qualified as any third party communication, the ideal solution for any coordination problem.

However, law can also obtain coordination by imposing sanctions, which is more or less the case with space treaties, e.g., states' behavior is regulated in space by the automatic attribution of state responsibility (Art. VI of the Outer Space Treaty) including obliging the state "to make full reparation for the injury caused by the internationally wrongful act" (in the case of space law, "international wrongfulness" is inessential).[38] But sanctions as focal points go against the liberal sentiment that players are rational actors who make free yet rational choices as against the normatively subdued welfarist actor bound to the preconceived "justness" of law. Moreover, we need to recall that imposing normative restrictions to the otherwise free choices of actors in outer space, has secured the status quo of peace and order in space, while pushing into a coordination problem. A commentator echoes this sentiment in a foreign policy perspective: "The negative consequences of the status quo in space are clear. If the U.S. and the international community do not change how they manage this space domain, the future of space exploration is bleak."[39]

If space treaties have to become focal points they need to recommend behavior rather than prompting non-behavior. Non-behavior is identical to inaction in the face of uncertainty regarding alternative outcomes. As Philippe C. Schmitter explains, the normative actors' dilemma is a "reluctance to give up acquired goods, the attachment to existing loyalties, the security of established cultural symbols, and/or the belief in prevailing normative standards"[40] such that actors find themselves in what Kaushik Basu calls "the suffocating control," the "legal snare" that prompts inaction.[41]

One way to build focal points that can overcome the coordination problem created by emphasis on negation, as in the case of space treaties according to McAdams, is "labeling." Labeling is

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[38] Art.31, Draft Article on the Responsibility of States for Internationally Wrongful Acts.

[39] Lance K. Kawane, *History of Space Policy*, MANUSCRIPT SUBMITTED TO THE UNITED STATES ARMY WAR COLLEGE 20 (2012), http://www.dtic.mil/dtic/tr/fulltext/u2/a561292.pdf.

[40] Philippe C. Schmitter, *A Prolegomenon to a Theory of Interest Politics*, ,http://www.mpifg.de/pu/mpifg_book/mpifg_bd_57/kap13.pdf.

[41] BASU, *supra* note.35.

when law provides a common knowledge or taxonomy of possible asymmetries in cases of inaction by the players. Providing common knowledge on asymmetries would help, as an incentive would, to nudge actors in a coordination dilemma.

In labeling, "law works by making focal the asymmetry the law embodies," however, asymmetries may be many and players may not investigate into all asymmetries.[42] In such cases, law focuses on the most prominent asymmetry so that existing equilibrium is upset, leaving it to the players to further strategize on other asymmetries. This type of focalness in law can be best illustrated by the United Nations Conventions on the Law of the Sea, 1982 (UNCLOS), which can be an instructive lesson for ISL.

Part XI of UNCLOS has been a contentious component of the Law of the Sea (LOS) because it established a common heritage of mankind (CHM)-based regime for the exploration and exploitation of the resources of the sea much to the discontent of developed states, which wanted a market-based regime for the commercial exploration and exploitation of the seas.[43] Any effort to globalize the seas was not acceptable to developing states. However, the status quo prevailed as if a default option and the CHM clause embodied in Art. 136, the provision for equitable allocation of the resources of the seas embodied in Art. 140 of UNCLOS, and the effort to institutionalize such allocation (Art. 160) had pushed states into an *n*-player coordination problem, reinforcing the status quo. The problem prevailed until the changes were made to Part XI because the normative positivism of CHM gave states zero scope of optimizing their preferences.[44]

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[42] McAdams, *supra* note 28 at 1709.

[43] Common Heritage of Mankind (CHM) has been a polemical component in the negotiations leading to the United Nations Convention on the Law of the Sea, 1982 (UNCLOS) as well as the Moon Treaty, 1979. In the negotiating fora, state positions never converged on CHM, particularly on the equitability the doctrine aimed to set in the allocation of resources of the sea and the moon. For details on the said split, *see e.g.* KEMAL BASLAR, THE CONCEPT OF THE COMMON HERITAGE OF MANKIND IN INTERNATIONAL LAW (1998).

[44] To ascertain this coordination dilemma, *see generally* MARKUS G. SCHMIDT, COMMON HERITAGE OR COMMON BURDEN? THE UNITED STATES POSITION ON THE DEVELOPMENT OF A REGIME FOR DEEP SEA-BED MINING IN THE LAW OF THE SEA CONVENTION (1989).

In 1994, the Agreement for the Implementation of Part XI of UNCLOS was adopted in order to help states overcome the coordination problem by operationalizing UNCLOS. It was a widely known fact at that time that the 1994 Agreement is prejudicial to the interests of developing states. It is true that the Agreement creates an asymmetry, which was seen as a normative power influence by the developed states. However, from a purely analytic standpoint, the asymmetry in UNCLOS was a nudge for states to act out of the inertia which status quo brought with it. Interestingly, the 1994 Agreement while imploring the states parties to UNCLOS to partake in the exploration and exploitation of the seas, provides—labelling—common knowledge about the asymmetries, e.g., the preamble of the 1994 Agreement states that the CHM is reaffirmed, yet the socio-political realities within which the UNCLOS has to function may be different. Further the Agreement aims to institutionalize seabed mining (through the International Seabed Authority), ensuring market-model public and private participation. The above provisions in the preamble of the Agreement articulate the status quo and statement of desire to overcome the coordination dilemma. Further,, in stating the production polices of the International Seabed Authority, the Agreement signals asymmetries and provides a strategy-set to play out a pure-strategy equilibrium:

> (b) The *provisions of the General Agreement on Tariffs and Trade*, its relevant codes and successor or superseding agreements shall apply with respect to activities in the Area [seabed and subsoil thereof];

However, the signaling of the type that the mighty multilateral trading system—which has innumerable asymmetries—will apply to seabed mining, might pose a second level coordination problem as players would find it difficult to investigate into each possible asymmetry.[45] In such cases, not only do they have to incur costs for investigating into asymmetries, but they will also have negative payoffs for failed strategies. Quite naturally, they will prefer to retain the status quo, causing another level of coordination problem.[46]

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[45] *See* McAdams, *supra* note 28 at 1707-09.

[46] *Id*.

In such situations law creates focal points to "make focal the asymmetry the law embodies."[47] Look at the Agreement again,

> (c) In particular, there shall be no subsidization of activities in the Area except as may be permitted under the agreements referred to in subparagraph (b). Subsidization for the purpose of these principles shall be defined in terms of the agreements referred to in subparagraph (b); (d) There shall be no discrimination between minerals derived from the Area and from other sources. There shall be no preferential access to markets for such minerals or for imports of commodities produced from such minerals, in particular: (i) By the use of tariff or non-tariff barriers; and (ii) Given by States Parties to such minerals or commodities produced by their state enterprises or by natural or juridical persons which possess their nationality or are controlled by them or their nationals.[48] (emphasis added)

In this case, law has "destabilized" the status quo, by addressing the coordination problem first by labelling the asymmetries and then by avoiding the second level coordination problem, which might have arisen due to labelling, by creating a focal point for the asymmetries.[49] In fact, what law has done here is create new possible equilibria.[50] McAdams points out that once new possible equilibria are created "evolutionary processes could drive the behavior to one of these new equilibria," which can be aided by the focal power of law.[51] The Agreement, in the context of seabed mining, has created such a focalness by institutionalizing the most optimal equilibria (to prevent market failures) in the form of dispute settlement mechanisms and economic assistance.[52]

The LOS model has sufficient motivational material and reasons to prompt ISL to rationally relook at the space treaties, for the

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[47] *Id*. at 1709.

[48] Convention on the Law of the Sea, United Nations Division for Ocean Affairs and the Law of the Sea, Dec. 10, 1982, Agreement Relating to the Implementation of Part XI of the Convention, Annex § 6, http://www.un.org/depts/los/convention_agreements/texts/unclos/closindxAgree.htm.

[49] *See* McAdams, *supra* note 28 at 1709.

[50] *Id*. at 1710.

[51] *Id*.

[52] *See* Convention on the Law of the Sea, Annex §§ 6, 7. See also Lisa L. Martin, *An Institutionalist View: International Institutions and State Strategies*, INTERNATIONAL ORDER AND THE FUTURE OF WORLD POLITICS 78, 83 (T.V. Paul & John A. Hall, eds., 1999).

causal reasons of a coordination problem for both LOS and ISL are distributional problems. However, more than a structural overhauling, what is required for ISL is a change in perceptions towards (and leitmotif of) space treaties. A few considerations in this regard are provided below.

B. Broader Scope for More Asymmetrical Interaction

As part of a larger reorganization of ISL, one plausible approach to overcoming the problem of *n*-player prisoner's dilemma is to make space treaties provide scope for more asymmetrical interaction between state parties. In present form, space treaties only have means for symmetrical interactions. A risk of such interactions is that each party will try to control the equilibrium. For example, Art. 11(5) of the *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies 1979* (hereinafter the Moon Treaty) provides for the establishment of an international regime for the exploration and exploitation of the natural resources of the Moon:

> States 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.

In the United Nations Committee on Peaceful Uses of Outer Space (UNCOPUOS), a set of states including Argentina, Brazil, Chile, Indonesia, Mexico, Nigeria, and Venezuela asserted that by virtue of Art. 11(5) an international regime for the equitable sharing of the benefits from lunar resources *inter alia* must be established because such a regime can bring economic profits, and a means for the equitable sharing of such profits, taking into consideration the need of least developed countries.[53] Opposing such a claim, the Soviet Union asserted that an international regime of the nature which the Third World states demand has the risk of creating an organization of supra-state nature and a statist internationalism, both of which are unfavorable to the socialist ideals which

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[53] CARL Q. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 293-94 (1982).

the Soviet Union cherishes.[54] This is a typical case of states making use of a symmetrical equilibrium exercising control, what may be called "competitive symmetry," resulting in a coordination problem caused by the mutual domination by states.[55]

The symmetrical equilibrium has also put players in a Volunteers' Dilemma whereby players do not see any payoffs in volunteering out of the status quo. Given the public good nature of the benefits accruing from outer space, the Moon and other celestial bodies, the Volunteers' Dilemma is likely to be serious, as strong players fear a free ride and weak players fear rivalrous behavior by strong states, turning outer space into a private good.[56]

One way to overcome this problem is for the space treaties to create scope for asymmetric equilibrium whereby one state or group of states has dominance and control. In the case of LOS, the linking with the multilateral trading system known for its competitive asymmetries has destabilized the inertia that was a result of status quo as equilibrium. If seen from a normative moralist perspective, a conscious upsetting of equilibrium, as LOS has done through the 1994 Agreement, can be subject to criticism. On the other hand, if international law is seen as "a focal point that states gravitate toward as they make rational decisions regarding strategy in light of strategies selected by other states," the status quo of ISL would get the new matrix of a Nash Equilibrium.[57]

However, in ISL the Nash Equilibrium has not turned out to be the best possible outcome, i.e., outcomes ISL have obtained are only minimally Pareto optimal. Hence, ISL shall facilitate players to play out of the Nash Equilibria. A way to do this is for the space treaties to broaden the scope for asymmetric interactions among the states parties. Asymmetric interactions are possible in hierar-

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[54] Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its One Hundred and Sixty-Fourth Meeting, A/AC.105/PV.164, pp.8-11 (1976).

[55] STEPHEN W. LITTLEJOHN & KATHY DOMENICI, COMMUNICATION, CONFLICT, AND THE MANAGEMENT OF DIFFERENCE 135 (2007).

[56] *See* PATRICK A. MCNUTT, THE ECONOMICS OF PUBLIC CHOICE 238-40 (2d. 2002).

[57] Jens D. Ohlin, *Nash Equilibrium and International Law*, 96 CORNELL L. REV. 869, 876 (2011).

chically organized systems, which are driven by established identities and shared goals.[58] However, in order to avoid a dominant-player takeover of the system controls, which hierarchically-ordered systems are highly prone to, Dan E. Miller, albeit in a societal context, recommends that in hierarchically coordinated systems, "[t]he interaction continually must be monitored, with new sequences of acts regularly introduced at a pace that maximizes superordinate control and minimizes [...] subordinate thought."[59]

Jun-Zhou He *et al* argue that another way to nudge the players out of a Volunteers' Dilemma is to focus on "super rational players," who "rather than simply seeking the best payoff for themselves […] pursue the strategy that maximize expected utility when employed by all players.[60] The response to such a situation is to have an assurance on the production of the common good, which is akin to shared identities and goals by all players.[61] However, as in the case of hierarchies, in the super-rationality framework too, there is possibility for the strong player to defect.[62] However, the probability of defection is less when the cost of volunteering is kept below the common benefits. Projected reputational gains can cut volunteering costs, prompting players to volunteer. Incentives like subsidization can also reduce volunteering cost. Then again, monitoring and dispute settlement mechanisms can regulate and balance appropriation by the strong players.

Such asymmetric interactions, however, cannot be created and response possibilities explored (those discussed above) explored in a balanced communitarian legal framework such as ISL. ISL's treaty framework needs to recognize the post-liberal economic rationality of state parties if ISL's ambition of commercialization of outer space is to be realized. Although researchers have explored the scope for market concerns in ISL vis-à-vis the existing framework of ISL, they have more or less hermeneutically extended the

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[58] For such inputs in a social parlance, *see* Dan E. Miller, *Social Construction of Hypnosis*, in SYMBOLIC INTERACTION: INTRODUCTION TO SOCIAL PSYCHOLOGY 351, 353-55 (Nancy J. Herman & Larry T. Reynolds, eds., 1995).

[59] *Id*. at 353.

[60] Jun-Zhou He et al., *Asymmetric Interaction Paired with a Super-rational Strategy Might Resolve the Tragedy of the Commons without Requiring Recognition or Negotiation*, 5 SCI. REP. 2 (2015).

[61] *Id*.

[62] *Id*. at 4.

scope of ISL from crude communitarianism to commercial applications. The question shall not be whether to extend the scope of space treaties to a market. Rather, the question shall be how and to what extent ISL can be modified in order to reduce the various costs it imposes. The considerations made above can form the beginning of a renewalist project for ISL.

IV. FUNCTIONAL COSTS: THE COSTS OF COOPERATION

It appears that ISL's treaty framework is less contemporaneous in liberal market societies. Whereas normatively ISL is a robust regime, realistically speaking what is seemingly ISL's normative perfection is in fact a structural flaw. We argued above that observance of the rule-guidance provided by such a framework would impose costs on actors. However, irrespective of its insufficiency in regulating market conditions, ISL has established a certain cooperation therein by means of its treaty framework, though such cooperation is nonfunctional due to the coordination problem. Below we illustrate how certain contemporary space applications that have the potential to lift the space market are foiled by the structural inappropriateness of ISL. We also suggest why one needs to return to the considerations made above for reforming ISL, with a few cases in point.

A. Private Property in Space

If part of the reason ISL does not recognize or even encourage considerations of private property in outer space is because enforcement and governance of property rights cannot take place without a sovereign,[63] then there is merit in exploring this issue here. When people have an option to cooperate (in respecting property rights) or not, and when cooperation is costly, they will choose not to cooperate even when social welfare for the society as a whole increases under cooperation. The analytical tool of PD is again very effective to understand this. Having referred to it earlier, it makes it all the more important to contextually illustrate its scope.

Consider two players Ronald and Richard, who have property on the Moon. They can choose to respect the other's property, or

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[63] Alexander W. Salter & Peter T. Leeson, *Celestial Anarchy: A Threat to Outer Space Commerce*, 34 CATO J. 581 (2014).

adopt a strategy to appropriate it. Their payoffs are higher in the second strategy. Ronald would not want his property to be appropriated by Richard, but he does not know what Richard would choose to do. Richard also has the same misgiving. In this uncertainty, both would imagine the worst and try to appropriate. If that happens, the social welfare/surplus goes down. The figure below explains this stylistically. Here, $0 < P < Q < R$, and $(Q + Q) > (P + R)$. In other words, when both the players respect each others' property rights, the total social payoff is the highest, but it is the lowest when they do not (when only one respects while the other does not, the individual payoff of the one respecting is lower than when both respected and that of the appropriator is higher). This is an example of what happens when, due to non-cooperation, the players end up choosing a strategy that makes both of them collectively worse off.[64]

		Richard	
		Respect	Appropriate
Ronald	Respect	Q,Q	P,R
	Appropriate	R,P	0,0

Enforceable property rights are unsustainable indeed. If there is a sovereign, then both Ronald and Richard would be compelled to respect each other's rights. Fact finding and litigation processes for matters dealing with outer space however difficult, do not make sense in a sovereign-less engagement. Although in a repeat interaction mode, PD could be averted because trust assumes central importance at that stage,[65] and often property rights could be self-enforcing as well, it does not assure us that private property endowments in outer space will be costless. How to draw an initial distributional matrix and what happens if property rights in (the unending) outer space trigger political tensions on Earth—given the blood-stained human history attributed largely to our obsession with property—are some inconvenient questions starkly posed.

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[64] See RAPOPORT &. CHAMMAH, *supra* n. 27. .

[65] For experimental proof, *see* James Andreoni, & John H. Miller, *Rational Cooperation in the Finitely Repeated Prisoner's Dilemma: Experimental Evidence,* 103 ECONOMIC J. 570 (1993).

Hence, Article II of the Outer Space Treaty, categorically precludes any possibility of cultivating private property rights in space:

> 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.

The idea of restraining private property in outer space is indeed welcome for a variety of other reasons. The principle of *res communis* in international law is a powerful impetus, and justifiably important in its scope and need, which is articulated in Art. 1 of the Outer Space Treaty:

> The 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.
>
> Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.
>
> There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international cooperation in such investigation.

If we look at it from an environmental perspective, the idea is powerful indeed. What humans have done on our own little blue planet, as (dis)regards its environment, is horrendously disastrous. If the entire 4.6 billion years of Earth's age is compressed into 46 years, then humans have taken the last few minutes to destroy the planet's ecosystem, wiping out forests, cleaning thousands of species from it forever, heating the planet up and exhausting its resources. If private property emerges institutionally in outer space, a repeat show may ensue. The problem of space debris in form of uncontrolled parts of human-launched objects in space, drifting aimlessly polluting the pristine outer space is an inconvenient case-

in-point.[66] The freeness of natural and cultural gifts of mankind to mankind is needed to reflect our commitment to each other, and to recognize our value systems. There could be little denying that sovereign-less celestial bodies are a reason we still view outer space in a poetic sense.

B. Discovery of Helium-3 and Need for a New View on Space Exploration

Now couple the legal framework with the discovery of helium-3 on the surface of the Moon, which is a clean, non-radioactive energy source promising a clean power for our industries for thousands of years.[67] If the legal framework does not grant private property rights, how can we make use of helium-3 that will only help us alleviate our environmental sins?[68] Advanced approach to controlled fusion reaction can very effectively employ helium-3 in helium-3 power plants.[69] With lower capital and operating costs, less complex and smaller size, absence of radioactive fuels and most importantly, no air or water pollution, humanity's atonement to its nature without having to deal with uncomfortable questions on intergenerational equity may be near.[70] Further, presence of water ice recently discovered on the Moon—frigid craters at both lunar poles—is offering more promise for future generations.

It is no wonder that in 2007, 31 years after the last landing on the Moon, Google Lunar X Prize was announced, which promises

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[66] *See generally* Pamela L. Meredith, *Legal Implementation of Orbital Debris Mitigation Measures: A Survey of Opinions and Approaches*, 6 AM. U. INT'L L. REV. 203 (1991).

[67] See for e.g., Steve Almasy, *Could the Moon provide clean energy for Earth?* Available at http://edition.cnn.com/2011/TECH/innovation/07/21/mining.moon.helium3/, 21 July 2011. See also, for an old scientific analysis, Wittenberg, L. J., Santarius, J. F., & Kulcinski, G. L. (1986). Lunar source of 3 He for commercial fusion power. Fusion Science and Technology, 10(2), 167-178.

[68] Of course, the Moon's surface has many other precious minerals that will only exacerbate our hunger for commercialization. Those minerals and metals from the Moon, we keep aside from this discussion.

[69] Almasy, *supra* n. 67. See also, *Mining the Moon,* available at http://www.popularmechanics.com/space/moon-mars/a235/1283056/

[70] There are alternative views as well, which show that helium-3 power plants may not be as easy to operate. Regardless, scientific community sees helium-3 as a very powerful answer to power generation without radioactive and environmental concerns.

$30 million to privately-funded spaceflight teams to compete to successfully launch a robotic spacecraft that can land and travel on the Moon's surface, sending data and images back to the Earth.[71] Two teams have already secured contracts for launch, and by 2017, the show has to happen. The world watches in amazement, oblivious to the host of legal and economic questions that will be thrown open after the successful launch. This could only be the beginning of a whole new world of planetary exploitation.

Given the pace of technology, the odds of celestial exploitation are not low. This is a point of inflexion, and it is imperative that legal architecture assumes more agility with the times, lest the triangular tensions in law, policy and practice become too unwieldy. The tremors of tension between privacy policy, freedom of speech and internet practice are still being felt in many countries. Nation states need to accept the fact that lunar mining and celestial exploration are ideas whose time have come. And in no uncertain terms, before it gets too late, they have to get together to identify possibilities which restrain unsustainable mining, and encourage that common heritage of mankind be nurtured.

The drafters of the Outer Space Treaty obviously did not have an imagination about how valuable celestial bodies would become for economic purposes. Their ideas hovered around prohibiting employing celestial bodies for establishing military bases or using outer space for carrying weapons, which is noteworthy. But the fact that lunar mining and other such economically useful ventures could motivate celestial missions was not foreseen. ISL today does not support the establishment of these enterprises. In the present architecture, orders of global governance leaves outer space as common property—global commons. So while no part of the Moon or other celestial bodies can be appropriated by any state, indeed any state can conduct operations there for peaceful purposes. After all, Google Lunar X Prize is encouraging private missions.

But we know that since Hardin's 1968 seminal piece, the tragedy of the commons has become an intellectual-household term.[72] If a property belongs to no one, it falls into disrepair eventually. Again, the problem of space debris comes to mind, where because outer space belongs to no one, there is little incentive to clean it up.

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[71] *See* LUNAR XPRIZE, http://lunar.xprize.org/about/overview.

[72] Garret Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

The story of environmental pollution is a case in point too. If outer space remains as a common property, there is a chance that nation states and their representatives will dig up the celestial bodies beyond repair (if such a term could be used), and we will be the center of oscillating packets of mutilated and destroyed celestial bodies.

ISL attempts to enable nation states to engage with celestial bodies, with careful caveats. For instance, Article 11 of the Moon Treaty lays down a strict prohibition of owning any part of the Moon even while installing stations and structures on it. Interestingly, to govern the exploitation of natural resources on the Moon, it provides for establishing an international regime. It also, while allowing states to conduct scientific explorations on the Moon, mentions that nation states involved in doing so must, "*take measures to prevent the disruption of the existing balance of [the Moon's] environment*,"[73] which reflects international commitment toward ensuring mistakes made on the Earth are not repeated on the Moon.

In particular, the Agreement allows for "use of the Moon anywhere on or below its surface," by any state party. Further, the state parties have unrestrained use of the Moon. Article 8, paragraph 2 states:

> For these purposes States Parties may, in particular: (a) Land their space objects on the Moon and launch them from the Moon; (b) Place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the Moon. Personnel, space vehicles, equipment, facilities, stations and installations may move or be moved freely over or below the surface of the Moon

This means, that the Agreement, and in general the body of ISL, encourages the exploration of the Moon and other celestial bodies for peaceful purposes. Mining clearly is one such purpose. The hope of article 7 (environmental concerns) dilutes our fears, at least in the beginning.

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[73] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, art. 7, para 1, U.N., 1979.

C. The Clause on Equitable Distribution of Benefits

Yet, why have we not seen any manned mission to the Moon or any major installation of mining activities on the Moon since the Moon Treaty came into force? In other words, if ISL generally does not discourage utilizing the Moon and other celestial bodies for peaceful purposes, why have we not seen such utilization being done?[74] Google Lunar X Prize is one unique model, and even that is private in nature. What discourages nation states to engage with outer space for commercial purposes?

Certain clauses discourage the possibility of peacefully mining (for say helium-3) without attracting economic implications afterwards. Article 11, para 7 mentions:

> The main purposes of the international regime to be established shall include: (a) The orderly and safe development of the natural resources of the Moon; (b) The rational management of those resources; (c) The expansion of opportunities in the use of those resources; (d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration

Notice sub-clause (d) which indicates that benefits derived out of resources in celestial bodies will be 'equitably' shared. Not only do the interests of countries which have assisted directly or indirectly with exploration of the Moon need special considerations while distributing the proceeds of the exploration, but the interests of developing countries also need the same special considerations. In other words, if people go to the Moon and find a sizeable quantity

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[74] Investments required for mining extraterrestrial objects are unimaginably large, and hence few. But there have been modest efforts in this direction. Luxembourg's Asteroid Mining Initiative and USA's passing of US Commercial Space Launch Competitiveness Act are interesting cases of mining asteroids and offer unique window to observe such motivations. See, Michael Sainato, *Luxembourg's Asteroid Mining Initiative could boost space exploration*, available at http://observer.com/2016/06/luxembourgs-asteroid-mining-initiative-could-boost-space-exploration/, 6 August 2016. See also, the US Congress website with details on passing of the Act, https://www.congress.gov/bill/114th-congress/house-bill/2262/text

of helium-3, they need to *equitably* allocate some of it for other countries which helped them in exploration as well as developing countries who had no role to play in it, if such countries demand. The question is whether anyone will undertake this voyage.

However, the idea of equitable allocation is welcome. Because developing countries lack the resources to exploit the proceeds from exploring the Moon themselves, it is unfair for space powers not to share the bounty with developing countries. In 1979, when the Agreement was drafted, all that the drafters had in mind, were mines and minerals that could be profitably exploited. However, if we look at the developments in discovery of elements like helium-3, sharing these elements makes even more sense given the inability of developing countries to fund alternative sources of energy while they move on the industrial highway. Because developing countries in the 21st century are some of the biggest emitters of greenhouse gases, helium-3 will be more effective if is offered to them.

The problem with this argument is that countries will not undertake risky and expensive operations of mining the Moon, on the prospects of finding helium-3 alone. They would want to extract all that is available. Assuming environmental considerations are taken care of by article 7, they need to be suitably incentivized to undertake those operations. In the present framework, where they are expected to share all of their exploration byproducts with developing countries, prospects of states exploring and mining the Moon are quite bleak. As rational actors, states necessarily need incentives, which the present structure of ISL does not provide.[75]

Even the Outer Space Treaty 1967 pushes these perspectives. Here, nation states that are launching missions to the Moon or other celestial bodies must consider requests of observation by other states. Article 10 mentions,

> In order to promote international co-operation in the exploration and use of outer space, including the Moon and other celestial bodies, in conformity with the purposes of this Treaty, the States Parties to the Treaty shall consider on a basis of equality any requests by other States Parties to the Treaty to

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[75] Even the Agreement treats nation states as rational actors. Art. 11, para. 7, cl. (b) mentions that the purpose of international regime is "rational" management of the resources.

> be afforded an opportunity to observe the flight of space objects launched by those States.

The information is also not supposed to be private. Indeed, Article 11 mandates that all activities of states being conducted on the Moon or other celestial bodies must be disseminated to the world at large.

In order to promote international cooperation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space, including the Moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities.

Further, Article 12 mentions that all equipment in outer space, regardless of who owns it, shall be available for other state parties, on a reciprocity basis.

All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity.

These clauses have a chilling effect on states party to the Treaty. In 1967, this effect would have been invisible,[76] but today, its implications on exploring the Moon in particular are stark. Even if state parties strongly desire to behave in mutual cooperation with each other regarding activities in space, the Treaty does not allow private parties or non-governmental entities to operate without being explicitly authorized by the state. This means that the responsibility for any space activity lies with the state in which the launching entity is located.[77] Private parties need to fulfill the State responsibility set forth in the Treaty. Again, this kills private incentives.

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[76] In fact, there are reports that even though the American and Russian versions of their respective drafts differed in their scope being the Moon and celestial bodies, and the whole of outer space respectively, the real points of contention were access facilities on celestial bodies, reporting on space activities and use of military equipment in space exploration. *See*, http://www.state.gov/t/isn/5181.htm.

[77] Article 6 is categorical in this: "States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty."

V. CONCLUSION

How do we then imagine an architecture of laws and treaties that favors exploitation of resources on the Moon without affecting the cause regarding equitable sharing of resources?[78] Due to the existing framework, nation states are desisting from operating on the Moon. With legal obscurity regarding title over mining products on the Moon, private firms are not willing to invest billions of dollars into this venture. We try to probe this further, and excavate possibilities in ISL which may enable private or state parties to be incentivized for undertaking mining operations on the Moon.

A. Cost-Reduction by Avoiding Nation-States Inertia

The two key instruments are the Moon Treaty 1979 and the Outer Space Treaty. The Moon Treaty offers the possibility of creating an international regime that will aid in appropriating governance of mining operations on the Moon. The Outer Space Treaty, on the other hand, is rather silent on governance mechanisms for sharing profits. Additionally, during its 39th session in 1984, the General Assembly adopted a Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of all States, taking into Particular Account the Needs of Developing Countries. This Declaration spells out what the Moon Treaty has briefly touched upon and invokes COPUOS.

The Declaration is contained within the Annex to the resolution and has eight clauses. In general, the Declaration spells out the normative considerations that nation states with higher levels of capabilities in space exploration must engage in exploration efforts for the benefit of all mankind, and in particular, in the interest of the needs of the developing world. Capable states must not only support and promote space science and technology in developing

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[78] It is imperative that we mention our strong impulses in favor of environment. Until several months, we didn't undertake to write this article, because our own preference tends toward protecting the celestial environment, even if it comes to exhausting metals and minerals on Earth. Helium-3 however, changed our priorities. If helium-3 can be effectively utilized as a clean fuel, it will help avert environmental catastrophe on our planet. For every favorable statement towards mining on the Moon therefore rests crucially on our belief that helium-3 is our redemption to what we have done to our planet; and in no way we intend to offer any justification for exploitation of the Moon's surface for mining.

nations, but also ensure that their activities are for the general development of mankind, and especially those in poor parts of the world. Importantly, the Declaration does not mention anywhere the need for equitable sharing of benefits derived from resources on the Moon which is clearly stipulated in Article 11 of the Moon Treaty.

Hence, if someone expresses some concerns on the lack of uniformity or a missing sense of certainty in ISL, there is a reason for it. In cases where cost of uncertainties can go up to billions of dollars, the uncertainty is as good as unsaid prohibition.

B. Reconsidering the Considerations

The fact that COPUOS was invoked in the 1984 Declaration becomes important here. Set up by the General Assembly in 1959, COPUOUS was instrumental in the creation of five treaties and five principles of outer space law. COPUOUS played a very important role in articulating a commitment to the global principle of peace and a commitment to alleviate the Cold War fears that outer space would become another venue for superpowers to exercise their strength. Given the iniquitous economic architecture of the world at the time (which has not changed since then), the fearful expectation that all of outer space's resources would be exploited by a select few nations wasn't unfounded. COPUOS was sensitive to these considerations, and hence, the five treaties reflect the Committee's unanimous priorities.

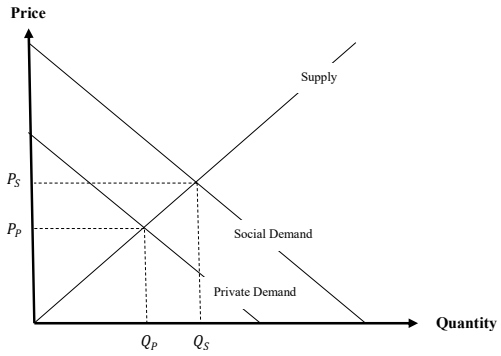
It is important that the Legal Subcommittee of COPUOS frames appropriate structure for incentivizing environmentally sensitive and ethical employment of mining operations. Given the cost implications, such a structure hinges on nation states' willingness to engage in mining operations. Once that hurdle is passed, which is likely, then nation states will need a form of credible commitment.[79] A firm (represented through the nation state it belongs to) will make investments toward mining the Moon only if it is assured of a credible commitment from the international community that their proceeds will not be appropriated later. In our case, Article 11 of the Moon Treaty militates such commitments. If the firms

[79] We borrow the term credible commitment from scholarship on regulatory governance. See Brian Levy & Pablo T. Spiller, *Institutional Foundations of Regulatory Commitment: A Comparative Analysis of Telecommunications Regulation*, 10 J. L. ECON. & ORG. 201 (1994).

are bound by international treaties to equitably allocate byproducts of exploration to developing countries, then *ex ante* they will not make this investment in the first place.

This problem is compounded by the fact that there are several countries that have the technical and financial capacity to make such investments and to engage in space exploration. The economic idea of positive externality is useful to explain this. When the social benefit of an activity is higher than the private cost, the activity will still not be undertaken because the cost is concentrated and the benefit thinly diffused. Thus, a firm that wants to engage in mining helium-3 on the Moon in accordance with the Moon Treaty may still not undertake the activity because the costs are all private despite the social benefits such an activity could bring. The benefit to the firm itself is thin because the benefits are shared equitably with developing nations. The activity will not take place. Governments need to subsidize activities that have positive externality, like education or vaccination. But here, because governments themselves behave as rational actors, they will recede from making any such intervention.

The graph below summarizes this point. The private demand of the activity is lower than the public demand. Hence, the actual equilibrium quantity (x axis) goes down and the activity does not take place.



Further, as Mancur Olson reminded us in 1965, members of a large group with thinly diffused benefits are incentivized to wait for others to perform the activity that produces the benefits.[80] So among those developing countries that are beginning to possess the requisite financial and technical capacity to explore outer space, celestial bodies and the Moon, no one wants to take the lead because free riding is costless.

The Legal Subcommittee of COPUOS has to take the lead in designing an institutional architecture which helps bypass Article 11 of the Moon Treaty (above, we have provided certain inputs in this regard). The Moon Treaty can be the starting point because it mandates that an international regime governs rational exploitation. This regime is what COPUOS has to create. We present three possible key considerations for the structure of equitable allocation regarding helium-3 specifically. First, the structure should ensure that the proceeds of helium-3 are given to nation states in payments that cover the costs of exploration for investors. Second, the structure should ensure that sharing is organized in a manner that takes into account the need for helium-3 in states that use and depend on fossil fuels because of a lack of available, affordable renewable sources of energy in their lands. Third, the structure should ensure that premiums are paid by user states who need helium-3 do not lead to reduction in their emissions.

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[80] *See* MANCUR OLSON, THE LOGIC OF COLLECTIVE ACTION (1965).

The Moon Treaty is one of the weakest in the ISL, which may ease organizing the structural addendum. We also think the problem with Article 11 of the Moon Treaty must have become clearly visible early on because only 13 states have signed the Moon Treaty while 103 have signed the Outer Space Treaty. The 1984 Declaration also does not echo many elements of the Moon Treaty. For practical purposes, the Moon Treaty is hardly invoked in international discourse on laws of the global commons of space. This may also be the reason that even though the Moon Treaty recommended the creation of an international regime, it has yet to see the (Moon) light of day.

C. By Way of Stock Taking

We attempted to unearth nuances in ISL and to recommend a more diverse view of agreements and treaties to find a favorable legal framework. With 50 years elapsed since the Outer Space Treaty was drafted, there is little tangible and commercial movement in that direction. Much of this stagnation can be credited to unclear and conservative laws. The Cold War era produced an environment wherein being even remotely liberal in areas beyond human control (like outer space) was risky. But with reductions in transaction costs every day, and a faster pace in technological progress, laws must be aligned with changing times to ensure humans behave appropriately while outer space becomes a victim of celestial lawlessness.

In this article, we set out to explore the costs that ISL imposes, which in turn render ISL structurally and functionally inappropriate in contemporary times. We first argued that by examining the contemporaneity in ISL, the diminishing relevance and utility of normative structures in the liberal market society are brought to light. Because ISL is such a normative structure with a highly formalized governance system, we found that it promotes stagnation among states so that a state's expectations and relations cannot adapt to changing socio-economic conditions. In doing so, ISL has singularized state interactions and negotiations. While consistency of functional patterns has kept transaction costs to a minimum, it has also reinforced the status quo among space players.

Second, we argued that in the wake of the commercialization of outer space, there were concerns that the scope of ISL could not

regulate or facilitate commercial utilization of outer space. We proposed many formulas within the positivist framework of in order to broaden the scope of space treaties, which ranged from hermeneutically broadening the scope of the treaties to proposing a comprehensive space treaty that *inter alia* addresses commercial concerns in space. Viewing space treaties from a rational choice perspective sheds light on the nature and function of international agreements, particularly space treaties from the perspective of rational market players. We argue that the perspectives on law and context need change more than the law needs a structural overhaul.

Third, we have specified how ISL's treaty structure imposes costs on state parties. And by doing so, it provides theoretical guidance on how the cost-reduction of ISL can be achieved through treaty-design improvement and strategic reasoning. We have attempted to refine the general pessimistic perception prevalent in ISL circles about a regime improvement with the line of the law of the sea.

Fourth, we have illustrated the manner in which ISL's present architecture disables productive engagement by humans with space exploration. Such exploration is an idea whose time has come, but the inertia of nation states (which is largely a result of a conflicting set of ideas embedded within ISL) prevents such ideas from being realized. This article shows that combatting this inertia requires us to reimagine the frame in which ISL is positioned and to redesign its provisions to develop an incentive structure within ISL treaties.

STUDENT ARTICLE

"IT'S DANGEROUS BUSINESS . . .": THE POSSIBLE EFFECTS OF THE SPACE RESOURCE EXPLORATION AND UTILIZATION ACT OF 2015 ON PLANETARY DEFENSE

*Marshall D. McKellar**

"The question to ask is whether the risk of traveling to space is worth the benefit. The answer is an unequivocal yes, but not only for the reasons that are usually touted by the space community: the need to explore, the scientific return, and the possibility of commercial profit. The most compelling reason, a very long-term one, is the necessity of using space to protect Earth and guarantee the survival of humanity."

~ William E. Burrows[1]

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[1] William Burrows, *Space and Civilization*, WSJ (Feb. 3, 2003), http://www.wsj.com/articles/SB10442391855747920 64 (last visited Jan. 14, 2017).

I. INTRODUCTION

As of the early twentieth century, Science fiction has provided an endless stream of films, television, and books imagining the hypothetical first discovery of extraterrestrial biological materials by mankind. The (now cliché') plot tends to begin with initial jubilation by the discoverers, followed by in-depth testing of the mysterious material, and of course, the inevitable eradication of the crew, colony, or planet by a suddenly deadly alien lifeform. The humans involved are almost always on either a deep-space mining mission or building new human settlements in outer space. The idea of mankind entering outer space as colonizers and entrepreneurs has been a staple of our collective imagination for many years; however, what once existed only in our imagination is now quickly approaching reality, expedited by the desire of governments and private entities to push human commercial industry into outer space.

There are now a host of private companies preparing to conduct space transportation and space-resource utilization, hoping to mine comets, asteroids, and even the moon for valuable resources. In November of 2015, gasoline was added to the fire of these hopes when the President signed into law the U.S. Commercial Space Launch Competitiveness Act (CSLCA),[2] opening the floodgates for commercial space resource utilization by United States citizens. Similarly, Luxembourg recently became the first European State to consider legislation granting its citizens the right to commercially utilize space resources.[3] This emerging legislation is a major victory for companies like Deep Space Industries[4], Bigelow Aerospace[5], and Planetary Resources[6]; however, it remains unclear what effects the

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[2] U.S. Commercial Space Launch Competitiveness Act, 51 U.S.C. § 10101 (2015) [hereinafter the CSLCA].

[3] *Luxembourg's New Space Law Guarantees Private Companies the Right to Resources Harvested in Outer Space in Accordance with International Law*, GOUVERNEMENT.LU (Nov. 11, 2016), http://www.gouvernement.lu/6481433/11-presentation-spaceresources.

[4] *Asteroid Mining: An unlimited future for all mankind*, DEEP SPACE INDUS., https://deepspaceindustries.com/mining/ (last visited Nov. 5, 2016).

[5] *B330*, BIGELOW AEROSPACE, http://www.bigelowaerospace.com/b330/ (last visited Nov. 29, 2016).

[6] *Our Technology Today, Enables The Vision Of Tomorrow,* PLANETARY RESOURCES, http://www.planetaryresources.com/technology/#technology-overview (last visited Nov. 5, 2016).