

Testimony of Laura Montgomery
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Subcommittee on Space
The Commercial Space Landscape: Innovation, Market, and Policy
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Chairwoman Horn, Ranking Member Babin, and Members of the Subcommittee, thank you for inviting me to participate in your discussions of the issues surrounding commercial space activity.

In my testimony, I will address the regulatory landscape, how to tell whether a launch or reentry needs a license or is a government activity, concerns with Federal Aviation Administration (FAA) and Federal Communications Commissions (FCC) forays into regulating matters outside their jurisdiction, and three contentious issues under the Outer Space Treaty. I will close with an analysis of how we may interpret the Outer Space Treaty so as not to unduly burden the private sector.

I. The regulatory landscape. As you are aware there are three regulatory agencies that oversee U.S. commercial space activities. Under authority delegated from the Secretary of Transportation, the FAA authorizes and regulates two legs of commercial space transportation, namely, launch and reentry to ensure they do not jeopardize the public health and safety, safety of property, or national security or foreign policy interests of the United States.ⁱ It also imposes financial responsibility requirements, usually in the form of insurance, and administers reciprocal waivers of claims among launch and reentry participants, including space tourists and other space flight participants. The FCC licenses and regulates communications satellites in outer space.ⁱⁱ Lastly, a commercial entity operating a remote sensing system in space must obtain a license to do so from the Secretary of Commerce'sⁱⁱⁱ National Oceanic and Atmospheric Administration (NOAA).

In the transportation context, the Commercial Space Launch Act makes clear when a launch or reentry is commercial: unless the launch or reentry is carried out by the U.S. Government and the activity is for the U.S. Government, the launch or reentry by a U.S. entity or anyone within the United States requires an FAA license, and is thus characterized as “commercial.”^{iv}

All three agencies impose regulatory requirements on commercial operators, with varying degrees of burden on the private sector. In response to industry concerns, the President's National Space Policy Directive-2^v (SPD-2) set a new direction for the FAA and NOAA. In SPD-2 the President directed the agencies to align their regulations with his goals, including ensuring that “regulations adopted and enforced by the executive branch promote economic growth; minimize uncertainty for taxpayers, investors, and private industry; protect national security, public-safety, and foreign policy interests; and encourage American leadership in space commerce.”^{vi}

Since then, the FAA, the FCC, and NOAA have all issued notices of proposed rulemaking to amend their regulations. They have all made good attempts to alleviate unnecessary regulatory burdens, but the FAA and the FCC have also taken advantage of the opportunity of a rulemaking to impose additional regulations, not all of which are clearly within the authority granted to them by Congress.

A. The FAA.

1. “Information” required of payload operators. Congress explicitly assigned the FAA authority to authorize and regulate the launch of launch vehicles, the reentry of reentry vehicles, and the operation of launch and reentry sites. Congress did not give the FAA authority to regulate activities on orbit, or the payloads of a launch or reentry vehicle. However, Congress did give the FAA the authority to prevent the launch or reentry of a payload if no other agency authorized it and if the FAA decided the launch or reentry would jeopardize the public health and safety, safety of property, or national security or foreign policy interest of the United States.^{vii} Nonetheless, the FAA proposes to require information about encryption for satellites on orbit, raising the question of whether this request for information is actually a disguised requirement and whether the FAA has exceeded the authority Congress granted it.

The FAA is walking a very fine line with its proposed request. The agency wouldn't technically require a satellite operator to employ encryption. It would merely *inquire* whether it does. The FAA proposes that a payload operator describe:

any encryption associated with data storage on the payload and transmissions to or from the payload. Encryption helps ensure against cyber intrusion, loss of spacecraft control, and potential debris-causing events. The FAA is proposing these additions to the information requirements for launches to assist other federal agencies because NASA and the Department of Defense [DOD] frequently have requested this information in response to the FAA's interagency review in order to determine whether the proposed payload would jeopardize the safety of government property in outer space, or U.S. national security.

2. The FAA's authority to stop a launch because of a payload. In the United States, the Constitution gives Congress, not the Executive Branch, the power to legislate, that is, the power to write laws. Congress may delegate that power (and has done so many times) to the Executive Branch, including to the FAA. Congress has given the FAA some authority over payloads. It's not much, but it's some. Under 51 USC 50904(c), Congress said that the FAA:

shall establish whether all required licenses, authorizations, and permits required for a payload have been obtained. If no license, authorization, or permit is required, the Secretary may prevent the launch or reentry if the Secretary decides the launch or reentry would jeopardize

the public health and safety, safety of property, or national security or foreign policy interest of the United States.

Congress delegated the FAA's authority to stop a launch because of a payload not otherwise licensed in 1984. Since then, however, Congress has been quite clear that it has not provided the FAA the authority to *regulate* payloads. When Congress granted the FAA the authority to regulate the reentry of reentry vehicles in 1997, the House Committee Report^{viii} reminded the FAA that the agency was not to regulate activities on orbit:

The original Act intended that a launch ends, as far as the launch vehicle's payload is concerned, once the launch vehicle places the payload in Earth orbit or in the planned trajectory in outer space. The Committee wishes to make clear that the Secretary [of Transportation and by delegations the FAA] has no authority to license or regulate activities that take place between the end of the launch phase and the beginning of the reentry phase, such as maneuvers between two Earth orbits or other non-reentry operations in Earth orbit; or after the end of a launch phase in the case of missions where the payload is not a re-entry vehicle.

This seems clear. Mostly, the Committee was intent on ensuring that the FAA did not regulate reentry vehicle activities on orbit. It made sure, however, to clarify that other payloads also fall outside the FAA's authority to license or regulate. Thus, the FAA's authority over a payload should be limited to its ability to stop it from being launched.

3. Implications of an “information” requirement. If the FAA may not regulate payload operations or other operations on orbit, what does it plan to do with the encryption information it wants to request? Does it plan to assess the adequacy of a payload operator's encryption? Would it stop a launch if a payload operator did not have encryption? What if another agency was concerned? The FAA cites rational policy reasons for wanting the information, but it must first have the authority to implement them. Just as the FAA may not decide to regulate the meat-packing industry because of rational, sound (but hypothetical) concerns over trichinosis that it fears the Department of Agriculture has failed to adequately address, so should the FAA not start down the road to subtly but effectively imposing requirements on payload operators over whom it does not have authority. Although couched as an information requirement, if the FAA uses a payload operator's lack of encryption to stop a launch, the FAA is effectively requiring the operator to employ encryption on orbit.

The genuine and sincere interest of these other agencies in the encryption information is not a grant of Congressional authority. Legislative authority does not come from NASA or the Department of Defense, but from Congress. If the FAA does not expect to do anything about the encryption information, then the proposed new burden appears to have no point. If the FAA would do something about a satellite operator's encryption plans, the FAA may be attempting to regulate on orbit.

The right way to do it. There is a more appropriate avenue for the other agencies to obtain this information. NASA and DOD could seek authority from Congress and have an open conversation about their needs with the Constitutionally designated lawmakers. They could ask Congress to amend the FAA's statute so that the FAA could ask for this information, and, perhaps, even do something about it. But that has not yet happened.

B. The FCC. The Federal Communications Commission also issued a notice of proposed rulemaking this year. In it the agency proposed to modify its 2004 orbital debris regulations. Under its current space debris mitigation regulations, the FCC requires satellite operators to disclose information regarding their operations, maintain their orbital locations, and, at the end of a satellite's life, dispose of it properly. Most of the FCC's proposed new requirements address these issues.

1. Jurisdiction over insurance requirements and indemnification. The FCC, without citing any authority from Congress and in contravention of Congress' own approach in a similar context, proposes that the satellite operators it licenses purchase insurance and indemnify the U.S. Government against damage claims under the Outer Space Treaty and the Liability Convention. The FCC's proposed requirements stand in stark contrast to the Commercial Space Launch Act, where a licensed launch or reentry operator may be eligible for indemnification from the U.S. Government. The FCC requirement, however, would require an operator to indemnify the government.

This is a questionable choice to make on the part of the FCC. Typically, allocation of financial risk involves the type of policy choices that are made by Congress, that is, the type of policy determinations that are legislative in nature. The Constitution vests legislative powers in Congress. Just as it is rational for Congress to decide to protect the launch industry to some extent from claims for damage so might it have chosen not to. Likewise with the satellite industry where Congress has not yet spoken.

If Congress has not said that the satellite industry must protect the U.S. Government, one might ask, first, how the FCC thinks it has the authority to do so, and, second, why it has chosen a different path for a related space industry? Because it is the legislative branch, Congress has the ability to choose a different path. The FCC does not.

2. Jurisdiction over orbital debris. Interestingly, the FCC also invited comments on its authority over orbital debris, asking whether it properly found authority for the requirements it promulgated in 2004, and for what it proposes now. The Commission said:

The 2004 Orbital Debris Order specifically referenced the Commission's authority with respect to authorizing radio communications, including the statements in the Act that charge the FCC with encouraging "the larger and more effective use of radio in the public interest," and provide for licensing of radio communications, upon a finding that the "public convenience, interest, or necessity will be served thereby." Did the 2004 order cite all

relevant and potential sources of Commission authority in this area? Do the provisions discussed, or other statutory provisions, provide the Commission with requisite legal authority to adopt the rules we propose today?

The FCC's claim to jurisdiction rests on a thin reed. According to the FCC in 2004, its jurisdiction over orbital debris rests merely on its conclusion that "orbital debris mitigation issues are a valid public interest consideration in the Commission's licensing process." Although the FCC has authority over "all interstate and foreign communication by . . . radio and all interstate and foreign transmission of energy by radio, which originates and/or is received within the United States," 47 U.S.C. 152(a), it is unclear how the FCC has interpreted this jurisdiction to extend to orbital debris, which is not radio communication.

If the FCC can regulate anything of public interest other than broadcast and transmissions, one wonders what it can't regulate? Debris generation is not radio communication.

II. The Outer Space Treaty's Opportunities.

There are three controversial provisions of the Outer Space Treaty where the three different branches of the U.S. Government could interpret ambiguities in favor of commercial operators to incentivize private commerce, exploration, science, and settlement. It is my own view that such interpretations are the right ones. They include Article II's prohibition on national appropriation of outer space, including^{ix} the Moon and other celestial bodies,^x Article VI's call for the authorization and continuing supervision of non-governmental entities in outer space,^{xi} and Article IX's requirement that States Parties pursue their studies and exploration of outer space so as to avoid harmful contamination to outer space and adverse changes in Earth's environment resulting from the introduction of extraterrestrial matter^{xii}. Advocates from academic and governmental institutions have argued that these provisions bar commercial ownership of property in outer space^{xiii}, require governmental authorization and supervision of all private activities in outer space^{xiv} or prohibit private U.S. activity without that authorization and supervision^{xv}, and that the harmful contamination provisions apply to private actors. These interpretations are burdensome and unnecessary.

A. Authorization and continuing supervision. Article VI of the Outer Space Treaty says that, "The activities of non-governmental entities in outer space, . . . shall require authorization and continuing supervision by the appropriate State Party to the Treaty." Article VI does not say that either all or any particular activity must be authorized, which leaves decisions regarding what activities require regulation to the member states. Article VI is not, under U.S. law, self-executing, which means that it does not create an obligation or a prohibition on the private sector unless and until Congress says it does. In other words, the regulatory agencies of the Executive Branch may not rely on Article VI to bar private access to space.^{xvi}

Article VI says neither that *all* or *any particular activity* shall require authorization and continuing supervision. One country might, for example, impose price controls on platinum group minerals returned to Earth from an asteroid. Another might not. Article VI grants the States Parties to the treaty the same latitude in deciding what activities require authorization and continuing supervision. Asteroid mining itself might require no regulation because it would harm no one. In contrast to mining on Earth, where safety and environmental concerns provide a need for independent oversight, robotic mining of rocks in space far from any human habitation may not require regulation because no one lives on the rock, it has no visitors, and no one will get hurt by it.

One administration interpreted Article VI to require the authorization of any and all non-governmental activities in outer space.^{xvii} Additionally, the Federal Aviation Administration has indicated that it may deny a private entity access to space because of Article VI.^{xviii}

The FAA's position ignores Supreme Court law regarding non-self-executing treaties. Although the Constitution describes treaties as the supreme law of the land, they must be self-executing in order to be enforceable federal law without implementing legislation from Congress. As the Supreme Court has noted, "not all international law obligations automatically constitute binding federal law enforceable in United States courts."^{xix} In the case of *Medellin v Texas*, the Supreme Court held that not even the President could execute a non-self-executing treaty provision.^{xx} Regulatory agencies such as the FAA should thus not claim the power to use Article VI, which is non-self-executing, to deny a non-governmental entity access to space.

B. Private conformity with the treaty. Some claim that Article VI's provision that States Parties to the treaty assure "that national activities are carried out in conformity with the provisions set forth in the present Treaty" means that commercial actors must abide today, even absent legislation, by each provision in the treaty, even the provisions that only apply to governments. This approach ignores the plain language of the treaty and would create unnecessary burdens in the context of property rights and harmful contamination.

Conforming to the treaty should not mean that what is forbidden to States Parties must be forbidden to private entities as well. The treaty doesn't say that. It only says that private entities must conform. First, when Article VI calls for private conformity to the provisions of the treaty, it leaves unsaid which provisions apply. A review of the treaty shows that most of it applies to "States Parties." When the treaty's drafters meant a provision to apply to non-governmental entities they said so, such as in the non-interference provision of Article IX. Accordingly, when we determine to which provisions a private entity must conform, we see that very few apply to private actors.

1. Private property. Legal certainty would help investment in the context of private property rights in outer space. Clear and recognized freely transferrable property rights lie at the heart of Western prosperity:^{xxi}

Absent legally recognized rights to buy, own, and sell titled property, it is difficult, if not impossible, to get a loan to purchase said property, improve it, mine it, drill for minerals on it, or sell the proceeds from any of those activities. Property rights are a sine qua non of wealth creation^{xxii}

For US companies, Congress resolved one-half of the uncertainty by recognizing private claims to extracted resources when it passed the Space Resource Exploration and Utilization Act of 2015. The question of what property interests a private entity may exercise or what right it may have against someone with a competing claim to terrain carries less certainty. Many scholars and government officials interpret the outer space treaties as barriers to private property under different theories. A careful reading of the treaties, however, shows that contrary theories may better reflect what the treaties actually say.

Additionally, what the treaties have to say about the permissibility of private property rights remains a question of first impression. This means that all the scholarly articles, the different position statements from federal agencies, the wishes of space pioneers, have not been put through the crucible of litigation, and no judge has rendered a decision as to the accuracy of those interpretations.

Accordingly, because a question of first impression is one where no binding legal authority controls the answer, it might help to take a fresh look at the permissibility of private property rights under the Outer Space Treaty.

There are several theories under which private entities may not claim property in space: a theory of the commons, the Outer Space Treaty's bar to national appropriation, and a desire to forbid to private entities whatever is explicitly forbidden to states through theories of conformity or responsibility. There are an equal number of responses.

a. Space as a commons. Many argue that space is a commons because it is “the province of all mankind” under the Outer Space Treaty or the “heritage of mankind” under the Moon Treaty. As the work of Professor Henry Hertzeld of George Washington University and Christopher Johnson and Brian Weeden of the Secure World Foundation shows, this is not correct. What really constitutes the “province of all mankind” is not outer space but the activity of exploring and using it.

Article I of the Outer Space Treaty says:

The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic and scientific development, and shall be the province of all mankind. Outer Space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

These scholars explain that, when read properly, it is exploration and use of outer space that is

the province of all mankind, not outer space itself. Additionally, since the United States has not signed the Moon Treaty, and most spacefaring nations have not, there is no need to explore the meaning of common heritage.

b. Bar on national appropriation Some suggest that the Outer Space Treaty's Article II, which prohibits national appropriation of outer space, including the Moon and other celestial bodies, means that no one may appropriate space. The quick answer to this is that the treaty prohibits national appropriation, not all appropriation or private appropriation.

c. Imputation of treaty prohibitions on state actors to private actors. Some claim that Article VI's provision that States Parties to the treaty assure "that national activities are carried out in conformity with the provisions set forth in the present Treaty" means that commercial actors must abide today, even absent legislation, by each provision in the treaty, even the provisions that only apply to governments. This approach ignores the plain language of the treaty.

Conforming to the treaty should not mean that what is forbidden to States Parties must be forbidden to private entities as well. The treaty does not say that. It only says that private entities must conform. When Article VI calls for private conformity to the provisions of the treaty, it leaves unsaid which provisions apply. A review of the treaty shows that most of it applies to "States Parties." When the treaty's drafters meant a provision to apply to non-governmental entities they said so, such as in the non-interference provision of Article IX. Accordingly, when we determine to which provisions a private entity must conform, we see that very few apply to private actors.

Article II's bar on national appropriation may have other interpretations, some of which are less burdensome for the private sector than a ban on recognizing private property rights. Indeed, to the extent that Article VI calls for conformity by private actors, a less burdensome interpretation would be that private actors may not serve as a conduit for national appropriation. Accordingly, state owned enterprises would not be able to appropriate parts of outer space, but private entities could.

In this same vein, others argue that Article VI's statement that "States Parties to the Treaty shall bear international responsibility for national activities in outer space... whether such activities are carried on by governmental agencies or by non-governmental entities..." means that what is forbidden to states must be forbidden to their citizens. Again, this theory ignores the plain language of the other provisions, which for the most part only apply to States Parties. The fact that an entity may be financially responsible for someone else does not automatically mean that what is forbidden to the first entity is forbidden to the second one. Person A may be responsible for Person B's debts, but when Person A loses his driver's license, Person B may continue to drive.

Accordingly, when we interpret Article II's bar on national appropriation, we see that it does not ban private appropriation. Although the U.S. State Department once claimed that "private ownership of an asteroid is precluded by Article II,"^{xxiii} the U.S. Congress

has since exercised its legislative authority to override and disagree at least in part when it passed the Space Resource Exploration and Utilization Act of 2015. That new law recognized the rights of private entities in resources they may extract from outer space.^{xxiv}

2. Harmful Contamination. The treaty offers another question of first impression in the form of Article IX’s admonition that States Parties to the treaty avoid “harmful contamination” of outer space and adverse changes in the environment of Earth. There are two questions at issue here. Does the admonition apply to non-governmental entities? Does harmful contamination mean the same thing as planetary protection?

a. Applicability to the private sector. The first reason to question the applicability of the so-called “planetary protection” provision is that the treaty itself limits this requirement, like many others, to “States Parties.” States Parties are governments. As noted above, when the drafters of the treaty intended a particular provision to apply to non-governmental entities they said so.

Secondly, even if it applied to the commercial sector, Article IX’s harmful contamination provision is not self-executing. It requires the legislative branch, Congress, to make numerous policy judgments, such as whether the goals of space science or space settlement should preempt one another or may be pursued together.

b. Article IX does not require “planetary protection.” Article IX warns against “harmful contamination.” NASA’s “planetary protection” policy^{xxv} is the term “given to the practice of protecting solar system bodies (*i.e.*, planets, moons, comets, and asteroids) from contamination by Earth life, and protecting Earth from possible life forms that may be returned from other solar system bodies.” Additionally, NASA states that its policy is designed “to preserve our ability to study other worlds as they exist in their natural states.” As a science agency that is part of the U.S. Government, NASA has interpreted Article IX of the Outer Space Treaty to mean that the agency’s own missions must not only avoid what the ordinary person might consider harmful contamination—no toxins, no Agent Orange, no peanuts—but microbial contamination as well. NASA tries to limit the presence of bacterial spores on any out-bound surface to no more than 300,000. Accordingly, NASA requires the sterilization of its spacecraft to avoid bringing microorganisms to Mars. The European Space Agency follows similar measures NASA is being a good steward with this approach, and its policy is designed to enhance scientific study.

The treaty, however, would have NASA only avoid “harmful” contamination, not all contamination. Thus, NASA’s planetary protection policy provides one interpretation of what the treaty means but not the only interpretation.

With this in mind, we must recognize that Congress has told NASA that the agency’s long-term goals must enable the extension of a human presence beyond low-Earth orbit and into the solar system, “including potential human habitation on another celestial body and a thriving space economy in the 21st Century.”^{xxvi} More explicitly, Congress

told NASA to work toward eventual “human habitation on the surface of Mars.”^{xxvii}
People are covered in bacteria, and yet the law says NASA must work to enable a human presence on Mars.

Logically, Congress having determined that a human presence in space is desirable, anything with equivalent or less biological baggage than a human being should not be required to undergo the expensive sterilization protocols now employed for government missions even if the United States had agreed to apply the harmful contamination provision to commercial operators. It might be time to recognize that a Congressional mandate overrides an agency policy.

In sum, the Outer Space Treaty may be interpreted to allow recognition of private property rights, regulation only when sufficient hazards exist to warrant the expenditure of government resources, and that the harmful contamination provisions only apply to States Parties, not to private operators.

Thank you for the opportunity to contribute to this discussion.

ⁱ Commercial Space Launch Act, 51 U.S.C. ch. 509.

ⁱⁱ Federal Communications Act of 1934, 47 U.S.C. §§ 153(42), 301, 303, 307, 309 and 332.

ⁱⁱⁱ National and Commercial Space Programs, 51 U.S.C. §§ 60101, 60121.

^{iv} 51 U.S.C. § 50919 (g).

^v *Streamlining Regulations on Commercial Use of Space*, Space Policy Directive-2, Presidential Documents, 83 Fed. Reg. 24901 (May 30, 2018), <https://www.whitehouse.gov/presidential-actions/space-policy-directive-2-streamlining-regulations-commercial-use-space/> (Space Policy Directive-2).

^{vi} Space Policy Directive-2 at sec. 1.

^{vii} 51 U.S.C. § 50904(c).

^{viii} <https://groundbasedspacematters.com/wp-content/uploads/2019/05/CRPT-105hrpt347.pdf>

^{ix} In the interests of brevity, the reader may assume that, unless otherwise indicated, references to “outer space” always include the Moon and other celestial bodies.

^x Outer Space Treaty, Art. II.

^{xi} Outer Space Treaty, Art. VI.

^{xii} Outer Space Treaty, Art. IX.

^{xiii} See e.g., Gbenga Oduntan, *Who Owns Space? U.S. Asteroid Mining Act is Dangerous and Potentially Illegal*, The Conversation, Nov. 25, 2015 <https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073> (Last visited Sept. 3, 2017)(contesting the international legality of the U.S. recognition of private property rights in resources extracted from outer space as contrary to “settled principles of space law,” which include “the prevention of unilateral and unbridled commercial exploitation of outer-space resources” under the Outer Space Treaty and the Moon Agreement of 1979.).

^{xiv} Report from the Executive Office of the President, Office of Science and Technology Policy, to Chairmen Thune and Smith, 3 (Apr. 4, 2016). Available at https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/csla_report_4-4-16_final.pdf.

^{xv} Fact Sheet—Moon Express Payload Review Determination, FAA, (Aug. 3, 2016) available at https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20595 (Last visited Sept. 3, 2017).

^{xvi} Laura Montgomery, *U.S. Regulators May Not Prevent Private Space Activity on the Basis of Article VI of the Outer Space Treaty*, Mercatus Working Paper, Mercatus Center at George Mason University,

Arlington, VA, 2018, <https://www.mercatus.org/system/files/montgomery-outer-space-treaty-mercatus-working-paper-v1.pdf>.

^{xvii} Report from the Executive Office of the President, Office of Science and Technology Policy, to Chairmen Thune and Smith, 3 (Apr. 4, 2016). Available at https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/csla_report_4-4-16_final.pdf.

^{xviii} Fact Sheet—Moon Express Payload Review Determination, FAA, (Aug. 3, 2016) available at https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20595 (Last visited Sept. 3, 2017).

^{xix} *Medellin v. Texas*, 552 U.S. 491, 526, 128 S.Ct. 1346, 1357 (2008).

^{xx} *Medellin*, 552 U.S. at 529, 128 S.Ct. at 1371; see also Ted Cruz, *Limits on the Treaty Power*, 127 HARV. L. REV. F. 93 (2014), <http://harvardlawreview.org/2014/01/limits-on-the-treaty-power/>

^{xxi} Rand Simberg, *Homesteading the Final Frontier, A Practical Proposal for Securing Property Rights in Space*, Competitive Enterprise Inst., <http://cei.org/sites/default/files/Rand%20Simberg%20-%20Homesteading%20the%20Final%20Frontier.pdf> (Apr. 2012)(Last Checked Sept. 6, 2017) *citing* Hernando de Soto, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else* (New York: Basic Books, 2003).

^{xxii} *Id.*

^{xxiii} Virgiliu Pop, *Who Owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources*, p. 42 *quoting* Letter from Ralph L. Braibanti, Director, Space and Advanced Technology, U.S. Department of State/Bureau of Oceans and International Environmental and Scientific Affairs (Aug. 15, 2003).

^{xxiv} 51 U.S.C. § 51303.

^{xxv} Office of Planetary Protection, <https://planetaryprotection.nasa.gov/overview> (last checked July 23, 2019).

^{xxvi} 42 U.S.C. § 18312.

^{xxvii} 51 U.S.C. § 70504(b).