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I. INTRODUCTION

Global governance of outer space activities faces many new regulatory challenges stemming from increased private and public ventures. In 1978, Donald Kessler, a NASA scientist, cautioned that the proliferation of space debris, a byproduct of space activities, may generate a cascade effect of uncontrolled collisions, undermining the use of Earth's orbits ("Kessler Syndrome").[1] But even without such catastrophic consequences, space debris is an externality generated by those who launch the material to outer space, which increases the resources all participants must expend to conduct space activities.[2] For policymakers, the main concerns stem from the effects of debris on space traffic management and the potential risks to life and property from possible accidents.[3]

1. Donald J. Kessler & Burton G. Cour-Palais, *Collision Frequency of Artificial Satellites: The Creation of a Debris Belt*, 83 JOURNAL OF GEOPHYSICAL RESEARCH 2637 (1978). *See also* Paul B. Larsen, *Solving the Space Debris Crisis*, 83 JOURNAL OF AIR LAW & COMMERCE 475, 476–82 (2018); STEPHAN HOBE, SPACE LAW 112–14 (2019); Alexander William Salter, *Space Debris: A Law and Economics Analysis of the Orbital Commons*, 19 STANFORD TECHNOLOGY LAW REVIEW 221, 224–27 (2016).

2. On space debris as an international externality, see *infra* Section II.A.; *see generally* Salter*, supra* note 1; Akhil Rao & Giacomo Rondina, *Cost in Space: Debris and Collison Risk in the Orbital Commons* (2020)*,* https://akhilrao.github.io/assets/working_papers/Cost_in_Space.pdf; Molly K. Macauley, *The Economics of Space Debris: Estimating the Costs and Benefits of Debris Mitigation*, 115 ACTA ASTRONAUTICA 160 (2015).

3. *See* United Nations Office for Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2007), https://www.unoosa.org/pdf/publications/st_space_49E.pdf [hereinafter COPUOS Guidelines]; G.A. Res. 74/82, International Cooperation in the Peaceful Uses of Outer Space (Dec. 26, 2019); Inter-Agency Space Debris Coordination Committee, IADC-02-01 Rev. 1, *IADC Space Debris Mitigation Guidelines* (2007), https://orbitaldebris.jsc.nasa.gov/library/iadc_mitigation_guidelines_rev_1_sep07.pdf [hereinafter IADC Guidelines]; Memorandum from President Donald J. Trump to the Vice President et al., Space Policy Directive-3: National Space Traffic Management Policy (June 18, 2018), https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/ [hereinafter SPD-3]. Others approached it from a purely environmental angle, see, e.g., Vishakha Gupta*, Critique of the International Law on Protection of the Outer Space Environment*, 14 ASTROPOLITICS 20 (2016); Mary Button, *Cleaning Up Space: The Madrid Protocol to the Antarctic Treaty as a Model for Regulating Orbital Debris*, 37 WILLIAM & MARY ENVIRONMENTAL LAW AND POLICY REVIEW 539 (2013).

This challenge facing the international community is further exacerbated by increasing activities in space,[4] reduced governmental control, and incentives for developing countries to attract space investors.[5] The underlying policy problem is compounded by the realization that the generation of space debris is, in many instances, a byproduct of developing capabilities and conducting certain space activities that provide for national progress and a wide array of domestic benefits.[6] In designing a global order for space debris mitigation, the international community must, therefore, prioritize the protection and promotion of the benefits and reduction of the costs from space activities for all participants, rather than be fixated on mitigating a particular activity's externality.

The potential adverse effects for all participants indicate that the mitigation of space debris provides a classic case for international cooperation.[7] Yet, as this article will explain, the international rules currently in place are inadequate[8] and can hardly be considered as effective instruments for swaying the policy choices of participants towards reducing space debris.[9] Scientists, policymakers, and scholars have proposed various national and international paths to confront the challenges posed by increased debris. International legal scholarship, in particular, has proposed a variety of international regimes to govern the interactions between the participants and to encourage both the reduction of future debris generation and the removal

4. *See* Salter, *supra* note 1, at 223–25; Paul B. Larsen, *Minimum International Norms For Mitigating Space Traffic, Space Debris, and Near Earth Object Impacts*, 83 JOURNAL OF AIR LAW AND COMMERCE 739, 754–55 (2018); Larsen, *Solving the Space Debris Crisis*, *supra* note 1, at 481; Arpit Gupta, *Regulating Space Debris as Separate from Space Objects*, 41 UNIVERSITY OF PENNSYLVANIA JOURNAL OF INTERNATIONAL LAW 224, 225 (2019).

5. *See* Larsen, *Minimum International Norms For Mitigating Space Traffic, supra* note 4. *See also* Gershon Hasin, *Developing a Global Order for Space Resources: A Regime Evolution Approach*, 52 GEORGETOWN JOURNAL OF INTERNATIONAL LAW 77 (2020).

6. Anél Ferreira-Snyman, *The Environmental Responsibility of States for Space Debris and the Implications for Developing Countries in Africa*, 46 COMPARATIVE AND INTERNATIONAL LAW JOURNAL OF SOUTHERN AFRICA 19, 44–55 (2013); Economic and Social Council, *Exploring Space Technologies for Sustainable Development and the Benefits of International Research Collaboration in this Context,* U.N. Doc. E/CN.16/2020/3 (Jan. 13, 2020).

7. Salter, *supra* note 1, at 237–38.

8. *See* Joseph Kurt, *Triumph of the Space Commons: Addressing the Impending Space Debris Crisis Without an International Treaty*, 40 WILLIAM & MARY ENVIRONMENTAL LAW AND POLICY REVIEW 305, 313 (2015).

9. *See infra* Section I.B.

of existing debris, including mandatory international standards, increased liability, and taxation.[10]

Most scholarship on outer space activities tends to view the corpus of global governance of the commons as individual specimens to be adapted and applied to space. Rather than evaluating other international regimes as "roadmaps" from which to deduce not only which but, critically, *why* certain rules were installed by participants, scholars propose to adapt, *mutatis mutandis*, other international regimes to confront the space debris challenge, without recognizing the distinct interactions underlining those regimes' development. This approach is misguided. It overlooks the fact that the international lawmaking process of authoritative decision-making is complex and requires careful balancing of the goals and interests of various participants exercising different degrees of leverage.[11] Since each regime is uniquely produced by this process, it is extremely problematic to claim that a regime governing a specific sphere of human activity can simply be applied to another regime that may, in fact, reflect different sets of participants, interactions, incentives, and leverages guiding its unique development. Such an approach may begin an analysis but is unlikely to result in success.[12] While international regulation is targeted at ameliorating the effects of a particular international externality or "problem," the rules are predominantly a product of compromises and "package-deals,"[13] accounting for various factors besides finding the most efficient method for solving the specific problem.

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10. *See, e.g.,* PETER STUBBE, STATE ACCOUNTABILITY FOR SPACE DEBRIS ch. 6(III) (2017); Arpit Gupta, *supra* note 4; Larsen, *Solving the Space Debris Crisis, supra* note 1; Rada Popova & Volker Schaus, *The Legal Framework for Space Debris Remediation as a Tool for Sustainability in Outer Space*, 5 AEROSPACE (2018), https://www.mdpi.com/2226-4310/5/2/55]; Megan R. Plantz, *Orbital Debris: Out of Space*, 40 GEORGIA JOURNAL OF INTERNATIONAL AND COMPARATIVE LAW 585 (2012); Ferreira-Snyman, *supra* note 6; Button, *supra* note 3.

11. Myres S. McDougal, Harold D. Lasswell & W. Michael Reisman, *The World Constitutive Process of Authoritative Decision*, 19 JOURNAL OF LEGAL EDUCATION 253 (1967). *See also* Harold Hongju Koh, *Is There A "New" New Haven School of International Law?*, 32 YALE JOURNAL OF INTERNATIONAL LAW 559 (2007). Although the author appreciates that international law does not have a recognized legislator, the functional term "international lawmaking process" refers to the complex process through which international law develops through the interactions between affected stakeholders and decisionmakers.

12. *See, e.g.*, Hasin, *supra* note 5, § IV.C.

13. *See* Hugo Caminos & Michael R. Molitor, *Progressive Development of International Law and the Package Deal*, 79 AMERICAN JOURNAL OF INTERNATIONAL LAW 871 (1985). *See also,* 1 UNITED NATIONS CONVENTION ON THE LAW OF THE SEA 1982: A COMMENTARY, 29–85 (Myron Nordquist ed., 1985); Xuexia Liao*, The LOSC as a Package Deal and its Implications*

As Professors Myres S. McDougal, Harold D. Lasswell, and W. Michael Reisman have shown, the development of international law is a process of claims and counterclaims, attuned to the interactions between the participants, based on their goals, interests, and leverages.[14] As Professor Harold Hongju Koh described, this process occurs transnationally through a circular process of interactions, interpretations, and internalizations.[15] Through this transnational legal process, international law develops in a repetitive process in which norms are internationalized from the domestic into the international sphere, promogulated and internalized through domestic interactions, to then be internationalized again.[16] This appreciation for the driving forces of the international lawmaking process will inform this article's identification and proposal of an optimum global order for space debris mitigation, one which promotes the aggregated gain in values for all participants.

This article applies the international regime evolution approach the author developed in a previous article[17] to the regulation of space debris by focusing on three elements: feasibility, effectiveness, and manageability. For an international regime to constitute a probable evolution of international law, it must be feasible, meaning that participants are likely to adopt such governance through their interactions based on accommodating their conflicting goals, interests, and leverages. Effectiveness considers the optimization of international values for all participants,[18] which may prescribe a less than perfect solution for any putative "problem." Manageability is the final yet critical element. It considers a regime's opposability by outliers, in other words, the ability to sway the policy choices of reluctant participants to conform with effectiveness. This approach will be applied in both a descriptive and a prescriptive manner.

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for Determination of Customary International Law, 35 INTERNATIONAL JOURNAL OF MARINE AND COASTAL LAW 1, 9–12 (2020).

14. *See generally* McDougal, Lasswell & Reisman, *supra* note 11; MYRES S. MCDOUGAL & WILLIAM T. BURKE, THE PUBLIC ORDER OF THE OCEANS: A CONTEMPORARY INTERNATIONAL LAW OF THE SEA ch. 1 (1962).

15. *See* Koh, *New Haven, supra* note 11, at 567–68.

16. *See id.* at 566–68. *See also* Harold Hongju Koh, *Transnational Legal Process*, 75 NEBRASKA LAW REVIEW 181 (1996).

17. Hasin, *supra* note 5.

18. The international "values" are based on the New Haven School of International Law and adapted to modern interactions. The term refers to desired events. The author considers that wealth, skill or innovation, equity, security, health and safety, human dignity, and environmental protection are among the modern international values that participants desire to optimized. *See further infra* Section III.A.

As the article elucidates, global governance for space debris mitigation will develop in three distinct stages: coordination, cooperation, and regulation. The effectiveness of the current international rules at the stage of coordination is undermined by present interactions. The article thus recommends that the international community adopt a dynamic, bottom-up, and nationally-based cooperation regime to alleviate the risks posed by space debris and promote space activities. This regime will be feasible based on current interactions, effective at optimizing the aggregated gain in values, and manageable vis-à-vis outliers. Such governance reconciles the interests of the various participants involved, given the realities of the international lawmaking process.[19] As future developments may render these rules ineffective, the final part will outline a further anticipated development.

Part II will describe the challenges posed by space debris and the current international rules. Part III will survey the participants involved and the values the regime ought to optimize. Part IV will analyze other regimes proposed by scholars to deduce their appropriateness and shortcomings. Part V will propose a dynamic international regime for mitigating space debris.

II. SPACE DEBRIS UNDER INTERNATIONAL LAW

A. Delineating the Space Debris Problem

The term "space debris" refers to an externality of space activities that creates risks and increases the costs of space ventures for all participants. This debris varies in shapes and sizes, from non-functioning satellites to fragments of spacecraft or launching equipment and even small pieces of metal or paint.[20] Although large pieces of debris can be monitored, tracked, and possibly avoided, smaller pieces may escape current sensor capabilities.[21] These small pieces of debris, potentially numbering in the millions of fragments, pose a significant risk.[22] Traveling at high velocity, a piece of paint can wreak havoc on a satellite or spacecraft.[23] Participants must thus incur

19. As further elaborated below the various participants have distinct goals, interests, and leverages to affect the international lawmaking process. They will be discussed in four groups: space-capable States, space-incapable States, private parties, and international organizations. *See infra* Section III.B.

20. Nodir Adilov et al., *An Economic Analysis of Earth Orbit Pollution*, 60 ENVIRONMENTAL AND RESOURCE ECONOMICS 81, 83–85 (2015); Rao & Rondina, *supra* note 2, at 3.

21. STUBBE, *supra* note 10, at 24.

22. HOBE, *supra* note 1, at 112–13; STUBBE, *supra* note 10, at 37.

23. HOBE, *supra* note 1, at 112–13.

costs to avoid collisions with debris and, if unsuccessful, may suffer losses due to accidents.[24]

While the risks are real, uncertainty surrounds the specific adverse effects and timetables for the cascade process,[25] as further confirmed by Kessler's 2010 reevaluation of his analysis.[26] In other words, while added space debris may increase costs and risks, the extent of its future proliferation is unclear, as is the possibility and tipping point for a potential catastrophic Kessler Syndrome.[27]

In contrast to scholars, who assert that such risks require an urgent remedy,[28] international policymakers have responded in measured steps by adopting only non-legally binding guidelines and promoting declaratory commitments.[29] This may stem from a discounting of risks by the latter because, given the vastness of space, the probability of collisions with small pieces of unidentifiable and untraceable debris is minimal at this point. Nonetheless, the risks and costs will increase unless participants undertake mitigation efforts. Costly maneuvers have already been executed to evade collisions,[30] and while accidents have thus far been rare, debris proliferation and the introduction of mega-constellations will increase their likelihood.

While some elements of space debris, such as radioactive components, may pose increased environmental or safety risks,[31] space debris can be accurately depicted, in general terms, as a traffic management problem that mainly affects the costs and risks associating with coordinating and safely

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24. Ferreira-Snyman, *supra* note 6, at 29; Salter*, supra* note 1, at 227–32; Kurt, *supra* note 8, at 308.

25. *See* Kurt, *supra* note 8, at 316; Rao & Rondina, *supra* note 2, at 3.

26. Kessler et al., *The Kessler Syndrome: Implications to Future Space Operations* (2010), https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.394.6767&rep=rep1&type=pdf.

27. *Id.*

28. *See, e.g.*, Adilov et al., *supra* note 20, at 92; Ram S. Jakhu, Yaw Out Nyampong & Tommaso Sgobba, *Regulatory Framework and Organization for Space Debris Removal and on Orbit Servicing of Satellites,* 4 JOURNAL OF SPACE SAFETY ENGINEERING 129, 129–30 (2017); Chelsea Muñoz-Patchen, *Regulating the Space Commons: Treating Space Debris as Abandoned Property in Violation of the Outer Space Treaty*, 19 CHICAGO JOURNAL OF INTERNATIONAL LAW 233, 241 (2018).

29. COPUOS Guidelines, *supra* note 3; IADC Guidelines, *supra* note 3; Artemis Accords, Oct. 13, 2020, https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf.

30. Jeff Foust, *Space Station Maneuvers to Avoid Debris*, SPACE NEWS (Sept. 23, 2020), https://spacenews.com/space-station-maneuvers-to-avoid-debris/.

31. *See* Button, *supra* note 3, at 545.

conducting launches, in-space activities, and re-entry. As such, a certain degree of adaptation is possible via the implementation of increased tracking, avoidance, and protective capabilities.[32] Yet, adaptation alone is insufficient as further proliferation may reduce its effectiveness.[33] International regulation must therefore strike a balance between adaptation and mitigation.

B. Current International Rules

To properly anticipate the regime's evolution through the international law-making process first requires evaluating the degree to which current international rules affect the policy choices of various participants. It is important to appreciate that the corpus of international law governing a putative subject matter or activity is complex, potentially encompassing multiple regimes, with direct and indirect effects, intentional or inadvertent.[34] In respect of space debris, direct rules include those codified in international treaties relating to outer space activities, non-legally binding guidelines,[35] U.N. General Assembly resolutions,[36] and general international law. Given these rules' relative weakness and vagueness as they pertain to debris, the importance of indirect rules increases. As explained below, space debris mitigation is affected by rules primarily directed at other spheres of activity, such as international environmental law and international investment law, presenting challenges and opportunities.

1. Treaties Regulating Outer Space Activities

Five treaties have been concluded to govern outer space activities: (1) Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer

32. *See* Larsen, *Solving the Space Debris Crisis, supra* note 1, at 481–82; Joseph N. Pelton, *Tracking of Orbital Debris and Avoidance of Satellite Collisions*, *in* HANDBOOK OF SATELLITE APPLICATIONS (Joseph N. Pelton et al. eds., 2d ed. 2017), https://link.springer.com/referenceworkentry/10.1007%2F978-1-4614-6423-5_106-2; *Space Debris and Space Traffic Management,* AEROSPACE (Nov. 14, 2018), https://aerospace.org/article/space-debris-and-space-traffic-management.

33. *See* Larsen, *Solving the Space Debris Crisis, supra* note 1, at 482.

34. *See* Karen J. Alter & Kal Raustiala, *The Rise of International Regime Complexity* (UCLA School of Law, Public Law Research Paper No. 17-47, Northwestern Public Law Research Paper No. 17-30, 2018), https://ssrn.com/abstract=3085043.

35. COPUOS Guidelines, *supra* note 3; IADC Guidelines, *supra* note 3.

36. *See, e.g.*, G.A. Res. 74/82, *supra* note 3.

Space Treaty);[37] (2) Convention on International Liability for Damage Caused by Space Objects (Liability Convention);[38] (3) Convention on Registration of Objects Launched into Outer Space (Registration Convention);[39] (4) Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space;[40] and (5) Agreement Governing the Activities of States on the Moon and Other Celestial Bodies.[41] Of these, only the first four may be deemed effective international law between the space-capable States,[42] and only the first three prescribe norms affecting space debris. Commentators recognize these treaties' limited applicability but overestimate their effects on participants' decisions regarding space debris mitigation.

The Outer Space Treaty was formulated during the Cold War when private space activities were works of fiction and the challenges of space traffic management were unappreciated. The appropriateness of the Outer Space Treaty as an instrument of global governance for modern interactions is thus doubtful. Many authors, however, attribute somewhat excessive qualities to this treaty, including labeling it "magna carta" or claiming that some of its

37. 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, T.I.A.S. No. 6347, 610 U.N.T.S. 205.

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

39. Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15.

40. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119.

41. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 21.

42. The Moon Treaty is subscribed to by less than twenty States, none of which are the leading space-capable States. *See* Frans G. von der Dunk, *Asteroid Mining: International and National Legal Aspects*, 26 MICHIGAN STATE INTERNATIONAL LAW REVIEW 83, 85, 89–90 (2017).

provisions constitute *jus cogens*.[43] Others purport to "elevate" some of its provisions to the status of customary international law;[44] a shaky proposition given the absence of any meaningful State practice, especially by non-party States. Under scrutiny, the treaty reveals itself as merely a treaty of "principles," as its title prescribes, drafted using broad language, lacking any enforcement mechanism, and allowing rapid, unconditional denunciation. These characteristics constitute part of the "context" for the purpose of interpretation as provided for by the Vienna Convention on the Law of Treaties[45] and the application of an evolutionary interpretation of its generic terms.[46]

Two additional treaties to consider are the Liability Convention and the Registration Convention. The latter imposes an obligation on States to register the space objects they launch, while the former concerns standards of liability for damage caused to another State party. Although the Liability Convention provides for the establishment of a claims commission, its award is a recommendation to be considered in good faith, and it only becomes legally binding if the parties consent.[47] As for registration, compliance by participants has been less than perfect.[48]

In respect of space debris mitigation, these three treaties—but chiefly the Outer Space Treaty and Liability Convention—are cited for two somewhat interrelated issues: the obligation and the ramification. In basic terms, scholarship considers whether these treaties impose any obligations on

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43. *See, e.g.*, Edwin W. Paxson III, Note, *Sharing the Benefits of Outer Space Exploration: Space Law and Economic Development*, 14 MICHIGAN JOURNAL OF INTERNATIONAL LAW 487, 489 (1993); Ram S. Jakhu & Steven Freeland, *The Relationship Between the Outer Space Treaty and Customary International Law*, 59 PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 183 (2016); FRANCIS LYALL & PAUL LARSEN, SPACE LAW: A TREATISE 73 (2d ed. 2018).

44. *See, e.g.*, RICKY J. LEE, LAW AND REGULATION OF COMMERCIAL MINING OF MINERALS IN OUTER SPACE 154–55 (2012); Paul B. Larsen, *Asteroid Legal Regime: Time for a Change,* 39 JOURNAL OF SPACE LAW 289 (2014); Jakhu & Freeland, *supra* note 43, at 191–94.

45. Vienna Convention on the Law of Treaties arts. 31–32, May 23, 1969, 1155 U.N.T.S. 331.

46. Dispute regarding Navigational and Related Rights (Costa Rica v. Nicar.), Judgment, 2009 I.C.J. 214, ¶ 66 (July 13).

47. Liability Convention, *supra* note 38, art. XIX.

48. *See* Priyank D. Doshi, *Regulating the Final Frontier: Asteroid Mining and the Need for a New Regulatory Regime,* 1 NOTRE DAME JOURNAL OF INTERNATIONAL & COMPARATIVE LAW 198, 205–6 (2016); Ram S. Jakhu, Bhupendra Jasani & Jonathan C. McDowell, *Critical Issues Related to Registration of Space Objects and Transparency of Space Activities*, 143 ACTA ASTRONAUTICA 406, 413–14 (2018).

States to mitigate space debris, and whether they prescribe responsibility or liability for any consequences resulting from failure to mitigate space debris.[49] The objective is to convince participants to reduce debris by imposing an obligation with a "stick" of liability attached. The complementary route concerns active debris removal and centers around the proposition that as States retain ownership of even the smallest pieces of debris, other States are precluded from deorbiting or otherwise interfering with or removing the debris.[50] Scholars then propose solutions to overcome this supposed hurdle through treaty interpretation or amendment.[51] As this section will explain, such approaches are unconvincing and inconsistent with an evolving interpretation and the principle of *effet utile*, and are unlikely to affect the decision-making process of participants.

Liability and responsibility under the space treaties are linked to the scope of the term "space object." Current scholarship disagrees on whether space debris constitutes a space object[52] under the treaties. The inclusion of "component parts" as space objects in Outer Space Treaty Articles VII and VIII and Liability Convention Article I is raised to justify considering all debris, including pieces of paint or metal, to constitute space objects.[53] Thus, the argument goes, the State launching or procuring the launch is liable for any damage caused by *its debris* to another State. Accordingly, the launching State is liable for all damage caused by debris on the Earth's surface or to aircraft, while liability for damage in outer space is limited to proof of "fault."[54] In an attempt to overcome the limiting criterion of fault, some have

49. *See* LYALL & LARSEN, *supra* note 43, at 272; Arpit Gupta, *supra* note 4, at 236; Vishakha Gupta, *supra* note 3, at 37; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 491.

50. Muñoz-Patchen, *supra* note 28, at 243–44; Arpit Gupta, *supra* note 4, at 247; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 486, 518–19.

51. *See, e.g.*, Muñoz-Patchen, *supra* note 28, at 244–52; Joel A. Dennerley, *State Liability for Space Object Collisions: The Proper Interpretation of "Fault" for the Purposes of International Space Law*, 29 EUROPEAN JOURNAL OF INTERNATIONAL LAW 281 (2018); Jakhu, Nyampong & Sgobba, *supra* note 28, at 131–32; Melissa K. Force, *When the Nature and Duration of Space Becomes Appropriation: Use as a Legal Predicate for a State's Objection to Active Debris Removal*, 56 PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 405 (2013).

52. Larsen, *Solving the Space Debris Crisis, supra* note 1, at 483; STUBBE, *supra* note 10, at 388.

53. *See* Muñoz-Patchen, *supra* note 28, at 235–38; Arpit Gupta, *supra* note 4, at 232–36; *see also* STUBBE, *supra* note 10, at 389.

54. Liability Convention, *supra* note 38, arts. II–III.

suggested lenient criteria for finding fault[55] or even to dispense with it entirely.[56] This distinction, however, seems to be consistent with the realization that small debris in space is either unidentifiable or an uncontrollable by-product of space activities, and, while these smaller pieces are likely to burn in the atmosphere, only large, and therefore easily identifiable, debris is likely to cause damage on the Earth's surface or to aircraft.

Scholarship needs to consider whether the inclusion of "all debris" under these rules is sensible, effective, or consistent with current realities. As this section will illustrate, to sway the policy choices of participants towards the optimum global order, it may be preferable to exclude, at the very least, small or unidentifiable pieces of debris from the application of these treaty rules.[57]

i. Obligation

What obligations do States have under current law with regard to space debris? Article IX of the Outer Space Treaty imposes a "due regard" standard on States. It is reasonable to conclude that this standard requires States to use their best efforts to mitigate the generation of space debris. However, the proposition that all debris generation must be avoided as "harmful contamination" seems to stretch the term's natural and ordinary meaning, which contains "biological, chemical or nuclear" elements, to cover an externality that causes mere obstruction or complication of use.[58] While some activities, such as the testing of anti-satellite weapons, may generate debris to a level that constitutes "harmful interference with activities" of others, Article IX prescribes merely "consultation." This suggests the softness of the intended degree of obligation vis-à-vis a disruptive element such as debris.

A best-efforts obligation is not only a textually reasonable interpretation of the treaty but is also consistent with the evolving context, including increased private activities. The obligation to authorize and supervise private activities indicates that limiting sovereign obligations to best-efforts is sound and would not exceed States' roles and capabilities. Given the anticipated growth in private activities, any higher degree of obligation is unlikely to gain support or compliance by space-capable States.

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55. *See generally* Dennerley, *supra* note 51; *see also* Arpit Gupta, *supra* note 4, at 247.

56. *See* Vishakha Gupta, *supra* note 3, at 37.

57. *See* Arpit Gupta, *supra* note 4, at 247; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 486.

58. *See* STUBBE, *supra* note 10, at 155.

The recently concluded Artemis Accords between the United States and its allied space-capable States are consistent with this interpretation. The Accords' purpose is to "establish a common vision via a practical set of principles, guidelines and best practices."[59] With regard to space debris mitigations, the parties "commit to plan for the mitigation of orbital debris,"[60] with their commitment to limit the generation of new debris confined "to the extent practicable,"[61] which is a best-efforts obligation. Thus, it is reasonable to conclude that a best-efforts standard of obligation, while lower than some scholars would desire, constitutes a reasonable interpretation that is likely to be acceptable to active participants.

ii. Ownership

Many scholars and commentators assume that "ownership" under the Outer Space Treaty somehow precludes an interested participant from actively removing space debris.[62] The proposition that without international law sanction a State lacks the right to remove destructive elements posing significant risks is an absurd result that may precipitate conflict, thus undermining the minimum order. But the application of such a rule lacks *effet utile* and undermines the legal maxim of *sic utere tuo ut alienum non laedas*,[63] mandating its reconsideration.

Reisman explained that when considering international incidents, it is more important to evaluate the responses of elites in other States than whether the incidents constitute a violation of a rule. Rather than reacting to incidents "in judgmental fashion, assuming that the norm in question is *a priori* and enduring,"[64] it is more important to evaluate "the reactions of other relevant actors and, through those reactions, the subjective conceptions of

59. Artemis Accords, *supra* note 29, § 1.

60. *Id.* § 12(1).

61. *Id.* § 12(2).

62. *See, e.g.,* Larsen, *Solving the Space Debris Crisis, supra* note 1, at 486, 518–19; Muñoz-Patchen, *supra* note 28, at 246; Jakhu, Nyampong & Sgobba, *supra* note 28, at 131–33; Arpit Gupta, *supra* note 4, at 238–41.

63. On this principle see Jutta Brunnée, *Sic utere tuo ut alienum non laedas* [Use your own property in such a manner as not to injure that of another], MAX PLANCK ENCYCLOPEDIAS OF INTERNATIONAL LAW (last updated Mar. 2010), https://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e1607.

64. W. Michael Reisman, *International Incidents: Introduction to a New Genre in the Study of International Law*, 10 YALE JOURNAL OF INTERNATIONAL LAW 1, 4 (1984) [hereinafter Reisman, *Incidents*].

right and/or tolerable behavior entertained by those other actors."[65] Assume, *arguendo*, that the United States decided to conduct or authorize a mission to remove small and unidentifiable debris from orbit. The potential responses from other space-capable participants to whom the debris might "belong" include silence, support, emulation, protest, or retaliation.[66] It should be evident that the prospect of retaliation is unlikely, yet it propels scholars to consider the regime of ownership as a legal obstacle.

Should a participant decide to retaliate by initiating a dispute settlement procedure, the first hurdle would be to establish jurisdiction, as the Outer Space Treaty lacks such a mechanism. As for the International Court of Justice, even if jurisdiction could be established, an adverse judgment or opinion is improbable and, even then, unproductive. It is a leap to assume that the prospect of a decision mandating cessation or advising of prospective reparations would deter a participant from removing the debris.

Regardless of whether it would even be possible to prove ownership of a piece of debris that was pushed into the atmosphere and burned, rendering it unidentifiable, it is unlikely that a participant will expend the resources necessary to sustain such a claim for limited gain. First, active removal of debris lends itself to the defense of "necessity" as an activity safeguarding an essential interest with minimal effects on the "owner."[67] Although necessity commands a high threshold,[68] it is a sensible proposition. But the exclusion of wrongfulness does not prejudice the "question of compensation for any material loss caused by the act."[69] Thus, irrespective of wrongfulness, such a tribunal award could include reparations. Exploring this remedy, however, exposes a deeper flaw.

Economist Alexander Salter attaches value to existing debris, based on the costs and efforts of launching an equivalent mass of it into orbit, proposing that such material may therefore be valuable to the owners.[70] This,

65. *Id.* at 17.

66. For instance, when the United States recognized property rights to space resources, silence, support, emulation, and protest were observed, but there was no retaliation. *See* Hasin, *supra* note 5, § II(E).

67. *See* JAMES CRAWFORD, STATE RESPONSIBILITY: THE GENERAL PART 305–15 (2013).

68. *Id.*

69. International Law Commission, *Draft Articles on Responsibility of States for Internationally Wrongful Acts with Commentaries*, 56 U.N. GAOR Supp. No. 10, art. 27(b), U.N. Doc. A/56/10 (2001), *reprinted in* [2001] 2 Y.B. Int'l L. Comm'n art. 27(b), U.N. Doc. A/CN.4/SER.A/2001/Add.1 (Part 2) [hereinafter ILC Articles on State Responsibility].

70. Salter, *supra* note 1, at 233–34.

however, disregards the costs associated with collecting those fragments and reprocessing them for use, rendering the actual value of the debris owned by each participant quite unclear. In our scenario, the owner of the debris will then be required to expend resources to prove to a tribunal the value of the debris, which will be the compensation—the reparation—owed by our "Good Samaritan" State. Irrespective of the futility of trying to prove the value of small and unidentifiable pieces of debris, the perceived costs and minimal benefits involved suggest that States are unlikely to resort to such procedures. This renders the probability of the threat of a dispute settlement process affecting the decision-making process quite imaginary.

The same analysis applies to the likelihood of retaliation through a countermeasure. A retaliatory violation must be proportional.[71] Because the value of the debris to the owner is small and intangible, any countermeasure will be limited in scope.

Additionally, attempts to stop the internationally beneficial collection of space debris may result in negative public opinion, including criticism or lobbying from environmental activists, space entrepreneurs, or even the general public.[72] Interestingly, Russia and China have indicated that interference with their space objects may count as an act of aggression.[73] The scope and circumstances of their claims are unclear, and it is likewise unclear if they were referring to space debris. Furthermore, it seems unrealistic to suggest that Russia would go to war, employ trade instruments, or position nuclear weapons in space because the United States removed Russian debris.

It is technology and cost-effectiveness,[74] not governing international law, that precludes active debris removal. Once debris removal becomes cost-effective, a participant will execute it regardless of any purported ownership. Such a conclusion is stronger for small and unidentifiable fragments. The inclusion of all debris as "component parts" of "space objects" is simply inconsistent with an evolutionary interpretation and the principle of *effet utile*.

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71. On countermeasures, see generally the ILC Articles on State Responsibility, *supra* note 69, ch. II and cmt.

72. While public opinion's effect on Russian policy is limited, China considers its global image important. *See, e.g.*, Emma Graham-Harrison & Tom Phillips, *China Hopes "Vaccine Diplomacy" Will Restore its Image and Boost its Influe*nce, THE GUARDIAN (Nov. 29, 2020), https://www.theguardian.com/world/2020/nov/29/china-hopes-vaccine-diplomacy-will-restore-its-image-and-boost-its-influence.

73. STUBBE, *supra* note 10, at 365.

74. *See* Adilov et al., *supra* note 20, at 94, 95; STUBBE, *supra* note 10, at 58–59; Salter, *supra* note 1, at 232–38.

iii. Ramification

As mentioned above, some scholars propose that space-capable States should mitigate their production of debris or even remove debris they have already produced because they may be held liable for any damage the debris cause. This proposition does not withstand scrutiny.

Even assuming that the owner could be identified and, when relevant, fault proven, for a rule of liability to affect policy choices it must be accompanied by procedural rights for its enforcement, which are absent from current international rules. The Outer Space Treaty does not provide such rights, and under the Liability Convention, the owner must *choose* to compensate the affected party for damages[75] because any claims commission's award is legally binding only by choice.[76] Moreover, the vagueness of the terms may be employed to argue against the scope of liability, as the Soviet Union did following the crash of a Soviet satellite with a radioactive power source in Canada.[77] Finally, a commission may find it difficult to render a decision should the parties fail to agree on the applicable law.[78]

The absurdity of this "stick" is further exposed when one considers a collision in space resulting in—or caused by—unidentifiable or untraceable pieces of debris.[79] It is unclear whether a post-accident analysis could even deduce the responsible owner of the debris. Even if a piece of debris is identifiable, the owner State would only be liable if the collision, detected and proved, was its fault, an ambiguous criterion requiring that a participant produce evidence to sustain it. In addition to the resources required to sustain a claim, an injured participant incurs potential political costs associated with the inter-State dispute settlement process. The effects of a dispute could spill over and undermine cooperation in other aspects of inter-State relations, such as investment, trade, or scientific exchange.

Absent procedural rights and given the low value of the debris, the ramification of liability proposed by some scholars to motivate States to reduce debris is a paper tiger. It is unlikely to affect policy choices precisely because the risk of retaliatory action by an injured participant is extremely low. This

75. Samuel Roth, *Developing a Law of Asteroids: Constants, Variables, and Alternatives*, 54 COLUMBIA JOURNAL OF TRANSNATIONAL LAW 827, 846 (2016).

76. Liability Convention, *supra* note 38, art. XIX(2).

77. Roth, *supra* note 75*,* at 846.

78. *Id.* at 845.

79. *See* Muñoz-Patchen, *supra* note 28, at 246; Matthew Weinzierl, *Space, the Final Economic Frontier*, 32 JOURNAL OF ECONOMIC PERSPECTIVES 173, 187 (2018).

again indicates that an interpretation of space object as including all pieces of debris lacks *effet utile*. An evolutionary and reasonable interpretation of the space treaties would exclude small and untraceable pieces of debris from the definition of space object and perhaps exclude even identifiable yet inoperable and unsalvageable objects.

2. Non-Legally Binding International Instruments

The corpus of international law includes non-legally binding instruments and soft laws that affect the decision-making process of participants.[80] Scholars have referred to some of these instruments, including General Assembly resolutions, as indicating *opinio juris*, which, if followed, would even generate State practice.[81] Yet, practice consistent with a recommendation may stem from its non-legally binding character rather than constitute an indication that compliance is due to an instrument's perceived legally binding nature.

Non-legally binding instruments relevant to space debris include General Assembly resolutions[82] and general guidelines adopted by the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and the Inter-Agency Space Debris Coordination Committee (IADC).[83] The guidelines adopted by COPUOS are based on those of the IADC, which is an informal intergovernmental organization for cooperation between the space agencies of space-capable States.[84]

Both sets of guidelines were intentionally adopted as voluntary recommendations, and States have adopted laws implementing them in varying degrees of conformity.[85] Their implementation is imperfect, and participants diverge from them due to conflicting objectives and interests, which may

80. EYAL BENVENISTI, THE LAW OF GLOBAL GOVERNANCE 37–68 (2014) [hereinafter BENVENISTI, GLOBAL GOVERNANCE]. *See also* Steven Freeland, *The Role of "Soft Law" in Public International Law and its Relevance to the International Legal Regulation of Outer Space, in* SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW 9, 19 (Irmgard Marboe ed., 2012).

81. *See* Michael Wood (Special Rapporteur), Fifth Report on Identification of Customary International Law conclusion 12, U.N. Doc. A/CN.4/717 (Mar. 14, 2018) [hereinafter ILC, Customary Law]; Stephen M. Schwebel, *The Effect of Resolutions of the U.N. General Assembly on Customary International Law*, 73 PROCEEDINGS OF THE ANNUAL MEETING OF THE AMERICAN SOCIETY OF INTERNATIONAL LAW 301 (1973); LYALL & LARSEN, *supra* note 43, at 370.

82. *See, e.g.*, G.A. Res. 74/82, *supra* note 3.

83. COPUOS Guidelines, *supra* note 3; IADC Guidelines, *supra* note 3.

84. *See* Salter, *supra* note 1, at 226–27.

85. Muñoz-Patchen, *supra* note 28, at 241.

include the reduction of regulatory burdens to facilitate the development of private industry. Some authors have suggested that when States follow the guidelines, this may generate State practice establishing customary international law, transforming the obligation to mitigate debris into binding international law.[86] Similarly, it is suggested that the mere failure to comply with the guidelines may constitute fault for the purpose of establishing liability.[87] Such approaches, however, ignore the rules governing the identification of customary international law.

The International Court of Justice and the International Law Commission (ILC) have stressed that a rule of customary international law may emerge from the general, actual practice by States, which they perceive as required by law ("*opinio juris*").[88] While practice by a few participants could be sufficient,[89] when rules originating in treaties are concerned, it is primarily the practice of non-parties that is indicative of the relevant State practice.[90] This makes sense because practice by State-parties consistent with a treaty may simply indicate compliance with treaty obligations.[91] Such considerations apply with equal or greater strength to a provision of an intentionally non-legally binding instrument.

Recently, the ILC adopted its recommendations for the identification of customary international law based on the report of Sir Michael Wood.[92] Conclusion 12 stipulates that while resolutions of international organizations, in themselves, do not generate customary international law, they may "contribute to its development."[93] However, the ILC also stressed that "regard must

86. *See* Ferreira-Snyman, *supra* note 6, at 30; Arpit Gupta, *supra* note 4, at 243–44; Kelly A. Gable, *Rules Regarding Space Debris: Preventing a Tragedy of the Commons*, 50 PROCEEDINGS ON THE LAW OF OUTER SPACE 257 (2007); HOBE, *supra* note 1, at 117–18; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 491. *But see* Plantz, *supra* note 10, at 609.

87. *See* Arpit Gupta, *supra* note 4, at 247.

88. ILC, Customary Law*, supra* note 81; Jurisdictional Immunities of the State (Ger. v. It.; Greece intervening), Judgment, 2012 I.C.J. 99, ¶ 55 (Feb. 3).

89. *See, e.g.*, DONALD ROTHWELL & TIM STEPHENS, THE INTERNATIONAL LAW OF THE SEA 102–11 (2d ed. 2016).

90. Liao, *supra* note 13, at 7–8, 19–20.

91. *Id. See also* North Sea Continental Shelf (Ger. v. Den., Ger. v. Neth.), Judgment, 1969 I.C.J. 3, ¶ 76 (Feb. 20).

92. ILC, Customary Law*, supra* note 81; *see also* International Law Commission, Identification of Customary International Law, U.N. Doc. A/CN.4/L.908 (May 17, 2018); *Analytical Guide to the Work of the International Law Commission: Identification of Customary International Law*, INTERNATIONAL LAW COMMISSION, https://legal.un.org/ilc/guide/1_13.shtml (last updated Apr. 16, 2020).

93. ILC, Customary Law*, supra* note 81.

be had to the overall context,"[94] and State practice "must be sufficiently widespread and representative, as well as consistent."[95] Where "the practice of a particular State varies," the ILC explains that "the weight to be given to that practice may, depending on the circumstances, be reduced."[96]

These understandings obviate the possibility that the guidelines reflect customary international law. The COPUOS guidelines were adopted for "voluntary" implementation, "to the greatest extent feasible" by member States.[97] Absent any meaningful and actual practice by non-parties, a claim of general State practice is unconvincing. Furthermore, given that implementation of the guidelines varies among States, practice is inconsistent. Critically, the context of the guidelines adoption and their voluntary nature undermine any proposition that their implementation is "undertaken with a sense of legal . . . obligation."[98]

The guidelines, however, constitute an important element of the international lawmaking process. When sufficiently internalized by space-capable States,[99] these norms are anticipated to internationalize, driving the development of international law both in the sense of best practices and perhaps even rules.[100] As mentioned above, evidence for such internationalization can be found in the Artemis Accords.

3. Indirect International Rules

States' policy choices concerning debris mitigation are also shaped through indirect rules, providing avenues to facilitate the optimum global order. This section evaluates the degree to which international environmental law and international investment law interrelate with space debris mitigation.

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94. *Id.* conclusion 3(1).

95. *Id.* conclusion 8.

96. *Id.* conclusion 7(2).

97. COPUOS Guidelines, *supra* note 3, at 3.

98. ILC, Customary Law*, supra* note 81, conclusion 9.

99. It should, however, be noted that internalization is inconsistent, may be difficult to measure, and may constitute only one reason for any outcomes observed on the international level.

100. *See* Koh, *New Haven, supra* note 11, at 566–68.

i. International Environmental Law

Many authors turn to international environmental law when considering global governance of space debris.[101] Although for policymakers space debris is mainly a traffic management problem, international environmental law includes several sets of rules and principles that may affect decisions. Critically, the international community must appreciate that any rules for mitigating space debris must be balanced with the mitigation of another international externality: greenhouse gas emissions.

The "polluter pays" principle has been suggested as an indication that space-capable States should bear the brunt of the costs of mitigation efforts, because they are responsible for most past and current debris.[102] Others have raised the precautionary principle as a source of obligations, based on the notion that States have a general obligation to "take preventive measures to protect the environment."[103] The core idea of this principle "is to prevent environmental harm in advance, even when full scientific certainty about a threat does not exist,"[104] thus imposing a preventative "due diligence" obligation depending on a State's capabilities.[105] But, as Lotta Viikari explains, the application of the precautionary principle under international law is challenging given that both its flexibility and generality are made worse in instances of scientific uncertainty and ambiguous risks.[106] With respect to

101. *See, e.g.*, Larsen, *Solving the Space Debris Crisis, supra* note 1, at 490–91; Gordon Chung, *The Emergence of Environmental Protection Clauses in the Outer Space Treaty: A Lesson from the Rio Principles*, *in* A FRESH VIEW ON THE OUTER SPACE TREATY 11 (Annette Froehlich ed., 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3188062; LOTTA VIIKARI, THE ENVIRONMENTAL ELEMENT IN SPACE LAW 175 (2008); Olavo de O. Bittencourt Neto, *Preserving the Outer Space Environment: The "Precautionary Principle" Approach to Space Debris*, 56 PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 341 (2013); Sophie Kaineg, *The Growing Problem of Space Debris,* 26 HASTINGS ENVIRONMENTAL LAW JOURNAL 277 (2019); STUBBE, *supra* note 10, at 164, 171; Vishakha Gupta, *supra* note 3, at 33.

102. Plantz, *supra* note 10, at 611, 617; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 490–91; Kaineg, *supra* note 101, at 288; Ferreira-Snyman, *supra* note 6, at 49; Vishakha Gupta, *supra* note 3, at 33.

103. Viikari, *supra* note 101, at 157; *see also* Neto, *supra* note 101, at 347–51; Chung, *supra* note 101, at 11–13.

104. Viikari, *supra* note 101, at 159.

105. *Id.*; *see also* STUBBE, *supra* note 10, at 209.

106. Viikari, *supra* note 101, at 164–65.

space debris, Viikari notes that applying the precautionary principle may require costly solutions, making its adoption "a complicated endeavor."[107]

Guidance may be found in the ILC's draft Articles on Prevention of Transboundary Harm from Hazardous Activities.[108] The Articles establish a due diligence obligation for States when approving activities which "involve a risk of causing significant transboundary harm through their physical consequences."[109] The ILC explains that a "State likely to be affected" can be more than one State and includes places under any State's jurisdiction or control.[110] Therefore, arguably, transboundary harm should, in principle, extend to include risks to space objects. While the ILC recognized that it "cannot forecast all possible future forms of 'transboundary harm,' "[111] it did, however, point out the need to distinguish between affected and affecting States.[112] "[D]rawing a clear line," as the ILC desires, may not be practical for space debris as it affects all participants, including the State of origin, whether immediately or in the future, subject to their adaptation capabilities.

Nevertheless, the ILC Articles signal the appreciation that States must conduct an "assessment of transboundary harm" of a potentially harmful activity prior to authorization, including "any environmental impact assessment."[113] In 2015, the International Court of Justice recognized an "obligation to exercise due diligence in preventing significant transboundary environmental harm,"[114] with substantive obligations that resemble the Articles.[115]

Both the ILC Articles and the International Court of Justice's *Construction of a Road* judgment impose obligations of conduct rather than of result with respect to transboundary harm. In operative terms, States are only required to notify and consult prior to authorizing hazardous activities, but are not

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107. *Id.* at 175.

108. International Law Commission, *Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with Commentaries*, 56 U.N. GAOR Supp. No. 10 cmt. to art. 2, ¶ 11, U.N. Doc. A/56/10 (2001), *reprinted in* [2001] 2 Y.B. Int'l L. Comm'n cmt. to art. 2, ¶ 11, U.N. Doc. A/CN.4/SER.A/2001/Add.1 (Part 2) [hereinafter ILC, *ATH*].

109. *Id.* art. 1; *see also* Dennerley, *supra* note 51, at 295.

110. ILC, *ATH*, *supra* note 108, cmt. to art. 2, ¶ 11.

111. *Id.* cmt. to art. 2, ¶ 9.

112. *Id.*

113. *Id.* art. 7.

114. Construction of a Road in Costa Rica along the San Juan River (Nicar. v. Costa Rica), Judgment, 2015 I.C.J. 665, ¶ 104 (Dec. 16).

115. *Id.* ¶ 104; *id.* ¶ 19 (separate opinion by Donoghue, J.).

prohibited from authorizing them.[116] Nevertheless, they are required to take "all appropriate measures to prevent significant transboundary harm or at any event to minimize the risk thereof,"[117] while considering "the importance of the activity,"[118] "the availability of means of preventing,"[119] and the prospect of "carrying out the activity . . . by other means."[120] The ILC also added the need to consider "the standards of prevention . . . applied in comparable regional or international practice."[121] In the case of space debris, these may extend to include the COPUOS guidelines.

Although it may be beneficial to have States perform environmental impact assessments when the risk may extend to the entire international community, the process requires actions directed at specific affected States. While the ILC may be justified in extending the obligation to installations of other States on the high seas, extending it to ships[122] that may be randomly affected presents difficulties in implementation. The situation in space is even more challenging because debris, once created, continues to exist in orbit and is likely to affect future participants. The proposition that space-capable States need not only take the interests of stakeholders into account, but must also assess possible transboundary and future effects, or provide notification and consultation to all States, is excessive and impractical given the instability of risks and changing affected parties.

One caveat is important. In a forthcoming article, Professors Donald Elliott and Daniel Esty propose to reconsider the theory of environmental externalities, suggesting to shift governance towards the internalization of all externalities, which they frame as an "end of externalities."[123] According to their approach, "all residual pollution that remains after the application of technologically feasible pollution controls must bear a harm charge that compensates as fully as is possible those subject to the ongoing emissions," in order to affect decisions towards "zero emissions goals."[124] They recog-

116. ILC, *ATH*, *supra* note 108, arts. 8, 9.

117. *Id.* art. 3.

118. *Id.* art. 10(b).

119. *Id.* art. 10(c).

120. *Id.* art. 10(e).

121. *Id.* art. 10(f).

122. *Id.* cmt. to art. 2, ¶ 9.

123. E. Donald Elliot & Daniel C. Esty, *The End of Environmental Externalities Manifesto: A Rights-Based Foundation for Environmental Law,* NYU ENVIRONMENTAL LAW JOURNAL (forthcoming 2021), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3762022.

124. *Id.* at 6.

nize that "concessions to practicality and feasibility" will be required but suggest that technological innovation will reduce the tradeoffs.[125] Although their approach is founded on individual harm and "a right to a healthy environment,"[126] which somewhat limits its application to a traffic management problem such as space debris, should this approach be adopted as a guiding principle of international environmental law, both the Articles of Transboundary Harm and the correlating obligations of States, will require reconsideration.

Even absent any mandatory assessment of transboundary harm, the ILC Articles may indicate that any State planning space activities must consider using available mitigation capabilities as a matter of principle. This should, of course, be balanced with the potential level of harm and benefits of the space activity, which, for many developing States, could be significant. Finally, any international regulation for the mitigation of space debris must take account of, and be affected by, the international rules and principles directed at the climate change crisis. These include, *inter alia*, the principle of "common but differentiated responsibilities"[127] and the commitments in the Paris Agreement to increase the mitigation of emissions.[128] Although space debris is not an emission on its own, rules governing space debris mitigation should facilitate, and be balanced with, the obligations to reduce greenhouse gas emissions and adapt to climate change. It is thus important to appreciate that while space activities promote the ability of participants to adapt to and mitigate the adverse effects of climate change, space launches generate significant emissions.[129] The urgency of adequately responding to the climate change crisis, through both adaptation and mitigation, indicates that the international community must balance the costs and benefits of space activities not only in the sense of debris but also in the sense of emissions.

Furthermore, in confronting climate change, space-based geoengineering efforts constitute an important instrument to achieving the public policy

125. *Id.* at 8.

126. *Id.* at 6

127. *See, e.g.,* United Nations Framework Convention on Climate Change art.4, *opened for signature* June 3, 1992, 1771 U.N.T.S. 107.

128. Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104.

129. David Verbeek & Helene Fouquet, *Can We Get to Space Without Damaging the Earth Through Huge Carbon Emissions?,* LOS ANGELES TIMES (Jan. 30, 2020), https://www.latimes.com/business/story/2020-01-30/space-launch-carbon-emissions.

objective.[130] Whether or not such endeavors are realized must also depend on their potential impact on space debris. In correlation, the urgency of confronting climate change may justify the increased generation of debris. Space debris mitigation would thus be affected by international rules and practices concerning climate change.

ii. International Investment Law

International investment law governs the relations between States and foreign investors. It includes historical elements of public international law concerning diplomatic protection of nationals and minimum standards of treatment, human rights law, and a myriad of over three thousand investment protection treaties. Although treaties may be formulated differently, the investment protection regime includes certain repeating themes intended to promote and protect foreign investments. These elements include not only substantiative protections for investors from measures adopted by host-States but also procedural rights, ranging from access to domestic courts to legally binding State consent to international arbitration. In broad terms, these rules are intended to create favorable terms for cross-border investment and provide investors protections from political decisions taken by the host-State to their detriment.[131] As private space activities gain momentum, international investment law may play a part in the governance of any cross-border space-related investment.

The increase in private space activities risks instigating a circular international process of reduced regulatory burdens described as a "regulatory race to the bottom."[132] The possibility of this spiral effect stems from a potential

130. *See* Mark G. Lawrence et al., *Evaluating Climate Geoengineering Proposals in the Context of the Paris Agreement Temperature Goals*, 9 NATURE COMMUNICATIONS (Sept. 13, 2018), https://www.nature.com/articles/s41467-018-05938-3.

131. On international investment law, see FOREIGN INVESTMENT DISPUTES: CASES, MATERIALS AND COMMENTARY 1–7 (R. Doak Bishop, James Crawford & W. Michael Reisman eds., 2d ed. 2014) [hereinafter FOREIGN INVESTMENT DISPUTES]; JESWALD W. SALACUSE, THE LAW OF INVESTMENT TREATIES ch. 1 (2d ed. 2015); RUDOLF DOLZER & CHRISTOPH SCHREUER, PRINCIPLES OF INTERNATIONAL INVESTMENT LAW ch. I (2d ed. 2012).

132. The risk of a regulatory race to the bottom has long been recognized in other regulatory fields, primarily with respect to environmental law. *See* Daniel C. Esty, *Revitalizing Environmental Federalism,* 95 MICHIGAN LAW REVIEW 570, 604, 627–38 (1996) ("The knowledge that one's competitors intend to lower or already have lowered environmental standards induces parties to act preemptively or responsively and to lower their own standards, triggering a downward regulatory spiral and nonoptimal results.").

flag of convenience problem in outer space activities,[133] emulating an endemic problem in maritime shipping.[134] Space-incapable States may adopt regulations to attract foreign investors as a means of participating in the new Space Age. Such an approach was adopted in Luxemburg, which has successfully attracted foreign investors to establish domestic operations by following the United States in recognizing property rights to space resources,[135] a proposition disputed by others, including Russia.[136] Increased ability to disconnect from terrestrial domains enables space investors to shift their operations to a State that offers favorable terms, such as reduced labor costs, a higher share of profits, and reduced safety and debris regulations to decrease costs. Investors and potential host-States may be incentivized to increase the generation of space debris in the short term, discounting potential future costs associated with higher levels of debris in orbit. As many State participants have incentives to attract investors, this situation risks turning into that regulatory race to the bottom.

It has been argued that international investment protection for space activities will encourage space investments in space-incapable States.[137] This sensible assumption leads to the conclusion that the rights and protections offered by investment treaties will exacerbate, indirectly, the problem of debris because (1) the investment protection system is widespread and mainly founded on the bilateral model;[138] (2) the effects of debris in space, rather than on the Earth, are subject to the supervision and fault-based liability of States; and (3) in a flag of convenience situation, space activities may be governed under the laws of a State offering lenient regulations, while, in fact, operating and being controlled from an entirely different location. With interactions occurring in these situations, the regulatory race to the bottom may be fueled by the investment protection system.

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133. Larsen, *Minimum International Norms For Mitigating Space Traffic, supra* note 4, at 754; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 515.

134. *See* ROTHWELL & STEPHENS, *supra* note 89, at 168.

135. Weinzierl, *supra* note 79, at 189.

136. *See* Hasin, *supra* note 5, at 111.

137. *See* Peter Malanczuk, *Investment Protection of Commercial Activities in Space: Treaties, Contracts, Licenses, Insurance, Arbitration*, 19 JOURNAL OF WORLD INVESTMENT & TRADE 951, 998–99 (2018); Ingo Baumann & Hussaine El Bajjati, *NewSpace: A Wave of Private Investment in Commercial Space Activities and Potential Issues Under International Investment Law, id.* at 930, 942–50 (2018); Stephan Hobe et al., *The Protection of Satellite Telecommunications Activities Under Bilateral Investment Treaties*, *id.* at 1024, 1025–27 (2018).

138. FOREIGN INVESTMENT DISPUTES, *supra* note 131, at 8–11.

Various protections offered by investment treaties, such as legitimate expectations or an agreement on regulatory stability, may impose hurdles on developing States wishing to alleviate the international externality by increasing their regulatory requirements. Tribunals may disregard international considerations and limit themselves to the case at bar.[139] Thus, even if, from an international perspective, increased debris mitigation standards are welcome, a tribunal may still find a State in violation of an investment treaty. Although it is unclear whether or how much of a "chilling effect" this may precipitate, the possibility of such an effect indicates that international investment law plays a part in any global efforts to mitigate space debris.

III. PARTICIPANTS AND VALUES

Global governance for space debris mitigation must be attuned to the goals and interests of the relevant participants: it must be feasible, effective, and manageable. A regime's feasibility can be measured by reference to the participants involved, their bases of power, objectives, and the outcomes of their anticipated interactions in the specific circumstances. Effectiveness depends on a given regime's ability to optimize the gain in values for all participants; manageability turns upon the situations in which the interactions transpire and upon the strategies the participants choose.[140]

To properly evaluate any proposed rules and postulate the anticipated evolution of the regime, this section outlines the international values participants will utilize and the regime must optimize, and then considers the relevant participants and their goals and interests as they relate to the optimization of values. Given the limited international rules in place, considering the "responses of key actors to . . . critical event[s],"[141] as Reisman explained, is essential for ascertaining the interactions that will develop the regime.

A. International Values

Although their content may evolve as space activities increase and global governance responds and develops further, the currently relevant international values are (1) wealth, (2) skill or innovation, (3) equity, (4) security, (5)

139. *See* W. Michael Reisman, *"Case Specific Mandates" versus "Systemic Implications": How Should Investment Tribunals Decide*?, 29 ARBITRATION INTERNATIONAL 131 (2013).

140. *See supra* notes 11–18 and accompanying text.

141. W. MICHAEL REISMAN, INTERNATIONAL INCIDENTS 5 (1988).

health and safety, (6) human dignity, and (7) environmental protection.[142] This section will briefly review these values in relation to space debris.

1. Wealth

Outer space activities both require and generate wealth. Space capabilities provide many advantages to States, including communication, geolocation, espionage, military command and control, urban planning, medical research, and more.[143] But developing space capabilities, either privately or publicly, requires significant capital for the development and acquisition of expertise, infrastructure construction, and personnel training.[144] In the past, the significant investment required, high risk, and minimal returns led to activities being funded primarily by governments for scientific knowledge, prestige, and security.[145] This pattern is changing.

The satellite industry was privatized due to its ability to generate revenue.[146] Currently, the potential gains in wealth generate private investment in other aspects of space activities, including tourism, launches, military, and, perhaps, resources.[147] The anticipated gains in wealth drive decision-making processes and, subsequently, the development of international law. In respect of space debris mitigation, anticipated interactions indicate that wealth produces conflicting effects on policy choices.

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142. These values are based on the New Haven School of International Law, but modified to modern interactions. *See* Hasin, *supra* note 5, at 116–17, 125; *see also* W. Michael Reisman, Siegfried Wiessner & Andrew R. Willard, *The New Haven School: A Brief Introduction*, 32 YALE JOURNAL OF INTERNATIONAL LAW 575, 576 (2007); MYRES S. MCDOUGAL, HAROLD D. LASSWELL & IVAN A. VLASIC, LAW AND PUBLIC ORDER IN SPACE ch. 1 (1963).

143. STUBBE, *supra* note 10, at 41; Committee on the Peaceful Use of Space, *Report on the United Nations/Austria Symposium on the Theme "Space: a Tool for Accessibility, Diplomacy and Cooperation,"* U.N. Doc. A/AC.105/1220 (Dec. 23, 2019); Ferreira-Snyman, *supra* note 6, at 44–45.

144. *See* Doshi, *supra* note 48, at 201–2; *see also* Economic and Social Council, *Exploring Space Technologies for Sustainable Development and the Benefits of International Research Collaboration in this Context*, ¶ 69, U.N. Doc. E/CN.16/2020/3 (Jan. 13, 2020).

145. *See* STUBBE, *supra* note 10, at 41; President's Science Advisory Committee, *Introduction to Outer Space*, NASA (Mar. 26, 1958), https://history.nasa.gov/sputnik/16.html; HOBE, *supra* note 1, at 29–37; John M. Logsdon, *Space Exploration*, BRITANNICA, https://www.britannica.com/science/space-exploration (last visited Aug. 5, 2021); *The Space Race is Dominated by New Contenders*, THE ECONOMIST (Oct. 18, 2018), https://www.economist.com/graphic-detail/2018/10/18/the-space-race-is-dominated-by-new-contenders.

146. *See* LYALL & LARSEN, *supra* note 43, at 37.

147. *See* Weinzierl, *supra* note 79.

The implementation of mitigation efforts increases the costs of space projects. Thus, any participant able to avoid or decrease their implementation of mitigation will potentially increase its gain in wealth.[148] A tragedy of the commons ensues: each participant is incentivized to generate debris as the externality's effects spread between all participants.[149] But the adverse effects of space debris on the costs associated with all participants' access to space, the safety of personnel, and protection of property, might offset gains from reduced mitigation efforts. Therefore, the increased consequence for major users generates incentives for them to self-mitigate.[150] Emerging State and private participants may, however, discount future risk and prioritize immediate gains, given their lower overall exposure to accidents.

Increased susceptibility to outliers, as with high seas fishing and climate change, indicates that the manageability of any international regulation for debris mitigation turns upon generating incentives for participants to moderate immediate gains in wealth in exchange for future ones. The effectiveness of any potential international regulation thus turns upon its ability to command universality, which imposes difficulties on the feasibility due to the need to achieve consensus.

2. Skill or Innovation

Wealth and innovation are interdependent. Wealth drives and enables innovation, and innovation generates wealth. Therefore, it is reasonable to assume that for most space activities, the gap between space-capable and space-incapable States could grow exponentially, as the former acquire more wealth from providing services and accessing resources to fuel their private and public innovation.[151] Coupled with the significant benefits of space activities, these prospects generate a strong incentive for emerging participants to accelerate their development of space capabilities without concern for the debris generated in the process.

148. *See* Viikari, *supra* note 101, at 175; Ferreira-Snyman, *supra* note 6, at 29; Weinzierl, *supra* note 79, at 186–87.

149. Weinzierl, *supra* note 79; Plantz, *supra* note 10, at 604.

150. *See* Larsen, *Solving the Space Debris Crisis, supra* note 1, at 496; *see, e.g.*, IADC Guidelines, *supra* note 3.

151. *See, e.g.*, Doshi, *supra* note 48, at 199–200; Adam Xu, *China Joins Race to Mine Moon for Resources*, VOA (Dec. 2, 2020), https://www.voanews.com/science-health/china-joins-race-mine-moon-resources.

Innovation increases debris generation by certain participants, yet debris mitigation is essential by and for all participants. Recently, SpaceX tested a launcher that landed back on the Earth rather than burning up in the atmosphere or remaining in orbit.[152] Similarly, other technological developments to reduce debris have been developed and adopted, as States implement the guidelines.[153] Policymakers must also appreciate the fact that innovation, through identification, tracking, and protection from debris, allows participants to adapt to the externality and reduce the cost-effectiveness of mitigation. But by reducing some participants' need for mitigation, innovation may undermine the goals and interests of other participants.

States may be incentivized to invest in innovation to enable and protect their operations to increase domestic gain in all values. Investors, however, will invest in mitigation and adaptation technology only as far as it corresponds with gains in wealth. For investors, predictability is essential. Thus, any global regime must secure, to a reasonable extent, investors' ability to innovate and protect their investments. Unclear and changing rules on debris mitigation may disincentivize investors, while strict rules limiting innovation risk incentivizing the relocation of space operations to less stringent jurisdictions, thereby promoting outlier decisions for both States and investors.

3. Equity

Claims of equity come from all types of participants but predominantly from developing countries. Such claims affect the development of international law. Myres McDougal and his co-authors emphasized that "space resources could serve . . . as a great 'equalizer' between different territorial communities."[154] But for space and its resources to truly "equalize" communities, a regime must be attuned to the goals and interests of all participants, including equity claims. Although items of space debris are not "resources" in the common sense, the increase in debris undermines the capability of participants to use all other resources of space, including valuable orbits.[155]

152. *Recent Launch*, SPACEX, https://www.spacex.com/launches/ (last visited Aug. 5, 2021).

153. Joana Ramos Ribeiro et al., *Evolution of Policies and Technologies for Space Debris Mitigation Based on Bibliometric and Patent Analyses*, 44 SPACE POLICY 40 (2018).

154. Myres S. McDougal et al., *The Enjoyment and Acquisition of Resources in Outer Space*, 111 UNIVERSITY OF PENNSYLVANIA LAW REVIEW 521, 540 (1963).

155. *See* Salter, *supra* note 1, at 227–28.

Claims for equity in debris mitigation and adaptation rest on the fact that most existing debris originates from activities conducted by space-capable States in the process of developing their skills.[156] But space-incapable States wishing to develop their own skills and industries will have to resist rules that increase their debris mitigation obligations to a level that undermines their ability to develop space capabilities.[157] Equity claims, therefore, include calls to prescribe for an equitable distribution of responsibility for mitigating the space debris problem while preserving the ability of participants to increase debris for the development of domestic industries.[158] For any international rules to command the universality required to reduce outlier behavior, the regime must implement elements of equity, which may take the form of common but differentiated responsibilities, either internationally or through national discretion.

In the past, developing countries have combined claims for equity with requests for technology sharing and financial assistance. The development of the law of the sea demonstrates that if such claims are directed at imposing preconditions on access to natural resources, they are likely to face significant opposition.[159] However, were such claims limited to mitigation and adaptation capabilities, they may be acceptable to developed States, as evident from the compromises reached in the efforts to confront climate change.[160]

Space-capable States may be more receptive to calls for sharing mitigation technology rather than adaptation technology, which may also have military and security aspects. It is worth recalling that domestic and international regulations impose costs on participants, thus encouraging the investment of capital for developing cost-reducing technological solutions. If all partici-

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156. *Id.* at 224–25; Ferreira-Snyman, *supra* note 6, at 47–48; STUBBE, *supra* note 10, at 210.

157. Committee on the Peaceful Uses of Outer Space, Report on the Work of Its Sixty-Second Session, ¶ 121, U.N. Doc. A/74/20 (2019) [hereinafter COPUOS Report].

158. *Id.* ¶¶ 121–24.

159. As a point of reference, the UNCLOS rules governing the regulation of the Area, and specifically the technology sharing obligation, were seriously opposed by developed States, which led to their amendment by the 1994 Implementation Agreement. *See* ROTHWELL & STEPHENS, *supra* note 89, at 18–19. In a similar sense, the Moon Treaty has been rejected by space-capable States due to its common heritage elements. *See* von der Dunk, *Asteroid Mining*, *supra* note 42, at 89–90; *see, e.g.*, Exec. Order No. 13,914, 85 Fed. Reg. 20,381 (Apr. 10, 2020)

160. *What is Technology Development and Transfer?,* UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/topics/climate-technology/the-big-picture/what-is-technology-development-and-transfer (last visited Aug. 5, 2021).

pants shared and implemented mitigation technologies, the demand for further technological innovation would be reduced. Investors, however, are unlikely to be enthusiastic about sharing cost-reducing technology.

4. Security

National security infrastructures of many States, predominantly space-capable States, rely heavily on space activities. These security interests will be jeopardized should the rate of debris generation exceed States' adaptation capabilities, thus increasing the potential for accidents. This equilibrium would affect less developed participants more than developed ones due to their different abilities to employ wealth and innovation. The increased adaptation capabilities of space-capable States indicate that security-related claims will only marginally affect the development of international law at the initial stage. But they will take an increasingly central role if debris proliferation exceeds their adaptation capabilities.

The proliferation of space debris not only threatens to adversely affect security interests but may precipitate conflict due to increased accidents and associated costs. The limited ability to prove fault or responsibility constitutes an obvious caveat to such a proposition, undermining the prospect of any tangible disputes stemming from debris, and especially very small fragments. The crash of the Soviet satellite in Canada was settled without dispute,[161] and while the testing of anti-satellite weapons by China and India has generated protest,[162] it did not culminate in international disputes. However, there is no guarantee that space debris will not generate disputes in the future that jeopardize security.

Increased private activities may further escalate security concerns given the reduced ability of States to exercise control. In addition, the current assignment of jurisdiction and responsibility indicates that disputes over damage between investors, and perhaps between investors and States, may become international if and when insurance no longer provides adequate protection.[163] As will be further elaborated below, the allocation of jurisdiction,

161. Roth, *supra* note 75, at 845–46.

162. SHIRLEY KAN, CONG. RCSH. SERV., RS22652, CHINA'S ANTI-SATELLITE WEAPON TEST 1–2 (2007); Helen Regan, *India Anti-Satellite Missile Test a "Terrible Thing," NASA Chief Says*, CNN (Apr. 2, 2019), https://www.cnn.com/2019/04/02/india/nasa-india-anti-missile-test-intl/index.html.

163. *See* Salter, *supra* note 1, at 230–32; Paul B. Larsen, *Does New Space Require New Liability Laws?*, 68 GERMAN JOURNAL OF AIR AND SPACE LAW 196, 223–24 (2019).

responsibility, and liability under the current international rules is somewhat inappropriate given the current and anticipated interactions. The potential engagement at the inter-State level may further generate claims to alter such rules either through modification or interpretation.

5. Health and Safety

All claims for increased mitigation rest upon the need to protect the safety of space crews and property. Accidents may bring about increased adverse effects on health, especially should radioactive components be damaged.[164] Furthermore, health is promoted through space activities, such as medical research, remote sensing, environmental efforts, and more.[165] Allowing accidents to undermine these vital space capabilities would adversely affect health and safety on the ground as well.

On the other hand, while debris mitigation is primarily intended to promote safety and health, overly strict mitigation rules could discourage space activities meant to promote domestic gains in these values. Therefore, the global regime must balance the risks to health and safety in space with domestic benefits in health and safety from increased space activities.

6. Human Dignity

For any global debris mitigation regime to attain universality it should promote human dignity as well as equity. This means that in addition to promoting the human rights of space personnel and terrestrial employees, universality will turn on a regime's ability to win wide participation in both its foundation and implementation, rather than being dictated by certain participants. "An instrumental goal of a public order of human dignity is of course the equipping of all individuals for full participation in authoritative decision."[166] Such claims may be supplemented by claims to prevent a democratic deficit from top-down international regulation.[167]

The regime's foundation must extend to include as many participants in the decision-making process as is feasible. The increased prospects of outlier behavior indicate that international command and control is neither feasible

164. *See* Button, *supra* note 3, at 545.

165. *See Overview of ISS Research Benefits to Human Health*, NASA, https://www.nasa.gov/mission_pages/station/research/benefits/human_health.html (last visited Aug. 5, 2021).

166. McDougal, Lasswell & Reisman, *supra* note 11, at 256.

167. *See generally* BENVENISTI, GLOBAL GOVERNANCE, *supra* note 80, chs. I, II.

nor advisable, and the prospects for convening a parliamentary diplomatic arena to produce an instrument by majority vote are quite low. Rather, any international regime must be based on cooperation, be adopted by consensus, recognize and appreciate participants' specific goals and interests, and be dynamic in allowing them to optimize domestic and international values.

7. Environmental Protection

As mentioned above, the promotion of environmental protection may conflict with debris mitigation, as outer space activities provide essential tools for combating domestic environmental concerns and their adverse effects, primarily climate change and natural disasters.[168] It is, therefore, essential to recognize that promoting such objectives may outweigh the adverse effects of increased space debris and its associated costs. International rules must balance the need to protect the Earth's environment and ensure the viability of space operations.

B. Participants

Modern global governance presents increased complexity and a multiplicity of participants. As far as the regulation of space debris is concerned, States continue to play a central role, but the participation of private and public-private entities is gaining momentum.[169] This section will review the various participants involved in the process of shaping international rules for space debris mitigation, their goals, and interests.

1. Space-Capable States

International rules governing the mitigation of space debris will be predominantly shaped through the interactions of space-capable States and thus will be attuned to their goals and interests. These participants are, and will likely remain, the major military and economic powers. Although the centrality of

168. *See Benefits of Space: Environment*, U.N. OFFICE FOR OUTER SPACE AFFAIRS, https://unoosa.org/oosa/en/benefits-of-space/environment.html (last visited Aug. 5, 2021); Directorate for Science, Technology and Innovation, OECD Space Forum, *Space Technologies and Climate Change*, OECD (Aug. 2014), https://www.oecd.org/futures/space-technologies-and-climate-change.pdf.

169. Weinzierl, *supra* note 79, at 177–80.

their goals and interests for the feasibility of any global order is self-evident,[170] their interests are contradictory, making the governance of space debris complex for these States.

Most space debris production originates from activities conducted by space-capable States, predominantly the United States and Russia.[171] Besides space operations, in recent years the testing of anti-satellite weapons has emerged as a source for space debris. Weapons testing by China and India disseminated large quantities of small but dangerous pieces of debris,[172] and recently the United States criticized Russia for conducting a "non-destructive" anti-satellite weapons test in orbit.[173] The international criticism of China's anti-satellite weapons test did not discourage India from executing its own test, indicating that other participants may develop and test such weapons to counterbalance these States.

The evolution of the regime governing the atmospheric testing of nuclear weapons[174] may assist in assessing the likely trajectory for global governance of anti-satellite weapons testing. Like atmospheric testing, the testing of anti-satellite weapons in space produces significant adverse economic, medical, and environmental effects on the rights and interests of other participants. But the prohibition on atmospheric testing only emerged after the major participants acquired the necessary capabilities through testing. Even then, the prohibition was drafted in a manner that allowed a participant to deviate from the regime on short notice.[175] Although the International Court of Justice attempted to impose the prohibition on France, a non-Party to the 1963 Nuclear Test Ban Treaty,[176] it eventually backed down due to both France's refusal to abide by its preliminary injunction and its statement that it would discontinue atmospheric testing, "in the normal course of

170. *See, e.g.*, Plantz, *supra* note 10, at 612; Ferreira-Snyman, *supra* note 6, at 29; Salter, *supra* note 1, at 232–33; Muñoz-Patchen, *supra* note 28, at 257.

171. Salter, *supra* note 1, at 224–25.

172. Kan, *supra* note 162, at 2–3; Salter, *supra* note 1, at 224; Yu Jiang*, Debris Cloud of India Anti-Satellite Test to Microsat-R Satellite*, 6 HILIYON (2020), https://www.sciencedirect.com/science/article/pii/S2405844020315358.

173. *Russia Conducts Space-Based Anti-Satellite Weapons Test*, UNITED STATES SPACE COMMAND (July 23, 2020), https://www.spacecom.mil/MEDIA/NEWS-ARTICLES/Article/2285098/russia-conducts-space-based-anti-satellite-weapons-test/.

174. W. MICHAEL REISMAN ET AL., INTERNATIONAL LAW IN CONTEMPORARY PERSPECTIVE 46–71 (2004).

175. *Id.*

176. Nuclear Tests (Austl. v. Fr.), Interim Protection Order, 1973 I.C.J. 99, 106 (June 22).

events."[177] It is thus reasonable to conclude that while the testing of anti-satellite weapons generates adverse effects, the consent of major powers to halting such tests is improbable until those powers perfect their capabilities. It is interesting, however, to ponder whether, at such a time, a conditional prohibition may be installed due to the adverse effects of debris generation.

With the vast majority of space activities in the near future conducted by space-capable States and their citizens, they arguably bear the heaviest exposure to the costs associated with increased space debris.[178] But this proposition is over simplified. Given the importance of outer space to their security and economy, these States have much to lose from the proliferation of space debris. But they also possess vast wealth and innovation capabilities, increasing their capacity to adapt to adverse effects short of total devastation, the timetables and potential of which are unclear. Thus, their potential risk is offset by increased skills.

Still, space-capable States realize the potential adverse effects of space debris on their interests, as is evident from the adoption of the IADC guidelines[179] and their internalization through domestic law.[180] But the inconsistency in application and compliance implies that other interests affect policy choices. Space-capable States are anticipated to continue promoting the development of economically viable private or public space industries.[181] Thus, for them, any rules on debris mitigation must refrain from undermining such objectives. The Artemis Accords,[182] for instance, illustrate that space-capable States prefer to coordinate the development of the space industry and debris mitigation between themselves through consortiums rather than on an international scale. However, because space-capable States have

177. Nuclear Tests (Austl. v. Fr.), Judgment, 1974 I.C.J. 253, ¶¶ 23–60 (Dec. 20); W. Michael Reisman, *International Lawmaking: A Process of Communication,* 75 PROCEEDINGS OF THE AMERICAN SOCIETY OF INTERNATIONAL LAW ANNUAL MEETING 101, 117–19 (1981).

178. Larsen, *Solving the Space Debris Crisis, supra* note 1, at 496; Muñoz-Patchen, *supra* note 28, at 257; Weinzierl, *supra* note 79, at 177–78.

179. *See* SPD-3, *supra* note 3.

180. *See, e.g.*, *id.*; *see also* Muñoz-Patchen, *supra* note 28, at 241.

181. *See, e.g.*, *Fact Sheet: President Donald J. Trump is Reforming and Modernizing American Commercial Space Policy*, THE WHITE HOUSE (May 24, 2018), https://trumpwhitehouse.archives.gov/briefings-statements/president-donald-j-trump-reforming-modernizing-american-commercial-space-policy/ [hereinafter U.S. Space Policy Directive 2]; INNOVATION FINANCE ADVISORY, EXECUTIVE SUMMARY: FUTURE OF THE EUROPEAN SPACE SECTOR (Report prepared for the European Commission, 2018), https://www.eib.org/attachments/thematic/future_of_european_space_sector_summary_en.pdf.

182. Artemis Accords, *supra* note 29.

different levels of industrial development and capabilities to avoid debris,[183] their interests may vary accordingly.

In addition, increased private participation in space activities may incentivize space-capable States to settle questions of liability and responsibility, propelling the establishment of an international dispute resolution mechanism to increase foreseeability.[184] Besides safeguarding investments, as space tourism increases, space-capable States will also aspire to install rules which increase the protection of their populations from potential accidents. As public entities, space-capable States may also promote debris mitigation as an environmental concern due to public or political pressure.

2. Space-Incapable States and States Developing Capabilities

Although States currently lacking space capabilities and those actively developing space-capabilities may have varied goals, interests, and leverages, their similarities justify treating them as a single group: space-incapable States. As with space-capable States, these participants possess similar interests concerning the protection of their populations and the environment but have different interests relating to the imposition of debris mitigation obligations.

As evident from recent discussions at the United Nations Committee on the Peaceful Uses of Outer Space, space-incapable States aspire to install a regime of common but differentiated responsibilities for the mitigation of space debris.[185] This claim of equity is based on three elements: (1) these participants are not responsible for the debris generated thus far by space-capable States; (2) imposing strict rules would undermine their capability to develop their own space industries and gain the associated benefits in other values; and (3) as they possess less developed adaptation capabilities, debris proliferation presents higher risks for them than for space-capable States.[186] This echoes a well-known conundrum from global efforts to mitigate greenhouse gas emissions.[187] Although this article will further develop the analogy

183. *See* Frans G. von der Dunk, *Space Traffic Management: A Challenge of Cosmic Proportions, in* 58TH IISL COLLOQUIUM ON THE LAW OF OUTER SPACE, PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 385, 391 (2015); Larsen, *Solving the Space Debris Crisis, supra* note 1, at 482, 496; SPD-3, *supra* note 3.

184. On problems in the current regime of liability, see Larsen*, Does New Space Require New Liability Laws?*, *supra* note 163.

185. COPUOS Report, *supra* note 157, ¶¶ 122–23.

186. *See* Ferreira-Snyman, *supra* note 6, at 47.

187. *See* Kurt, *supra* note 8, at 320.

later,[188] it is important for purposes of this section to realize the conflicting and complex interests of space-incapable States regarding space debris mitigation efforts.

The development of space capabilities is essential for developing countries[189] as it promotes wealth and innovation from public and private endeavors.[190] Moreover, because developing countries are disproportionately exposed to the adverse effects of climate change,[191] the benefits in mitigation and adaptation offered through space technology[192] promote domestic environmental interests, health, safety, and wealth. The significant gain in values for space-incapable States that stems from developing a space industry will be counterbalanced by international values and the potential risks to their domestic values from increased costs associated with debris.

Thus, space-incapable States aspire to install a regime that enables their development of space capabilities while limiting the generation of debris by current space-capable States. Some space-incapable States may, however, prioritize short-term gains over future costs resulting in higher levels of debris generation.[193] Although less likely at this point in time, accidents could lead to setbacks with dire results for these States due to their limited resources.[194] Therefore, emerging participants with reduced abilities to develop their own space capabilities are likely to attract space investors through regulatory benefits. As such, given the likelihood that high levels of debris will be generated in developing their space industries, emerging participants have an interest in retaining the nationally based, non-legally binding structure of the international order and the limited regime of liability. However, the more capabilities a State acquires, the more it will appreciate the risks posed by space debris.

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188. *See infra* Part V.

189. G.A. Res. 74/82, *supra* note 3; Ferreira-Snyman, *supra* note 6, at 44–45.

190. STUBBE, *supra* note 10, at 41.

191. Paritosh Kasotia, *The Health Effects of Global Warming: Developing Countries Are the Most Vulnerable*, UN CHRONICLE, https://www.un.org/en/chronicle/article/health-effects-global-warming-developing-countries-are-most-vulnerable (last visited Aug. 5, 2021); *Climate Change and the Developing World: A Disproportionate Impact*, U.S. GLOBAL LEADERSHIP COALITION (Mar. 2020), https://www.usglc.org/blog/climate-change-and-the-developing-world-a-disproportionate-impact/.

192. *Space and Climate Change*, U.N. OFFICE FOR OUTER SPACE AFFAIRS, https://www.unoosa.org/oosa/en/ourwork/topics/space-and-climate-change.html (last visited Aug. 5, 2021).

193. *See* Larsen, *Solving the Space Debris Crisis, supra* note 1, at 515.

194. Ferreira-Snyman, *supra* note 6, at 47.

In contrast to the case of space-resources,[195] space-incapable States possess certain leverage vis-à-vis space-capable States with respect to debris mitigation. An increasing number of States, including developing countries, currently have, or are developing, capabilities to launch satellites to the various Earth orbits.[196] In addition, allocating territory for the construction of a launching facility by a foreign investor requires little effort or technical expertise. Because space-incapable States can increase the externality with which the mitigation regime is concerned, their interests and goals will restrain the regime's evolution.

3. Investors

Space entrepreneurs not only generate space debris but also affect the policy choices of States. As the case of space resources demonstrated, investors can influence legislation adopted by their States.[197] With private activities lying at the core of the United States' future space policy and strategy,[198] the interests of private industry will likely sound in both its policy choices and in any international rules to be agreed upon.

Investors will likely lay claims to maximize their gain in wealth and innovation at the expense of environmental protection, equity, health, and security. They will lobby for international rules which maximize their ability to conduct space operations at minimal costs. Some have suggested that given the potential risks to their operations, investors would be incentivized to come together to agree upon rules to mitigate debris.[199] It has even been argued that private regulation of debris generation might be successful, and no international governance is required.[200] Such proposals, however, assume that private activities are transparent, and thus an outlier may not free-ride

195. *See* Hasin, *supra* note 5, Section IV(C).

196. COMPETING IN SPACE, NASIC (2018), https://media.defense.gov/2019/Jan/16/2002080386/-1/-1/1/190115-F-NV711-0002.pdf; John Polansky & Mengu Cho, *Classification of Countries Worldwide According to Satellite Activity Level*, 14 TRANSACTIONS OF THE JAPAN SOCIETY FOR AERONAUTICAL AND SPACE SCIENCES, AEROSPACE TECHNOLOGY JAPAN 7 (2016).

197. *See* von der Dunk, *Asteroid Mining*, *supra* note 42, at 94.

198. U.S. Space Policy Directive 2, *supra* note 181.

199. Kurt, *supra* note 8, at 334; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 508–11.

200. *See e.g.* Kurt, *supra* note 8, at 334; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 508–11.

the system while maximizing short-term gains in wealth. In any event, investors will only endorse mitigation efforts up to a level that affects their profitability.

To a certain degree, public pressure affects the decision-making process of corporations. Therefore, investors may be motivated to sustain additional debris mitigation costs should the public express concern over debris proliferation. This is evident from climate change efforts, where corporations take mitigation efforts, attributed, *inter alia*, to efforts at increasing profitability through public perception.[201] It is reasonable to conclude that as space tourism increases, two sets of incentives for mitigation may develop for investors: (1) collisions may become a business liability and (2) assuming public opinion favors debris mitigation, being a "green" or "nonpolluting" provider may become marketable to attract environmentally conscientious consumers.

Finally, claims by investors in respect of liability are affected by the feasibility of insurance to properly compensate for losses. Specifically, if risk increases and insurance premiums rise so as to no longer provide sustainable protection,[202] corporations may lobby States for increased mitigation rules, press for strict liability with caps to enable cost-effective insurance, and favor the installment of dispute settlement mechanisms to offset such costs.[203] Furthermore, investors will aspire to retain the protections found in investment treaties and extend their application to outer space activities. While some investors will promote debris mitigation rules that protect the health and safety of their crews and equipment, they will likely object to rules that undermine their gains in wealth and innovation. The equilibrium for their interests swings significantly towards wealth and innovation at the expense of other values but will likely be capped through public pressure. Any domestic or international governance regimes should therefore put in place incentives to counterbalance such goals to optimize environmental protection, equity, health, and security.

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201. DANIEL ESTY & ANDREW WINSTON, GREEN TO GOLD 7–29 (2009).

202. Some insurers have recently withdrawn from the space insurance business. *See* Julien Cantegreil, *The Building of Space Environment, in* ARBITRATION BEYOND BORDERS: ESSAYS IN MEMORY OF GUILLERMO AGUILAR ALVAREZ 15 (W. Michael Reisman & Nigel Blackaby eds.) (forthcoming 2021) (manuscript on file with author).

203. On dispute settlement, see Larsen*, Does New Space Require New Liability Laws?*, *supra* note 163, at 223–24; Salter, *supra* note 1, at 230–32.

4. International Organizations – Public and Private

International organizations, public and private, form an integral part of global governance, affecting the development of any regime for space debris mitigation. These participants may be divided into three groups: (1) the United Nations system; (2) intergovernmental organizations, formal and informal; and (3) non-governmental organizations.

The United Nations system includes various participants with distinct interests and powers. On the one hand, the space-incapable States dominate the General Assembly, but its mandate is budgetary and declaratory. While General Assembly decisions may affect the development of *opinio juris*, they are not legally binding. In contrast, the Security Council, which can issue legally binding decisions, is dominated by space-capable States with veto power. The selection process for the Secretary-General also indicates that the Secretariat is likely to be more attuned to the interests of space-capable States.[204]

An upsurge in space debris may adversely affect the security of space-capable States.[205] It is thus reasonable to conclude that at some point, unless mitigation efforts are successful, space debris may come to be characterized as a "threat to the peace."[206] The powers of the Security Council have been interpreted in the past to include indirect threats to peace under its mandate.[207] But in its belated response to the Covid-19 pandemic, the Council only called for a universal cease-fire in countries where there was an ongoing armed conflict.[208] This may signal a retreat to a restrictive interpretation of the Council's constituent instrument.[209]

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204. *Appointment Process*, UNITED NATIONS SECRETARY-GENERAL, https://www.un.org/sg/en/appointment.shtml (last visited Aug. 5, 2021).

205. STUBBE, *supra* note 10, at 41.

206. U.N. Charter art. 39.

207. *See, e.g.*, S.C. Res. 1308 (July 17, 2000).

208. S.C. Res. 2532, ¶ 2 (July 1, 2020).

209. On dynamic interpretation of constituent instruments by international organizations, see MAHNOUSH H. ARSANJANI, RAPPORTEUR, INSTITUTE DE DROIT INTERNATIONAL, 7TH COMMISSION, ARE THERE LIMITS TO THE DYNAMIC INTERPRETATION OF THE CONSTITUTION AND STATUTES OF INTERNATIONAL ORGANIZATIONS BY THE INTERNAL ORGANS OF SUCH ORGANIZATIONS (WITH PARTICULAR REFERENCE TO THE UN SYSTEM)?, https://www.idi-iil.org/app/uploads/2019/06/Commission-7-Interpretation-constitution-of-international-organizations-Arsanjani-Travaux-La-Haye-2019.pdf (last visited Aug. 5, 2021) [hereinafter ARSANJANI, DYNAMIC INTERPRETATION].

Nevertheless, facing clear security risks, space-capable States may be inclined to use their power through the Council to mandate mitigation rules, counterbalancing the risk of a regulatory race to the bottom. But as space-capable States enjoy significant traffic management capabilities, the tipping point for such action may be higher than that which would impair the activities of States developing space capabilities. It is therefore important to consider how the General Assembly and other organs may respond to an increase in space debris.

It is doubtful whether space-incapable States could successfully act through the General Assembly based on the Uniting for Peace precedent. Under this precedent, the General Assembly may act when the Security Council is deadlocked and failing to perform its function.[210] This model's pretension to demonstrate a superiority of the General Assembly over the Security Council is, as Reisman explained, an illusion:

> The effective powers in the Security Council, the United States and the Soviet Union, were joined in opposition to France and the United Kingdom and used the Assembly or, if one prefers, enabled it, by their support, to employ Uniting for Peace in ways that otherwise could not have been used.[211]

The similarity of interests and incentives between the space-capable States indicates that a repeat occurrence is improbable, and the effectiveness of a General Assembly resolution based on this precedent would crumble absent similar support.

Assuming that the Security Council mandates certain rules, it is interesting to contemplate the possibility of an overwhelming majority of the General Assembly undermining the legally binding nature of such rules. The General Assembly may, *arguendo*, request a legal opinion from the International Court of Justice. The *Lockerbie* case, although dismissed, introduced the proposition of an International Court of Justice judicial review of Chapter VII resolutions.[212] Whether the measures mandated by the Council could be considered *ultra vires* would depend more on the specific measure rather

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210. *Id.* at 123–29.

211. W. Michael Reisman, *The Constitutional Crisis in the United Nations*, 87 AMERICAN JOURNAL OF INTERNATIONAL LAW 83, 84 n.2 (1993).

212. *See* Michael J. Matheson, *ICJ Review of Security Council Decisions*, 36 GEORGE WASHINGTON INTERNATIONAL LAW REVIEW 615 (2004).

than on the justification. Any overwhelming resolution of the General Assembly may tempt the court to address the question in an advisory opinion. But as such fictional rules would exhibit the consensus of the most powerful participants, they would significantly affect policy choices irrespective of the court's opinion.

Besides the Charter organs, other bodies, such as COPUOS, may provide a forum for discussions or decision-making. However, since any decision requires consensus, it would reflect the same balance of power. Nevertheless, given the ongoing discussions on debris in COPUOS, the transparency of the proceedings along with their publicity may affect public opinion and encourage compromises. Other international organizations may also participate in their specific fields of interest, such as health (the World Health Organization), labor (the International Labour Organization), or financing development (the World Bank Group).

Formal and informal intergovernmental organizations could affect the regime's evolution. The IADC influenced the voluntary guidelines for debris mitigation adopted by COPUOS and subsequently internalized by States. Other forums concluded between space-capable States, if such are established through a development of the Artemis Accords, may further coordinate their efforts and affect decisions. But other international organizations, such as those associated with climate change mitigation, may promote geoengineering efforts through space activities, which could exacerbate the debris problem. Since space capabilities augment efforts to confront climate change, an incentive exists for such organizations to discount the risks of debris generation.

As with other aspects of human activity that exhibit either perceived or real environmental effects, efforts to mitigate space debris may be supported through non-governmental organizations.[213] These may include public-private partnerships whose objectives combine both those of investors and the specific State-parties. Although their effects on the formulation of any constituent instruments may be limited and may depend on their composition, public-private partnerships may promote the manageability of the global rules by increasing transparency.[214]

213. *See, e.g.*, Cantegreil, *supra* note 202, at 21.

214. *See* BENVENISTI, GLOBAL GOVERNANCE, *supra* note 80, ch. II.

IV. EVALUATION OF PROPOSED INTERNATIONAL REGIMES

International policymakers, lawyers, and scholars have proposed various avenues through which international law could affect the policy choices of participants concerning the mitigation and removal of space debris. Proposals can be divided into two categories: (1) self-enforcing regulations by private and public entities and (2) international command and control regimes. This section will outline certain characteristics of the proposed structures and then evaluate their feasibility, effectiveness, and manageability.

A. Self-enforcing Regulations

Some scholars suggest that global governance for space debris mitigation could rely on independent decision-making by States or the private sector.[215] Such an approach follows two rationales: (1) the decline of multilateralism signals low prospects for negotiating another treaty[216] and (2) because both space-capable States and private industry suffer adverse effects from space debris, they have an incentive to cooperate and adopt mitigation policies. Corporations, it is argued, could successfully reduce debris through coordination and best practices,[217] and space-capable States could follow the IADC scheme to further coordinate their efforts on a semi-multilateral basis.[218] Such coordination, it is proposed, may even become legally binding and encourage others to join.[219]

But non-legally binding regulation, although feasible, entails risks and limitations for its effectiveness and manageability. These proposals oversimplify the incentives of States and investors. As far as investors are concerned, as Paul B. Larsen explains, "Past experiences with the private sector regulating safety obstacles to their operation have proven problematic."[220] As he points out, their "motivation for competition and profit conflicts with and

215. *See, e.g.*, Kurt, *supra* note 8, at 334; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 496–99, 508–11; Steven A. Mirmina, *Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument*, 99 AMERICAN JOURNAL OF INTERNATIONAL LAW 649 (2005); Popova & Schaus, *supra* note 10.

216. Salter, *supra* note 1, at 232–33; *see also* Adilov et al., *supra* note 20, at 92.

217. *See* Larsen, *Solving the Space Debris Crisis, supra* note 1, at 508–11; Kurt, *supra* note 8, at 334.

218. Larsen, *Solving the Space Debris Crisis, supra* note 1, at 514–17.

219. *Id.*

220. *Id.* at 510.

is sometimes stronger than their motivation for safety,"[221] but such motivation is counterbalanced by public opinion and economic considerations.[222] Furthermore, lack of universality and enforcement generates incentives for outlier behavior, prioritizing short-term gains in wealth over future risks to health and safety.[223]

As an analogy, in confronting climate change, corporations have endeavored to mitigate emissions in response to public pressure or gain a future advantage.[224] Yet, such a process is less common where high polluters are concerned.[225] For the latter, short-term profits are prioritized over potential long-term competitive advantages from developing emission-reducing technologies.[226] Although debris increases costs for space investors, some may prefer guaranteed short-term gains in wealth, discounting both future risks to their business module and environmental concerns. It should further be noted that it took time until public pressure was successfully applied to confront the climate crisis, and it is far from certain when, or even if, such pressure may be exhibited in relation to space debris.

With respect to the capacity of the private sector to self-regulate an externality, high seas fishing is a good example of a common resource and the effects on corporate decision-making.[227] Absent a monopoly or strict regulations,[228] each participant is incentivized to grab more of the resource in question, thus depleting the resource and increasing the externality for all participants.[229] While stark differences exist between the proliferation of

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221. *Id.* at 511.

222. *See, e.g.*, ESTY & WINSTON, *supra* note 201, at 7–29.

223. *See* Larsen, *Solving the Space Debris Crisis, supra* note 1, at 515.

224. U.S. Environmental Protection Agency, Center for Corporate Climate Leadership*, GHG Reduction Programs & Strategies*, EPA, https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-reduction-programs-strategies (last visited Aug. 5, 2021). *See also* Matthias J. Pickl, *The Renewable Energy Strategies of Oil Majors – From Oil to Energy?*, 26 ENERGY STRATEGY REVIEW 1 (2019).

225. *See, e.g.*, David Shepardson, *Several Automakers Back Trump in Two Other California Vehicle Emissions Suits*, REUTERS, Oct. 31, 2019, https://www.reuters.com/article/us-autos-emissions-california/several-automakers-back-trump-in-two-other-california-vehicle-emissions-suits-idUSKBN1XB33K.

226. For a possible change, see *Our Path to an All-Electric Future*, GM, https://www.gm.com/electric-vehicles.html (last visited Aug. 6, 2021).

227. *See* Eric A. Posner & Alan O. Sykes, *Economic Foundation of the Law of the Sea*, 104 AMERICAN JOURNAL OF INTERNATIONAL LAW 569, 571–77 (2009) [hereinafter Posner & Sykes, *Law of the Sea*].

228. *Id.* at 595–96.

229. *Id.* at 571–72.

space debris and high seas fishing,[230] such processes seem to be echoed in the decisions made by private entities engaging in space ventures. One example is the launch of a Tesla into space;[231] another is SpaceX's "Starlink" project which generated concerns for space debris and led the European Space Agency to maneuver one of its satellites to avoid a collision.[232] While these are only anecdotal examples, they illustrate that for a private participant, the potential benefit in wealth and innovation offsets any aggregated adverse effects from the externality shared by all stakeholders.

The potential for States to counterbalance investors must not be overestimated and needs to account for each State's specific interests, goals, and adaptation capabilities. For instance, for the United States, given its debris-avoiding capabilities, a higher debris generation rate may be acceptable to promote its objective to develop private space capabilities. Although such an approach may not be shared by Russia and China, as long as their focus remains on public activities, these participants may continue to increase debris through weapons testing.

The incentives of individual space-capable States and private entities are complex and may not be geared towards effective mitigation of debris. The challenge is exacerbated by the realization that the incentives of space-capable States to rein-in investors provide space-incapable States with the opportunity to capitalize on the investors' motivation to generate more wealth, which may lead to reduced efforts by all States in a regulatory race to the bottom. Thus, reliance upon private regulation or diffused regulation by space-capable States risks becoming ineffective and unmanageable vis-à-vis outliers.

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230. Fish are a resource while debris is a byproduct, and high seas fishing is governed, albeit unsuccessfully, on a regional basis.

231. Kevin McKenna, *We've Trashed the Oceans; Now We are Turning Space Into a Junkyard for Billionaires*, THE GUARDIAN (Feb. 10, 2018), https://www.theguardian.com/commentisfree/2018/feb/11/weve-trashed-oceans-now-turning-space-into-junkyard-for-billionaires-elon-musk-tesla.

232. Jonathan O'Callaghan, *SpaceX's Starlink Could Cause Cascades of Space Junk*, SCIENTIFIC AMERICA (May 13, 2019), https://www.scientificamerican.com/article/spacexs-starlink-could-cause-cascades-of-space-junk/; Jeff Foust, *ESA Spacecraft Dodges Potential Collision with Starlink Satellite*, SPACE NEWS (Sept. 2, 2019), https://spacenews.com/esa-spacecraft-dodges-potential-collision-with-starlink-satellite/.

B. International Command and Control

Some scholars and commentators propose to sway policy choices towards the mitigation of space debris through legally binding international regimes. The proposed regimes vary and include elements such as international organizations, binding standards, financial contributions, fees, verification methods, and dispute settlement.[233] Although varying in form, proposals seek to affect policy choices through (1) uniform international standards for debris mitigation (preferably legally binding) while (2) incorporating certain financial instruments to encourage behavior or provide compensation. These two elements usually coexist with many proposals incorporating economic and standardization elements. But a review of these proposals reveals an inherent flaw.

Most scholarship on outer space regulation in general, and space debris in particular, fails to appreciate that instruments of global governance develop through the international lawmaking process. The predominant approach can be labeled "regime transplantation," predicated on the assumption that if a certain international regime successfully confronted an externality, it could be adopted, *mutatis mutandis*, to confront another externality; in this case, space debris. This approach fails to consider the underlying policy-related attributes of the externality concerned. It overlooks the fact that an international regime reflects outcomes of certain interactions, between certain participants, with certain interests, capabilities, and leverages, addressing a certain externality, under certain circumstances, at a certain point in time. These attributes illustrate the case-specific, *sui generis* nature of each international regime and the arbitrariness of attempting to imprint *an outcome* on an entirely distinct set of interactions.

Recognizing the *sui generis* character of international regimes does not exclude the benefits that a review of existing global governance could provide to regulatory proposals. Far from it. But it does indicate that an appropriate evaluation must consider the interactions which led to specific regimes and whether similar or different interactions are anticipated to occur with

233. Larsen, *Solving the Space Debris Crisis, supra* note 1, at 503–8, 518; Ferreira-Snyman, *supra* note 6, at 48–50; V. Gopalakrishman & M. Prases, *Space Debris Remediation – Common but Differentiated Responsibility*, 56 PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 379, 391–92 (2013); Plantz, *supra* note 10, at 608–18; Vishakha Gupta, *supra* note 3, at 35–37; STUBBE, *supra* note 10, at 445; Jakhu, Nyampong & Sgobba*, supra* note 28; Button, *supra* note 3; Muñoz-Patchen, *supra* note 28, at 255–57.

respect to a given externality, rather than attempting to transplant the outcomes of those interactions.

1. Uniform International Standards

Many authors lament the fact that the COPUOS guidelines are neither universal, specific, nor legally binding.[234] The recommendatory and broad language of the guidelines leads to each State setting its own rules or standards rather than to uniform international standards. This produces different degrees of compliance, and failure to implement does not constitute an internationally wrongful act. This propelled commentators to suggest that uniform international standards for debris mitigation must be accepted, preferably as legally binding rules.[235] Such rules would ease verification of compliance but entail the abrogation of sovereign discretion. As this section will explain, the different characteristics of space debris hardly justify the political costs and compromises associated with installing such standards through negotiations and their subsequent enforcement.

Reviewing the situations in which the international community saw it necessary and appropriate to install uniform international standards reveals completely different settings. States have consented to uniform international standards to ameliorate and facilitate international externalities of activities that are inherently transboundary in nature and engage the jurisdiction of random participants.

Participants installed uniform international standards and complied with them to alleviate conflicting sovereign jurisdictional interactions. Improving the mitigation of particular externalities was not a motivation. Activities generating space debris, however, remain subject only to the sovereignty and jurisdiction of specific States.

Universal standards for safety exist in various fields, such as for products through the International Organization for Standardization (non-legally binding but widely accepted),[236] shipping under the International Maritime

234. *See, e.g.*, Larsen, *Solving the Space Debris Crisis, supra* note 1, at 499–500; Ferreira-Snyman, *supra* note 6, at 30; Adilov et al., *supra* note 20, at 93; Plantz, *supra* note 10, at 587–88.

235. Larsen, *Solving the Space Debris Crisis, supra* note 1, at 503–6, 518; Vishakha Gupta, *supra* note 3, at 35–37; STUBBE, *supra* note 10, at 451.

236. Larsen, *Solving the Space Debris Crisis, supra* note 1, at 509; *Consumer Product Safety—Guidelines for Suppliers*, ISO, https://www.iso.org/standard/45967.html (last visited Aug. 5, 2021).

Organization and its conventions,[237] and commercial aviation through the International Civil Aviation Organization (ICAO).[238] This has encouraged scholars to propose different models for similar international standardization for mitigating space debris. Larsen, for instance, relied on the decision-making process at the ICAO as a model for uniform and mandatory international standards and procedures for space debris.[239] But the challenges arising from the interactions generated in these fields are not comparable to those stemming from space activities, nor are the situations in which the interactions occur.

Take the ICAO, for example. International commercial aviation, by definition, crosses international boundaries into and over sovereign territories of various States, affecting not only the lives of passengers from multiple nationalities but also lives and property on the ground. Uniform international safety standards for commercial aviation thus stem from conflicting sovereignties rather than the need to effectively mitigate the externality. Imagine a world in which each State sets its own safety standards for aircraft. Each aircraft manufacturer and operator would then be required to adjust their operations to the specific standards mandated by each State where the aircraft would land or even fly over, or otherwise be forced to avoid such States. The immense costs associated with such a situation render the possibility of international commercial aviation dependent on international standardization.

Michael Milde explained that "[c]ivil aviation could not have evolved without worldwide uniformity in regulations, standards and procedures."[240] The Chicago Convention thus prescribes for the establishment of international standards, justifying deviations solely when "impracticable" and mandating notification thereof.[241] The rationale is that "in the absence of such notification the foreign aircraft operators would rely on the standardized procedures, facilities or services and the flight safety could be seriously jeopardized."[242] As Paul Dempsey explained, "a State that fails to comply may

237. *List of IMO Conventions*, IMO, https://www.imo.org/en/About/Conventions/Pages/ListOfConventions.aspx (last visited Aug. 5, 2021); Posner & Sykes, *Law of the Sea, supra* note 227, at 577.

238. PAUL STEPHEN DEMPSEY, PUBLIC INTERNATIONAL AIR LAW ch. IV (2017).

239. Larsen, *Solving the Space Debris Crisis, supra* note 1, at 503–5, 517–18.

240. Michael Milde, *Enforcement of Aviation Safety Standards: Problems of Safety Oversight*, 45 GERMAN JOURNAL OF AIR AND SPACE LAW 3, 4 (1996).

241. Convention on International Civil Aviation arts. 37, 38, Dec. 7, 1944, 61 Stat. 1180, T.I.A.S. No. 1591, 15 U.N.T.S. 295.

242. Milde, *supra* note 240, at 5–6.

find its airman, aircraft air carrier, and/or airport certification and licenses not recognized as valid by a foreign government, thereby terminating their operations to, from, or through foreign territories, isolating it from the global economy."[243]

Uniform international aviation safety standards and their subjection to the decision-making process of the ICAO limit both the sovereign discretion of States and the decision-making of private participants. Participants were, and still are, ready to accept such international jurisdiction and mandates, confining, at least de jure, their discretion to an "impracticability" criterion, given the unique characteristics of international commercial aviation.

Conflicting sovereignties underly other fields which commanded uniform international standards. Maritime shipping traverses the economic zones, territorial seas, and internal waters and enters ports of many different participants, with safety standards established under the International Maritime Organization conventions and enforced by port authorities.[244] The globalization of markets also means that products produced in one jurisdiction could be exported and used or sold inside the sovereign territory of other countries. Potential transboundary effects and the subjection of an activity to multiple and changing jurisdictions justify the adoption of universal standards, even if not legally binding. The more severe the potential effects on health, safety, and the environment of each potentially affected sovereign, the more likely sovereigns are to subject their decision-making to uniform international standards and enforcement mechanisms.

As alluded to above, the interactions and situations which led the international community to install uniform international standards in other contexts do not pertain to outer space. In contrast to commercial aviation, space activity can be conducted without ever engaging the jurisdiction of another sovereign or affecting the nationals of another State. While it is true that *accidents* may cause transboundary effects or the engagement of jurisdiction, it is not a prerequisite for successful space activities. Uniform standards would require States to relinquish part of their sovereign discretion without a correlating challenge from multiple sovereignties and to expend unnecessary political and economic resources to reach a consensus on substance and enforcement. Uniform international standards for debris mitigation constitute a superfluous and thus improbable outcome of the lawmaking process.

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243. *Id.* at 104.

244. On port State control, see, e.g., J. Ashley Roach, *The Polar Code and Its Adequacy*, *in* GOVERNANCE OF ARCTIC SHIPPING 144, 167–68 (Robert C. Beckman et al., eds. 2017).

Current global governance for space debris mitigation should focus on generating incentives for participants rather than dictating standards or procedures.

2. Economic Instruments to Affect Policy Choices

Successful mitigation of space debris turns upon incentivizing participants to implement effective policies. To that effect, scholars have proposed a variety of economic instruments, including increased liability,[245] fees,[246] funds,[247] Pigouvian taxes,[248] cap and trade systems,[249] trade mechanisms,[250] and more. The biggest drawback of such proposals, as some commentators recognize, lies in their infeasibility for adoption as international law.[251] As this section will explain, such proposals are inconsistent with the international lawmaking process through which international rules develop and exhibit a limited potential enforcement capability vis-à-vis outliers.

i. Monetary Obligations

Domestic legal systems employ economic instruments, *inter alia*, to affect individual or corporate behavior.[252] Direct carbon taxes, or indirect cap-and-trade systems, were proposed and implemented domestically to reduce greenhouse gas emissions.[253] Taxes on products such as gasoline or cigarettes discourage harmful activities that would otherwise impose additional costs

245. Vishakha Gupta, *supra* note 3, at 37; Muñoz-Patchen, *supra* note 28, at 255.

246. Plantz, *supra* note 10, at 610, 613, 617; LYALL & LARSEN, *supra* note 43, at 514.

247. Plantz, *supra* note 10, at 610; Muñoz-Patchen, *supra* note 28, at 255; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 485–86; STUBBE, *supra* note 10, at 449.

248. Adilov et al., *supra* note 20.

249. Gopalakrishman & Prases, *supra* note 233, at 391–92; Ferreira-Snyman, *supra* note 6, at 49.

250. Vishakha Gupta, *supra* note 3, at 36.

251. *See, e.g.*, Plantz, *supra* note 10, at 611; Adilov et al., *supra* note 20, at 92; Salter, *supra* note 1, at 228.

252. *See, e.g.*, Shanjun Li, Joshua Linn & Erich Muehlegger, *Gasoline Taxes and Consumer Behavior*, 6 AMERICAN ECONOMIC JOURNAL 302 (2014).

253. *See, e.g.*, *EU Emission Trading System*, EUROPEAN COMMISSION, https://ec.europa.eu/clima/policies/ets_en (last visited Aug. 5, 2021); Gary M. Lucas Jr., *Behavioral Public Choice and the Carbon Tax*, 2017 UTAH LAW REVIEW 115.

on society,[254] while import taxes or tariffs can be used to protect certain domestic industries.[255] The rationale is that society not only imposes costs to force participants to minimize externalities but can use the resources collected for other national interests.[256] For example, one proposal is that carbon taxes could be collected and invested domestically to develop renewable energy.[257] Although States may employ domestic taxes or fees to effectuate debris mitigation policies,[258] proposals for imposing such measures internationally are misguided.

For space debris, taxation or fees would apply only to developed space-capable States that conduct space activities, forcing them to expend resources to be distributed for the benefit of other States or to limit an externality with which these States have a greater ability to cope. While taxation can successfully promote change domestically,[259] space-capable States are unlikely to impose international taxes upon themselves contrary to their own interests. For example, in the case of climate change efforts, although developed countries agreed to provide funding to developing counties for mitigation and adaptation efforts,[260] doing so is a far cry from accepting a global tax on emissions. Similarly, the attempt to establish a cap-and-trade system

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254. *See Tobacco Taxation*, WORLD HEALTH ORGANIZATION, https://mca.essen-sys.ro/teams/health-promotion/tobacco-control/economics/taxation (last visited Aug. 5, 2021); James M. Sallee, *The Taxation of Fuel Economy*, 25 TAX POLICY & ECONOMICS 1 (2011).

255. *See* CHRISTOPHER A. CASEY, CONG. RSCH. SERV., IF 1 1030, U.S. TARIFF POLICY: OVERVIEW (Jan. 11, 2021).

256. *See, e.g.*, Donald B. Marron & Adele C. Morris, *How Should Governments Use Revenue from Corrective Taxes?*, BROOKINGS (Jan. 2016), https://www.brookings.edu/wp-content/uploads/2016/07/How-Should-Governments-Use-Revenue-from-Corrective-Taxes-Marron-Morris-1.pdf.

257. *See, e.g.*, Mark Muro & Jonathan Rothwell, *Institute a Modest Carbon Tax to Reduce Carbon Emissions, Finance Clean Energy Technology Development, Cut Taxes, and Reduce the Deficit*, BROOKINGS (Nov. 2012), https://www.brookings.edu/wp-content/uploads/2016/06/13-carbon-tax.pdf.

258. As a point of reference, Elliot and Esty propose to impose fees or taxes on excess pollution to facilitate the achievement of a zero-emission goal: "Charging polluters user fees makes sense not only as a matter of compensatory justice, but also to create incentives to develop better production processes as well as better pollution control in the future." Elliot & Esty, *supra* note 123, at 16.

259. For example, the Montreal Protocol led to the adoption of domestic tax instruments to encourage the reduction of ozone depleting substances. *See* RICHARD ELLIOT BENEDICK, OZONE DIPLOMACY 197–202 (1998).

260. *Climate Finance in the Negotiations*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/topics/climate-finance/the-big-picture/climate-finance-in-the-negotiations (last visited Aug. 5, 2021).

in the Kyoto Protocol[261] failed to achieve broad compliance and the desired goals.[262]

Fees have also been suggested by some as a method for affecting behavior. For instance, some propose to distinguish between orbits and to impose fees on the most widely used.[263] However, such proposals are unconvincing. Unlike taxes, fees have been implemented successfully under international law, but they were not intended to shape participants' behavior. For example, in the United Nations Convention on the Law of the Sea (UNCLOS), fees are predicated upon the proposition that, except as provided for in the Convention, the resources beyond 200 nautical miles from the baselines of coastal States are the common heritage of mankind, and thus "owned" by the international community.[264] The resources of the international Area were largely inaccessible when UNCLOS was signed.[265] Also, most ocean resources outside the Area were subject to exclusive State jurisdiction.[266] The rationale of funding international organizations through fees may, in fact, extend to space, but such a proposition requires the existence of an interest for cooperative action through such institutions. More importantly, neither membership fees nor UNCLOS royalty payments were installed to affect policy choices.

Similarly, because international law is founded on State consent, the proposition of using funds to compensate investors for damage from space debris when the liable party cannot be determined is also inappropriate for international law. National funds to compensate people involved in motor vehicle accidents are predicated on different incentives than those underlying space debris. Such funds are based on the proposition that almost all of society engages in a dangerous activity that exposes it equally to its potential externality, and therefore the public should collectively pay for injured parties when specific liability is unidentifiable. While a comparison in this case is appealing, one must not forget that space activity is far less prevalent than

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261. Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 11, 1997, 2303 U.N.T.S. 162.

262. Daniel Bodansky & Lavanya Rajamani, *The Evolution and Governance Architecture of the United Nations Climate Change Regime, in* INTERNATIONAL RELATIONS AND GLOBAL CLIMATE CHANGE (Detlef Sprinz & Urs Luterbacher eds., 2d ed.) (forthcoming 2021) (manuscript at 33–34), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2168859.

263. *See* Arpit Gupta, *supra* note 4, at 247.

264. United Nations Convention on the Law of the Sea art. 82, Dec. 12, 1982, 1833 U.N.TS. 397 [hereinafter UNCLOS].

265. ROTHWELL & STEPHENS, *supra* note 89, at 87.

266. Hasin, *supra* note 5, § IV(C)(1).

the use of motor vehicles and, at least currently, the victims are not individuals suffering bodily harm. Nor will accidents produce severe environmental harm or detrimental effects on human rights, which have previously justified attempts to establish international funds to compensate for damage caused by oil spills or nuclear activities (these funds also suffer from severe implementation problems).[267]

Critically, because imposing duties on States under international law requires their consent, financial instruments intended to affect policy choices become improbable. In principle, governments impose behavior-modifying taxes against the perceived self-interest of most, if not all, perpetrators of the activity. For such a purpose, domestic systems have a recognized legislator, either elected or imposed, that sets rules governing the actions of individuals and exercises a monopoly over domestic power. But international law lacks such a recognized authority, with only the Security Council possessing a similar, but rather confined, power. Under international law, the participants whose actions constitute the target of any proposed behavior-modifying tax or fee must consent to imposing such an instrument upon themselves. Outliers would severely undermine the effectiveness and manageability of such rules—an investor could simply switch its operation to a non-member State to free-ride the system. Therefore, behavior modifying financial instruments must gain the consent of all potential participants, requiring them to impose, on themselves, behavior modifying financial instruments in contrast to their own perceived interest. That is as if smokers in the domestic system could exclude themselves from the cigarette tax. The absurdity of such a proposition illustrates why the international legal system, with its current structure, is unreceptive to behavior-modifying financial instruments.

Monetary obligations are thus neither appropriate nor likely to be adopted on the international level. As any contributions would be predominantly laid on the developed space-capable States, which also possess the greatest ability to adapt, their benefit from such a system is reduced. Yet, a participant from a space-incapable State may be willing to increase debris generation and risk since its share of the compensation for the effects of the externality would be low. The international lawmaking process, based as it is upon State consent, is simply inappropriate for imposing such instruments to affect policy choices.

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267. *See generally* Chie Kojima, *Compensation Fund*, MAX PLANCK ENCYCLOPEDIAS OF INTERNATIONAL LAW (last updated July 2019), https://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e1837?rskey=Lt1jJV&result=1&prd=MPIL.

ii. Liability

Several authors have proposed to increase State liability for accidents caused by debris in the hope that in doing so participants are deterred from generating debris and encouraged to remove it.[268] The evolution of international investment law elucidates the limited effectiveness of liability without a dispute settlement mechanism and the improbability of such an instrument being adopted for space debris given current interactions and situations.

Before the establishment of the international investor-State dispute settlement system, when the host-State injured a foreign investor, the investor's home-State *could have chosen* to initiate a dispute with the host-State through diplomatic protection.[269] Diplomatic protection, however, was subject to a political process, in which the investor's claims and rights are subject to the discretion of the home-State.[270] The next evolution of protection through access to domestic courts was also deemed insufficient given the perceived inherent bias of such institutions. The international investor-State dispute settlement system was established to promote international investments and overcome these challenges.[271] The separation between an investment claim and the political process is essential for the effective protection of investors against damage from foreign States.[272] Accordingly, many investment tribunals have deemed procedural rights to be essential for protecting the substantive rights of investors.[273]

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268. LYALL & LARSEN, *supra* note 43, at 272; Vishakha Gupta, *supra* note 3, at 37; Muñoz-Patchen, *supra* note 28, at 255; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 491.

269. On diplomatic protection, see International Law Commission, *Draft Articles on Diplomatic Protection*, 61 U.N. GAOR Supp. No. 10, art. 1 at 16, U.N. Doc. A/61/10 (2006), https://undocs.org/A/61/10, *reprinted* in [2006] 2 Y.B. Int'l L. Comm'n 26, U.N. Doc. A/CN.4/SER.A/2006/Add.1 pt. 2.

270. FOREIGN INVESTMENT DISPUTES, *supra* note 138, at 3–4.

271. *Id.* at 8–9.

272. The Comprehensive Economic and Trade Agreement, Can.-EU, Oct. 30, 2016, O.J. (L 11) 23, departs from this underlining rationale by establishing of an inter-State court.

273. *See* Siemens A.G. v. Argentine Republic, ICSID Case No. ARB/02/8, Decision on Jurisdiction, ¶ 102 (Aug. 3, 2004), 12 ICSID Rep. 171 (2007); RosInvestCo UK v. Russian Federation, SCC Case No. 079/2005, Award on Jurisdiction, ¶ 130 (SCC Arb. Trib. 2007); Renta 4 et al. v. Russian Federation, SCC Case No. 24/2007, Award on Preliminary Objections, ¶ 100 (SCC Arb. Trib. 2009); KENNETH J. VANDEVELDE, BILATERAL INVESTMENT TREATIES HISTORY POLICY AND INTERPRETATION 345 (2010).

The evolution of international investment law indicates that liability for damage from space debris, without accompanying procedural rights, is insufficient on its own to sway the policy choices of participants against causing damage to individuals. To claim damages against another State, an investor would be required to submit its claim in that State's domestic courts[274] or to convince its own State to initiate the claim, infusing inter-State considerations into the equation.[275] But even if the investor convinced the relevant State, or if the damage caused to a State justified an inter-State dispute, the claimant State would be required to establish jurisdiction for any legally binding award. For the substantive rule to effectively encourage debris mitigation, it must be accompanied by procedural rights.

It is unlikely, however, that a system like the international investor-State dispute settlement system would be established for disputes between individuals and responsible States for damage from debris. The investment protection scheme strikes a balance between the participants: host-States benefit from foreign investments, but these investments also pose a risk to investors. The international investor-State dispute settlement system is intended to reduce such associated risks for investors by establishing a legally binding dispute settlement mechanism. The States that agree to the mechanism (in anticipation of hosting other State's investors) assume the risk and gain the benefit. This simply does not, at this point in time, pertain to outer space.

Consider the following example: State A and State B are both space-capable States interested in promoting private space activities by their respective entities—Entity A and Entity B. Each State benefits from the activity of *its* entity. State B has no incentive to reduce the costs of Entity A by providing it with a potential dispute settlement mechanism if it were to sustain damage from the activities of Entity B. Furthermore, in contrast to the bilateral risk-benefit character of investment systems, space activities are vulnerable to adverse effects by the actions of third parties. So, a suggestion that States A and B may wish to provide a dispute settlement mechanism to reduce the costs of their respective entities disregards the fact that the potential risks and costs for Entity A and Entity B revert to their pre-dispute settlement levels, with the introduction of the risks from activities by an outlier State C.

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274. *See* Larsen*, Does New Space Require New Liability Laws?*, *supra* note 163, at 209.
275. *See id.* at 204.

For such a mechanism to effectively sway policy choices, it must be universal or almost universal. As explained above, at this point, participants, especially emerging ones, may have contradictory incentives, prioritizing short-term gains in wealth and innovation. The international system is not structured to provide international legislative mandates but rather requires a careful balancing of conflicting interests and leverages.

V. THE GLOBAL ORDER FOR SPACE DEBRIS MITIGATION THROUGH THE REGIME EVOLUTION APPROACH

The international regime governing space traffic management, including the mitigation of space debris, will develop through the international lawmaking process, in which the rules evolve pursuant to interactions between participants based on their goals, interests, and leverages. Although it is impossible to anticipate its precise development, this section will outline its anticipated evolution, proposing the adoption of a dynamic regime as its next stage.

To recall, the international rules for space debris mitigation would develop from "responses of key actors to . . . critical event[s],"[276] to shape norms, practice, and law.[277] But it is also important to emphasize that "[a] public order of human dignity is defined as one which approximates the optimum access by all human beings to all things they cherish."[278] Given that the proliferation of space debris risks upsetting society's access to outer space and the benefits such access provides, the international community must aspire to install rules that would promote the highest aggregated gain in values for all participants. The high probability of outliers indicates that any instrument for space debris mitigation must command universality. As the prospects of assembling a parliamentary diplomatic arena to negotiate an authoritative instrument by majority vote[279] are slim, such instrument must be adopted by consensus, thus balancing the conflicting or correlating interests of all relevant participants.

Before turning to the stages of evolution, it is important to delineate the underlining characteristics of the externality in relation to the international lawmaking process. As the review above indicates, space debris mitigation is

276. Reisman, *Incidents, supra* note 64, at 2.

277. *See generally id.*

278. Reisman, Wiessner & Willard, *supra* note 135, at 576.

279. This requires the existence of many participants exerting different leverages. *See generally* 1 UNITED NATIONS CONVENTION ON THE LAW OF THE SEA 1982: A COMMENTARY, *supra* note 13, at 29–86.

a problem of "cooperation" rather than "coordination."[280] Its resolution is in fact "mired by the fact that despite common goals, it is strategically advantageous for every actor to 'cheat.' "[281] As Professor Eyal Benvenisti explained, "The extant literature on global cooperation emphasizes the following as being influential: the number of participants (whether a bilateral or multi-party game); their expectation that they will repeat their engagement indefinitely; and the quality of the information they have about the performance of their partners."[282] He then emphasized that "additional antecedent factors that help predict successful cooperation [include]: (1) scope (whether single-issue or multiple issues); (2) frequency of iterations; and (3) relative vulnerability of the parties."[283]

From a policy perspective, mitigating the adverse effects of space debris constitutes a "super wicked" problem.[284] Richard Lazarus explains that such problems defy "resolution because of enormous interdependencies, uncertainties, circularities, and conflicting stakeholders implicated by any effort to develop a solution."[285] Horst Rittel and Melvin Webber formulated the special characteristics of "wicked" problems.[286] These include, *inter alia*, the absence of a stopping rule to define an "end"; the existence of multiple possible solutions; lack of "true and false" solutions; no ability to determine whether a proposed solution is good; no opportunity for trial and error, with each action leaving " 'traces' that cannot be undone"; and the underlying problem is a symptom of another problem.[287] Building on their analysis, Kelly Levin and her co-authors added four unique features for what they define as "super wicked problems": (1) the time for taking action is running out, "exacerbating the 'one shot' problem"; (2) the absence of a central authority undermines the prospect of cooperation; (3) "[t]hose seeking to end the problem

280. *See* Eyal Benevenisti, *The WHO—Destined to Fail?: Political Cooperation and the COVID-19 Pandemic*, 114 AMERICAN JOURNAL OF INTERNATIONAL LAW 588, 589–90 (2020).

281. *Id.* at 590.

282. *Id.* at 590–91.

283. *Id.*

284. Kelly Levin et al., Playing it Forward; Path Dependency, Progressive Incrementalism, and the "Super Wicked" Problem of Global Climate Change (2010) (unpublished manscript), http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.464.5287&rep=rep1&type=pdf.

285. Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future,* 94 CORNELL LAW REVIEW 1153, 1159 (2009).

286. Horst W. J. Rittel & Melvin M. Webber, *Dilemmas in a General Theory of Planning*, 4 POLICY SCIENCES 155 (1973).

287. *Id.* at 160–67.

are also causing it"; and (4) "hyperbolic discounting," in which decisionmakers discount "evidence of significant impacts, [and] tend to make decisions that disregard this information and reflect, instead, very short time horizons."[288]

Space debris exhibits similar challenges for the international lawmaking process. While scientific consensus may exist, the potentially catastrophic effects and timetables are unclear.[289] Moreover, potential adaptation mechanisms in combination with the natural atmospheric sink magnify the ambiguity of specific risks to participants, increasing the relative costs of any cooperation. Any regime for the mitigation of space debris must be dynamic and of continuing duration because there is no defined "end" for mitigating an externality that increases with space activities. There are multiple possible avenues but no ability to determine, *ex ante*, the most successful path. Critically, given that success needs to be evaluated in the long term, any decision will leave significant factual and regulatory traces, and the possible adverse effects of failure could be catastrophic.

Reducing space debris entails costs.[290] A recent COPUOS report illustrates that for space-capable States, regulations must not hinder the development of private industry, while for emerging participants, regulation must not hamper their ability to develop space capabilities or industry.[291] The report includes calls by States for equity, including the "view that there was a need for *differentiated degrees of responsibility* in the clearing of space debris, in line with the space activities of each Member State."[292]

Reviewing the evolution of the regime for the mitigation of greenhouse gas emissions reveals a stark similarity between the two externalities in relation to the international lawmaking process. The undisputed responsibility of space-capable States for existing debris underlies suggestions for imposing on them increased mitigation obligations and costs.[293] In climate change efforts, the concept of common but differentiated responsibilities similarly responds to the realization that, historically, most emissions were generated by

288. Levin et al., *supra* note 284, at 5–7.

289. *See supra* note 26 and accompanying text.

290. Ferreira-Snyman, *supra* note 6, at 29; Adilov et al., *supra* note 20, at 85, 95; Viikari, *supra* note 101, at 175; Roger Walker & C.E. Martin, *Cost-Effective and Robust Mitigation of Space Debris in Low Earth Orbit*, 34 ADVANCES IN SPACE RESEARCH 1233 (2004).

291. COPUOS Report, *supra* note 157, ¶¶ 121, 124, 231.

292. *Id.* ¶¶ 122, 123 (emphasis added).

293. Muñoz-Patchen, *supra* note 28, at 257; Ferreira-Snyman, *supra* note 6, at 48; Plantz, *supra* note 10, at 617; Viikari, *supra* note 101, at 183.

developed countries, while developing countries must generate such emissions as a byproduct of industrialization critical for increasing their own quality of life.

In addition, similarly to space debris, although some scientific consensus exists regarding greenhouse gas emissions, "there is a great deal of uncertainty about the details," including the severity of the result and ability to adapt.[294] For some developing countries, urgent developmental concerns outweigh future risks from climate change.[295] More importantly, climate change presents a greater danger to developing countries, primarily in the Southern Hemisphere and small island States, than it does to developed northern States, which may even benefit from change.[296] Critically, developed countries possess greater capabilities to adapt to the adverse effects of climate change, arguably reducing their incentive to subject their decision-making process to regulations that impose strict emission reductions.[297]

With increased private and public space activities, the international community must confront yet another super wicked problem. The interactions that developed the regime governing climate change have much to teach scholars and policymakers about the feasibility of any regime to mitigate space debris. As analyzed below, this regime is anticipated to develop in three distinct stages: (1) coordination, (2) cooperation, and (3) regulation.

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294. ERIC A. POSNER & ALAN O. SYKES, ECONOMIC FOUNDATION OF INTERNATIONAL LAW 231 (2013) [hereinafter POSNER & SYKES, ECONOMIC FOUNDATION]; *Scientific Uncertainty*, NATURE CLIMATE CHANGE (Oct. 29, 2019), https://www.nature.com/articles/s41558-019-0627-1; *What are the Uncertainties and Their Implications?*, AUSTRALIAN ACADEMY OF SCIENCE, https://www.science.org.au/learning/general-audience/science-climate-change/8-what-are-uncertainties-and (last visited Aug. 5, 2021).

295. POSNER & SYKES, ECONOMIC FOUNDATION, *supra* note 294, at 231.

296. *Id.* at 231–32; Meetings Coverage, Unprecedented Impacts of Climate Change Disproportionately Burdening Developing Countries, Delegate Stresses, as Second Committee Concludes General Debate, U.N. Meetings Coverage GA/EF/3516 (Oct. 8, 2019), https://www.un.org/press/en/2019/gaef3516.doc.htm; Abrahm Lustgarten, *How Russia Wins the Climate Crisis*, NEW YORK TIMES (Nov. 16, 2020), https://www.nytimes.com/interactive/2020/12/16/magazine/russia-climate-migration-crisis.html.

297. *See, e.g.*, Barry Smith & Olga Pilifosova, *Adaptation to Climate Change in the Context of Sustainable Development and Equity*, *in* CLIMATE CHANGE 2001: IMPACTS, ADAPTATION, AND VULNERABILITY 877, 879–80 (James J. McCarthy et al. eds., 2001), https://www.ipcc.ch/site/assets/uploads/2018/03/WGII_TAR_full_report-2.pdf.

A. Stage of Coordination

In the initial stage of a regime's evolution, the international community engages in scientific discourse defining the problem, intergovernmental discussions begin, and perhaps non-legally binding rules agreed upon. In the case of ocean resources, this was the age of *mare liberum* and its initial transformation during the late nineteenth/early twentieth century. For climate change, this was the stage before the adoption of the 1992 United Nations Framework Convention on Climate Change.

Daniel Bodansky and Lavanya Rajamani identified six stages of development of the current international rules governing climate change efforts.[298] The first three of these stages, labeled "foundational phase," "agenda-setting phase," and "pre-negotiation phase," constitute initial stages of discourse in which the problem is defined, publicized, and elevated to the intergovernmental realm for coordination between governments.[299] Global governance for space debris mitigation is currently at this early stage of development.

The problem was defined, publicized, and elevated to the intergovernmental level where the discourse of the problem has produced non-legally binding international guidelines by space-capable States and the United Nations system, later internalized by States through domestic law. The intergovernmental process continues but on a limited scale. The negotiations of the Artemis Accords, for instance, produced a political commitment rather than legally binding rules and are, in any event, concluded only on a multilateral basis between certain space-capable States. This indicates that the United States and its allies do not currently consider a parliamentary diplomatic arena necessary or desirable. But the conclusion of the Accords indicates that after internalization of the guidelines by States, they were again internationalized, continuing the international lawmaking process.

The interactions observed in the preliminary stage promote awareness and produce "best practices," in which States exchange knowledge and methods to reduce debris. During this stage, each State unilaterally determines the mitigation obligations it imposes on its activities or on those it authorizes. While susceptible to outliers, the limited number of active participants and low risk allowed such rules to effectively sway policy choices while providing States with the flexibility to increase debris in furtherance of national interests (e.g., weapons testing or leeway for investors). This type of

298. Bodansky & Rajamani, *supra* note 262, at 3–20.
299. *Id.* at 4.

governance allows the space-capable States to optimize their gain in wealth, innovation, and security while assuming limited safety risks in the short term.

The currently limited ability of space-incapable States to lodge interfering claims reduces incentives for participants to establish a regime that promotes equity and addresses environmental concerns. As explained above, emerging participants, such as investors and space-incapable States, may prioritize short-term gains in wealth, but given that the activity generates a debilitating externality, others may exert pressure to reduce it. Public pressure may originate from accidents or simply through growing awareness,[300] thus affecting the decisions of these participants. For space-incapable States, such governance facilitates the attraction of investors, but their reduced adaptation capabilities may generate an incentive to accept firmer rules, albeit with certain concessions to alleviate their equity claims.

Thanks to the limited number of active participants, space-capable States have been able to balance their adaptation capabilities with acceptable debris levels. But greater participation of public and private entities diminishes the regime's effectiveness. Despite the augmented adaptation abilities of space-capable States, the increased possibility for outlier behavior, which could threaten gains in wealth, safety, health, and security for these States, propels the need to strengthen manageability. This process will inevitably lead to the regime's evolution from coordination and national regulation to international cooperation. The following section will therefore propose a cooperation regime for space debris mitigation.

B. Stage of Cooperation

Greater participation generates greater incentives for cooperation to alleviate the externality caused by the proliferation of space debris. As Eric Posner and Alan Sykes explained, "[w]hen the behavior of governments deviates from global cost-effectiveness, an opportunity for beneficial cooperation arises that can improve the welfare of all nations *as long as cooperation is not too costly*."[301] Significant policy costs affect the regime's evolution: space debris results from essential activities that have various effects on multiple values for participants and is produced through increasingly frequent interactions between participants with varying levels of vulnerability. Because even minor and random participation could generate debris, successful mitigation must

300. Although the public indirectly consumes space activities, it may not appreciate the risks of an externality removed from daily life until its effects materialize.

301. Posner & Sykes, *Law of the Sea*, *supra* note 227, at 571 (emphasis added).

be inclusive and designed to incorporate the most participants possible, whether active or potential. Inclusivity requires compromises between the interests and goals of varied participants, sounding in levels of discretion, jurisdiction, and compliance mechanisms.

As discussed above, a rigid and static regime would be inappropriate given the dynamic, developing, and inconsistent nature of space activities. A regime must include dynamic elements in its governance structure to optimize values and allow decision-makers to quickly adapt their mitigation and compliance strategies. Because of the participants' varying stages of development and different economic interests, broad consensus requires that any obligations be discretionary and include a bottom-up engagement of the private sector. Although the exact content of the rules will develop through the lawmaking process, to optimize the aggregated gain in values, a feasible regime must include the following elements: (1) principles; (2) dynamic target setting; (3) verification through transparency; (4) bottom-up engagement; (5) dispute settlement; (6) assistance in space traffic management; (7) technological and financial assistance; and (8) preventing the regulatory race to the bottom. Claims relating to these elements will be discussed below.

1. Principles

As explained above, successful global governance for space debris mitigation must be dynamic and of continuing duration in order to accommodate changing technological capabilities and factual circumstances. It must stipulate a set of principles, using generic terms, that would govern the relations between the parties in the long term while allowing for their evolutionary interpretation. Such principles may be articulated in a framework convention (similar to the UN Framework Convention on Climate Change) or a constituent instrument of an organization. The following discussion will outline the most important principles that will guide the other elements of the regime.

Participants must agree upon a definition of what constitutes space debris and the nature of the relationship between this definition and the concept of a "space object" for purposes of liability, responsibility, and jurisdiction. As explained above, the definition must exclude unidentifiable debris, certain dispensable component parts, and perhaps even inoperable equipment from the definition of space objects.[302] Although the reduced responsibility entailed in such a proposition could, *arguendo*, undermine the prospect

302. *See* Arpit Gupta, *supra* note 4, at 247; Muñoz-Patchen, *supra* note 28.

of affecting policy choices through liability,[303] as explained above, liability produces limited, even illusionary, effects on policy choices, especially with respect to small and unidentifiable debris.

Besides clarifying definitions, principles must include a general commitment to undertake best efforts to reduce debris. The obligation may be inferred from the treaties and is incorporated in the Artemis Accords. It also stems from the concept of sovereignty as responsibility[304] and the legal maxim of *sic utere tuo ut alienum non laedas*.[305] As Benvenisti explained, as *trustees of humanity*, sovereign States must take into account the interests of all affected stakeholders in their decision-making process when producing international effects on their interests.[306] Taking into account does not mean affording primacy, but consideration. If all participants remain guided by such a conviction while retaining a certain degree of discretion, the values of equity, environmental protection, and safety could be balanced with wealth, innovation, and security, on a broader scale.

Any inclusive regime must be based, even if only partially, on the principle of common but differentiated responsibilities. But it should avoid prescribing a differentiation in strict mitigation obligations between States, e.g., space-capable and -incapable States, differentiated as Annex I and Annex II parties in a potential treaty. Such differentiation failed to gain traction in climate change efforts. Since the space-incapable States' ability to contribute to the externality in space is significantly lesser than with greenhouse gas emissions, it is doubtful that space debris negotiations will produce such rules. Rather, claims expected to gain broad support include differentiation in limited financial or technological contributions, assistance in adaptation through traffic management, and national differentiation based on State discretion.

To achieve the universality essential for the regime's success, the governance structure should impose obligations of conduct rather than of result, be contingent on national discretion, and encourage participation and compliance.[307] At the same time, obligations must be predicated on principles of scientific accuracy and efficiency. Scholars and policymakers must remember

303. Dennerley, *supra* note 51; Larsen, *Solving the Space Debris Crisis, supra* note 1, at 491; LYALL & LARSEN, *supra* note 43, at 272.

304. On a modern conception of sovereignty, see generally Eyal Benvenisti, *Sovereigns as Trustees of Humanity: On the Accountability of States to Foreign Stakeholders*, 107 AMERICAN JOURNAL OF INTERNATIONAL LAW 295 (2013).

305. *See supra* note 63 and accompanying text.

306. BENVENISTI, GLOBAL GOVERNANCE, *supra* note 80, at 117–36.

307. *See, e.g.*, Bodansky & Rajamani, *supra* note 262, at 29.

that promoting outer space activities and the benefits these provide constitutes the objective of any international regulation. The mitigation of debris serves only as the instrument to achieving this objective. Any international governance structure must ensure debris reduction to the point where any additional resources spent for prevention or removal would exceed the costs produced by the externality itself. While any mitigation targets must necessarily prevent the potential of a Kessler Syndrome materializing, the international community would be required to conduct reasonable risk assessments and set appropriate targets for debris mitigation, subject to subsequent scientific reevaluation. Such targets could vary based on orbit, fragment size, or type of debris but would need to be measurable to avoid incurring costs to reduce debris beyond the point of economic efficiency.

The increase in private activities may diminish the effectiveness of governmental control over activities States have authorized and supervise. Specifically, increased private ventures reduce the effectiveness of the broad responsibility under Outer Space Treaty Article VI as international law. The more private ventures become independent from State activities, the less these ventures should be considered "national activities." Globalization and the possibility of launches without authorization[308] further undermine the effectiveness of Article VI in extending State responsibility for national activities, comprised of all activities by its nationals. Therefore, the international community should consider conforming responsibility and liability issues regarding outer space activities to principles of due diligence and attribution under international law.[309]

Responsibility for private activities in space should align with general attribution under international law. Negotiating an instrument for space debris mitigation provides an opportunity for the international community, especially the space-capable States, to adopt an interpretation distinguishing responsibility based on jurisdiction and presumed degrees of control exercised over relevant entities:[310] (1) jurisdiction over sovereign activities, which translates into overall international responsibility given the assumed high degree

308. *See, e.g.*, Larsen, *Minimum International Norms For Mitigating Space Traffic, supra* note 4, at 755.

309. On liability for space activities, see generally Larsen*, Does New Space Require New Liability Laws?*, *supra* note 163.

310. This approach is similar to, though distinguishable from, the one discussed by Frans von der Dunk. *See* Frans G. von der Dunk, *The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law*, SPACE, CYBER, AND TELECOMMUNICATIONS LAW PROGRAM FACULTY PUBLICATIONS 69, https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1068&context=spacelaw.

of control; (2) supervisory jurisdiction over non-sovereign activities by the relevant non-governmental organizations, resulting in a due-diligence type of responsibility consistent with an assumed lower and fluctuating degree of control; and (3) jurisdiction of member States over activities conducted by international organizations, resulting in a shared overall responsibility with the international organization, again assuming a high degree of State control.

The final, critical principle constitutes the bottom-up engagement of the private sector as part of the international lawmaking process. As Professor Daniel Esty and Dena Adler explained, in the twenty-first century, an international regime architecture based solely on the Westphalian State system is "ill-equipped to deal with many of today's global challenges."[311] Such concerns apply neatly to space debris, not only due to the sheer distance from any effective control by a terrestrial government but also because corporations may exacerbate the externality by employing "flags of convenience," operating from the high seas, and launching independently of any governmental oversight.[312] The development of private capabilities indicates that corporations may become outliers on their own accord,[313] making the effectiveness of any mitigation efforts contingent upon cooperation with the private sector.[314] Private entities should therefore be integrated into the international regime.

2. Dynamic Target Setting

Broadly speaking, three methods exist for swaying policy choices towards mitigating space debris: (1) reliance upon self-enforcement of non-legally binding guidelines, (2) legally binding negotiated commitments for targeted mitigation quantification, and (3) dynamic target setting based on national discretion. As this section will explain, the third option is the most appropriate for achieving this public policy goal.

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311. Daniel C. Esty & Dena P. Adler, *Changing International Law for a Changing Climate*, 112 AMERICAN JOURNAL OF INTERNATIONAL LAW UNBOUND 279, 284 (2018).

312. *See, e.g.*, Caleb Henry, *FCC Fines Swarm $900,000 for Unauthorized Smallsat Launch*, SPACE NEWS (Dec. 20, 2018), https://spacenews.com/fcc-fines-swarm-900000-for-unauthorized-smallsat-launch/.

313. *See id.*; *see also, e.g.*, Kameron Virk, *Tardigrades: "Water Bears" Stuck on the Moon After Crash*, BBC (Aug. 7, 2019), https://www.bbc.com/news/newsbeat-49265125.

314. As a point of reference, with respect to the success of the Montreal Protocol, Benedick explained that "The history of efforts to protect the ozone layer clearly demonstrates the crucial role played by industry in developing and implementing international environmental policy." BENEDICK, *supra* note 259, at 309.

The current international governance regime follows the first approach, but its effectiveness diminishes with increased participants and potential outliers.[315] The second approach includes installing mandatory mitigation standards, financial instruments such as taxes and fees, and specific debris mitigation targets for participants. Although the analogy is imprecise, the Kyoto Protocol attempted a similar regulatory approach for the mitigation of greenhouse gas emissions, failing precisely because of the same policy characteristics exhibited by space debris. The lessons learned from Kyoto indicate that as long as such characteristics persist, the feasibility of participants adopting the second approach is doubtful, as is its potential to effectively sway policy choices towards increased mitigation. The interactions observed so far indicate that the implementation of dynamic nationally based targets, similar to the method chosen in the Paris Agreement, will generate the broad participation essential for successful debris mitigation.

Targets for debris mitigation may be composed of caps on debris generation based on the tonnage of space activities, the number of launches, or the rate of growth.[316] Regardless of the specific metric chosen, it must be relative and measurable progressively. States must be able to demonstrate that through mitigation efforts the relative debris they generate, both short term from launches and long term from deorbiting debris, improves over time. "Improvement" in this sense may be curve-shaped for States developing space capabilities. In the initial stages of capabilities development, a State's debris generation will necessarily increase, but parties would commit to a dynamic reduction process rather than to strict obligations. Such a dynamic process protects the interests of space-incapable States to increase their gain in values through space activities. It does not hamper their ability to develop capabilities, as some claimed in COPUOS.[317] Differentiation based on national interests, while committing to the progressive realization of mitigation objectives, may be acceptable to most, or even all, members of the international community.

In the same sense that the Paris Agreement expects States to increase their ambition for mitigation in every successive nationally determined contribution, any instrument to mitigate debris must also encourage every State conducting or authorizing space activities to progressively reduce the levels of debris it generates. Assume, for instance, that State A is developing space

315. *See supra* Section III.A.

316. For rate of growth, see Viikari, *supra* note 101, at 177.

317. COPUOS Report, *supra* note 157, ¶ 231.

capabilities. Given the need to develop technology and capabilities, the debris generation may be a high level of X at the beginning. In the first commitment, it may thus commit to X+5. In its following commitment, it should aspire to X+2, then X-1, X-5, and so forth. For State B, an established space-capable State, with an existing relative debris generation of Y, it may commit to Y-1, Y-2, and so on.

Dynamic targets promote universality and cost-effectiveness because they reduce the probability that a participant will conclude that the benefits of withdrawal exceed those of compliance. While shaming could marginally affect States' choices, the ability to adjust commitments according to specific security or wealth considerations could promote cooperation even under more modest mitigation targets. As will be explained below, to encourage emerging participants to reduce their relative debris generation, space-capable States should execute agreements to implement limited technology sharing and financial contributions to assist developing participants.

3. Verification Through Transparency

To be meaningful, dynamic targets must be accompanied by transparent tools for the verification of progress. Dynamic targets, by nature, do not command strict verification and compliance mechanisms. But a transparent procedure for evaluating progress could allow administrative bodies to signal the need to increase commitments or shame outliers and motivate action.[318]

Any verification process must not compromise the significant security interests associated with space activities. Therefore, it is reasonable to conclude that military activities and their resulting debris should be exempt from scrutiny as an initial step. As discussed above, although significant debris originated from weapons testing, participants are unlikely to self-impose limitations to testing until they have developed the desired capabilities and further testing becomes unnecessary. Furthermore, given the inherent secrecy involved, States are unlikely to consent to full transparency regarding their military space activities, even if limited to debris generation. As an indication of this, the Artemis Accords limit transparency between space-capable allies to "policies," "plans," and "scientific information."[319] It would therefore be easier to achieve consensus for debris mitigation by excluding purely military

318. *See, e.g.*, Benvenisti, *WHO*, *supra* note 280.

319. Artemis Accords, *supra* note 29, § 4.

activities from either target setting or verification—or both. Admittedly, participants could abuse this limitation, defining civilian activities as "military-related," but the dynamic nature of the targets themselves indicates a minimal adverse effect.

To properly evaluate progress, the verification mechanism must include transparent periodical reporting. The purpose would be "to ensure clarity and tracking of progress towards achieving the parties' NDCs [nationally determined contributions] and adaptation actions, as well as to provide clarity on support provided and received by parties."[320] Space debris originates from activities by some participants while potentially affecting all participants relative to their stage of national development and adaptation capabilities. A reporting mechanism for space debris mitigation should thus extend only to States that launch, procure, or otherwise authorize space activities.[321] It would be counterproductive to extend the reporting responsibility to all activities by nationals; reporting must follow the ability to regulate and exercise some control. As will be further elaborated below, issue linkage between technological and financial assistance and reporting is necessary to ensure proper incentivization of compliance.

Reporting on adaptation capabilities should be performed by all States that may potentially authorize or launch space activities. Such reporting ensures that when launches occur, States avoid creating unnecessary risks to others. Ensuring that all States develop minimal capabilities to avoid debris through information sharing is essential and may require limited concessions from space-capable States. The United States, for instance, already shares its traffic management capabilities with some partners.[322] Assisting others to avoid collisions would benefit the more substantial participants.

Verification must not only rely on data collection but incorporate an independent scientific assessment. The mandate of an independent review must include identifying failures, employing shaming tools, and suggesting improvements when appropriate. Confining the decision-making process of

320. Bodansky & Rajamani*, supra* note 262, at 39.

321. Another alternative is to obligate universal reporting, with space-incapable States allowed to claim an exception and avoid reporting. However, this would infuse an unnecessary bureaucratic step.

322. SPD-3, *supra* note 3; Quentin Verspieren, *The United States Department of Defense Space Situational Awareness Sharing Program: Origins, Development and Drive Towards Transparency*, 8 JOURNAL OF SPACE SAFETY ENGINEERING 86 (2020).

a regulatory international organization risks undermining its ability to respond to evolving risks and to propose necessary measures.[323] It is therefore important that verification institutions can make dynamic interpretations of their constituent instrument and have the power to expose non-compliance.[324] Although shaming seems a poor substitute for enforcement, it has consequences, as complying participants may implement political or economic tools to express their disapproval of non-compliance.

Note that verification of progress is unlikely to be accompanied by trade mechanisms to enforce the obligation to mitigate debris. The Montreal Protocol[325] and the prospect of trade sanctions have been proposed as a model for a space debris instrument.[326] But the circumstances that commanded such measures for the mitigation of ozone-depleting substances (ODS) are distinct from those concerning the mitigation of space debris. This proposition thus disregards the distinct characteristics of the externality in relation to the lawmaking process. The Montreal Protocol[327] imposes obligations on all members to phase out ODSs, even if under differentiated responsibilities, in accordance with fixed timetables. It is enforced through trade sanctions on non-members and non-compliant members.[328] The Protocol successively reduces ODSs and advances the world towards restoring the ozone layer by the mid-twenty-first century. But it was directed at a rather simple problem with specific characteristics. ODSs are specific aerosols used in certain products, produced by limited companies with available alternatives.[329] Replacement of ODSs had limited economic implications and did not require significant investment, while the health risks were certain and extremely high.[330] Critically, production of ODSs was not a necessary byproduct of developing an essential industry to promote other values. Therefore, replacing their use had a limited scope of effect. It is also important to remember that it would have been increasingly costly in both wealth, health, and innovation to try

323. *See, e.g.*, Benvenisti, *WHO*, *supra* note 280, at 595.

324. On dynamic interpretation, see ARSANJANI, DYNAMIC INTERPRETATION, *supra* note 209.

325. Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 1522 U.N.T.S. 3.

326. Vishakha Gupta, *supra* note 3, at 36; Weinzierl, *supra* note 79, at 187.

327. The treaty has since been amended to include additional ODSs. On the negotiating history and success of the Montreal Protocol, see generally BENEDICK, *supra* note 259.

328. *See* Scott Barrett, *The Strategy of Trade Sanctions in International Environmental Agreements*, 19 RESOURCE & ENERGY ECONOMICS 345, 346 (1997).

329. POSNER & SYKES, ECONOMIC FOUNDATION, *supra* note 294, at 229–30.

330. *Id.*

and adapt to the destruction of the ozone layer, to which all participants would be exposed unless it was arrested. It is clear that such characteristics do not apply to space debris, and it is unlikely that State interactions would produce a similar solution.

Trade mechanisms, however, may be employed by interested parties. As was suggested in respect of greenhouse gas emissions, "climate clubs,"[331] or in this case "debris clubs," may be formed as consortiums of interested States to employ trade mechanisms between themselves to encourage further mitigation by parties and non-parties. The IADC and the Artemis Accords serve as examples for coordination and cooperation between major space-capable States concerning space activities in general and debris specifically. Currently, however, given the strained relationship between Russia, China, and the United States, clubs may have little overall effect without the joint participation of these States.

4. Bottom-Up Engagement

As explained above, given the nature of space activities, private participants may become outliers on their own accord or encourage developing participants to lower debris mitigation standards. To ensure the commitment of private entities to the mitigation of space debris, space investors should be allowed to assume international commitments for debris mitigation. In recent years, global governance has shifted from intergovernmental organizations to include many private entities exercising semi-regulatory roles in international law, such as standard setting and verification of compliance.[332] As Esty and Adler noted, the Paris Agreement failed to implement the necessary step of incorporating private entities and subnational units in favor of a strict Westphalian architecture.[333] They explained that "global issues occur along a structural spectrum, with some needing multi-tiered solutions and some being amenable to more traditional top-down solutions. Where on this spectrum a particular issue falls depends on the specific nature of the concern and the distribution of authority and capacity to respond."[334] In the context of space debris, federal units, cities, and municipalities may not be

331. William Nordhaus, *A New Solution: The Climate Club,* NEW YORK REVIEW OF BOOKS (2015), http://www.nybooks.com/articles/2015/06/04/new-solution-climate-club/.

332. BENVENISTI, GLOBAL GOVERNANCE, *supra* note 80, ch. 2.

333. Esty & Adler, *supra* note 311, at 283.

334. *Id.* at 284.

as relevant as they are to greenhouse gas emissions, but the cooperation of space investors is essential for success.

As explained above, corporations will aspire to increase their gains in wealth and innovation, while States should establish rules to promote health, safety, security, equity, human dignity, and environmental protection. But States have conflicting incentives, and space-incapable States may attract investors through lenient regulations, thus sacrificing such values for the benefit of their wealth and innovation. The fact that space activities may largely be removed from terrestrial jurisdiction and control indicates that the cooperation of private entities is essential for mitigating both the regulatory race to the bottom and the debris problem.

In producing debris, space corporations generate an externality that affects their field of operations.[335] Therefore some incentives to cooperate with mitigation efforts exist. This contrasts with the climate crisis, where the businesses generating the externality, such as fossil fuel companies, electricity producers, and auto manufacturers, do not directly suffer the adverse effects. Space debris provides the opportunity to engage the private "polluters" in achieving international public policy objectives.

An international instrument for space debris mitigation should incorporate non-governmental organizations as observers[336] and allow private space investors to assume international commitments for progressive debris mitigation. Investors could benefit from the publicity and respect involved, as well as reduced debris, and space-capable States would offset the leverage space-incapable States may exert in attracting investors with weaker commitments. Space debris mitigation thus provides the opportunity to introduce a new international treaty architecture, modeled on Esty and Adler's proposal.

5. Dispute Settlement

Dispute settlement constitutes an important part of any effective international regulation. In contrast to the mitigation of greenhouse gas emissions, where violations are necessarily non-adversarial,[337] in the case of space debris, certain failures may exhibit adversarial qualities. As explained above, however, as an instrument to affect space debris policy choices, liability is relatively weak, given both lack of jurisdiction and evidentiary problems, and

335. Adilov et al., *supra* note 20, at 95.

336. On non-governmental organizations observer status, see ROSALYN HIGGIN ET AL., OPPENHEIM'S INTERNATIONAL LAW: UNITED NATIONS ¶¶ 8.81–8.85 (2017).

337. Bodansky & Rajamani*, supra* note 262, at 42.

investor-State dispute resolution mechanisms stem from characteristics lacking in space activities. But for cooperation purposes, dispute settlement may be weaker and voluntary, with enforcement between States contingent more on verification than arbitration.

International law usually provides for rather weak enforcement mechanisms relying mostly on reciprocity, power, and outcasting.[338] Many treaties prescribe for dispute settlement through negotiations, non-legally binding commissions, and, on rare occasions, international arbitration. But even when States consent to extensive inter-State arbitration, such as under UNCLOS, exclusions apply, demonstrating that international dispute settlement rarely includes issues at the core of national interests.[339] The prominent exception is found in international investment protection treaties,[340] but even this regime is under stress.[341]

States would probably reject a mandatory third-party decision-making instrument for space debris that would affect their ability to protect their national security and optimize domestic gain in values such as health, wealth, and innovation. Rather, any dispute settlement will likely require negotiations in good faith or prescribe an additional optional consent, as was the case of the optional protocol to the 1958 Convention on the Territorial Sea and the Contiguous Zone.[342] But, were the verification mechanism to allow an extended ability to shame a participant that may reduce the need for any dispute resolution. It should also be noted that private participants may be exposed to compulsory domestic litigation and may be susceptible to enforcement by domestic courts.

6. Assistance in Space Traffic Management

International space traffic management must develop to avoid collisions between active spacecraft and space debris or immovable active objects during

338. *See* Oona A. Hathaway & Scott J. Shapiro, *Outcasting: Enforcement in Domestic and International Law*, 121 YALE LAW JOURNAL 252 (2011).

339. *See, e.g.*, UNCLOS, *supra* note 264, art. 298.

340. Charles H. Brower II, *Politics, Reason, and the Trajectory of Investor-State Dispute Settlement*, 49 LOYOLA UNIVERSITY CHICAGO LAW JOURNAL 271, 272–78 (2017).

341. *Id.*; W. Michael Reisman, *Negotiating and Maintaining Investment Treaties: Mechanisms for Anticipating and Controlling Textual Drift*, 6 JOURNAL OF INTERNATIONAL AND COMPARATIVE LAW 75, 75–6 (2019) [hereinafter Reisman, *Textual Drift*].

342. Optional Protocol of Signature to the Convention on the Territorial Sea and the Contiguous Zone Concerning the Compulsory Settlement of Disputes, Apr. 29, 1958, 450 U.N.T.S. 169.

launch, orbit, or reentry.[343] Adaptation to the space debris problem means developing and deploying monitoring and maneuvering capabilities to avoid space debris and increasing protection capabilities for new satellites and craft, especially from small and unidentifiable fragments. As alluded to above, for an international regime for debris mitigation to be efficient, it must balance mitigation and adaptation. Increasing adaptation may require less investment in mitigation and vice-versa.

Excluding the dreaded, though uncertain, materialization of a Kessler Syndrome, the space debris problem provides for much greater capacity for adaptation than greenhouse gas emissions, thus mandating a different approach. In the case of greenhouse gas emissions, adaptation is analogous to using a band-aid to cover a gunshot wound. Many participants can do little to adapt to rising sea levels that threaten to sink cities and nations, destroy coral reefs and biodiversity, and diminish primary food supplies. But for space debris, participants may avoid a specific activity altogether or successfully adapt through technological innovation by increasing tracking, maneuverability, or protection.

Establishing international data sharing for identification and location of debris[344] not only promotes mitigation but may be acceptable to space-capable States possessing such means. By increasing the ability of States and private entities to avoid debris, space-capable States will achieve gains in safety and security while avoiding injury to other values.

7. Technological and Financial Assistance

Participants wishing to mitigate space debris must incur costs to develop and implement relevant technological innovations. Thus, space-incapable States will likely demand financial assistance and technology sharing from developed space-capable States as a precondition for accession to any international regime for space debris mitigation. The space-capable States will have an incentive for some concession on this point, as increased debris adversely affects their wealth, safety, and security. To prevent a regulatory race to the bottom, emerging participants must be incentivized to implement stricter debris mitigation schemes by, *inter alia*, providing them with the means and technology to do so. To gain broad consensus, however, any such element

343. On space traffic management, see von der Dunk, *Traffic Management, supra* note 183.

344. STUBBE, *supra* note 10, at 446; G.A. Res. 74/82, *supra* note 3, ¶ 13.

must be subject to compliance verification and be more voluntary than mandatory.

In the past, claims for equity of developing participants were accompanied by requests for technology sharing or financial assistance. When raised as preconditions for accessing resources, such claims have had limited success.[345] As long as a level playing field has been preserved, technological edge has not been a source of public outcry.[346] On the other hand, the United Nations Framework Convention on Climate Change and the Paris Agreement provide for technology sharing and financial contributions for developing countries for mitigation and adaptation efforts.

However, while certain elements, such as traffic management and information about the location of debris, may be shared internationally, other elements, such as maneuverability technology and protective equipment are unlikely to be shared. As explained above, space debris mitigation depends on technology, yet the more space-capable States invest in developing a private industry, the more the technology will be proprietary private technology. Adaptation technology, such as maneuvering systems, protective equipment, and guidance systems, may provide a competitive edge for corporations, thus making them extremely valuable. In addition, space technology could be dual-use, meaning that it may have both military and civilian applications.[347] For some participants, providing others with space technology may be akin to promulgating nuclear power as a replacement for fossil fuels.[348] Nuclear weapon programs have been developed under the cover of civilian nuclear power generation, and space programs may be used to develop ballistic missiles.[349]

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345. *See, e.g.*, ROTHWELL & STEPHENS, *supra* note 89, at 18–19.

346. *See* Dani Rodrik, *Populism and the Economics of Globalization*, JOURNAL OF INTERNATIONAL BUSINESS POLICY (2018), https://drodrik.scholar.harvard.edu/files/dani-rodrik/files/populism_and_the_economics_of_globalization.pdf.

347. LYALL & LARSEN, *supra* note 43, at 371, 467; von der Dunk, *Traffic Management*, *supra* note 183, at 391.

348. *See* ROBERT J. GOLDSTON, CLIMATE CHANGE, NUCLEAR POWER AND NUCLEAR PROLIFERATION: MAGNITUDE MATTERS (2011) (prepared for the U.S. Department of Energy), https://www.osti.gov/servlets/purl/1013075.

349. *See, e.g.,* STEPHEN M. MCCALL, CONG. RSCH. SERV., IF 1 0938, IRAN'S BALLISTIC MISSILE AND SPACE LAUNCH PROGRAMS 2 (2020); Uzi Rubin, *Iran's Space Program,* JISS (Sept. 10, 2020), https://jiss.org.il/en/rubin-irans-space-program-2/; Michael R. Pompeo, U.S. Secretary of State, *Iran's Space Program Is Dangerous, Not Peaceful* (Apr. 25, 2020), https://ge.usembassy.gov/irans-space-program-is-dangerous-not-peaceful-april-25/.

In conclusion, some technology sharing will become necessary as debris proliferation increases the costs of space operations for States and investors. The more mitigation technology each participant employs, the less additional investment in both mitigation and adaptation technology would be required for others. At the same time, the significant security implications require finetuning technology sharing to avoid the sharing of dual-use technology. Thus, technology sharing will likely be limited to that which reduces debris during launch or in orbit, rather than to deorbiting technology, which may include propulsion and other capabilities. Investors will, however, be reluctant to share technology, and it is unclear whether overall reduced costs will provide sufficient incentives.

8. Preventing the Regulatory Race to the Bottom

The effectiveness of any instrument adopted for space debris mitigation depends, *inter alia*, on reducing the potential of a regulatory race to the bottom that weakens mitigation controls. To that end, any governance structure must incorporate rules that: (1) reduce incentives for space-incapable States to relax mitigation regulations, (2) facilitate all States in increasing their commitments for debris mitigation, and (3) discourage investors from shifting their operations to a State with lenient mitigation regulations. This section outlines a proposal to utilize the interrelation between international investment law and space debris mitigation to promote such public policy goals.

Esty explains that with respect to terrestrial investments, "there is little empirical evidence of companies moving to 'pollution havens.' "[350] He suggests that differences in environmental commitments may even be beneficial from a trade perspective.[351] While many factors may affect a company's choice to move terrestrial operations, certain counter considerations exist. First, such operations will necessarily be subject to some level of control and risk of a political decision by the host-State, which may or may not be subject to investment protection. Second, certain ventures require natural resources and employees with expertise that may not exist in such "havens." Finally, infrastructure may be difficult to move, jeopardizing long-term reliance upon

350. Daniel C. Esty, *Free Trade and Environmental Protection*, *in* THE GLOBAL ENVIRONMENT: INSTITUTIONS, LAW, AND POLICY 389, 394 (Regina S. Axelrod & Stacy D. VanDeveer eds., 5th ed. 2019) [hereinafter Esty, *Free Trade*].

351. *Id.*

currently lenient regulations, while challenging amendments through investment protection is costly and far from certain to succeed. Space investments are somewhat different in this regard.

Launch facilities will exhibit similar characteristics, but post-launch activities are only theoretically subject to the jurisdiction of the launching or authorizing State. These States, especially if they are space-incapable, may have only a limited ability to exercise control or pose any risk to investments. Operators could register in one State while conducting their operations entirely in another State and threaten to amend such de jure jurisdiction if regulations change. With expropriation and domestic litigation proceedings against investors in host-States becoming less likely, the potential for a race to the bottom increases. To borrow from environmental rules, in certain circumstances,

> competition across jurisdictions may precipitate a welfare-reducing cycle of weakening environmental commitments as political leaders seek to relax their environmental standards to attract investment and jobs. In practice, governments rarely lower their legal standards to improve their competitive position. They may, however, relax the enforcement of these standards or fail to raise environmental requirements to optimal levels for fear of exposing their industries to higher costs than foreign competitors face.[352]

Furthermore, pursuant to what has been called the "governance gap," space investors, like other foreign investors in the past, "may have sufficient economic power to dissuade a state from regulating them, so their duties under local law may be in name only."[353] To encourage emerging participants to impose increased standards on mitigation and progress towards more ambitious targets, any incentive to reduce regulatory enforcement must be counteracted.

Allowing an externality to adversely affect a common area, as Esty insightfully commented, is an "unfair (and economically inefficient) basis on which to establish a competitive advantage."[354] Esty explained how trade agreements might present opportunities to confront such challenges:

> [The North American Free Trade Agreement's] investment chapter also broke new ground in addressing environmental issues. . . . The treaty also

352. *Id.* at 394.

353. Steven R. Ratner, *Survey Article: Global Investment Rules as a Site for Moral Inquiry*, 27 JOURNAL OF POLITICAL PHILOSOPHY 107, 120 (2019).

354. Esty, *Free Trade*, *supra* note 350, at 395.

> contains a "pollution haven" proviso that declares that parties will not seek to attract investments by relaxing environmental standards or cutting back on enforcement—language recently replicated by the EU and Canada in their 2017 trade agreement [the Comprehensive Economic and Trade Agreement].[355]

The North American Free Trade Agreement provision, however, provided only for consultation in case of the commitment's violation,[356] and the recent United States-Mexico-Canada Trade Agreement removed even this symbolic normative statement.[357] Crucially, neither the North American Free Trade Agreement nor the similar Article 24.5 of the EU-Canada Comprehensive Economic and Trade Agreement[358] provides for enforcement of a normative obligation or even excludes projects attracted through relaxed environmental standards from investment protection. An instrument adopted for space debris mitigation must, however, exclude certain investments in space from investment protection. Doing so would discourage corporations from shifting operations to potential "debris havens."

This section proposes two interrelated modifications for the investment protection system: (1) the exclusion of investments located in outer space from investment protection, and (2) the exclusion of foreign investments attracted through lenient debris mitigation standards from the definition of a qualifying investment. These modifications will incrementally affect decisions through their application by investment tribunals, which will be required to take them into account for treaty application and interpretation purposes and application per the Vienna Convention on the Law of Treaties.[359]

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355. *Id.* at 399.

356. North American Free Trade Agreement art. 1114, Dec. 17, 1992, 32 INTERNATIONAL LEGAL MATERIALS 289 (1993).

357. Agreement between the United States of America, the United Mexican States, and Canada art. 14.16, Jan. 1, 2020, https://ustr.gov/sites/default/files/files/agreements/FTA/USMCA/Text/34_Final_Provisions.pdf.

358. Comprehensive Economic and Trade Agreement, *supra* note 272, art. 24.5(1).

359. Vienna Convention on the Law of Treaties, *supra* note 45, art. 31.

i. Exclusion of Investments Located in Outer Space

Investments located entirely or primarily in outer space should be excluded from investment protection. This proposal stems from two interrelated characteristics of such investments: (1) the control exercised by the host-State is limited, and (2) extending such protections is detrimental to the home-State.

In a 2018 issue of the *Journal of World Investment and Trade*, several authors considered the application of the investment law regime to outer space activities.[360] The authors assumed that the extension of investment protection to space activities was warranted or constituted a beneficial international policy. As the international investor-State dispute settlement system is already under serious stress, considering whether such coverage was plausible under definitions found in investment treaties, as the authors had,[361] is insufficient. Scholarship must consider whether the international community would gain from the extension of investment protection to space activities, that is, whether it is good policy and whether expansion could result in another backlash from private capital and technology exporting States as an indicator of whether it would be a good systemic policy. Careful consideration leads to the conclusion that it would not.

Some suggest that providing investors the necessary assurances by extending investment protection would promote the development of space capabilities and would thus be beneficial.[362] This is based on two interrelated misconceptions: (1) the triangular relationship between the home-State, host-State, and investor extends equally into outer space; and thus (2) space investments are identical to terrestrial investments in the sense that protection offsets political risk for investors from the host-State.[363] When space investments are located solely—or primarily—in outer space, the rationale of investment protection under this triangular relationship ceases to exist.

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360. Stephan W. Schill et al., *Oceans and Space: New Frontier in Investment Protection?*, 19 JOURNAL OF WORLD INVESTMENT & TRADE 765 (2018); Christopher Greenwood, *Oceans and Space: Some New Frontiers for International Investment Law*, *id.* at 775; Mahulena Hofmann & P.J. Blount, *Emerging Commercial Uses of Space: Regulation Reducing Risks*, *id.* at 1001; Baumann & Bajjati, *supra* note 137; Malanczuk, *supra* note 137; Hobe et al., *supra* note 137.

361. *See, e.g.*, Hobe et al., *supra* note 137, at 1035–44; Malanczuk, *supra* note 137, at 973–86.

362. Hobe et al., *supra* note 137, at 1034.

363. *See* FOREIGN INVESTMENT DISPUTES, *supra* note 138, at 8–10; SALACUSE*, supra* note 131, ch. 2; Alan O. Sykes, *The Economic Structure of International Investment Agreements with Implication for Treaty Interpretation and Design,* 113 AMERICAN JOURNAL OF INTERNATIONAL LAW 482, 497–500 (2019).

Operating in outer space under a flag of convenience State would only subject the investor to risks arising from the State's modifications to the authorization and its supervision,[364] rather than subjecting its tangible property to potential expropriation. To be sure, licenses and permits issued by host-States would be considered eligible assets under most, if not all, asset-based definitions of investment. Many early definitions of investment were extremely broad, extending to "every kind of asset" and "designed to protect as wide a range of investment forms as possible,"[365] with some specifically referring to "licenses" as examples for such assets.[366] But even the recent United States-Mexico-Canada Trade Agreement, which prescribes a much narrower definition of an eligible investment, would extend coverage to licenses to conduct space activity as these will likely confer rights protected under domestic law.[367] Scholars might quibble over whether it truly includes risk, but risk as an element of the *Salini* test only applies to disputes under the Convention on the Settlement of Investment Disputes between States and Nationals of Other States[368] and treaties that include such conditions under the definition of investment.[369]

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364. To borrow from the terminology used in the Outer Space Treaty.

365. SALACUSE, *supra* note 131, at 180.

366. *See, e.g.,* Energy Charter Treaty art 1(6), Dec. 17, 1994, 2080 U.N.T.S. 95; Agreement between Japan and the Republic of Armenia for the Liberalisation, Promotion and Protection of Investment art. 1, Arm.-Japan, Feb. 4, 2018, https://www.mofa.go.jp/mofaj/files/000343447.pdf; Treaty Between the United States of America and Jamaica Concerning the Reciprocal Encouragement and Protection of Investment art. 1, Jam.-U.S., Feb. 4, 1994, T.I.A.S. 97-307 [hereinafter U.S.-Jamaica BIT]; *see also* Malanczuk, *supra* note 137, at 984–86.

367. United States-Mexico-Canada Trade Agreement, *supra* note 357, art. 14.1 n.2

368. Convention on the Settlement of Investment Disputes between States and Nationals of Other States, Mar. 18, 1965, 17 U.S.T. 1270, 575 U.N.T.S. 159.

369. The *Salini* test refers to three criteria: contribution, duration, and risk. Some International Centre for Settlement of Investment Disputes (ICSID) tribunals have considered these criteria to apply as conditions for an eligible investment under the ICSID Convention through interpretation of the term "investment." While investment is not defined under the ICSID Convention, it is questionable whether such conditions may be interpreted to delineate an eligible investment under investment protection treaties that precisely define the investment. *See* Anglia Auto Accessories Ltd. v. Czech Republic, SCC Case No. V2014/181, Final Award, ¶ 150 (SCC Arb. Trib. 2017), https://www.italaw.com/sites/default/files/case-documents/italaw8556.pdf; *see also* W. Michael Reisman & Anna Vinnik, *What Constitutes an Investment and Who Decides*?, *in* CONTEMPORARY ISSUES IN INTERNATIONAL ARBITRATION AND MEDIATION: THE FORDHAM PAPERS 50 (Arthur W. Rovie ed., 2010).

Under normal circumstances, an authorization or license for a foreign investor to conduct space activities would be covered under many definitions of "investment." Although some treaties may include an "in the territory" requirement either for a qualified investment, or the dispute settlement mechanism,[370] tribunals have varied on how strictly such a "condition" was interpreted or applied to limit the international investor-State dispute settlement system.[371] But while the property itself may be in space, and thus strictly speaking, outside the "territory" of the State, a license to operate is not.

A tribunal faced with a claim by an investor concerning a license is therefore likely, in many instances, to conclude that a license granted by the State is, in fact, a protected investment.[372] Scholars, however, fail to question whether such a conclusion promotes the optimum global order or benefits the international community.[373] Because a license entails supervision, it may include elements relating to the safety of personnel, royalty payments to the host-State, or rules concerning debris mitigation. Revocation or amendment of a license may thus be subject to investment arbitration should it adversely affect the investors' gains in wealth. As a corollary, subjecting such a license to investment protection may affect the policy choices of the host-State in respect of the investor's activities.

The exact scope of protection will depend on the circumstances, including the expectations of the specific investor and any agreement on regulatory stability. Emerging State participants are, however, incentivized to provide such assurances because they may otherwise be unable to participate in space activities and the benefits they entail. As Jean-Michel Marcoux explained, "[w]hen facing the proposition of a large investment on its territory several countries are ready to offer incentives and adopt a legal framework that is consistent with the interests of foreign investors."[374]

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370. *See, e.g.,* U.S.-Jamaica BIT, *supra* note 366, art. 1; Agreement Between the Government of the State of Israel and the Government of Ukraine for the Reciprocal Promotion and Protection of Investments art. 1, Isr.-Ukr., Nov. 24, 2010, https://www.gov.il/BlobFolder/dynamiccollectorresultitem/ukraine_bit/he/international_agreements_ukraine_bit-eng.pdf.

371. *See* Christina Knahr, *Investments "In the Territory" of the Host State, in* INTERNATIONAL INVESTMENT LAW FOR THE 21ST CENTURY: ESSAYS IN HONOUR OF CHRISTOPH SCHREUER 42 (Christina Binder et al. eds., 2009); SALACUSE, *supra* note 131, at 188–92.

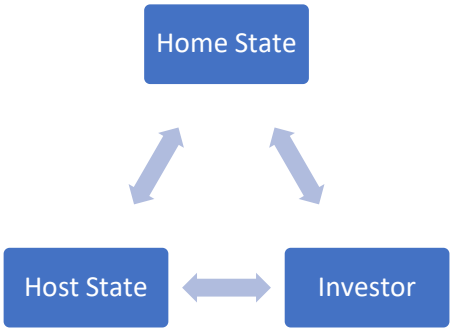
372. *See, e.g.*, Malanczuk, *supra* note 137, at 984–85.

373. *See, e.g., id.* at 979–81; Hobe et al., *supra* note 137, at 1042–44.

374. JEAN-MICHEL MARCOUX, INTERNATIONAL INVESTMENT LAW AND GLOBALIZATION 64–65 (2019).

Emerging State participants may offer corporations long-term benefits in wealth while compromising safety and environmental protection. Extending investment protection to space activities risks perpetuating those policies and exacerbating the regulatory race to the bottom. Although the extent of the risk is unclear, and it is unknown whether a tribunal would be willing to compensate an investor for a regulatory change correcting an internationally harmful activity, there are few justifications for providing such protection in the first place.

Understanding why the rationales of investment protection do not apply to space requires returning to the triangular relationship mentioned above and considering the interests and goals of the participants involved:



The relationship between the investor and the host-State is quite straightforward and revolves around gains and risks to wealth. For the host-State, the investment generates domestic gains through the investor's infusion of capital and technology. Investors invest to increase their own wealth but assume many risks in engaging in foreign investment. These risks include, *inter alia*, expropriation, regulations tantamount to expropriation, revocation of benefits, failure to provide safety and protection, and arrest and imprisonment. Such risks concern the regulatory and police powers of the host-State, which may adversely affect a foreign national or corporation due to a preference for domestic interests over those of foreigners.[375] In agreeing to avail the investors of investment protection, host-States ameliorate, to a certain degree, some of these risks.[376]

375. *See* Sykes, *supra* note 363, at 499.
376. *See id.* at 491–503.

Investors engaged in outer space activities, however, assume significantly lower risks from decisions of host-States. Space investments are not physically located under the control of the host-State, which makes the prospect of expropriation or failure to provide protection quite limited. The investor may operate and control the property from another State, thus not being personally subject to the host-State's police powers. The only element subjected to home-State control is the "license," but it is not difficult to imagine that an alternative "license" might be issued by another State, and the investment transferred to the jurisdiction and control of a different participant. Therefore, investors would assume a very low level of risk while immersing themselves in the protections offered by investment treaties.

But a more stunning realization stems from the fact that home-States have little, or perhaps even opposing, incentives when it comes to protecting foreign space investments by their citizens. Home-States do not conclude investment protection treaties solely for the benefit of their citizens but rather are driven by their own goals and incentives.[377] As Marcoux put it, "Acting as the home states of foreign investors, capital exporting states perceive foreign investment as a means to increase trade with host states, secure procurement in natural resources for their economy and ensure the repatriation of parts of the profits earned by national investors."[378] Space investments flip these incentives.

Home-States of space investors will likely be the developed space-capable States, as is evident from current private ventures.[379] Because these investments can be controlled from anywhere, home-States gain little from having such investments licensed under the domestic laws of another State. As host-States can only attract space investors through regulations, these may allow for increased debris or otherwise "relax the enforcement" of mitigation standards,[380] thus augmenting investors' gains in wealth. But the proliferation of debris increases the costs for all participants in space, with the largest users arguably incurring most costs and risks. Foreign investments in space could be detrimental to the interests of space-capable States, not only from the perspectives of lost revenue, jobs, or resources, but also due to increased costs from debris and potential security and environmental risks.

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377. *See* Jeswald W. Salacuse, *The Treatification of International Investment Law*, 13 LAW AND BUSINESS REVIEW OF THE AMERICAS 155, 158 (2007).

378. MARCOUX, *supra* note 374, at 63.

379. *See* Weinzierl, *supra* note 79, at 177–80.

380. *See* Esty, *Free Trade, supra* note 350, at 394.

States have excluded certain types of investments from investment protection due to adverse effects on their national interests. As Michael Loughlin has shown, the United States-Mexico-Canada Trade Agreement has modified the North American Free Trade Agreement to exclude from investment protection, and thus promotion, both through *ratione materia*e and *ratione personae*, investments deemed detrimental to U.S. economic interests.[381] Given the risks posed to their national interests, space-capable States should strive to exclude foreign investments in outer space from investment protection to discourage investors from transitioning.

One caveat for such a policy concerns the prospect of investors negotiating such terms via contracts with potential host-States. Julian Arato recently suggested that contracts may replace investment protection by allowing investors and States to contract around treaty terms.[382] The problem with Arato's suggestion from an investment protection perspective is that he views investments narrowly as single transactions. In contrast, investments are dynamic long-term processes, with interactions occurring throughout the life of an investment. Investment protections are placed through treaties precisely because the incentives of the host-State change after the initial costs are incurred.[383] After an investment has been made, the host-State has significant leverage to negotiate around treaties for any subsequent investment.

However, for space-related activities, negotiating contracts between investors and States can alleviate some of the dire effects of relying on bilateral investment treaties. Contracts are weaker than investment treaties as instruments for the promotion and protection of investments. Breach of an investment treaty, or withdrawal from it, has broader implications than the breach of a single contract with an investor.[384] More importantly, shifting investor-State disputes from the realm of investment protection to one resembling commercial arbitration through contracts may even entail benefits for public order. It will allow countersuits and be subject to a "public policy" exception for enforcement.

The exclusion of space-based investments from investment protection may be achieved through provisions made part of any instrument concerning space debris or by forcing the renegotiation of existing treaties. Whatever

381. Michael Loughlin, NAFTA Chapter 11 to USMCA Chapter 14 (unpublished manuscript) (on file with author).

382. Julian Arato, *The Private Law Critique of International Investment Law*, 113 AMERICAN JOURNAL OF INTERNATIONAL LAW 1, 26 (2019).

383. Sykes, *supra* note 363, at 498.

384. *Id.* at 500.

the specific mechanism space-capable States may successfully employ, it will be consistent with the distinct situations of such investments, and it will increase the overall gain in values by arresting, even slightly, the regulatory race to the bottom.

ii. Exclusion of Investments Attracted to "Debris Havens"

As explained above, the North American Free Trade Agreement and the Comprehensive Economic and Trade Agreement pioneered a provision that recognizes that the use of lenient environmental rules to attract investments should be avoided. Both treaties, however, failed to provide for the enforcement of this normative obligation. Space debris mitigation provides an opportunity to avoid this mistake and exclude assets procured through the violation of normative environmental obligations from qualified investments.

In a similar vein, many investment treaties include a caveat that covered investments must have been conducted lawfully under domestic law. Intended to confront corruption in investment practice, these provisions exclude investment protection for investments procured through bribes or in violation of domestic law. While many investment cases include allegations of misconduct, few have excluded protection based on those claims. Exclusion based on corruption is debatable, to say the least; it is a claim available to one side to the detriment of the other, although both are in the wrong.[385] An investor is denied the right to benefit from conduct that is denounced internationally, even if officials demanded it as a de facto prerequisite for investment.

The same rationale applies to space debris. Engaging in space investments through flag of convenience States to the detriment of the other members of the international community is not only unfair, but it should similarly exclude international protection. From an international perspective, by promoting such conduct, the host-State not only fails to consider the interests of foreign stakeholders but acts contrary to the interests of the international community, thus adversely affecting all participants.

Concluding that an investment was attracted through a "debris haven" would require a tribunal to evaluate whether the regulations in place or their enforcement were, in fact, unacceptably lenient. If the case concerns the

385. *See* Andrew T. Bulovsky, *Promises Unfulfilled: How Investment Arbitration Tribunals Mishandle Corruption Claims and Undermine International Development*, 118 MICHIGAN LAW REVIEW 117 (2019).

"weakening" of enforcement, an analysis by a tribunal can be straightforward, but to conclude that regulations were lenient to begin with will require a comparison to other States. As the claim would be raised by the State vis-à-vis the investor, the State would be required to muster evidence in that respect. The history of investment treaties shows that when arbitrators are provided with generic terms and broad obligations, they tend to develop those terms and obligations through interpretation and application.[386] While the application of such a treaty may take on a life of its own, when an investor actively engages in conduct to the detriment of the international community for personal gain, international law should not protect and perpetuate the wrongful conduct.

For the reasons given above, space-capable States possess an incentive to promote such a rule when it comes to space debris, even if they lack such incentives for other environmental concerns. Space debris is a prime candidate for pioneering an amendment to the international investment system that may, in the future, spillover and increase gains in health and environmental protection in other areas as well.

C. Stage of Regulation

The regime proposed in the second stage would only remain effective as long as participants cooperate, States retain significant control, and the number of interactions remains moderate. Certain intervening factors may render this regime ineffective, but as space activities increase, it will necessarily develop further. Such development may generate claims to install some of the instruments proposed by scholarship today, but that would only become effective and feasible when situations and interactions change. The following analysis of these possible developments could facilitate a quick and informed response by policymakers.

A significant increase in private space activity may reach a point at which State authorization and supervision will no longer constitute effective regulation. In addition, as evident from the Artemis Accords,[387] claims will be made for evolving security zones around space installations, perhaps developing to resemble those around artificial islands and ocean installations.[388] Absent effective State control, and with participants subject to multiple jurisdictions, interactions will begin to resemble those observed in maritime

386. *See generally* Reisman, *Textual Drift, supra* note 341.
387. Artemis Accords, *supra* note 29, § 11.
388. UNCLOS, *supra* note 264, art. 60.

shipping or commercial aviation. This may generate the incentives necessary to establish legally binding rules for safety, which will likely include debris prevention and avoidance.[389]

With the development of technology necessary to remove space debris from orbit, and especially should such debris removal activities become cost-effective, the interpretation and application of jurisdiction and responsibility will be forced to evolve accordingly. In respect of space resources, the United States chose to present its claim to recognize property rights as an interpretation of the Outer Space Treaty rather than to attempt its amendment. This was a sensible path. The treaty includes provisions for the prohibition of sovereignty claims, certain military activities, and the placing of nuclear weapons in outer space. Any attempt to renegotiate the treaty may have led to the renegotiation of these provisions, which is premature at this juncture. A similar path should be chosen in respect of space objects. Through interpretation, participants will need to further qualify claims to retain jurisdiction over inoperable space objects, supported by the evolving context, including the technological ability to remove them in a commercially viable way.

A critical intervening element in the development of the regime for space debris may stem from security considerations. Significant proliferation of space debris by space-incapable States and corporations will necessarily adversely affect the security interests of space-capable States. Thus, if the regime proposed above was adopted, but participants, particularly space-incapable States, failed to comply, incentives could be generated for legally binding mitigation targets. Were the security interests of space-capable States seriously undermined, even before a Kessler Syndrome materializes, they would be incentivized to use their economic and military power to enforce compliance with rigid debris standards. Whether or not such an eventuality will occur, or whether it would be beneficial, remains to be seen.

VI. CONCLUSION

Space activities by both public and private entities usher in a new age of human development. But the new "Space Age" offers challenges in human rights, governance, and environmental concerns. This article analyzed the challenge to governance posed by space debris through the perspective of

389. *See, e.g.*, Larsen, *Solving the Space Debris Crisis, supra* note 1, at 503–6.

policy-oriented jurisprudence. It evaluated the development of the global order through a process of claims and counterclaims that will shape the development of the rules through a dynamic, evolutionary, international lawmaking process. Based on this analysis, the article proposed adopting a dynamic regime to mitigate space debris as the next stage of the regime's evolution toward a feasible, effective, and manageable global order.