of celestial bodies. For instance, an assay of only 30km of lunar surface explored during Apollo-17 missions' turned up substantial deposits of Helium-3, a radiation free fusion reactor fuel, which being non-existent on Earth and more efficient than any radio-active fuel currently available envisages the possibilities of establishment of a 'lunar colony with cash export commodity.'[11] Amongst the celestial bodies, near-Earth asteroids ('NEAs') might be considered for optimal development. NEAs seem to be rich in raw materials which are either rare and valuable on Earth, or common on earth, needed in space and difficult to launch.[12] There's also evidence on the probabilities of NEAs containing gold, rhenium, germanium, and platinum group metals, the likes of platinum, palladium, osmium, rhodium, ruthenium among others, at reserves over a hundred times more than ever mined on the Earth.[13]

Improvements in technological capability and increased competition has significantly lowered launch costs to levels to enable robotic space missions and several real world companies envisage profiteering from space mining, in the not too distant future.

Bringing down space mineral reserves on Earth will only increase the total wealth available to humanity. Helium 3 reserves on the Moon is capable of creating in a controlled fusion reaction, ten times more energy as contained in the Earth's organic resources.[14]

More than the financial resources or technology, its the conspicuous uncertainty of a legal regime that precludes such companies from being operational. The need of the hour is to establish a space property legal system that would provide for incentives to promote entrepreneurial investment and predictability in the law. Space development is not only expensive, its risky as well. Why would private industry be interested in developing a space colony, if they can't be certain of the projects' legality? With the ever-growing demands of energy and the Earth set to run out its supply of fossil fuel, solar panels can be set up in Earths' orbit and on the brighter side of the Moon, and this source could be used to power space development projects, by way of transferring the reserves down to Earth as micro-wave energy for terrestrial use. Unless a private company can make use of a legal system that provides for commercial exploitation and a strong rate of

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[9] 'United Nations Office for Outer Space Affairs', Highlights in Space: Progress in Space Science, Technology and Applications, International Cooperation and Space Law, U.N. Doc A/AC.105/618 98-99 (1995); *cited by* Ezra J. Reinstein, Owning Outer Space, 20 NW. J. INT'L L. & BUS. 59 (Fall 1999) [hereinafter "Owning Outer Space"]

[10] Supra 9, "Owning Outer Space"; *citing* 'United Nations Office for Outer Space Affairs', Highlights in Space: Progress in Space Science, Technology and Applications, International Cooperation and Space Law, Ann. Rep. 1 (1996)

[11] Robert Zubrin, *Entering Space: Creating a spacefaring civilization*, 79, (New York: Penguin Putnam Inc., 2000)

[12] Jeffrey S. Kargel, Digging For Gold: U.S. National Aeronautics and Space Administration's Plans For Mining Extraterrestrial Resources, Astronomy, (Dec. 1997), 48; *cited in* "Owning Outer Space", supra 9.

[13] Id.

[14] Richard S. Lewis, Space in the 21st Century, 143 (1990); *cited in* "Owning Outer Space", supra 9. It will also help bring about reduction in our dependence on fossil fuels, and promote environmental evangelism.

return on investment, mankind will be denied of the benefits of space.

One of the most critical issues involved in the commercialization of space is determining who has the right to limited space resources. The United States, the erstwhile Soviet Union (now, the Russian Federation), and other nations active in space have attempted to utilize international law to govern disputes that arise over space resources. However, current international space law does not provide clear guidelines for the commercial development of space resources. This deficiency leads to uncertainty, and consequently to conflicts over these valuable resources. Historically, property rights have been clearly defined to prevent conflicts over the use and regulation of new and valuable resources. For example, as offshore oil became commercially valuable, international law developed new regulations for the seabed and sub-oil of the continental shelf.[15]

III. WHITHER A PROPERTY REGIME...??

A. Are existing international space treaties insufficient for a regime of property rights'?

Currently there are several treaties in effect that were created to address space exploration. Most of these treaties were drafted during the Cold War, when outer space was seen as the next battlefield and the Moon as a potential military outpost. These fears were fueled by the "space race" between the United States and the Soviet Union, each country trying to beat the other to the Moon. Other nations feared that the two rising superpowers would dominate space and claim it for themselves. In 1967, in response to these fears, the United Nations drafted the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies.[16] ("Outer Space Treaty")

According to Robert Crane, the then-Director of the Duke University Space Institute, the "value" of space law, was "as an instrument to deny control of outer space to any single power."[17]

On the one hand, the OST seems to endorse some property rights in space. At the very least, it pays lip service to the **"exploration and use"** of outer space in its Preamble and Article I. On the other hand, the OST declares that all such exploration and use *"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.**"*[18] Thus the Outer Space Treaty seems to acknowledge the rights of nations and persons to exploit space, but subjects it to vague qualifications about benefiting all nations and mankind generally. What does the OST mean by permitting use of space only for the "benefit of all countries?" Will the United Nations step in and seize the profits de-

[15] Ian Brownlie, *Principles of Public International Law*, 6th. Ed., 222-232, (USA: Oxford University Press, 2003)

[16] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Jan. 27, 1967), 18 U.S.T. 2410. [hereinafter "OST"]

[17] Robert D. Crane, Planning for Space Legal Policy 1 (1961); *cited in* "Owning Outer Space", supra 9.

[18] Art I, OST.

rived from private use of space, if it determines that the usage has not benefited all nations?

One school interprets the phrase as being no more than a non-binding guide, a moral exhortation, for each state-party.[19] Others read "for the benefit of all countries" as packing a powerful legal mandate.

The characteristic hermeneutic arising from "fear by the have-not nations" is to read this phrase in light of the Agreement governing the activities of the Moon and Other Celestial Bodies[20] ("Moon Treaty"). Those espousing this interpretive stance, hostile to property rights and national sovereignty in space see the two Conventions as requiring a system to be imposed whereby all development is undertaken by a unified international organization, with profit spread amongst all nations without regard to involvement.[21]

Evidence indicates that the US Senate, while debating whether to ratify the OST, also understood this phrase to require an equitable distribution of space-borne wealth among nations.[22] GA Resolution 1962-XVIII states: "the use of outer space should be carried on for the betterment of mankind and for the benefit of States irrespective of their degree of economic or scientific development." It is not unreasonable to understand this language, with its strong egalitarian flavor, as requiring that we read "for the benefit of all countries" as creating a legal mandate for wealth redistribution.

Such a system would likely devastate the development of space. An international body, being a necessarily political body would determine what degree of wealth sharing is fair to "all countries."[23] The parties that take the initiative to create and improve technology, and take the financial and physical risks that are part and parcel of the pioneering development of space, would be required to defer to international political consensus. Must all development be held hostage while this cumbersome commission is designed, negotiated, and ratified? Might not such a system be more politics-driven rather than profit-driven, inevitably leading to inefficient 'pork-barreling'? Should

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[19] Fred Kosmo, The Commercialization of Space: A Regulatory Scheme That Promotes Commercial Ventures and International Responsibility, 61 S. CAL. L. REV. 1055, 1067 (1988). [hereinafter "Kosmo"] See also, Treaty on Outer Space: Hearings Before the Senate Committee on Foreign Relations, 90th Cong., 1st Sess., 1, 74 (1967); *cited in* "Kosmo".

[20] Agreement Governing the Activities of the Moon and Other Celestial Bodies, (Dec. 5, 1979), 1984 U.N.T.S. 22. [hereinafter "Moon Treaty"] The Moon Treaty, completed in 1979, was meant to clarify the Outer Space Treaty, especially with regard to property law. Some of the Moon Treaty's more radical language includes: Article 11: "The moon and its natural resources are the common heritage of mankind... Neither the surface nor the subsurface of the moon...shall become property of any state." Article 4: Allocations of property, if they are to occur, must heed "the need to promote higher standards of living and conditions of economic and social...development." The Moon Treaty thus rejects wealth maximization in favor of wealth redistribution. The Moon Treaty was championed by the developing nations, but has not yet been signed by any of the space powers.

[21] This stance is espoused primarily by the Group of 77, in whose view ownership of all space property would vest in an international body which would oversee its use, *citing* George S. Robinson & Harold M. White, Jr., Envoys of Mankind 186 (1986). It is this ideology that the Moon Treaty was meant to support; *quoted by* Eric Husby, Sovereignty and Property Rights in Outer Space, 3 J. INT'L L. & PRAC. 359, 370 (1994) [hereinafter "Husby"]

[22] The Staff Report to the Committee on Aeronautical and Space Sciences wrote in its commentary on Article I, "International cooperation rather than national rivalry is the policy adopted for exploring and using the outer space environment. Instead of space activities being regarded as a monopoly of those nations able to afford the expense of launching satellites, all nations are to share in the benefits of space exploration without regard to their levels of economic and scientific development.

[23] "Husby", supra 21 at 370-371

private parties worry that profits earned at great personal risk, expense, and effort be stripped and spread, equitably or otherwise, "for the benefit of all countries?" It is no wonder that the Moon Treaty, which represents the apex of the philosophy of forced wealth sharing, was opposed by both the United States and the Soviet Union, and has been ratified by only nine relatively minor nations.[24]

Adrian Buckling observes the use of the term "mankind" causes "the relevant clauses of the Space Treaty [to] offer little guidance as to what states may derive from them. Neither can it be satisfactorily established what rights a state not involved in space exploration might have in the achievements of the space powers."[25]

The OST specifies in Article II that nations are forbidden from "appropriating" any part of outer space, whether by "claim of sovereignty, by means of use or occupation, or by any other means." The OST thus attempts to draw a line between appropriation of outer space territory, which article II forbids, and the exploitation of that same territory, which article I permits. Glenn Reynolds and Robert Merges believe that the "the restrictions of Article II's non-sovereignty provision do not bar the exploitation of space resources, but merely the staking of exclusive claims to tracts of celestial bodies or space."[26] But, as H. G. Darwin notes in his groundbreaking article, "many types of "use' or "exploitation' are inconceivable without appropriation of some degree at least of any materials taken."[27] In other words, it is not at all farfetched to say that the OST actually installs a blanket prohibition on many beneficial forms of development.

Right now, reservoirs of great wealth sit untapped in space. Unless people and nations are encouraged to exploit the riches of space, humanity will never know their benefit. And the more we are able to exploit, the more humanity stands to benefit. If commercialization is to be successful, space law must encourage investment in outer space development. But to do so, space law must work as a comprehensive regulatory scheme, with maximum predictability and minimum regulatory interference, that both rewards space development and accounts for the rights of all nations and individual participants.[28] What is needed is an amendment to the Outer Space Treaty, one that both clarifies and expands property rights in outer space.

B. Why can't we do sans property?

Commercialization of Space aint any long technologically unfeasible. The most fundamentally important document in space law for the last three decades has been the "Outer Space Treaty". The Outer Space Treaty was negotiated in a politically tense environment. Negotiations began on the heels of the Soviet Union's earth-shaking Sputnik launch in 1957. Each side of the Cold War was concerned that the other might gain irreversible

[24] The 1979 Moon Treaty contains a non-appropriation clause which is more inclusive than Article II [of OST]. Although Article 11, paragraph 2 of the Moon Treaty reiterates the language of Article II of the Outer Space Treaty, Article 11, paragraph 3 further provides that 'neither the surface nor subsurface of the moon . . . shall become property of any state, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person' (references to 'the moon' in the Moon Treaty refer to all celestial bodies and areas of outer space other than Earth and Earth orbits). The [Moon] treaty also says, in Article 11, paragraph 1, that 'the moon and its natural resources are the 'common heritage of mankind.' Opponents of the treaty note that the developing nations often interpret 'common heritage' to mean 'common property' of mankind. As a result, the Moon Treaty has encountered resistance from countries with free market economies.

[25] Adrian Buekling, The Strategy of Semantics and the "Mankind Provisions" of the Space Treaty, 7 J. SPACE L. 15, 20 (1980).

[26] Reynolds & Merges, Outer Space: Problems of Law and Policy, at 82; *cited by* Carl Q. Christol, Article 2 of the 1967 Principles Treaty Revisited, 9 ANNALS OF AIR & SPACE LAW 217 (1984)).

[27] H.G. Darwin, The Outer Space Treaty, 42 B.Y.I.L. 278, 282-283 (1967)

[28] "Kosmo", supra 19 at 1057-58

advantage by militarizing outer space. The OST grew up as much a document of prevention as one of hope. The U.N. General Assembly Resolution 1348 (XIII) of October 17, 1963, on which parts of the OST were based, explicitly intended to "avoid the extension of present national rivalries into this new field."[29]

The U.S. Representative to the U.N. General Assembly remarked at a U.N. plenary session during OST negotiations: *'We of the United States regard this treaty as an important step toward peace... Therefore, as we stand on the threshold of the space age, our first responsibility as governments is clear: we must make sure that man's earthly conflicts will not be carried into outer space... [The Outer Space Treaty] responds to that desire and hope...* [30]

Creating a space property law supportive of private development was not a priority. Each side of the Cold War was hoping to prevent the other from advancing as a sovereign into outer space and achieving an insurmountable military and geographic superiority. As a result, the OST is at best ambiguous, and at worst hostile, to the privatization and commercialization of space resources.

Delving on the need for a law on property, three reasons can be formulated:

1. Rights' of less developed nations

Developing nations argue, that it is morally imperative to take the interests of the non-space-capable nations into account when designing a system of space property law. A legal regime based on the "right of grab," the first-come, first-served theory of property acquisition, should be feared. By the time space-incapable nations develop the technological prowess and capital reserves to fund meaningful development of outer space, the earlier space-faring nations, left unchecked, might already have locked up the most accessible and valuable resources. Present inequities of global wealth distribution thus would be carried forward into the space age.[31]

2. The Green Evangelist[32]

The root causes of Earth's environmental problems are limited resources, limited waste disposal sites, and limited living space. Commercial development of space might be an effective solution. If minerals are extracted from dead asteroids floating through our solar system, perhaps there would be one less strip-mined rain forest. If solar energy is captured and beamed down to Earth's electric grid, that could be one less oil spill in our oceans. And if other worlds are colonized, then overpopulation can be allayed, possibly forever. This begs the question - *which legal regime will best satisfy the needs of the terrestrial and extraterrestrial environments?*

3. Limited nature of resources

Space may be vast, but many of the most valuable resources - especially those convenient to Earth are limited. Our moon is one example. It may be one of the most promising sites for mining, energy-capture projects, and spaceship refueling, but a limited amount of usable land exists, with an even more limited quantity of usable water.[33] Also, the Geo-Stationary Orbit ("GSO") is probably the most valuable of all space resources to date. The GSO is a loop of space above Earth's equatorial surface.[34] Satellites placed in GSO orbit the Earth at the

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[29] "Husby", supra 21 at 362-363

[30] Id.

[31] Interestingly, the International Telecommunications Union ("ITU"), an international body with the duty of assigning Geostationary Orbit ("GSO") positions and communications frequencies, operates on what is basically a first-come, first-served basis. The ITU permits anyone to place a satellite in the GSO as long as it does not interfere with an existing satellite. Although the ITU, at the insistence of developing nations, has modified slightly the system so that the GSO needs of all nations should be considered, the principle remains the same. "Kosmo", supra 19 at 1062-1063.

[32] Lawrence Roberts, Ensuring the Best of All Possible Worlds: Environmental Regulation of the Solar System, 6 N.Y.U. ENVTL. L.J. 126, 127 (2003) (Other environmental concerns particular to space exist also. Orbiting litter may soon seriously hinder our ability to maintain a global communications link. Waste disposal and resource maintenance techniques may determine whether the moon's limited water supply will be contaminated and the moon will remain a dead satellite. Environmental considerations are, and must be, a factor in any system of space law.) [hereinafter "Lawrence"]

[33] Id

[34] Office of Technology Assessment, UNISPACE 82: A Context for International Cooperation and Competition 42 (1983); *cited in* "Kosmo", supra 19 at 1064.

same rate and in the same direction as the Earth's rotation. Thus, objects in the GSO can stay fixed above a single point on Earth's surface. The GSO's inherent usefulness for observation (e.g. weather, military intelligence) and communications links has led to big business.

The debate therefore raises who should have the rights to the riches of space? A system of space law, if it is to be viable, must provide an answer.

IV. PROPOSAL FOR A SPACE PROPERTY REGIME

A. Ownership of Real Property

The ideal legal regime should create maximum incentives for efficient development of space, in recognition of the fact of the potential wealth in space. Any legal regime should guard against inefficient exploitation, waste, and environmental despoliation.

Humanity's welfare demands that we alter the current law to allow real estate ownership and not just usufructary rights to those who would best develop land in space. The potential wealth of outer space, in the form of minerals, energy, living space, etc., doesn't do us any good unless we are able to harness it. And, as Jeffrey Kargel, a planetary scientist at the U.S. Geological Survey, has written, "if you want to cross the bridge into the 21st century of space [development], then space must pay its way and give private investors a handsome early return on investment."[35]

What do we mean by "ownership?" Property is commonly recognized as being a "bundle" of disparate rights regulating relations between people with respect to things. The bundle of rights can be unpacked. It includes: the *right to possess*, the *right to use*, the *right to exclude*, and the *right to transfer*.[36]

Current space law ostensibly respects the right to use real property in space and to collect and own its fruits. Historically, this has been known as the usufructary right.[37] But the current law doesn't even provide this right freely; it seems to be limited by several clauses of the Outer Space Treaty (e.g. use "for the benefit of all countries").

Nor does the OST recognize the right to exclude, as is evidenced by article I's prohibition on appropriating what it recognizes as being "the province of all mankind," the guarantee in the same article of "free access to all areas of celestial bodies," and article XII's requirement that "all stations [and] installations shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity." Likewise, lets illuminate in a hypothetical *SpaceX*, the prohibition on appropriation seems to negate a long-term right of possession. Without the right to exclude or possess, of course, a legal system need not provide the right to transfer real estate. Anyone else may simply help themselves. As such, the OST demands that "no State can obtain such possessions as will entitle it to claim ownership or sovereignty over them. There can be no exclusive appropriation of [celestial bodies] and any part thereof as a result of their "use."[38]

A new law of space real property must enliven and support all four rights that comprise ownership.

First, there must be a right to permanent possession: barring some extraordinary circumstance or the enforcement of a judgment, no one should face dispossession of his real estate on Earth or in space. This rule supplies a needed measure of certainty, in two ways: (1) it's a definite rule and almost any such rule is better than the fogginess of the current regime, and (2) it moves the presumption away from public conversion of private lands, and therefore makes it clear that the OST's statement, that space development must be "for the benefit of all countries," is a moral exhortation and not a loophole through which the United Nations can dispossess a private party of his site.

Second, the right to use be unlimited, except by environmental regulations and the developer's domestic law.

The third right, the right to exclude, creates the certainty vital to an optimal entrepreneurial investment environment. As noted, the current system precludes such a right, for it would certainly run afoul of the prohibition

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[35] Supra 12.

[36] James William Benson, Property Rights In Space, PRESENTATION AT THE INT'L ASTRONAUTICAL FEDERATION 41ST INT'L COLLOQUIUM ON THE LAW OF OUTER SPACE, Sept. 29, 1998 available online at http://www.spacedev.com/media/papers/98-09-29_IISL-98-IISL.1.05.html, last accessed on 7 July 2010.

[37] L. F. E. Goldie, Title and Use (and Usufruct) - An Ancient Distinction Too Oft Forgot, 79 AM. J. INT'L L. 689, 691-692 (1985).

[38] Ogunsola O. Ogunbanwo, International Law and Outer Space Activities 78 (1975); *quoted by* Ty S. Twibell, Space Law: Legal Restraints on Commercialization and Development of Outer Space, 65 U.M.K.C. L. Rev. 589, 595 (1997)

on appropriation and the requirement that there be "free access to all areas of celestial bodies."[39] Without the right to exclude, however, pioneer investors would be at the mercy of free riders. After investing countless hours in (or paying someone else for) a survey of the real estate, after setting up a mining colony at great expense, the pioneer would have no recourse if another party took advantage of the pioneer's research and began a copycat mine on the very same site. So the right to exclude must form a part of the new legal system.

Finally, the right to transfer must accompany the rights of exclusion and perpetual possession. The Coase Theorem of economics tells us that, in a legal environment supportive of bargaining, property rights will be allocated to the party who values them most, i.e. the most efficient user of the property.[40] When transaction costs are high enough to prevent bargaining, property rights only end up in the most productively efficient hands if the law happens to initially assign them that way.[41] Without any right to transfer, transaction costs are infinite, and no bargaining can occur. In order to avoid the inevitably inefficient solutions of a command-and-control regime of property usage, the right to transfer, i.e alienability, must be a part of our system.[42]

Space being an international zone is, in a sense, the heritage of all humanity. We must not forget, when considering the governance of outer space, that the rules should first and foremost attempt to maximize the benefit to all humankind. So, ideally, celestial bodies should be put to the uses most beneficial to humanity. This is guaranteed by a system that puts land in the hands of those for whom the territory is most profitable. It is a matter of elementary economic theory. Whoever can use a site to humanity's greatest benefit will be the one who can profit most from the site; whoever can profit most from the site will be the one for whom the site is most valuable. Thus the person who can put a site to humanity's greatest benefit will be the one willing to spend the most to own the site.[43]

This is the bargain theory of economics, and will form the basis for:

1. Ownership helps reduce wasteful use

Ownership, and the attendant right of alienability, would promote the efficient use of space resources.

Again, a hypothetical will help illustrate: a Martian site has been identified as being rich with manganese and silicon. *Manganese Mining Co.* ("M.M.Co."), interested in the manganese and the manganese alone, decides to send up a team of miners. They begin operations, develop shipping routes, and build a sustainable mining colony. Without the right of ownership, *M.M.Co.* has no reason not to blast through and obliterate silicon deposits in order to more quickly uncover the manganese. Furthermore, once the manganese is depleted, there is no reason for them to leave the colony's structures and life support systems intact. If, on the other hand, space law grants ownership to *M.M.Co.*, then *M.M.Co.* has incentive to act with greater over-all efficiency. There is incentive to preserve the silicon deposits, because silicon will increase the amount for which, another hypothetical *Silicon Mining Co.* ("*S.M.Co.*") is willing to purchase the site from *M.M.Co.* Along similar lines, there is also incentive to preserve the shipping routes and the colony structures and life support systems.

Hence, *M.M.Co.* receives the benefit of the manganese deposits, and is further rewarded for developing the mining colony and transportation routes, and for preserving the silicon deposits and the colony itself when it sells the site. Because *M.M.Co.* owned the site, there would be reason for it to prospect for silicon and advertise its presence to interested parties, even though *M.M.Co.* did not itself have an interest in mining the silicon. Thus *S.M.Co.* receives the benefit of *M.M.Co.'s* mineralogical research. *S.M.Co.* also need not waste resources setting up new routes, mines, and colonies; it could purchase them intact. Under such a system, people are better rewarded for pioneering efforts and pioneers have incentive to research and preserve that which they find and build. The second-comers receive the benefit of the pioneers' efforts; they need not reinvent the wheel. And, in the end, people on Earth receive the benefit of plentiful manganese and silicon, instead of, as would result in a non-ownership system, just manganese.

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[39] Article I, OST

[40] Robert Cooter and Thomas Ulen, *Law and Economics*, 2nd ed., 78-84, (Pittsburgh: Pearson Addison- Wesley,, 1997). [hereinafter "Cooter and Ullen"]

[41] Id at 84-87

[42] Furthermore, costs of bargaining should be reduced as much as possible, to minimize the possibility that transaction costs would inhibit the most efficient user from owning a site.

[43] "Cooter and Ullen", supra 40 at 72-75

2. The right to transfer (alienability) will compensate for positive externalities, thereby creating added incentive to productively develop space.

Another advantage of an ownership regime over a use regime can be found in the following hypothetical situation. Suppose the bark of a tree found only deep in the Amazon has cancer-curing properties. Whoever first attempts to harvest the tree bark would be required to build a road to the grove, at tremendous expense. All subsequent pharmaceutical harvesters would have use of the road and consequently be able to turn a much larger profit on the harvested bark. The problem arises, then, that no company would want to make the costly first trek.

As a result, since no company would rationally sacrifice itself in the quest for bark, the rest of us will have to do without this life-saving cure.

The cause of the problem is an uncompensated positive externality. The right of use does not, by itself, reward the first company for the positive externality it produces, i.e., the road. One way of rewarding that first company's pioneering effort would be to grant it ownership of the grove. So if company *X* made the first trek to the grove, the right of ownership would let them decide whether to utilize their exclusive rights to the trees in perpetuity, or to sell the grove to company *Y* for a price that accounts for the expense of building the road. Either way, ownership allows company *X* to internalize the positive externality.

The same problem exists in space development. The early developers will encounter huge costs, many of which will produce positive externalities (e.g. improved site assaying techniques). In space, following the analogy, ownership rights can help a company internalize its positive external effects.

B. A Cost Benefit Analysis of the Right to Property

1. Will incentivizing development of space lead to environmental problems?

The current space law governing environmental responsibilities is well-meaning, but not effective enough. It comprises of OST article VII and the Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention").[44]

Article VII of the OST asserts that each State Party to the Treaty that launches or procures the launching of an object into outer space is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object. The Liability Convention limits liability to "fault."

The Liability Convention supplies no definition of fault. Both treaties refer only to harms caused by launched objects; while these might be interpreted to include harms caused by unlaunched installations constructed on celestial bodies, such an interpretation is by no means certain.[45] A detailed dispute resolution procedure neither has been described nor has arisen.[46] Even if the liability standards fashioned by these two treaties can provide for a remedy, they cannot redress those harms which are communal or otherwise unattributable.[47]

One reason for the inadequacy of the current law might be that its formulators did not correctly foresee the course space development would take. The approach taken by the OST and Liability Convention resonates with the expectation that space activity would remain limited to periodic governmental exploratory missions.[48]

First of all, an approval process, overseen by an international organization, must precede any actual development. This would be similar in function to the International Telecommunications Union ("ITU"), an organization whose most essential duty is to certify that proposed communications satellites will not interfere with each other.[49] Any party wishing to engage in the development of space would first present a proposal to the overseeing organization. The organization would then only grant project approval after an environmental review, ensuring that the project complies with environmental standards agreed to by COPUOS.

Environmental safeguards embody the recognition that environmental degradation harms humanity in very real ways: it can endanger our health and lives, and can ruin a

[44] Convention on International Liability for Damage Caused by Space Objects, opened for signature Mar. 29, 1972, 24 U.S.T. 2389.
[45] "Lawrence", supra 32 at 135
[46] Id
[47] Id
[48] H. L. van Traa-Engelman, Commercial Utilization of Outer Space 83 (1993); *cited in* "Kosmo", supra 19 at 1069.
[49] "Lawrence", supra 32 at 131

site's utility. Without environmental precautions, a mining corporation might dirty a distant planet's lone water supply, forever destroying a world that might have grown into a great and productive colony.

Another way to solve the problem of space environmental ruination is by accepting the right of ownership into our system of space law. It would be a simple but effective step in the right direction. As Lawrence Roberts has written, the current law "is rather damaging from an environmental perspective," because "without a means to secure control of a resource in the ground," i.e. without ownership, "each individual developer will seek to maximize his or her own gain by extracting as much value as quickly as possible without regard to the effect on the communal resource."[50]

Ownership creates a strong incentive to act with an environmentalist ethos. As owner of a site, *SpaceX* would want to maximize the site's value. This self-interest protects the environment in two related ways.

First, because *SpaceX* is not just a squatter on a plot of celestial territory, because it will have more than an expiring usufructary interest, *SpaceX* will avoid despoliation of the land. Despoliation would reduce the value of the property to a purchaser, and thus *SpaceX's* potential revenue. Poor land management might also harm *SpaceX*'s current interests, if its actions contaminate its own site to the point that its settlement loses viability.

Second, *SpaceX* will avoid ripping through the site; instead, it will either preserve materials it does not use to maximize the site's resale value, or it will itself use the site as fully and efficiently as possible. *SpaceX* will either use the site with preservationist techniques, sparing the site from wasteful destruction, or it will use the site as a conservationist, i.e. wholly and completely, sparing other sites from exploitation. The incentive to use space non-wastefully, discussed above in the context of economic efficiency, clearly has positive environmental repercussions. An owner has an interest in keeping his own site clean, as well as using it with minimal waste and maximum efficiency, because if he wants to eventually sell the property, any despoliation will devalue it.

Of course, the right of ownership would not make an environmental violation whose harm extends onto another site less likely, but it wouldn't make it more likely, either. And ownership, by creating an incentive to care about one's own property, protects the interests of others: both those nearby (who instantly feel the effects of more care given to, e.g., waste disposal and water management), and those who come later.

2. The Dilemma of the Developing World

Developing nations oppose incorporating rights of ownership into the property regimes governing international zones. First, developing nations do not want to be permanently disadvantaged just because they lag in space-capability right now. The second rationale is more historical. It is a deep-seated distrust of colonial imperialist doctrine such as that which the world faced in previous centuries. It is a readily understandable distrust as most, if not all developing nations were harmed by European nations who treated the non-European lands as theirs for the taking.

The difference being there are no occupants native to outer space. The colonialist "right of grab" policy was morally objectionable because it ignored the property rights (and other rights) of those already occupying the "discovered" lands. In the absence of prior existing property rights, however, there seems to be nothing inherently immoral about a right of grab.[51]

Except that it may severely disadvantage the developing nations in future. Developing nations fear that by the time they gain the wealth and technology necessary to become players in the space game, the most readily available resources will have already been claimed as private property and be under sovereign control of other nations. The developing nations argue that they will again be left in the economic lurch. This argument against a right-of-grab-based system gains credibility when one considers that the reason the developing nations are not yet space-capable may well be attributable to past wrongs the developed nations inflicted on them. The perpetuation of past wrongs thus makes the right of grab doubly objectionable in the eyes of developing nations.[52]

This can be addressed in two ways. First, the universe, for practical purposes, is not finite. Whenever developing nations become space-capable, there will be plenty of available unused space real estate. Second, corporations based in space-incapable nations could, of course, contract out to a space launch company from a space-capable nation. Developing nations can take advantage

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[50] Id at141

[51] Brandon C. Gruner, 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, 307 (2004)

[52] Id at 310-313

of space development without themselves being space-capable.

Perhaps less straightforward is the notion that ownership rights, by incentivizing the development of outer space, would fund intense R&D of launch technology. Launches would become more reliable and cheaper. In this way, ownership rights might hasten the day that developing nations are able to afford hiring a launch company, or even to have their own space programs.[53]

3. Would property rights result in inappropriate incentives and lead to inefficient development?

Any property system based on the right of the first comer creates artificial value unrelated to the property's inherent worth. This disturbs the economic efficiencies of the market. We might call this the "get it while you can" problem.[54]

Does the possibility that an ownership-based property regime that could lead to less efficient development mean that we should reject such a system? The answer is no, for two reasons.

First, the most efficient and effective way to spur the development of better space technology is to encourage private commercial space flights. Government funding was no doubt needed at the inception of the space program, because there was no understanding of space's commercial value. Now, however, tremendous amounts of private money are being invested in space-oriented projects[55] and that's without ownership rights. Ownership rights would speed up space development, which would pump even more money into space technology R&D. Furthermore, money would go to R&D in needed areas, not pork-barrel projects. The industry could become self-sufficient, free of the need for government funding. Pioneering space flights may have many positive externalities, but this would be perhaps the most important one of all. These early endeavors bring the future of space technology a great deal closer to the present.

Second, it is impossible to know, *ex-ante*, how much space flight technology will improve. Surely hindsight will show that development could have achieved greater efficiency, in some cases, by waiting five years. On the other hand, should property law let a governmental authority force a company to wait five, ten, or fifty years on a project on the belief that fusion engines are just around the corner? If fusion engines never materialize, humanity will have been deprived for no reason. Do we wish to put the decision in the hands of a centralized politics-driven authority, who has no personal stake in the development projects? Is it not better to let individual companies, experts in their fields, decide when to take risks and when to wait for improved technology.

4. Would a 'right to property' by creating additional incentives lead to increased entrepreneurial invest-

[53] Rocket Renaissance: The era of private spaceflight is about to dawn, THE ECONOMIST (11 May 2006)

[54] A concrete example might help explain. Suppose a site is worth Rs. 1 million. *CorpA*, operating alone, would not commence on a mission to exploit the site until it felt that there was enough demand, and cheap enough exploitation technology, to carry the mission out. However, operating in competition with *CorpB* and *CorpC*, *CorpA* will recognize that it might not be able to harness the site's value at all if *Corp*B or *CorpC* get to the site first. Thus *CorpA* will feel compelled to use up the site, using today's less efficient technology, simply because of the being the first-in-time to exploit. See "Owning Outer Space", supra 9.

[55] Private Spacecraft: Virgin Birth - After many false starts Space Tourism is set to arrive, THE ECONOMIST (24 January 2008)

ment and therefore transgress into efficient development?

Lets assume that companies will act rationally, in their best interests. A company would not rationally engage in a development project if it expected a net loss. Let's say that *CorpA* expected a net profit, but, to their dismay, the project was a net loser. This is still of no concern, because all that has occurred is a transfer of wealth within the system. *CorpA's* revenue was less than its costs. Humanity, as a whole, has not lost anything; wealth has merely been shifted around.

However, there is a means by which a project can decrease humanity's total wealth. When *SpaceX* buys rocket fuel from *CorpB*, nothing has been lost to the system; that's a wealth transfer. But when *SpaceX* burns the rocket fuel, they've depleted humanity's wealth. That fuel is gone, lost to the system. Humanity's aggregate wealth has declined by exactly as much as the value of the unrecyclable materials that were exhausted, which is quintessential of "inefficient development." A legal system operates inefficiently if the prospect of ownership leads *SpaceX* to expend more of humanity's wealth than it extracts from space resources.

But can ownership rights really cause inefficiencies? The right of ownership cannot cause humanity's aggregate wealth to decline, although it can cause what seems to be less efficient behavior.[56]

V. CONCLUSION

Exploration is not suicidal and it is usually not altruistic, rather it is a means to obtain wealth. There must be rewards for the risks being taken. - Lawrence Risley

It has been contended that a property rights regime will evolve naturally, once we get done with establishing a space settlement. It is stated that establishing a settlement without prior legislation, would lead to preposterous claims.[57] This legal uncertainty scares off space developers who fear that, after they have spent a fortune developing space, they will only win the right to spend another fortune on legal bills. Reinstein says, "A legal system that is unclear as to the rights of developers in the land they develop is almost as prohibitive of positive development as a system forbidding development altogether." [58]

David Everett Marko comments, "Free enterprise institutions simply cannot make significant investments in space while they are under the threat of lawsuits over the meaning of treaty terms . . . ."[59] Therefore, it is not at

[56] Assume that ownership rights are assigned on a "right of grab" basis. An asteroid contains manganese and silicon deposits worth Rs. 1 and Rs. 3 billion respectively. Fuel costs to the asteroid are Rs. 1.5 billion per round trip. *Manganese Mining Co.* (M.M.Co.), expert only in mining manganese, is able to secure ownership rights to the asteroid. Without ownership rights, it has no cause to make the journey; it will not waste Rs. 1.5 billion in fuel to retrieve Rs. 1 billion in manganese. However, *Silicon Mining Co.* (S.M.Co.) values the asteroid at (Rs. 3 billion of silicon) - (Rs. 1.5 billion fuel) at Rs. 1.5 billion. Thus, with ownership rights, M.M.Co. can sell the asteroid's remains to S.M.Co. for a split-profit price of Rs. 0.75 billion. This gives M.M.Co. a Rs. 0.25 billion profit, and leaves S.M.Co. Rs. 0.75 billion in the reserve revenue. Both projects would happen, but there's no inefficiency: Rs. 4 billion of ore is gained at a cost of Rs. 3 billion of fuel, therefore adding Rs. 1 billion increase in humanity?s total social welfare. What if fuel costs were higher? If a round trip cost Rs. 2.5 billion, would M.M.Co. acquire ownership rights to the asteroid? Not unless it could sell the property rights for (Rs. 2.5 billion of fuel) - (Rs. 1 billion of manganese) at Rs. 1.5 billion; which M.M.Co. could not do. S.M.Co. would only be willing to bargain to a maximum of (Rs. 3 billion of silicon) - (Rs. 2.5 billion of fuel) at Rs. 0.5 billion. M.M.Co. could not profitably sell ownership rights, and consequently would have no incentive to "grab" the asteroid. With M.M.Co. out of the picture, S.M.Co. could acquire sole ownership and make a Rs. 0.5 billion profit. In the above example, humanity is enriched by M.M.Co. and S.M.Co.'s projects. However, humanity would have been even better off had M.M.Co. not done anything. In each case, our total social welfare would have had a greater net increase had S.M.Co. acted alone. It was only the right of ownership that led M.M.Co. to execute what is not, in itself, a fruitful mining venture.

[57] Lawrence L. Risley, An Examination of the Need to Amend Space Law to Protect the Private Explorer in Outer Space, 26 W. ST. U. L. REV. 47 (1998–99).

[58] "Owning Outer Space", supra 9.

[59] David Everett Marko, A Kinder Gentler Moon Treaty: A Critical Review of the Current Moon Treaty and a Proposed Alternative, 8 J. NAT. RESOURCES & ENVTL. L. 293, 315 (1993).

all surprising that, without the incentive that advanced legal certainty would provide, space settlement is not currently happening, and it probably never will.[60]

This perhaps led Rosanna Sattler to comment - "The establishment of a reliable property rights regime will remove impediments to business activities on these bodies and inspire the commercial confidence necessary to attract the enormous investments needed for tourism, settlement, construction, and business development, and for the extraction and utilization of resources."[61]

One primary reason advanced for the exploitation of these resources has been economic prudence. Keeping in mind the necessity of developing and exploiting space resources, it has been suggested without exaggeration that "the quality of our future social and economic welfare is inextricably linked intertwined with the successful commercialization of space by private enterprise."[62]

The potential enterprise must contend with the uncertain state of the law in outer space, which makes the status of its interests in outer space uncertain, even if it were to be profitable. It would seem clear that, the absence of a legal regime in this area, would hinder country or private enterprise to undertake the substantial risks and costs involved in such an exploitation.

What should be the basis to award property rights in space? The legal system has to contend with this challenge, keeping in mind the need to build a regime that encourages the beneficial aspects of property rights, while formulating rules that discourage conflict and predation. A 'World Space Organization', carrying the legitimacy of the United Nations, can co-ordinate private industry so that market forces can operate and at the same time provide for regulation.

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[60] The Commission stated - The issue of private property rights in space is a complex one involving national and intenational legal issues. However, it is imperative that these issues be recognized and addressed at an early stage in the implementation of the vision, otherwise there will be little significant private sector activity associated with the development of space resources, one of our key goals.

[61] Rosanna Sattler, Transporting a Legal System for Property Rights: From the Earth to the Stars, 6 CHI. J. INT'L L. 23, 28 (2005)

[62] "Kosmo", supra 19 at 1056.

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