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INTRODUCTION

The Emerging Commercial Space Age: Legal and Policy Implications

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Once considered the final frontier, outer space has become the modern day Yukon territory. A burgeoning commercial economy is reshaping the balance of powers and expanding the breadth of activities beyond our atmosphere. Outer space is no longer the exclusive province of a select number of nation states engaged in geopolitical competition. A robust private sector has begun to stake its claim, ushering in a fundamentally different incentive environment that answers to shareholders and venture financers. As a consequence, the principles that persisted

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from the Cold War, and ultimately motivated the Outer Space Treaty[1] and its subsequent counterparts,[2] are no longer sufficient. Truth be told, they were never expected to be so. The United Nations Committee on the Peaceful Uses of Outer Space ("COPUOS") never contemplated commercial uses when it adopted—and many nations subsequently ratified—its longstanding space treaties. While private actors have interacted with this environment for decades, the commercial space industry has only recently reached a point of maturity where entities can productively utilize orbital environments, cultivate an entirely new source of natural resources in lunar and cislunar space and further explore the translunar realm. Commercial space is having its moment, and it represents a monumental paradigm shift for space law and policy.

Considering the radical evolution of actors and activities in space, do the instruments and institutions that oversee it need to evolve as well? Traditional forms of public international lawmaking—multilateral treatymaking and institution building followed by each participant's cooperative consent—may not meet the needs of private actors who bear little affiliation to the country they select to license their operations. Similarly, domestic regulations and policies from a government-mission minded era appear ill suited for the novel complexities of the commercial launch and communications capabilities that are rapidly eclipsing those of national governments. The diverse set of actors and activities in outer space also introduce a novel set of contexts and conflicts that impact private law. In effect, commercial space activity is spurring change that no one track can resolve independently, necessitating pluralist reform that extends the bounds of both public and private law.

A second-order problem that emerges is how to manage an ecosystem in which collective commercial interests diverge from national interests. As many nations become dependent on commercial space services and infrastructure, the balance of power is shifting toward a new calculus. Decisions by private actors now impose externalities that national actors experience immediately and directly, and vice versa, making both sides of the public-private dichotomy increasingly intertwined. Thus, if the law is intended to evolve into more efficient, wealth-maximizing rules, we must also ask who reaps the benefits of these efficiencies, and do they lead to

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[1] 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, 610 U.N.T.S. 205 (entered into force Oct. 10, 1967) [hereinafter Outer Space Treaty].

[2] 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; Convention on the 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]; Convention on Registration of Objects Launched into Outer Space, Nov. 12, 1974, 1023 U.N.T.S. 15; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].

sound policy?

These questions are vexing but timely and provide ample room for further scholarly development exploring ways to better manage the use of outer space. On February 3, 2023, the *Journal of Law & Innovation* hosted its symposium, "The Emerging Commercial Space Age: Legal and Policy Implications" at the University of Pennsylvania Carey School of Law.[3] The Symposium brought together leading international law scholars, economists, and telecommunications and antitrust policymakers to assess the twenty-first century space domain and its implications for legal and policy frameworks. Panelists and moderators emphasized the progress of commercial enterprise in outer space, how these increasingly complex and multifaceted interests would influence international space law and the paradigm shifts that must emerge in economic regulation and public policy to foster innovation and sustainable competition. The Articles in this volume touch each of these considerations and are an outgrowth of the presentations and moderated discussions at the Symposium.

I. COMMERCIAL SPACE AND THE PARADIGM SHIFT IN INTERNATIONAL LAWMAKING

A number of contributions to this volume address the methodological shift in public international law being realized in an era of commercial space activity. Traditional, "top-down" governance appears antiquated for an increasingly blended environment comprised of both public and private actors. The top-down approach was effective, in part, because of its simplicity and linearity—a treaty or institution disseminates general rules and principles, nations subscribe and commit to these principles through their own internal procedures, and these commitments then establish a common ground for continued, multilateral coordination. But this simplicity was predicated on an environment consisting of a relatively small number of nation-state actors, each of whom was similarly resourced and motivated by a common set of interests or pressures. Even when those actors had diverging interests, the way they interacted was familiar.

Commercial actors do not share these commonalities. A corporation's motives are uniquely tailored to their business plans and profit motives, neither of which easily conform to generalist, top-down governance. Instead, private actors actively seek to invert this framework by advocating for "bottom-up" governance in which they can shape domestic policymaking and subsequent development of international law to reflect their interests. The dramatic growth in commercial activity is putting

[3] The symposium program and webcasts of the presentations and discussions are available at https://www.law.upenn.edu/institutes/ctic/jli/events.php [https://perma.cc/5RPG-PEDM].

force behind this re-calibration of international lawmaking, with business curated legal rights and interpretive rules that supplant traditionalist, multilateral lawmaking and coordination.

Melissa J. Durkee, a leading authority on international governance, considers this shift in the groundwork of space law to be emblematic of a broader shift in twenty-first century international law.[4] Durkee suggests that this bottom-up methodology will emerge through evolutive international lawmaking that relies on interpretation of existing treaties and development of customary norms. Evolutive lawmaking leverages incremental, practice-based reforms to confirm the meaning of general principles and rules, or to craft new customs, through governmental practices and relevant activities. Commercial industry comes into play when they shape these reforms to align with their business objectives. This "interpretive entrepreneurship" resembles classical liberal theories of international relations, in which private actors shape domestic policies that then direct the positions that nations take in international fora. Critically, Durkee points out that evolutive lawmaking offers private actors a broader array of opportunities with fewer temporal constraints. For example, the United States is currently pursuing interpretive lawmaking in the space sector through multiple parallel conduits, including legislation through Congress;[5] Executive Branch activity;[6] norm-building through civilian organizations, such as NASA's Artemis Accords;[7] and contractual activity that validates an interpretive position, much of which is directed at a that has been in force for well over fifty years.[8] These flexible, ex-post machinations are more commonly known as standards and provide commercial actors the advantage of giving content to international law once they are aware what circumstances are preferable.[9]

But the ex-post crafting of international law through corporate-minded interpretations also complicates global consensus building. Specifically, if each

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[4] Melissa J. Durkee, *Space Law as Twenty-First Century International Law*, 6 J.L. & INNOVATION 11 (2023).

[5] *See e.g., Babin and Lucas Introduce Legislation to Modernize Commercial Space Sector*, COMM. ON SCI. SPACE AND TECH. (Nov. 2, 2023), https://science.house.gov/2023/11/babin-and-lucas-introduce-legislation-to-modernize-commercial-space-sector [https://perma.cc/FVU3-H3RR].

[6] *See e.g., National Space Council*, THE WHITE HOUSE, https://www.whitehouse.gov/spacecouncil/ [https://perma.cc/B7PU-WZJ3] (last visited Nov. 28, 2023).

[7] The Artemis Accords: Principles for Cooperation in The Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, National Aeronautics and Space Agency (Oct. 13, 2020).

[8] Sandra Erwin*, Pentagon Looks To Commercial Space For An Edge*, SPACE NEWS (Nov. 27, 2023), https://spacenews.com/pentagon-looks-to-commercial-space-for-an-edge/ [https://perma.cc/24H9-SQWL].

[9] *See* Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L. J. 557, 580 (1992).

nation acts as proxy for its private-sector interpretation of what the law is, these interests may emerge as mutually exclusive alternatives. Durkee refers to this as parallel lawmaking but acknowledges its more colloquial label—fragmentation. In the long-run, one interpretive theory is likely to prevail; however, the road to get there will be circuitous and filled with friction, evinced by the disparate paths being taken by the United States and its geopolitical rivals, Russia and China.

One context in which these disparate tracks are emerging is the exploration and use of resources on celestial bodies, commonly referred to as "space mining." The legality of commercial exploitation of natural resources on lunar surfaces has emerged as one of the most contentious topics of disagreement on the international stage. Frans von der Dunk, one of the world's foremost experts on space law, provides a complete assessment of the interpretive theories associated with space mining and the implications of these perspectives for space law.[10] Von der Dunk notes that the Outer Space Treaty did not envision or specifically address exploitation of lunar resources, leaving only interpretation of the vaguely ascribed principles in various articles of the text. Notably, Article I establishes that "[o]uter space, including the Moon and other celestial bodies, shall be free for exploration and use by all States."[11] Meanwhile, Article II declares that the same defined domain "is not subject to national appropriation by claim of sovereignty" through possession, use, or anything in between.[12] These provisions create an interpretive tension that allows for conflicting conclusions. On one hand, Article I appears to endorse any actor utilizing lunar resources, so long it does not exceed the general boundaries of international space law. On the other, Article II seems to suggest that equities would be threatened unless and until a public governance regime is in place for conserving joint lunar resources that belong to all nations.

The interpretive materials that many actors intentionally do not recognize may be just as influential as those that they do. For example, the United States—arguably the strongest advocate of an Article II-centric "freedom of activity" approach—has renounced the Moon Agreement as an applicable instrument for interpreting international space law. Von der Dunk notes that the motive for avoiding the Moon Agreement is that it expressly requires development of procedures for international governance of lunar resource exploitation.[13] The United States and others abandoned adoption of these procedures—and in the United States case, the Moon Act entirely—in the mid-1990's following their dismay over implementation of a similar

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[10] Frans G. von der Dunk, *Property Rights Over the Moon or On the Moon? The Legality of Space Resource Exploitation on Celestial Bodies*, 6 J.L. & INNOVATION 93 (2023).

[11] Outer Space Treaty, *supra* note 1, art. I.

[12] Outer Space Treaty, *supra* note 1, art. II.

[13] *See* Moon Agreement, *supra* note 2, art. 11.

provision for the Law of the Sea.[14] Such a regime is fundamentally inapposite to the United States position of open authorization and continuing supervision of space mining on lunar surfaces by the numerous commercial actors investing in the sector and actively contracting with the United States government. The United States strategy makes clear that the practice-based reforms are equally offensive and defensive. Not only must public and private actors openly advocate for the interpretation that aligns with their underlying public and private sector interests; they must also disclaim any additional, opposing avenues of practical interpretation or customary law before they reach consensus.

Each of these dynamics presuppose that the incentives and interests of commercial enterprises directly align with the nation states through which they bootstrap governance and that conflict occurs only at higher levels of international lawmaking. But there is ample evidence to suggest that frictions between commercial and public interests persist throughout the process. Gershon Hasin, a theorist in international law, directly confronts these complications and the avenues for shaping decisions.[15] Following the frequented theme of policy-oriented jurisprudence in this issue, Hasin focuses on anti-satellite ("ASAT") weapons and their continued testing through the militarization of outer space. In particular, the unwillingness of several national powers to relinquish their right to develop and place weapons in orbit has prompted geopolitical rivals to hold steadfast to their ASAT capability, ultimately leading to an impasse between competing factions and a collective action problem on the international stage. But, as Hasin explains, the geopolitical conflict is only a bookend to the frictions that exist. Notably, the militarization of outer space has implications for the commercial players in both factions, jeopardizing the security and financial interests of private entities that could become collateral damage in a space conflict.

While military objectives may have previously eclipsed commercial interests, the recent ascendancy of commercial activity has redefined this balance. As one symposium author aptly states, "commercial capacity has outstripped what many nations can do,"[16] leading to a defense establishment that is increasingly reliant on commercial actors to provide underlying resources and services. The U.S. Department of Defense exemplifies this growing dependence by rapidly expanding its private contract arrangements with its traditional "Big 5" contractors and relatively new entrants, such as SpaceX, to furnish capabilities across a myriad of critical outer space functions. As explained in a separate context below, this engagement with commercial enterprise should be welcomed, particularly because

[14] U.N. Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397.

[15] Gershon Hasin, *Controlling Decisions on Anti-Satellite Weapons: A Policy-Oriented Perspective*, 6 J.L. & INNOVATION 32 (2023).

[16] *See* Durkee, *supra* note 4, at 14.

such franchise bidding enables competition for the market.[17] Contestable markets allow the government to reap cost efficiencies from competitive bidding, all while simultaneously leveraging private research and innovation.[18] A byproduct of this dependence is that commercial interests have more sway in the government's decision-making. This use of private actors' reliance on economic measures to shape government behavior is one of five potential paths for policy-oriented international lawmaking that Hasin identifies but is arguably the most prolific to date.

II. REGULATORY POLICY FOR THE MODERN SATELLITE ECONOMY

The proliferation of satellite mega-constellations in low-earth orbit is a byproduct of the competitive evolution of telecommunications services. Much like its terrestrial counterparts, the satellite communications industry was initially structured as a natural monopoly. The United States incorporated Comsat in 1963,[19] and subsequent intergovernmental joint-ventures such as Intelsat, Inmarsat, and Eutelsat all followed the same template—government embeddedness and oversight, defined market operations, and common carriage treatment through rate regulation. But the costs of this pervasive regulatory micromanagement far exceed any costs of competition, meaning that such a template would only be efficient if the market for satellite communications was a bona fide natural monopoly.[20] In the throes of the de-regulatory movement of the 1970s, it became clear that the telecommunications industry did not fit the mold, regardless of transmission technology. Technological innovation would erode the economic arguments that had justified an integrated monopoly, enabling market entry and competition within the industry. The liberalization of space quickly produced numerous competitors for long-distance communications and the concomitant reduction in prices opened entirely new industries, such as satellite distribution of cable TV programming and direct broadcast satellite networks.

The demands of the Internet caused another market shift, leading to a second wave of satellite industry investment and market entry in the late 2010s, this time in low-earth orbit ("LEO"). Following Joseph Schumpeter's theory of creative

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[17] *See, e.g.*, Harold Demsetz, *Why Regulate Utilities?*, 11 J.L. & ECON. 55 (1968).

[18] *See generally* WILLIAM J. BAUMOL, JOHN C. PANZAR, & ROBERT D. WILLIG, CONTESTABLE MARKETS AND THE THEORY OF INDUSTRY STRUCTURE (1982). *But see* Oliver Williamson, *Franchise Bidding for Natural Monopolies—In General and with Respect to CATV*, 7 BELL J. ECON. & MGMT. SCI. 73 (1976).

[19] The Communications Satellite Act of 1962, Pub. L. No. 624, 76 Stat. 419 (1962) (codified at 37 U.S.C. § 701). For the Articles of Incorporation in their initial form, see 2 ILM 395-416 (1963).

[20] E. THOMAS SULLIVAN ET AL., ANTITRUST LAW, POLICY, AND PROCEDURE 1114 (8th ed. 2019).

destruction,[21] satellite communications is actively reinventing itself by innovating to lower orbits. Previously, LEO satellite deployments had been considered uneconomical, with operational costs far exceeding the latency reductions of operating at much lower altitudes. A LEO constellation requires hundreds of satellites to achieve the same coverage as a single geosynchronous satellite, each of which decays from its operating orbit in a fraction of the time. But dramatic improvements in launch services, such as reusability of rockets, and modernization of satellite components, such as multi-frequency phased array antennas and efficiencies in computational hardware, have made low-earth orbit a cost effective reality.

Former Federal Communications Commission ("FCC") Chief Economist Thomas Hazlett, along with co-authors Dongning Guo and Michael Honig, observes that this economic dynamism compels regulatory promotion of a forward-looking property rights regime.[22] As the authors recognize, gains in productivity often increase the relative value of scarce orbital and spectrum resources prompting exclusive rights that can efficiently accommodate the flow of resources to their highest valued uses. This evolution is rooted in the pioneering work of Harold Demsetz, who explained that competition for access should compel legal rules for exclusive property rights that internalize economic externalities and maximize productive use.[23] Recognition of such property rights creates three benefits—first, rightsholders have superior incentives for investing in and developing resources; second, the right to exclude eliminates rent dissipation and premature consumption; and third, more defined boundaries enable management and control of spillovers.[24]

The authors emphasize these rationales, explaining that the thousands of satellites now seeking access to space require an improved method for claiming rights that regulators such as the FCC must facilitate. This very evolution already occurred in the terrestrial context following Congress's authorization of spectrum auctions in the 1990s that pioneered the practices that persist today.[25] In contrast, satellite spectrum remains behind the times. Despite burgeoning interest and billions

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[21] JOSEPH SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 83 (1942).

[22] Thomas W. Hazlett, Dongning Guo, & Michael Honig, *From "Open Skies" to Traffic Jams in 12 GHz: A Short History of Satellite Radio Spectrum*, 6 J.L. & INNOVATION 66 (2023).

[23] *See* Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 350 (1967).

[24] *Id.*; *see also* Thomas W. Merrill, *The Demsetz Thesis and the Evolution of Property Rights*, 31 J. LEGAL STUD. S331, S331-33 (2002).

[25] Spectrum assignment via competitive bidding in an auction setting was first authorized in 1993 for commercial wireless communications. Prior to the authorization, spectrum licenses were awarded through regulatory processes (e.g., specific applications and comparative hearings) or lotteries. *See* Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, § 6002(a), 107 Stat. 312, 387-92 (1993) (codified at 47 U.S.C.§ 309(j)).

of dollars invested in next-generation satellite systems, their operators still rely on an open-access rights system in which orbital and frequency resources are shared.

This type of property regime is inconsistent with the competitive ambitions and dramatic increase in relative value of satellite broadband. Most regulatory bodies continue to permit an unbounded number of operators to apply for satellite systems, each of which is granted access to, and must coordinate sharing of, the band. As a consequence, the property rights that satellite operators attain actually diminish over time as new competitors enter the market. This leads operators to register claims for significantly more resources than they ever intend to use, imposing additional information costs on competing operators that must discern fact from regulatory fiction. Satellite licenses are also poorly suited to demand revelation because they are not easily transferred through secondary markets. Unlike terrestrial flexible-use licenses, nearly all regulators issue highly bespoke satellite authorizations that are tailored to the specific operations of an applicant's system. The lack of flexibility in the license itself makes secondary transfers nearly impossible.[26]

The need for modernized regulatory treatment of emerging satellite systems also extends to the programs that subsidize broadband access. Numerous markets present cost barriers or sparse revenue opportunities that make operating a network unprofitable. In such instances, modern subsidy programs rely on franchise bidding to promote competition for the market in order to achieve competitive pricing despite awarding an exclusive right to supply.[27]

Gregory Rosston, who was an economist at the FCC during implementation of the Telecommunications Act of 1996, and Scott Wallsten, who was director for the FCC's National Broadband Plan, focus on one pervasive failure of such programs: they either severely limit or exclude satellite broadband.[28] Rosston and Wallsten argue that the emergence of LEO satellite broadband removes many of the network performance limitations previously justified its exclusion from subsidy programs.

Yet political influences have kept satellite services on the outside looking in. Relying on empirical data from the FCC's Rural Development Opportunity Fund, Rosston and Wallsten measured the economic harms of the FCC's ex-post exclusion of auction winner satellite provider SpaceX. Two major risks are evident from the

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[26] An insightful example is the defunct satellite operator Theia, whose still active FCC authorization remained under the control of a court appointed receiver throughout its protracted search for a buyer. *See* FCS Advisors, LLC v. Theia Group, Inc., No. 21-cv-06995 (PKC), 2021 WL 5042719 (S.D.N.Y. Oct. 29, 2021). The eventual sale of substantially all of Theia Group's assets to one of its secured creditors generated its own controversy. FCS Advisors, LLC v. Theia Group, Inc., No. 21-cv-6995 (PKC), 2023 WL 7103284 (S.D.N.Y. Oct. 26, 2023).

[27] *See* BAUMOL, PANZAR, & WILLIG, *supra* note 14.

[28] Gregory Rosston & Scott Wallsten, *Should Satellite Be Included in Universal Service Subsidy Programs?*, 6 J.L. & INNOVATION 134 (2023).

data. First, exclusion limits the cost effectiveness of subsidies by deferring to second-best alternatives where, in many cases, satellite services provide a cheaper transmission technology option. Second, by picking technologies, regulators dissuade market entry and impede intermodal competition. Rosston and Wallsten's prescriptive response is simple: satellite broadband has become a viable alternative for broadband services, so let it enter the competitive landscape for connecting the unconnected.

III. SIZING UP THE PRIVATE LAW EFFECTS OF A NEW SPACE AGE

The ascendancy of private enterprise in outer space places newfound importance on private ordering and the legal institutions to manage potential use conflicts. Private law governs the relationships between persons, relying on baselines furnished by the law to make the complex interactions between private parties a tractable problem. Commercial space operations spark a renewed debate between contextualism and formalism and a novel context for assessing where private law must be refined.

Authors in this volume explore these dynamics through property rights design and governance regimes. These discussions serve as a useful initial inquiry, considering that property is the foundation for the rest of private law.[29] For example, Hazlett and his co-authors present useful initial sketches of exclusive property rights in outer space that specify permissible interference limits at receiving locations. Critically, the engineering design of orbits and spectrum create additional dimensions of potential conflict that affirm the need for a more formalist, architectural approach to property. In the context of spectrum transmissions alone, satellite operators must consider the complications of geographic spillovers, adjacent-channel spillovers, co-channel systems at altitudes above or below an operator, receiver elevation angles that dictate the horizon for potential interference, and the number of co-frequency satellite beams transmitting at a given point on earth. This dynamism lends itself to a more modular conception of property in which certain characteristics may be decomposable, while others are intimately bound by interdependencies.[30]

The complications of private space activities are particularly pronounced for liability conventions under tort law. As Hasin recognizes in the context of ASAT operations, any outer space function that creates debris—intentionally or

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[29] For discussion on this perspective, see Henry E. Smith, *Property as the Law of Things*, 125 HARV. L. REV. 1691, 1691-94 (2012).

[30] This conception is rooted in the groundbreaking work on modularity by Carliss Baldwin and Kim Clark. *See* CARLISS Y. BALDWIN & KIM B. CLARK, DESIGN RULES: THE POWER OF MODULARITY 58-59, 236-37 (2000).

negligently—risks spurring a collision event. However, under the Liability Convention, a launching state is only liable for damages due to its fault or the fault of a culpable commercial entity under its registration.[31] Even when fault can be established, indemnification is complicated by complex commercial agreements under which launch providers provide rideshare services for satellites registered in numerous countries, each of which contain on-board hosted technical payloads owned by separate entities. While contract provisions may address such liability, it is unlikely that every commercial agreement would completely contemplate every scenario. These complexities are even further complicated when considering changes in private ownership. The New Skies NV saga exposed the limitations in the liability and oversight of satellite systems after the Netherlands refused to register the satellites that a Dutch company acquired from Intelsat in order to avoid any association of liability going forward.[32] As a result, the original launch nation of these satellites remained formally liable despite no longer having any oversight of their operator and therefore having no practical ability to supervise the satellites.

Finally, von der Dunk expounds on the broader private law challenges that come out of the Registration Convention. Notably, many operators already seek "flags of convenience" from licensing countries to which they bear little-to-no relation simply to avoid oversight by their real home states. Entrepreneurial operators may take it a step further by developing highly complex corporate structures, bidding vehicles, and licensing entities in an attempt to conceal themselves from obligations in their home country. These circumstances present a scenario that is analogous to conflicts in agency theory, where piercing the corporate veil may be necessary to avoid inequities.[33]

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The Articles in this volume present important analyses and relevant scholarly contributions that will inform the burgeoning commercial space age. We, along with all of the conference participants, are grateful to the Center for Technology, Innovation and Competition for its support of the symposium and the *Journal of Law & Innovation*.

[31] Liability Convention, *supra* note 2, art. III.

[32] *See In the Matter of New Skies Satellites, N.V.*, 14 FCC Rcd 13003 (1999).

[33] *Cf.* Barcelona Traction, Light & Power Co. (New Application: 1962) (Belg. v. Spain) (1962-70) 1970 I.C.J. 3 (Second Phase).